PART 7

MECHANICAL/FIRE PROTECTION/PLUMBING

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I. BASIC DESIGN CRITERIA

A. Basic design criteria is established by Technical Instructions TI 800-01 issued by the Office of the Chief of Engineers. The TI is a living document and is frequently reviewed, revised, and redistributed. As such, it is imperative that the current edition of the TI be obtained and used for project designs. Current editions are available from the District Design Manager. The AE should clearly indicate in each section of the Design analysis which (by date) edition and changes (by date) of the TI are being used for the design.

B. Generally, Chapters 1, 2, 9, 11, 13, 14, and 15 of the TI 800-01 are of definite significance to the mechanical design effort. A review of the entire TI with specific emphasis on the listed chapters should be performed prior to completing fee negotiations or initiating design effort.

C. In the event conflicts arise between information contained herein and the TI, the TI shall have precedence.

D. This instruction package was prepared using the basic TI dated 20 July 1998.

E. This instruction package is prepared pursuant to executing designs for Army projects. Air Force projects are to be designed using Military Handbook 1190 as the basic design guidance package. Although the TI (ARMY) and Military Handbook 1190 (AIR FORCE) are different documents, the documents share similar requirements and design intent. Designers are required to thoroughly review the applicable criteria for the specific project design.

F. All abbreviations and symbols used on drawings and sketches shall be based on ASHRAE Handbook Fundamentals and CADD Details Library by Tri-Service CADD/GIS Technology Center (latest editions).

G. ASHRAE Handbook of Fundamentals (latest edition), Chapter 35, shall be used as a reference in developing metric project designs. The use of inch-pound or metric systems for each specific project shall be determined by the Design Team Leader (DTL).

II. MECHANICAL:

A. GENERAL: These instructions outline the highlights of the applicable criteria for designing the principal mechanical systems; where criteria for special systems is required, the A-E should check on availability of Corps criteria, and in the absence of Corps criteria, rely on the best available criteria of the industry.

1. These instructions also cover both fire protection and plumbing design requirements.

2. Much of the information contained herein is taken out of context. The user should study the original references and investigate to make sure that the criteria has not changed since this outline was written. Special supplementary criteria should be requested for USAR Centers and other military facilities covered by standard criteria.

3. Basic instructions on preparation of drawings, specifications and design analysis are contained in ER 1110-345-700, ER 1110-345-710, and ER 1110-345-720.

4. Equipment selection shall be based on not less than three (3) manufacturers (whose equipment meets project requirements) for each item. The design analysis shall indicate dimensions and capacities of all equipment. The project design is not complete until the designer is assured that there is sufficient physical (space in rooms/areas where equipment is to be placed/located) to install and to maintain the selected equipment with associated appurtenances in accordance with project documents, including applicable codes.

B. HVAC/REFRIGERATION/FIRE PROTECTION/PLUMBING: The mechanical design shall follow the latest dated criteria.

1. General: TM's are technical manuals and form part of basic criteria. ETL’s are for the purpose of modifying the basic manuals or for supplying later superseding information. Unless otherwise indicated, chapter/paragraph references preceded herein by "TI" refer to the DAEN issued architect-engineer instructions as described in the PREAMBLE and those preceded by "TM" refer to TM 5-810-1. OSHA Safety and Health Standards shall be incorporated where required or applicable.

2. Popular Design Criteria: Criteria used should be current as of the date of Notice to Proceed with design.

- TI 800-01, Technical Instructions Design Criteria
- Uniform Federal Accessibility Standards (UFAS)

- Americans with Disabilities Act Accessibility Guidelines (ADAAG)

- Air Force Design Manual (Applicable Handbook for Air Force Projects)

- Military Handbook 1190

- Comprehensive National Energy Policy Act (PL.102-486)

- OMB Circular A-131, 21 May 1993, Subject “Value Engineering”

- CEMP-ET/CEMP-5 Memorandum, 31 August 1992, Subject “Programming of Phased Construction for Utility Work”

- MIL-HDBK 1008C - Military Handbook Fire Protection for Facilities Engineering, Design, and Construction

- MIL-HDBK 1022 - Military Handbook Petroleum Fuel Facilities

- Architectural and Engineering Instructions for Installation Support (4 April 1996)

- TM 5 805-4 - Noise and Vibration Control for Mechanical Equipment

- TM 5-785 - Engineering Weather Data

- TM 5-802-1 - Economic Studies for Military Construction Design-Applications

- TM5-804-2 - Solar Energy Systems

- National Fire Protection Association Standards

- SMACNA Manuals and Guides (latest editions)

- TM 5-809-10/No. 000-09-01 - Seismic Design/Structural Support Details for No. 000-09-01 Seismic Standard Detail Protection of Mechanical and Electrical Equipment

- TM 5-810-1 - Heating, Ventilating and Air-Conditioning Manual

- TM 5-810-2 - High Temperature Water Heating Systems

- TM 5-810-3 - Mechanical Refrigeration and Ventilation in Cold-Storage Facilities

- TM 5-810-4 - Compressed Air
- TM 5-810-5 - Plumbing
- TM 5-810-6 - Non-Industrial Gas Piping Systems
- TM 5-810-7 - High-Pressure Gas and Cryogenic Systems
- TM 5-810-15 - Central Steam Boiler Plants
- TM 5-810-17 - Heating and Cooling Distribution Systems
- TM 5-812-2 - Firestopping
- TM 5-813-6 - Water Supply for Fire Protection
- TM 5-815-3 - Heating, Ventilating and Air-Conditioning (HVAC) Control Systems
- TM 5-842-2 - Laundries and Dry Cleaning Plants
- TM 5-848-1 - Gas Distribution
- TM 5-848-2/COE Standard Design AW 78-24-20/AW 78-24-27, Standard Fuel Systems - Handling of Aircraft and Automotive Fuels
- TM 5-855-4 - Heating, Ventilation, and Air-Conditioning of Hardened Installations
- AR 11-27 - Army Energy Program
- AR 420-49 - Heating Energy Selection and Fuel Storage Dispensing System
- AR 420-54 - Air-Conditioning and Refrigeration
- AR 420-90 - Fire Protection
- EM 1110-3-178 - Removal of Underground Storage Tanks (UST)
- ER 1110-345-100 - Design Policy for Military Construction
- ETL 1110-3-438 - Engineering and Design, Indoor Radon Prevention and Mitigation

- ETL 1110-3-440 - Engineering and Design Cathodic Protection

- ETL 1110-3-455 - Engineering and Design, Humidity Control for Barracks and Dormitories in Humid Areas

- ETL 1110-3-465 - Engineering and Design of Water Meters and Appurtenances at New Army Facilities

- ANSI/ASHRAE 34-1992 - Number Designation and Safety Classification of Refrigerants

- ANSI/ASHRAE 15-1994 - Safety Code for Mechanical Refrigeration

- ANSI A13.1-1981 - Scheme for the Identification of Piping Systems

- ASHRAE Guideline 3-1990 and Addendum 3a-1992 - Reducing Emission of Fully Halogenated Chlorofluorocarbon (CFC) Refrigerants in Refrigeration and Air Conditioning Equipment and Applications

- ASHRAE 62-89 - Ventilation for Acceptable Indoor Air Quality

- ASHRAE - Systems and Applications

- Plumbing and Drainage Institute (PDI-WH-201) Water Hammer Arrestors

- CABO A 117.1 - American National Standard for Assessable and Usable Buildings and Facilities

- National Standard Plumbing Code

- CECW-OA Memorandum, 22 May 1996, “USACE Operated Facilities” Environmental Compliance Guidance Letter No. 6, Managing Ozone-Depleting Substances (ODSS) at USACE Projects and Facilities

- CEMP-ET Memorandum, 3 August 1993, “Eliminating of Ozone-Depleting Chemicals; Implementations of the Requirements of the National Defense Authorization Act for FY-93”

- National Environmental Policy Act (NEPA)

- The National Ambient Air Quality Standards (NAAQS)

- Clean Air Act Amendments (CAAA)

• CENAB-EN SOP 340-5 Engineering Division Standard Operating Procedure/Regulatory Compliance Check List

3. Temperature Conditions -- Army Criteria:

a. Outside: TM 5-785, TI 800-01 and TM 5-810-1, 2-2

b. Comfort:
Winter - 97-1/2% tables,
Summer - 2-1/2% DB., 2-1/2% MCWB tables;

c. Special Technical Requirements:
Winter - 99% tables;
Summer - 1% DB, 1% MCWB

d. Water and Air Cooled Equipment: TM 5-810-1, 2-2

e. Inside: TI 800-01

f. Comfort:
Winter 68 F. Admin, 55 F. work areas, 40 F. freeze protection.

Summer 2-1/2% DB outside less 15 F. but not greater than 78 F and not less than 75 F.

4. Thermal Coefficients: See TI 800-01, Chapter 11 - Table 11-4.

5. Economic Studies: Unless directed otherwise by the specific criteria, TM 5-802-1 shall be used for cost comparisons between alternative designs. Criteria exists for Total Energy and Life Cycle Studies. The LCCID Computer Program can also be used.

a. Fuel Studies: DAIM-FDF-U memorandum dated 10 Jan 1994 or latest guidance, Economic Studies MCA and MCAF Designs and ECIP

1. TI 800-01, Chapter 14 and AR 420-49

b. If the project is under a special program such as MCA Energy Conservation Investment Program (ECIP), then Program criteria is applicable.

6. Air Conditioning:

a. General Design Requirements:

1. Multiplicity of refrigeration units is discouraged except as permitted by TM 5-810-1. See also AR 420-54 and TI.

2. A central refrigeration plant is required to serve a building or group of buildings. A central plant is a source of refrigeration consisting of an integrated refrigeration system which may supply a building or number of buildings containing air handling or fan-coil units, etc., serving designated areas.

3. Refrigerant policy - refer to CECW-OA memorandum, 22 May 1996, “USACE Operated Facilities Environmental Compliance Letter No. 6, “Managing Ozone-Depleting Substances (ODSS) at USACE Projects and Facilities,” for guidance on specification of refrigerants to reduce impact on ozone depletion. In addition, incorporate ASHRAE 15 and 34 into the design as well as ASHRAE Guideline 3.

b. Cold Generators (TM 5-810-1, 5-2):

1. A single reciprocating compressor shall not exceed 200 tons.

2. A packaged reciprocating unit shall not exceed 400 tons and will not have more than 8 compressors.

3. Units greater than 200 tons may be centrifugal, helical rotary screw, absorption type, or reciprocating type compressor selection shall be based on a life-cycle cost analysis.

4. Two or 3 refrigeration units may be used in lieu of 1 unit if the life cycle cost analysis shows the initial cost and operation and maintenance are less for multiple units.

5. Standby compressors, pumps, etc., shall not be provided for personnel cooling application. See special criteria for air conditioning required for life support and critical areas.

6. Reciprocating compressors over 10 tons shall use only capacity controls which reduce the power requirements as the load varies (TM 5-2a).

7. Absorption refrigeration should only be considered where waste heat is available (TM 5-2e)

8. Use R-22, R-123 and R-134a wherever feasible due to environmental concerns.

c. Heat rejection equipment:

1. Condenser or cooling tower outside air requirements.

2. Winter operation of cooling towers

d. Cooling Systems: (TM 5-810-1, 3-3, 3-5):

1. Chilled Water: The supply and return chilled water temperature differential will be determined by LCCA. (TM paragraph 3-3(a)).

2. Heating and air conditioning systems shall be combined (TM 3-b).

3. Location of air conditioning equipment should be designed to give complete and unobstructed access to equipment for maintenance.

4. Integrated air conditioning and lighting systems are required where the general lighting level is 100 foot candles or greater (See TM paragraph 3-3b).

5. Air conditioning systems shall be designed for a 100% economy cycle. Except, that controller shall sense outside air dry bulb temperature in lieu of enthalpy as indicated in TM 5-810-1. Operating experience has shown enthalpy sensing to be not reliable.

6. Low velocity air systems will generally be used. Medium and high velocity systems will be used only if shown to be economical .

7. Winter humidity control is permitted on a zone basis.

8. Standby Heating Equipment: Will not be provided unless justified.

9. Heating: (TI 800-01, Chapter 14 & TM 50810-1, 5-3)

a. Heating Plants: Central and Individual (See AR 420-49 and TI 800-01, Chapter 14/2)

1. Economic Analysis and fuel study (See AR 420-49 and TI 800-01, Chapter 14/1a(3))

2. Fuel Selection (See AR 420-49 and TI 800-01, Chapter 14/1c)

b. Heating Systems: (TM 3-2)

1. Where a building is to be provided with heating and air conditioning, the system selected shall be a combination system. (See TM 3-6).

2. Minimum of 30 days oil supply shall be provided based on criteria. (AR 420-49 and TI 800-01, Chapter 14/1d.) Oil storage systems shall conform to Federal, State and local environmental standards.

10. Mechanical Ventilation: TI 800-01, Chapter 13/5 & TM 5-810-1, 2-4 and ASHRAE 62-89.

a. Ventilation in accordance with TM 5-810-1, paragraph 3-4, and TI requirements as follows: With and Without Attic Space: TI 800-01, Chapter 13/4l (5).

b. Outside air generally shall be in accordance with ASHRAE 62-89 including ANSI/ASHRAE Addendum G2a-1990.

c. Industrial and special ventilation is covered in latest ASHRAE Handbooks Industrial Ventilation Manuals (ACGIH), OSHA/NIOSH Regulations; ANSI/AIHA Z9.5, American National Standard for Laboratory Ventilations and TM 5-810-1, Chapter 4.

d. Industrial ventilation system shall comply with OSHA/NIOSH exposure limits and shall be designed in accordance with Industrial Ventilation Manual (ACGIH) and ANSI/AIHA Z9.5, American National Standard for Laboratory Ventilation.

11. Design Analysis Drawings, and Specifications:

a. For type and amount of information to be contained in these elements, see ER 1110-345-700, ER 1110-345-720, and ER 1110-345-710.

12. HVAC Controls: The Corps of Engineers has developed and is implementing a new design philosophy regarding the design of HVAC controls systems. The Corps of Engineers has developed a series of standard heating, ventilating and air-conditioning (HVAC) control systems. These systems are based on reliable, quality, non-proprietary components including single loop digital controllers. These control systems and the design required to implement the criteria and guidance is described in TM 5-815-3 and guide specification CEGS 15950, HEATING, VENTILATION AND AIR CONDITIONING HVAC CONTROL SYSTEMS. These documents address the design requirements for the vast majority of HVAC systems and shall be used for all new MCA designs. These standard HVAC control systems have also been mandated by our Air Force customers. Savannah District is the Corps center of expertise for HVAC controls and can provide contract type drawings for the most recent standard control systems. These drawings can then be edited by designers to reflect system specific requirements. Any waiver request should be processed through the Government design manager and forwarded to NAD/HQUSACE and must address operating and maintenance capabilities of the user, as well as functional requirements that necessitate a different approach to HVAC controls. For additional information see; Army: TI 800-01, Chapter 13/5 & TM 5-810-1 chapter 2 and applicable ETL's, Air Force: Military Handbook 1190 and applicable Air Force ETL's.

C. ENERGY CONSERVATION:

1. General: The items below represent important criteria and issues in the energy conservation program for the U.S. Army Corps of Engineers. These items are for general guidance. Other energy saving measures shall be considered as applicable for each project. If a project is under a specific program, then the criteria for that program must be followed. (The MCA Energy Conservation Investment Program is one specific program.)

a. A significant amount of rules and regulations governing energy conservation focus on existing facilities and the responsibilities of the installation. However, some of these rules and regulations also pertain to new designs.

b. All mandatory requirements of 10 CFR 435 have been incorporated into Corps of Engineers criteria and cannot be waived.

c. The Design Energy Use and Energy Use Budget method of compliance indicates conformance with 10 CFR 435 and Executive Order 12759. This requirement cannot be waived but previous studies can be used to verify compliance, when applicable.

d. Life cycle cost analysis is mandatory in conformance with 10 CFR 436 and cannot be waived. However, previous studies may be utilized to insure selection of the optimum alternative, when applicable.

References:

- TI 800-01, Chapters 1 and 11
- DAIM-FDF-15 Memorandum 10 January 1994, “ECIP Guidance”
- TM 5-802-1
- NIST Handbook 135, Energy Prices and Discount Factor for Life Cycle Cost Analysis (Latest Edition)
- TM 5-810-1
- ETL 1110-3-282
- AR 11-27 Army Energy Program
- ASHRAE/IESNA 90.1-1989 (Guidance when not covered by Corps criteria)
- TM 5-815-2, Energy Monitoring and Control Systems with Associated Guide Specs.

2. Life Cycle Cost Studies/Energy Budget Comparisons: Chapter 1 of the TI establishes the scope of the design studies to be performed to substantiate the design of a project. Chapter 13 establishes that the mechanical systems and equipment will be selected on the basis of lowest life cycle costs. Design decisions for all projects will be based on life-cycle cost considerations. For all projects, the relative costs of each of the 4 major costs factors; initial costs, operating costs, maintenance costs and replacement costs, of each design option will be documented as part of the design analysis. For projects where the total estimate of construction costs exceed $500,000 or the costs associated with all mechanical systems exceed $75,000, the proposed design will be further justified on the basis of a present value life cycle cost analysis. LCCA implementation of Chapter 11 should be accomplished in the following manner as part of the design analysis.

3. Concept Design: All potential mechanical systems and combinations thereof shall be narratively discussed and reduced to not less than two functionally equivalent most promising alternative designs. These alternative designs should be modeled to determine their respective DAE. The annual operating requirements for use in LCCA shall be determined using actual anticipated hours of operation. The life cycle cost of each alternative design will be determined and compared. The "best conventional" design will normally be the alternative with least life cycle cost. A determination of the DAE for the "best conventional" design shall be made and compared to the DET. For this comparison (DET compliance check) operating hours will be the same as specified in the TI 800-01, table 11-1. If the DAE for this "best conventional" is less than the DET the design sufficiently complies with criteria. If the DAE for this "best conventional design exceeds the DET, a design team approach will be used to develop a "revised" design incorporating both (a) extraordinary energy conservation features into the mechanical systems design and (b) extraordinary electrical and building envelope energy conservation features. This revised design, incorporating these extraordinary features will then be modeled to arrive at the LCC (using actual operating hours) and the DAE for each extraordinary feature and combinations thereof. A design shall be determined which will be less than the DET and which represents the least life cycle cost. If all efforts and alternative extraordinary designs fail to produce a design which will be less than the DET, a waiver request shall be pursued. Consult the Government's design manager for details on obtaining a waiver.

4. Measures to be considered:

a. Buildings - General:

1. Orientation of building was considered and is most "economical" for heating and air conditioning purposes.

2. Use of air locks, rotating doors, air curtains, vestibules, etc.

3. Perimeter insulation

4. Use TI 800-01, Chapter 11 "U" values as a maximum unless otherwise indicated.

b. Glass:

1. Reflective glass coating
2. Solar screens
3. Solar shading
4. Double glass
5. Tinted glass
6. Structural shading devices
7. Glass "U" factor has been considered
8. Minimum glass area

c. Roof:

1. White or light colored aggregate for roof
2. "Light colored roof"
3. Ventilated attic space
4. Ventilated ceiling space

d. Air Conditioning:

1. Economy cycle
2. Night and/or weekend temperature cut-back or cut-off.
3. Run-around system
4. Minimum fresh air provided
5. Air-to-Air heat recovery
6. Absorption refrigeration
7. Double bundle condensers
8. Energy storage systems (water tanks, etc.)

9. Cut-off of outdoor air during non-occupied times

10. Centrally located supervisory control systems.

11. Modular VAV system

12. Higher chiller Efficiencies

13. Variable-speed drives

14. High-efficiency cooling units

e. Heating:

1. Night and weekend cut-back of room temperature by 15-20 F for non-occupied times.

2. Only minimum fresh air provided

3. Air-to-Air heat recovery

4. Energy storage systems

5. Cut-off outside air during non-occupied times

6. Turn off pumps and heat generators at out-door temperature of 65 F.

7. Use condenser heat

8. Consider lowest life cycle cost fuel available

9. Use of stack heat reclaimers

10. Use of incinerator heat

11. Run-around system for heat recovery

12. Use of equipment heat to heat exterior zones of building

13. High-efficiency heating equipment

f. Ventilation:

1. Use minimum fresh air quantities permitted

2. Cut off ventilation air during non-occupied times

3. Demand-control ventilation strategy

g. Plumbing:

1. In recreation, administration, industrial buildings consider use of self-closing valves/flow limiting faucets in lavatories and sinks

2. Low flow (maximum of 2.5 gpm) showerheads as well as water closets (1.5 gpm)

3. Flow control devices

4. Design Branch Standard Operating Procedure, Energy Conservation Compliance Checklist (See Appendix).

D. AIR POLLUTION AND ENVIRONMENTAL PROTECTION REQUIREMENTS:

1. General: The designer of a boiler room, plant, industrial facility, etc., shall familiarize himself with the Federal, State and Local pollution control and environmental protection requirements before design of any facility is started which contributes to air pollution or presents a hazard to the environment. Any water pollution resulting from the anticipated design must also be taken into account.

2. State and Local Criteria: All requirements of Federal, State and Local agencies shall be complied with. If state or Local requirements exceed the Federal, then the State or Local requirements shall be followed. If there are no other more stringent requirements than the Federal, then these shall prevail.

3. References:

a. AR 200-1/2, Environmental Protection and Enhancement and Environmental Effects of Army Actions

b. AR 385-10

c. TI 800-01, Chapters 2 and 14

E. SEISMIC CRITERIA: The tri-service seismic design manual TM 5-809-10/NAVFAC P-355/AFR 88-3, Chapter 12, "Seismic Design for Buildings" and Standard Detail Nos. 000-90-01/2, Structural Support Details for Seismic Protection of Mechanical and Electrical Equipment, Volumes 1 and 2, contain the information for structural design of anchorage and supports for mechanical and electrical equipment in the various seismic areas.

1. Pipe supports are schematically delineated on Plate 8 of the manual and should be applied per guide specification "Seismic Protection for Mechanical, Electrical Equipment." Typical details of seismic bracing for M&E elements shall be shown on the drawings. Because of the relatively light commercial exposure to seismic restraint of mechanical/electrical elements, contractors executing work for the geographic area of the Baltimore District are not familiar with or accustomed to addressing seismic supports. As such, typical details must also show how the brace for the mechanical/electrical element is to be attached to the structural systems. Coordination with the structural designer must be effected to ensure that internal building structural elements will withstand the lateral loads imposed upon them by mechanical/ electrical bracing. Another source of seismic bracing techniques, details and methods for mechanical systems is Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems, published by the Sheet Metal and Air Conditioning National Association, Inc. (SMACNA Manuals and Guides (latest editions)). Seismic zone determinations shall be based on information in TM 5-809-10. Seismic restraints and considerations for fire protection are covered by NFPA.

2. Other supports are generally shown on the structural drawings.

F. COMMON DESIGN MISTAKES TO BE AVOIDED: The following are some common design mistakes or omissions.

1. When writing guide specifications, using standard Corps guide specifications, optional items are deleted from the specifications. When writing specs, first read the "Notes on Use of This Guide Specification", appearing at the end of each specification section. These notes explain what can be deleted from each paragraph. Except when using the SPECSINTACT system which automatically renumbers paragraphs, do not renumber paragraphs that have been removed but write the word "OMITTED" and retain the paragraph number. Ensure that non-applicable sections of the specifications are crossed out or deleted.

2. Where insulation is applied to mechanical systems, the requirements of NFPA govern.

3. All fire dampers locations must be shown on the drawings.

4. ASHRAE weather data information should not be used for outside design temperatures. The engineering weather data given in TM 5-785 must be used.

5. Reduced pressure type backflow prevention devices should be shown in all water make-up systems. All water make-up systems for all mechanical systems such as chillers, condensers, boilers, heat exchangers, diesel generators, photographic equipment, industrial equipment, etc., shall be provided with reduced pressure backflow preventers, regardless of whether the liquid is treated or not at the time of design.

6. Do not provide comments on drawings as to the type of pipe insulation to be provided; specs cover this.

7. Provide control diagrams and other necessary documentation as required by TM 5-815-3. Show all thermostats. Indicate setting of thermostats. Indicate room design temperatures. Provide a narrative control sequence for each automatically controlled device. Sequence of control should follow those presented in TM 5-815-3 and CEGS 15950, HEATING, VENTILATION AND AIR CONDITIONING HVAC CONTROL SYSTEMS.

8. Do not specify combustible insulating material in air plenums and spaces used as plenums. This is in direct violation of NFPA 30A.

9. Seismic design and details for mechanical systems must be included in the project documents.

10. The need for cathodic protection should be established and if necessary design should be provided. See TM 5-811-7.

11. Pipe strainers, flexible connections and check valves should be provided at pumps, compressors, etc. Provide piping details for all mechanical equipment.

12. Equipment supports, ladders, walkways, access panels, etc., should be provided. Clearly detail and locate these items when required for proper maintenance.

13. Fusible link valves, double solenoid valves, flexible connections should be shown at fuel oil burners. Check need for auxiliary fuel pump. Review suction lift requirements for fuel pumps.

14. Specify correct type room thermostats. Adhere to CEGS specifications and applications.

15. Be certain that shop drawing editing and approval procedure is correct. See specifications instructions and guidance for preparation of submittal registers.

16. Make certain the design calculations are properly checked for technical accuracy and completeness, initialed by designers, and dated on design analysis sheets. Ensure design work is checked for technical accuracy, consistency and completeness before release.

17. Do not use general notes which result in costly clarifying change orders. Examples of such notes are:

a. Relocate pipes and ducts as required

b. Remove piping and ducts as needed

c. Reuse existing if in good condition

d. Insulate as needed

e. ....as necessary...

18. Work required must be shown on drawings and notes shall be specific. CEGS commonly contain such words as "as indicated" or "where shown"; these statements must be supported by the drawings.

19. Motor voltage on mechanical drawings are to be indicated as follows:

Electrical System Voltage	Motor Voltage	Phase
208	200	3
230	230	3
480	460	3
120	115	1

20. Submittal register shall be provided for all mechanical specifications. The submittal registers shall include all information required to be submitted by the project specification. In addition, the designer should list all major pieces of equipment that it is felt should be reviewed for conformance to the project design and specifications.

21. All above /underground fuel storage tanks shall comply with U.S. Army Corps of Engineers Standard Design AW 78-24-20/27 and Military Handbook 1022.

22. DDC building control systems are not allowed.

23. ASHRAE CLTD cooling calculations are done incorrectly. Be sure to read notes regarding the calculation of CLTD values included in ASHRAE FUNDAMENTALS.

G. PLUMBING:

1. Design shall be in accordance with TM 5-810-5 and the National Standard Plumbing Code. A design analysis shall be provided to document pipe sizing and equipment selections.

2. Other information relating to materials, fixtures, applicable Federal Specifications, etc., are contained in the Corps Guide Specifications.

H. COMPUTER BASED AUTOMATIC CONTROL AND/OR MONITORING SYSTEMS:

1. All computer based automation systems, regardless of size or purpose, which sense the physical environment and/or control equipment in real time shall not be included in any design without prior approval of the Engineering Division EMCS Technical coordinator at or before the concept submission.

2. The current EMCS Technical Coordinator is John Kelly, CENAB-EN-D, (410) 962-3881.

3. The EMCS shall be a separate procurement and not part of the general construction contract.

ATTACHMENTS:

1. Army Concept Design requirements.
2. Air Force Concept Design requirements.

ARMY
CONCEPT DESIGN
BALTIMORE DISTRICT CORPS OF ENGINEERS
MECHANICAL DISCIPLINE

1. The following information is presented to give the architect-engineer (A-E) a listing of the most important requirements to be considered in preparing a concept design. This is not intended to be all inclusive and should be used in conjunction with ER-1110-345-700, 710, and 720.

2. It will be the responsibility of the A-E to design in accordance with the basic instructions and guidance using current criteria in all cases. The design analysis (D.A.) prepared by the A-E is a matter of public record and must be complete.

3. The Design Analysis should be easily followed so that the A-E's work can be reviewed step-by-step. It must be well organized so a person who hasn't been involved with the project can still follow the A-E's thought process. It must be well organized with all calculations shown, all values referenced, and all assumptions discussed.

BE SURE TO OBTAIN THE REQUIRED ARMY ETL’s AND TM's WHICH ARE APPLICABLE TO THE PROJECT AND THE UPDATED TI WITH CHANGES TO DATE OF NTP

ATTACHMENT 1

1. HVAC DESIGN ANALYSIS

a. Scope of Work - Narrative description of the design

b. Criteria listing - manuals, codes, etc., with dates

c. Design conditions used in calculations:

1. building occupancy profile/usage data
2. inside and outside temperatures
3. personnel load requirements
4. equipment load requirements
5. infiltration load values
6. electrical lighting load requirements
7. outside air ventilation requirements (summer/winter)
8. personnel ventilation requirements
9. U factors
10. vibration/noise isolation requirements
11. emissions control requirements
12. other special conditions pertaining to the project

d. Design Calculations:

1. block cooling load
2. block heating load
3. building air balance
4. any special cooling/heating requirements

e. Narrative: Types of systems and full description including justification for consideration, description of air distribution design method, zoning, and control description and justification for any connections to existing systems. This narrative should indicate energy conservation features/items and should highlight the conclusions of the life cycle cost analysis performed to arrive at the proposed system.

f. Equipment: Brief description of various items of equipment; indicate operating temperatures, fuels and capacities.

g. Drawings: Show all pieces of HVAC equipment and locations, air distribution duct layout (may be single line at concept), hoods, and other equipment required for the facility. Provide installation and support details. Sections shall be provided to show installation elevations.

h. Specifications: Provide a listing of the mechanical specifications to be used on the project. Submittals after concept shall consist of marked up Corps Guide Specs.

2. COMPUTER PROGRAMS: Provide a complete, separate listing of all the computer program inputs, and outputs. Provide a discussion of the computer program methodology. This listing must fully explain the inputs and outputs and how the computer will utilize that information. If the computer program used is CERL/BLAST, TRANE/TRACE, or CARRIER/HAP then the program methodology need not be discussed.

3. STUDIES TO BE PROVIDED AT CONCEPT DESIGN

a. New buildings require the following studies at concept:

1. Energy Budget – TI 800-01, Chapter 11

2. Fuel Study/Selection - depending on availability of fuels and design conditions provide a narrative of fuels considered and reasons for rejecting/using fuels. If cost differences are not easily discernible then a fuel cost analysis must be completed (life cycle costed in accordance with TM 5-802-1 and the TI 800-01, Chapter 14).

3. Life Cycle Cost Analysis - Alternative HVAC systems must be life cycle costed in accordance with TM 5-802-1 and the TI 800-01, Chapters 11, 13, 14. Provide all backup documentation.

b. Major or total building renovations require the following studies at concept design.

1. Fuel Study - see requirements addressed above

2. Life Cycle Cost Analysis - see requirements addressed above

3. Energy Budget - see requirements addressed above

4. PLUMBING DESIGN ANALYSIS

a. Scope of Work - narrative description of the design.

b. Criteria listing - manuals, codes, etc., with dates.

c. Design conditions used in calculations

1. facility classification or category code
2. building occupancy profile (male or female)
3. plumbing code requirements
4. handicap/health/safety regulations
5. personnel requirements/usage data
6. domestic chilled/hot/cold/vacuum/special type gas/compressed air pressure/temperature/flow requirements
7. Sewer elevation/waste pitch vent pipe requirements
8. equipment/piping insulation requirements
9. equipment/piping flexibility and support requirements
10. plumbing connection for HVAC equipment requirements
11. equipment electrical connection requirements
12. other special conditions pertaining to the project

d. Design calculations:

1. plumbing fixture unit value load calculations
2. domestic hot/cold/waste/vent/drain pipe sizing calculations
3. vacuum/compressed air/special gas/vacuum load calculations
4. domestic hot water/storage capacity sizing calculations
5. grease trap, oil/water separator, neutralizing tank, elevator pit and other special tank sizing calculations
6. equipment/system safety/relief/vent/hammer arrester sizing calculations
7. hot water circulation/pump, water cooler/fountain and eye-wash/emergency shower sizing requirements
8. any special plumbing and/or related equipment/system requirements

e. Narrative: Types of equipment/systems and full descriptions, including justifications for consideration, description of hot/cold/domestic chilled, etc., distribution design method, toilet/shower facility location/distribution and control description and justification for any connections to existing systems. This narrative should indicate energy conservation features/items and should highlight the conclusions of the life cycle cost analysis performed to arrive at the proposed system.

f. Equipment: Brief description of various items/components/accessories of equipment indicating operating temperatures, pressures, flow rates, capacities, as well as primary fuels selected, etc.

g. Drawings: Show all pieces of plumbing equipment/systems and locations, piping/system layout (may be single line at concept), and other components/accessories required for the facility. Provide complete plans, sections, elevations, riser diagrams, including installation and support details.

AIR FORCE
CONCEPT DESIGN
BALTIMORE DISTRICT CORPS OF ENGINEERS
MECHANICAL DISCIPLINE

1. The following information is presented to give the architect-engineer (A-E) a listing of the most important requirements to be considered in preparing a concept design. This is not intended to be all inclusive and should be used in conjunction with ER 1110-345-700, 710, 720 and the applicable Air Force design criteria including all AF ETL's and Military Handbook 1190. It will be the responsibility of the A-E to design in accordance with the basic instructions and guidance using current criteria in all cases. The design analysis (D.A.) prepared by the A-E is a matter of public record and must be complete.

2. The Design Analysis should be easily followed so that the A-E's work can be reviewed step-by-step. It must be well organized so a person who hasn't been involved with the project can still follow the A-E's thought process. It must be well organized with all calculations shown, all values referenced, and all assumptions discussed.

BE SURE TO OBTAIN THE REQUIRED AIR FORCE ETL's WHICH ARE APPLICABLE TO THE PROJECT AND THE UPDATED MILITARY HANDBOOK 1190 WITH CHANGES TO DATE OF NTP.

ATTACHMENT 2

1. HVAC DESIGN ANALYSIS

a. Scope of Work

b. Criteria listing - manuals, codes, etc.

c. Design conditions used in calculations:

1. building occupancy profile/usage data
2. inside and outside temperatures
3. personnel load requirements
4. equipment load requirements
5. infiltration load values
6. electrical lighting load requirements
7. outside air ventilation requirements (summer/winter)
8. personnel ventilation requirements
9. U factors
10. vibration/noise isolation requirements
11. emissions control requirements
12. other special conditions pertaining to the project

d. Design Calculations:

1. block cooling load
2. block heating load
3. building air balance
4. any special cooling/heating requirements

e. Narrative: Types of systems and full description including justification for selection, description of air distribution design method, zoning, and control description and justification for any connections to existing systems

f. Equipment: Brief description of various items of equipment; indicate operating temperatures, fuels and capacities.

g. Format: All pages shall be consecutively numbered in addition to any sheet designations which may be indicated.

h. Drawings: Show major pieces of HVAC equipment and locations, air distribution duct layout (may be single line at concept), hoods, and other items of major equipment required for the facility. Provide installation and support details. Sections shall be provided to show installation elevations.

i. Specifications: Provide a listing of the mechanical specifications to be used on the project. Submittals after concept shall consist of marked up Corps Guide Specs.

2. COMPUTER PROGRAMS: Provide a complete, separate listing of all the computer program inputs and outputs. Provide a discussion of the computer program methodology. This listing must fully explain the inputs and outputs and how the computer will utilize that information. If the computer program used is CERL/BLAST, TRANE/TRACE, or CARRIER/HAP then the program methodology need not be discussed.

3. STUDIES TO BE PROVIDED AT CONCEPT DESIGN

a. New buildings require the following studies at concept:

1. Energy Budget - see Military Handbook 1190 and applicable AF ETL for energy budget figures

2. Fuel Study - Depending on availability of fuels and design conditions provide a narrative of fuels considered and reasons for rejecting/using fuels. If cost differences are not easily discernible then a fuel cost analysis must be completed.

3. Life Cycle Cost Analysis - Alternative HVAC systems must be life cycle costed in accordance with AFR-178-1, AFP-178-8, and the requirements of Military Handbook 1190. Provide all backup documentation.

b. Major or total building renovations require the following studies at concept:

1. Fuel Study - see requirements addressed above

2. Life Cycle Cost Analysis- see requirements addressed above

3. Energy Budgets - see requirements addressed above

4. PLUMBING DESIGN ANALYSIS

a. Scope of Work - narrative description of the design.

b. Criteria listing - manuals, codes, etc., with dates.

c. Design conditions used in calculations

1. facility classification or category code
2. building occupancy profile (male or female)
3. plumbing code requirements
4. handicap/health/safety regulations
5. personnel requirements/usage data
6. domestic chilled/hot/cold/vacuum/special type gas/compressed air pressure/temperature/flow requirements
7. Sewer elevation/waste pitch or vent pipe requirements
8. equipment/piping insulation requirements
9. equipment/piping flexibility and support requirements
10. plumbing connection for HVAC equipment requirements
11. equipment electrical connection requirements
12. other special conditions pertaining to the project

d. Design calculations:

1. plumbing fixture unit value load calculations
2. domestic hot/cold/waste/vent/drain pipe sizing calculations
3. vacuum/compressed air/special gas/vacuum load calculations
4. domestic hot water/storage capacity sizing calculations
5. grease trap, oil/water separator, neutralizing tank, elevator pit and other special tank sizing calculations
6. equipment/system safety/relief/vent/hammer arrester sizing calculations
7. hot water circulation/pump, water cooler/fountain and eye-wash/emergency shower sizing requirements
8. any special plumbing and/or related equipment/system requirements

e. Narrative: Types of equipment/systems and full descriptions, including justifications for consideration, description of hot/cold/domestic chilled, etc., distribution design method, toilet/shower facility location/distribution and control description and justification for any connections to existing systems. This narrative should indicate energy conservation features/items and should highlight the conclusions of the life cycle cost analysis performed to arrive at the proposed system.

f. Equipment: Brief description of various items/components/accessories of equipment indicating operating temperatures, pressures, flow rates, capacities, as well as primary fuels selected, etc.

g. Drawings: Show all pieces of plumbing equipment/systems and locations, piping/system layout (may be single line at concept), and other components/accessories required for the facility. Provide complete plans, sections, elevations, riser diagrams, including installation and support details.

h. Specifications: Listing of all the plumbing specifications to be used on the project. Submittals after concept shall consist of marked up guide specifications.

III. FIRE PROTECTION:

A. SERVICES AND QUALIFICATIONS OF FIRE PROTECTION ENGINEERS: Major projects require the services and review of a qualified fire protection engineer. In addition, projects which involve design or modification of fire detection, fire suppression, or life safety systems shall required the services and review of a qualified fire protection engineer. A qualified fire protection engineer shall be an integral part of the design team, and shall be involved in every aspect of the design as it relates to fire protection. This includes, but is not limited to, building code analysis, life safety code analysis, design of automatic detection and suppression systems, water supply analysis, and a multi-discipline review of the entire project. For the purpose of meeting this requirement, a qualified fire protection engineer is defined as an individual meeting one of the following conditions:

1. An engineer having a bachelor or master of science degree in fire protection engineering from an accredited university engineering program, plus a minimum of 2 years fire protection engineering work experience.

2. A registered professional engineer (P.E.) in fire protection engineering.

3. A registered professional engineer in a related discipline and member grade status in the National Society of Fire Protection Engineers.

4. An engineer with a minimum of 10 years experience in fire protection engineering and member grade status in the National Society of Fire Protection Engineers.

5. A registered architect (R.A.) with member grade in the National Society of Fire Protection Engineers. Services of the R.A. shall be limited to building code applications and the life safety code analysis.

B. FIRE PROTECTION:

1. Design Criteria:

a. ER 1110-1-260, Engineering and Design, Fire Protection Engineering Policy

b. MIL-HDBK 1008C, Military Handbook Fire Protection for Facilities Engineering, Design, and Construction.

c. National Fire Protection Association Standards.

d. TM 5-812-2, Fire Stopping.

e. TM 5-813-6, Water Supply for Protection.

f. AR 420-90, Fire Protection

g. Fire Protection Handbook

h. Military Handbook 1022, Petroleum Fuel Facilities

i. Other criteria pertinent to the project as directed.

j. Exterior fire protection - hydrants and hose streams, in addition to criteria of MIL-HDBK-1008C and NFPA, see Instructions And Guidance To Architect-Engineers, Military Construction, Site Development (latest edition).

2. Design Analysis:

a. A design analysis shall be submitted with concept or preliminary and final design submittals. Design analysis will contain the following information applicable to the project. Reference all criteria.

1. Type of building construction and type of occupancy.

2. Description of structural members including fire resistive rating (where required).

3. Fire area limitations and building height limitations.

4. Separation between buildings or exposure protection.

5. Hazardous area separation.

6. Exiting requirements NFPA 101.

a. Exit unit width.

b. Travel distance and common path travel (dead ends, where permitted).

c. Vertical and horizontal exits.

d. Exit signs, lighting and emergency lighting.

e. Interior Finishes.

7. Specific compliance with MIL-HDBK-1008C, applicable Design Guides, and National Fire Codes.

8. Fire alarm (and automatic detection where required) systems; type and operation.

9. Fire damper requirements.

10. Smoke control system (smoke containment and/or smoke evacuation system including smoke dampers operated automatically).

11. Automatic extinguishing systems (automatic sprinklers, carbon dioxide, etc.

12. Standpipe systems.

13. Type, size and locations of fire extinguishers and extinguisher cabinets. Army or Air Force provide extinguishers; cabinets, where required, will be included by the designer.

14. Special hazards.

15. Water supply information from recent hydrant flow test. Water supply needed for building in accordance with MIL-HDBK-1008 C, Section 5.

16. Connection to and description of base fire reporting system.

3. Automatic Sprinkler Systems:

a. Indicate type of hazard.

b. Include water pressure and flow available in distribution system. See DESIGN REQUIREMENTS for Site Section.

c. For systems less than 3,000 square feet, standard pipe size layout will normally be acceptable. Submit sufficient calculations to show that water pressure and flow are adequate.

d. For systems over 3,000 square feet, hydraulic design is required. This will be the responsibility of the sprinkler

contractor under the construction contract (specification requirement); however, the designer must submit sufficient hydraulic calculations in the design analysis to show that system will function satisfactorily.

e. Generally, systems will be wet-type equipped with alarm check valves. Paddle type water flow indicators normally used for systems containing 20 or less heads. Use dry pipe valves and deluge valves where required.

f. Cover alarm transmission - Coordinate with Post concerning method of transmission and connection to post facilities.

4. Standpipe Systems:

a. Submit hydraulic calculations to show that system with function properly.

b. Carbon dioxide and other systems - Discuss type of system (total flooding, local application), method of activation and quantities of CO2, etc. required.

5. Concept or Preliminary Design Analysis:

a. Submit sufficient information to permit reviewer to clearly understand proposed fire protection features and to permit realistic cost estimate.

b. Water flow tests will be conducted to determine available water supply for fire protection. The designer should perform or witness the required flow testing. Accepting historical water supply information or similar data without verification should be avoided. Tests will be conducted prior to the concept design submission. It is vital that the adequacy of the water supply be determined to allow the design to proceed with planning sufficient architectural or site spacing for any fire pump rooms or water storage tanks which may be required.

6. Final Design Analysis: Submit complete design data for all fire protection features.

7. Drawings:

a. Concept or preliminary - include the following, as applicable, in sufficient detail to permit reviewer to clearly understand proposed features and to permit realistic cost estimate.

1. All rated separation required (show rating on drawings).

2. Exit signs, lighting and emergency lighting.

3. Fire alarm bells and pull stations (and automatic detectors where required).

4. Locations of fire/smoke dampers required; show locations on HVAC drawings; show openings (horizontal, vertical) required for dampers on architectural drawings.

5. Indicate areas to be provided with automatic extinguishing systems.

6. Show locations of standpipes.

7. Show locations of fire extinguisher cabinets.

8. Special hazards.

b. Final drawings - similar to the requirements for concept or preliminary drawings except that drawings will be complete with all details.

1. Include details of fire/smoke dampers.

2. Show layout for sprinkler systems; include building cross sections showing sprinkler piping. Coordinate layout with mechanical, electrical and structural work. Include water distribution system flow and pressure data where hydraulic design of sprinkler systems are required.

3. See DESIGN REQUIREMENTS for Electrical, Mechanical and Architectural Sections for additional requirements.

8. Specifications:

a. Automatic sprinkler and standpipe systems - for wet systems use CEGS 15330 Wet Pipe Sprinkler Systems, Fire Protection; for Dry Systems use CEGS 15331 Dry Pipe Sprinkler Systems, Fire Protection. For preaction or deluge systems use CEGS 15332 Preaction And Deluge Sprinkler Systems, Fire Protection. Edit to suit project.

b. Carbon Dioxide, etc. - no guide specification available; consult manufacturers and applicable references.

c. Fire extinguisher cabinets - no guide specification available; generally use manufacturers data; make this a separate section, Division 10.

d. If necessary, use CEGS 15320 Fire Pumps, edit to suit project.

e. Foam Extinguishing Systems - use CEGS 15355 Aqueous Film-Forming Foam (AFFF), Fire Protection Systems.

f. Cooking hoods, use CEGS 15371 Wet Chemical, Fire Extinguishing System.

g. For any specification which references the District Fire Protection Engineer as a reviewer, when the A-E is conducting Title II services, the A-E remains responsible for approval but must forward a set to the District Fire Protection Engineer for review, concurrence and file.

h. See DESIGN REQUIREMENTS for Electrical, Mechanical and Architectural Sections for additional requirements.

9. SPECIAL PRECAUTIONS:

a. Insulation.

1. Thermal and acoustical insulation must comply with MIL-HDBK 1008 C, Subsection 2.8.

2. Insulation for mechanical systems must comply with Guide Specification, CEGS 15250, Thermal Insulation for Mechanical Systems.

IV. STANDARD REQUIREMENTS FOR DESIGN SUBMITTALS: The requirements of the guidance are a minimum that must be submitted at each phase of design. A submission is not complete, and will not be sent out to the customer until all of the requirements in the guidance are met. Every designer should have a copy of the list and use it to ensure that their submission is complete. The following is the list of the design submittals required for each phase of design:

A. Pre-Concept Design Phase:

1. Mechanical:

a. Narrative - brief description of each HVAC/refrigeration/special equipment and systems that will be considered.

b. References - criteria, codes, etc.

c. A brief description of fuels available at the site.

2. Fire Protection:

a. Narrative - brief description of occupancy classification of the building.

b. References - criteria, codes, etc.

c. Water Supply Analysis - In the Design Analysis provide hydrant flow test results showing water supply at the site, evaluate the fire protection water demand required for the building and compare to test results. Determine the adequacy of available water supply (need for pump, tank, etc.). A-E should perform or witness the hydrant flow test.

3. Plumbing:

a. Narrative - brief description of each piece of plumbing equipment and plumbing systems that will be considered..

b. References - criteria, codes, etc.

c. A brief description of fuels available at the site (coordinate with mechanical fuel description/narrative).

B. Concept Design:

1. Mechanical:

a. Narrative - specific description of each proposed HVAC/refrigeration/special equipment, systems, and controls.

b. Complete List of References - criteria, codes, etc.

c. Design conditions.

d. Site visit trip report/data and list of equipment/computer mechanical/electrical technical data (inputs, outputs, etc.).

e. Energy budget study.

f. Solar analysis.

g. Fuel study.

h. Life cycle cost analysis (equipment, systems, etc.)

i. Complete specification outline.

j. Single line drawings showing equipment, systems, exterior utilities, and locations, including other special equipment or systems required for the facility.

k. Preliminary construction work estimate.

l. Action/response to VE.

2. Fire Protection:

a. Narrative - fire protection and life safety design analysis in accordance with Mil-HDBK-1008 C, Sections 1.4 and 1.5.

b. Complete List of References - criteria, codes, etc.

c. Prepare life safety drawings illustrating occupancy classes, occupant load, travel distances, exit capacity capabilities, building separation and exposure protection requirements, and location of fire-related or smoke-related building components.

d. Complete specifications outline.

e. Preliminary construction work estimate.

f. Respond to/incorporate comments to pre-concept design.

3. Plumbing:

a. Narrative - specific description of each piece of plumbing equipment and systems

b. Complete list of references - criteria, codes, etc.

c. Proposed special type plumbing equipment/system design overview.

d. Design conditions.

e. Fuel study (coordinate with mechanical study).

f. Life cycle cost analysis (coordinate with mechanical study).

g. Complete specifications outline.

h. Single line drawings showing plumbing equipment, systems, exterior site utilities, and locations, including other special equipment/systems required for the facility.

i. Preliminary construction work estimate - include plans.

j. Action/response to VE.

C. Final Design:

1. Mechanical:

a. Complete mechanical narrative.

b. All comments and responses from previous submissions.

c. Complete final design analysis containing calculations, equipment/systems sizing/selections, copies of manufacturer’s catalogs/technical data/model numbers, etc.

d. Complete final drawings including cover sheet, index of drawings, legends/symbols/abbreviations, exterior utilities plans/sections/details, interior plans, sections, elevations, risers, details, flow and control diagrams, seismic/support details, etc., for all mechanical equipment and systems; equipment schedules and other special equipment/system/ controls required for the facility.

e. Complete marked-up specifications.

2. Fire Protection:

a. Update/complete fire protection, water supply, and life safety analysis (containing sprinkler calculations, and flow data).

b. All comments and responses from previous submissions.

c. Update life safety drawings to show fire extinguisher locations, and other important fire protection/life safety features.

d. Ensure mechanical and HVAC drawings show fire dampers and smoke dampers locations.

e. Ensure electrical, power and lighting drawings show fire alarm devices and existing locations.

f. On fire protection drawings show extent and type of fire protection system; provide detailed information and criteria; show location of supply (point of connection); show location of special fire protection systems; show locations of fire department connections and test connections; and show locations of risers, stand pipes, pumps and associated equipment.

g. Provide details of water lines entering the building, of the riser system from point entering the building to the sprinkler system piping, of fire department connection, of test connections.

h. Complete marked-up specifications.

i. Construction work estimate.

3. Plumbing:

a. Complete plumbing narrative.

b. All comments and responses from previous submissions.

c. Complete final design analysis containing calculations, equipment/fixture sizing/selections, copies of manufacturer’s catalogs/technical data/model numbers, etc.

d. Complete final drawings including cover sheet, legends/symbols/abbreviations, exterior utilities plans/sections/details, interior plans, sections, elevations, risers, details, flow and control diagrams, seismic/support details, etc., for all plumbing equipment and systems; equipment schedules and other special equipment/system/controls required for the facility.

e. Complete marked-up specifications.

f. Construction work estimate.

D. “Backcheck” Design (Mechanical, Fire Protection and Plumbing):

1. The submission for backcheck submission shall incorporate the comments from final design submission and all appropriate outstanding comments from earlier submissions. The submission shall include complete design analyses, backcheck design drawings, construction cost estimate, and typed specifications.

2. AE/designers must ensure that the backcheck design submission documents have been reviewed for technical accuracy, completeness, biddability, constructibility and maintainability prior to delivery to the Corps of Engineers or customer.

Design Branch
Standard Operating Procedure
ENERGY CONSERVATION COMPLIANCE

1. PURPOSE: The purpose of this Standard Operating Procedure is to define procedures for ensuring compliance with Federal laws and mandates on energy conservation criteria affecting project design and execution.

2. APPLICABILITY: This SOP is applicable to all design projects in the Design Branch.

3. POLICY: Increasing checks, audits, and controls mandated by Federal laws and regulations dictate that Design Branch examine each design for compliance with all applicable regulations. Close coordination, timely action, and adherence to this checklist could prove to be beneficial in ensuring that energy conservation requirements are not overlooked in the design process. Energy conservation compliance requirements are subject to DoD/IG audits.

4. RESPONSIBILITY: Design Team Leaders are to ensure that the subject checklist is maintained throughout the entire design as a record of compliance with various regulations which impact design. At each project design, designers are to review the checklist for applicability, suitability, accuracy, and completeness.

5. REFERENCES/DEFINITIONS: Appendix A consists of the list of the current applicable references and a glossary of terms found in the checklist for clarity.

1. ENERGY CONSERVATION COMPLIANCE CHECKLIST

Project Name/Location:_____

_____

Project Number:_____ FY:_____

Building/Facility Classification:_____

Building/Facility Function:_____

A-E/In-House/Other:_____

Designer's Organization Name/Symbol:_____

_____

Designers Providing Information:

Name	Signature	Tel. No.

Project Manager:

Name	Signature	Office Symbol	Tel. No.

Design Manager:

Name	Signature	Office Symbol	Tel. No.

Data provided should be consistent with references listed on Appendix A and other current guidance. Questions should be answered as "N/A" that are not applicable, "Yes" for compliance, and "No" option. Explanations/justifications for "No" option should be provided under "remarks" or on a separate sheet of paper. Use the letter "X" to answer the appropriate column. NOTE: Designers providing information should properly coordinate

their answers or input data to the checklist for technical accuracy, appropriateness, consistency, and completeness.

APPENDIX A

1. References:

a. ER 1110-345-700, Design Analysis, Drawings and Specifications, 30 May 1997.

b. TI 800-01, Technical Instructions Design Criteria.

c. Energy Policy Act of 1992 (P.L. 102-486)

d. DOE/National Institute of Standards and Technology (NIST)/Office of Management and Budget (OMB), Circular 94.

e. DoD Compliance with Federal Methodology for LCCA, Title 10., Part 436, Subpart A.

f. ETL 1110-3-465, New Water Meters and Appurtenances at New Army Facilities.

g. Memorandum, CEMP-ET, 25 May 1994, Subject: Executive Order 12902, Energy Efficiency and Water Conservation at Federal Facilities.

h. Memorandum, DAIM-FDF-A, 10 April 1994, Energy Conservation Program (ECIP) Guidance.

i. Memorandum, CEMP-ET, 6 November 1995, Subject: Flow Limiting Shower heads.

j. National Institute of Standards and Technology's Building Life Cycle Cost (BLCC)

k. Federal Regulation 10 CFR 435, Energy Conservation Voluntary Performance Standards for New Buildings

l. Presidential Executive Order 12759 - requires Federal agencies to develop and implement energy strategy plans that ensure compliance with overall energy reduction levels.

m. Memorandum of Agreement (Army, Navy and Air Force) on Criteria/Standards for Economic Analysis/Life Cycle Costing for Military Design

n. TM 5-802-1, Economic Studies for Military Construction Design/Applications.

o. Memorandum, CEMP-EC/CEMP-ET, Subject: Economic Studies for MCA and MCAF Designs.

p. Message, CDR USACE, December 1993, Subject: National Energy Conservation Act of 1992 - requires that plumbing fixtures used in projects be water conservation type.

q. AR 11-27, Army Energy program.

r. AR 420-49, Heating, Energy Selection and Fuel Storage, Distribution, and Dispensing Systems.

2. Definitions:

Absorption Chillers - Machines that utilize heat energy directly to chill the circulating medium, usually water. The absorption cycle utilizes an absorbent (usually a salt solution) and a refrigerant (water).

TI - Technical Instructions TI 800-01, dated 20 Jul 1998

ASHRAE - American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc.

Ballasts - Energy-saving magnetic ballasts mandated by the 1988 Federal Ballast Energy Law, reduced lighting by 10 percent. Solid-state electric ballasts have further reduced energy use by almost 20 percent.

British Thermal Unit (BTU) - Approximately the amount of heat required to raise the temperature of one pound of water from 59 degrees F to 60 degrees F.

Building Loads Analysis and System Thermodynamics (BLAST) computer program for building energy analysis. BLAST performs hourly simulations of buildings air handling systems and central plant equipment in order to provide the designer with accurate estimates of a building's energy needs. The program allows the study of many design alternatives in order to assist its design in choosing the most cost effective design.

Building Passive Design - The configuration of a building, and the orientation and envelope, determined in a large part the amount of energy used. The building plan responds to the functional program, but a critical review of a functional program that includes energy consideration often reveals

opportunities to change the plan for energy conservation. The site also may influence the direction of the building axis so that the most adverse effects of sun and wind are felt. In the latter case, specific envelope design tactics are required to off-set the hostile climate. A building with a north-south major axis receives more solar radiation than one with an east-west major axis, anywhere in the country. The following energy concerns are greatly influenced by the building shape and orientation which, in turn, may be influenced by a particular site:

- Trade-offs between heat loss and heat gain on each exposure with particular regard to wind and sun.

- Utilization of natural daylight versus heat loss and heat gain and glare problems peculiar to each exposure.

- Beneficial effects of direct solar radiation for heating versus adverse effects during the cooling season.

CARRIER/HAP and TRANE/TRACE - Carrier Corporation and Trane Company are HVAC equipment manufacturers whose software uses predefined systems to simulate packaged systems and central heating-cooling equipment. These programs primarily use performance equations based on their equipment test data to simulate the capacity and-power use of their equipment.

CEGS - Corps of Engineers Guide Specifications.

Coefficient of Performance (COP) - cooling: the ratio of the rate of heat removal to the rate of energy input in consistent units, for a complete system or factory assembled equipment as tested under a nationally recognized standard or designated operating conditions.

Coil Run-around Cycle (air-to-water, water-to-air) - This system is typically used to preheat outside ventilation air or make up air during the heating season. It can be used during the cooling season to pre-cool the outside ventilation air or make up air whenever the exhaust air is colder than the outside air.

Control Loop, Local - a control system consisting of a sensor, a controller, and a controlled device.

DD Form 1391 - DoD/DA construction project justification documents, Chapter 3 requires compliance with energy conservation Federal laws and mandates.

Demand-Control Ventilation (DCV) - is a strategy that uses direct or indirect measurement of air quality to control the flow of outside air into buildings. It goes beyond occupant or timeclock control to measure air quality parameters, primarily using carbon dioxide (CO.) sensors.

Design Energy Usage (DEU) - The completed annual energy usage of a proposed building design based on normal loads for maintaining comfort and amenities for the occupants. Refer to TI 800-01, Chapter 11.

Double Bundle Condenser - In cool weather, part of a building may need heating at the same time as another part needs cooling. In that event, the condenser heat can be applied to the heating load, instead of being dissipated to the atmosphere in a cooling tower.

ECIP - Energy Conservation Investment Program - The ECIP is a special Military Construction (MILCON) funded program to improve the energy efficiency of existing facilities. Projects funded under ECIP can improve living and working conditions of Army personnel, enhance mission capabilities, and decrease negative environmental impacts of energy systems. Funds designated for ECIP are managed by DoD and do not compete with Army's MCA program. The ECIP MILCON program has separate project submission and execution requirements. The National Energy Policy Act (P.L. 102-486) and recent DoD guidance have placed renewed emphasis on energy conservation. Installations/MACOMs are required to use ECIP, along with other programs, to assist in meeting the Army's energy reduction goals.

Economizer, air - a ducting arrangement and automatic control system that allows a cooling supply for systems to supply outside air to reduce or eliminate the need for mechanical refrigeration during mild or cold weather.

Efficiency, HVAC System - the ratio of the useful energy output (at the point of use) to the energy input in consistent units for a designated time period, expressed in percent.

Energy Efficiency Ratio (EER) - The ratio of new equipment cooling capacity in BTU/HR to total rate of electric input in watts under designated operating conditions.

Energy Management System - a control system designed to monitor the environment and the use of energy in a facility and to adjust the parameters of local control loops, to conserve energy while maintaining a suitable environment.

Energy Recovery in HVAC Systems - Systems involved in transferring heat from one airstream to another. In summer months, intake air at a higher temperature rejects heat to cooler exhaust air prior to being mechanically cooled by the chilled water or direct expansion coil. Conversely, during the winter, intake air is warmed by transferring heat from exhaust air.

Energy Storage System - When recoverable energy will not be available at the time it is needed, temporary energy storage equipment must be provided. The additional cost to provide, operate, and maintain the required thermal storage facilities (including the cost, if any, of the loss of ventable space that the storage tanks occupy) must be included in the life-cycle costs of the system. Thermal storage can yield substantial ownership and operating savings, especially in geographic locations which have utility time-of-day rates with high on-peak demand charges.

Energy Use Budget (EUB) - The maximum allowable computed energy in BTU/SF/YR consumed by buildings. Refer to TI 800-01, Chapter 11.

Evaporative Cooling - A system that utilizes the cooling effect of evaporating water as the heat sink. The use of this effect in condensing refrigerant and providing condenser water. In many situations, it is possible to use evaporative cooling directly at considerably lower cost than that for mechanical refrigeration.

Fenestration - any light-transmitting section in a building wall or roof. The fenestration includes glazing material (which may be glass or plastic), framing (mullions, muntins, and dividers), external shading devices, internal shading devices, and integral (between glass) shading devices.

Gray-Water recycling - an on-site waste-water treatment and recycling system - receives nonfecal and non-chemical waste water from lavatories, washing machines, non-kitchen sinks, water coolers, bathtubs, showers, and other similar equipment and fixtures. The water is treated and then recycled as an alternate to fresh water for toilet and urinal flushing, landscape irrigation, and make-up water for ornamental ponds and cooling towers.

Heat-Pipe Recovery System - This system makes use of self-contained refrigeration cycle. Thermal energy (warm air) is applied to either end of this pipe and vaporizes the

refrigeration at that end. The refrigerant vapor then travels to the other end of the pipe where cooler air is applied, condensing the refrigerant gas and absorbing the latent heat of condensation. The condensed liquid refrigerant then flows back to the evaporator section (hot side). As long as there is a temperature difference between the evaporation (hot) end and the condensing (cold) end, the transfer of energy will be continuous.

Heat Recovery Wheels - typically recover 60 to 80 percent of the sensible heat difference between the upstream exhaust air and the outside air. Special heat recovery wheels are manufactured with properties like those of a desiccant dryer. They will recover 60 to 80 percent of the total (sensible and latent) energy difference between the upstream air and the outside air.

HVAC system - The equipment, distribution network, and terminals that provides either collectively or individually the process of heating, ventilating or air conditioning to a building.

IAW - In accordance with.

Insulation - Thermal insulation is a material used for covering pipes, ducts, equipment/vessels, etc., to effect a reduction of heat loss or gain.

Life-Cycle Costing (LCC) - is a method of calculating the total cost of ownership over the life span of the asset/ building/equipment/systems. Accuracy is the best policy for life cycle cost analysis.

Life-Cycle Cost in Design (LCCID) - an economic analysis computer program tailored to the needs of the Department of Defense (DoD). It is intended to be used as a tool in evaluation and ranking design alternatives for new and existing buildings. LCCID incorporates the economic criteria of the Army, Navy, and Air Force for design, studies, and operates in a manner that requires little knowledge of this criteria by the program user.

Lumen - The measure of the quantity of light. It is analogous to quantity of fluid flow in a hydraulic system or current flow in an electric power system and is a measure of the total amount of light generated by a light source.

Meters - Devices to measure water and fuel volumes and electric energy consumption.

Motor Efficiency - A measure of the effectiveness with which motor converts electrical energy to mechanical energy.

Occupancy Sensors - A device that detects the presence or absence of people within an area and causes any combination of light, equipment, or appliances to be adjusted accordingly.

Peak Loads - Utility rate structures are based not only on the building's total usage of electricity but also on the peak demand - which may occur for only a few hours or twice each year but which established demand charges for the rest of the month.

Roofs - These portions of the building envelope including all opaque surfaces, fenestration, doors, and hatches which are above conditioned space and which are horizontal or tilted at less than 60 degrees from horizontal.

Selecting the Type of Fuel - Before selecting any HVAC equipment, the type of fuel must be chosen. The fuel for heating is selected independent of cooling systems and is chosen based on economy and availability. The basic fuels are natural gas, propane gas, oil, steam, electricity, solar energy, and coal.

Skyliqht - In a roof, an opening which is glazed with a transparent or translucent material; used to admit diffused light to the space below.

Solar Energy Source - natural day lighting or thermal, chemical, or electrical energy derived from direct conversion of incident solar radiation at the building site.

Solar Screen - A non-structural openwork or louver panel of a building, arranged so as to act as a sun-shading device.

Solid Fuels - Include bituminous and anthracite coals, coke, peat, and sawdust.

System - a combination of equipment and/or controls, accessories, interconnecting means, and terminal elements by which energy is transferred so as to perform a specific function, such as HVAC, service water heating, or illumination.

Thermostat - an automatic control device responsive to temperature.

Total Energy System - a total energy system is an on-site electrical power generating system arranged for the maximum use of input fuel energy by utilizing the waste heat for space heating, space cooling, and domestic water heating.

Transformer Losses - Transformers reduce transmission and distribution voltage to equipment operating voltage. Heat

generation and dissipation, due to electrical resistance in the transformer, result in electrical energy losses.

Variable-Speed Drivers (VSDS) - used to accurately control motor speed, are often praised in case studies that note savings of more than 50 percent in energy consumption, compared to fixed-speed systems. VSDs sometimes are called variable-frequency drives, or adjustable-frequency drives. Today, most use a microprocessor control system with an AC or DC motor. The DC motor is used in highly specialized applications requiring torque, tension control, and quick reversing.

U-Factor - Overall heat transmission coefficient, the amount of heat expressed in British Thermal Units (BTU) transmitted in one hour through one square foot of a building section (wall, floor, or ceiling) for each degree F of temperature difference between air on the warm side and air on the cold side of the building section.

Ventilation - The process of supplying or removing air by natural or mechanical means to or from any space. Such air may or may not have been conditioned (cooled or heated).