APPENDIX B

DESIGN ANALYSIS

1. General. This appendix prescribes the requirements and procedures for the preparation of design analysis (basis for design) for military and/or HTRW construction projects.

2. Design Analysis Requirement.

a. A design analysis will accompany project drawings and specifications required for all new construction and/or HTRW remedial action projects, and projects involving major alteration or expansion of existing facilities, unless specifically exempted.

b. A design analysis shall be developed by the architect-engineer (design agency in-house or contracted design professional) of record for the military and/or HTRW construction project being designed.

c. The design analysis is developed in coordination with installation or customers, and summarized in a format appropriate for:

(1) Review, approval and record purposes.

(2) Revision of designs during construction, as required.

(3) Use in adapting designs to other sites.

(4) Operations and maintenance (O&M) enhancement and cost reduction.

(5) Post-occupancy evaluation.

d. Design analysis shall be prepared in metric. Where computer programs or technical references are used, the metric version of the program or reference is preferred and should be used. Where metric versions are not readily available or practical, that portion of the design analysis based on non-metric program or reference may use inch-pound (IP) units. In these cases, the final values that are to be placed in the contract documents shall be converted to their metric equivalent in the design analysis prior to use in project drawings or specifications. Unit designations and conversions shall be in accordance with ASTM E 621-84 as modified by the Metric Guide for Federal Construction, unless specifically indicated otherwise.

3. Definition. A design analysis is a document that contains written material covering general parameters, functional and technical requirements, design objectives, design assumptions, and provides design calculations applicable to a project's design.

4. Organization and Content. The design analysis will be organized into three parts; Part 1 - "General Description," Part 2 - "Design Requirements and Provisions," and Part 3 - "O&M Provisions." Characteristics of the three parts of a design analysis are as follows:

a. General Description (Part 1). This part of the design analysis will state the purpose, authorization, applicable criteria and the project description for the project, and provide a summary of the factors influencing the choice of the civil, environmental, architectural, structural, mechanical, electrical, communications, fire protection, physical security systems, and HTRW aspects used in the project along with an indication of how the initial and life cycle costs were considered. Identify all additional utility requirements,

calculate the total requirement, and compare the total existing capabilities. The requirements of the Record of Decision or other decision document will be included for HTRW projects.

b. Design Requirements and Provisions (Part 2). This part of the design analysis will include subparts for each major design discipline and basic project design requirements that should be addressed in the design analysis with justifications to validate the design decisions. Additional facility requirements are provided in Architectural and Engineering Instructions (AEI), Design Criteria, and its appendices, and special medical facility design requirements in AEI, Medical Design Standards.

(1) Civil. This includes soil analysis and survey data, site design, site improvements, planting and landscaping, paving, grading and drainage, water, waste-water and soil treatment, contaminant containment, utilities systems analysis and design, and provisions for airfields, ports and railroads, if required.

(2) Environmental. This includes an impact assessment checklist covering air, water and noise effects from the project and construction; worker health and safety; HTRW remediation cleanup and action levels; transportation and disposal regulation requirements; quality control for chemical sampling/analysis; wetlands determination (tidal and nontidal); special wildlife, plant, and endangered species considerations; ground water, waterway and floodplain protection assessment; pollution prevention control requirements; and design measures to be implemented (i.e., construction site sediment and erosion control requirements by Federal, state and local governments); and hazardous material management, natural and cultural resources, and environmental permits.

(3) Architectural. This includes space allowance, functional layout, interior design, furniture planning, signage, accessibility, security, energy conservation, space-mass composition, materials used and details with respect to image, safety, maintenance and cost effectiveness.

(4) Structural. This includes foundation, structural, seismic, hardened structure, nuclear radiation and blast protection systems analysis and design.

(5) Mechanical. This includes heating, ventilation and air conditioning systems, refrigeration, plumbing, elevators and cranes, energy conservation, pollution control, noise and vibration control, heating and chilled water distribution, gas distribution, fuel storage and dispensing, and process systems design.

(6) Electrical. This includes power generation, transmission and distribution systems, lighting (interior and exterior), voice and video communications, intrusion detection, utilities monitoring control systems (UMCS), cathodic protection, lightning and static electricity protection systems analysis and design, aviation lighting, and electromagnetic protection.

(7) Fire Protection and Life Safety. This includes building construction, exit requirements, fire extinguishing systems, fire protection water supplies, surge analysis, and alarm and detection systems analysis and design.

(8) Physical Security. This includes fencing, vaults, protective lighting, security systems, locks, arms rooms, controlled substances, entrances, guard facilities, classified material, patrol roads, clear zones, restricted areas, surveillance and penetration resistance.

c. Operation and Maintenance (O&M) Provisions (Part 3). This part of the design analysis will describe the design provisions

made to enhance and to reduce the cost of operating and maintaining the facility when completed.

(1) This part of the design analysis should include the O&M design intentions for the major design disciplines covered in Part 2.

(2) This part of the design analysis will be in a format that can be used separately to supplement the completion records required by Army Regulation (AR) 415-1-10, or to form the basis for assembling a facility user's manual.

d. Special Aspects for HTRW Projects. The design analysis for HTRW projects will include all applicable regulatory, chemical sampling/analytical, safety and occupational health, geotechnical, cost engineering, and process engineering provisions and criteria required by the HTRW guidance references listed in Appendix A and the HTRW examples listed in Appendix B (Part 2).

5. Preparation.

a. Assembly and Identification.

(1) The design analysis should be assembled, when possible, into a single volume with a complete table of contents. When more than one volume is required, each volume should be labeled, numbered sequentially and assembled under a cover page. The cover page should indicate the volume number and the total number of volumes in the design analysis for the project. Likewise, the cover page should indicate the name and location of the project, the project number and fiscal year, and the identification of the design agency. Applicable local file numbers and references to drawings, including Computer Aided Drafting and Design (CADD) file numbers, and specification numbers will be included as appropriate.

(2) Studies performed as part of the design process, such as life cycle cost analysis, energy use budget and design energy use calculations and simulations, solar feasibility analysis, treatability studies, and hydro geological modeling will be stand alone reports and included in the design analysis as appendices (referenced in the design analysis as appropriate).

b. Size and Layout.

(1) The table of contents, cover page layout and page layouts, as appropriate, will be guided by the standards prescribed and delineated in this ER. Supplemental guidance may be found in Engineer Pamphlet (EP) 310-1-6.

(2) The design analysis will be clearly and legibly expressed.

(3) All materials will be prepared in relation to a vertically oriented A4 metric, 210 mm x 297 mm (8.3 inches x 11.7 inches) standard page size (8-1/2 x 11-inch when metric paper stock is not available). Larger material may be folded to the standard page size, i.e., when reduction is not feasible, the A3 metric sheet, 297 mm x 420 mm (11.7 inches x 16.5 inches), easily accommodates folding in to the A4 metric sheet as a half-size of a standard A1 metric construction drawing.

(4) When drawings, published data or automated data processing printouts are used, these materials will be trimmed, reduced or folded to conform to the standard page size.

c. Classified Material. Every effort will be made to prepare the design analysis to be an unclassified document with proper references to sources of classified material.

d. Design Calculations. Design calculations will be computed and checked for accuracy and initialed or signed by qualified design professionals, applicable by discipline,

other than the project's designer. The names or initials of these individuals will be indicated on the page, or an insert, carrying the calculation.

(1) All design assumptions, loads and conditions, as applicable, will be clearly indicated and legible with tabulations indicated on the page, or an insert, carrying the calculation, and will be clear and legible with the tabulation. The sources of loading conditions, design assumptions, formulas and references will be identified. Assumptions and conclusions will be explained and cross-referenced.

(2) When a commercial computer program (software) is used:

(a) The program will be named and described to include a flow chart, or other documentation, showing how the program attains the solution. This description must be sufficient to verify the validity of methods, assumptions, theories and formulas, but should not require source code documentation or otherwise compromise any proprietary programs.

(b) The input shall be reviewed for accuracy and initialed or signed by a registered architect or engineer, or design professional as applicable to the input being checked. The output shall be reviewed to ensure the reasonableness and applicability of the result and initialed or signed by the design professional that reviewed the input.

e. Use of Existing Design Analysis. If a standard design or other design is being site adapted, the design analysis for the new project will include appropriate material from the existing design analysis modified to incorporate site adaptations and other essential requirements.

6. <u>Exceptions to Appendix B Requirements</u>.

a. Medical Facility Projects.

b. Family Housing Projects.

c. Army Reserve Projects.

d. Non-appropriated Funds (NAF) Projects.

e. Design-Build Projects.

f. Simplified Design Method (SDM) Projects.

g. Defense Environmental Restoration Program, Superfund, and BRAC time critical removal actions (including Ordnance and Explosives projects).

- PART 1 -

GENERAL DESCRIPTION

1. Design Analysis. The design analysis -Part 1- will comprise five (5) sections with subsections as follows:

a. Purpose. A purpose section will be provided with a description of the project's functional purpose and other supporting dialogue from project information prepared by the installation and the organization for which the project is to be designed.

b. Authorization.

(1) Directives. A synopsis of applicable design directives for the project will be included in this part of the design analysis. For HTRW projects, include a discussion of the appropriate Federal and/or state regulations governing the project (RCRA, CERCLA, Clean Water Act, etc.).

(2) Scope of Work. A synopsis of the project authorized under the DD Form 1391 program, A106, FUDS work plan or ROD (record of decision) will be included in this part of the design analysis, to include the authorized project scope of work and programmed amount.

c. Criteria. References will be made to applicable Technical Manuals (TM), ER, AEI, Engineering Instructions (EI), other prescribed criteria, specific studies and minutes of meetings held to define the scope of the project, cost limitations and the character of the design.

d. Project Description.

(1) Project Site. A synopsis will be provided that indicates the general site conditions, project siting requirements, existing utilities available to the site, topography, wetlands designated areas, unusual environmental characteristics to be impacted by the project, and conformance with the installation master plan.

(2) Functional Objective. The basic functional objective or objectives of the proposed project and the estimated functional life will be described.

(3) Personnel and Equipment. The number of civilian and military personnel and visitors, and the types of service and/or organizational equipment to be accommodated in the project will be described.

(4) Constructibility. The basic construction materials and systems selected, and the estimated structural life of the project will be described.

e. Economic Summary. Economic factors affecting the project will be described, especially those factors influencing the choice of basic materials, and the civil, architectural, structural, mechanical, electrical and fire protection systems selected to include:

(1) Results of economic studies which consider not only the initial construction cost but also costs incurred over the estimated functional life of the project. Applicable requirements in ER 1110-1-1300, ER 1110-3-1300, ER1110-3-1301, and TM 5-802-1 must be adhered to in preparation of cost estimates.

(2) Results of value engineering studies performed on the project design.

(3) Design analysis prepared so that they may be edited using computer systems and

software standards by the design agency.

2. Review and Approval. Review and approval of design analysis will coincide with the review and approval of the project drawings and specifications in accordance with Appendices C and D of this ER including:

a. Project Engineering with Parametric Estimating Design Stage (Code 3). The general summary statement will be in accordance with Architectural and Engineering Instructions (AEI), Code 3 Design.

b. Concept Design Stage (Code 2). The design analysis will cover the progress of all of the design disciplines (refer to Part 2).

c. Final Design Stage (Code 6). All parts of the design analysis, including the O&M provisions (refer to Part 3), will be complete within themselves, without requiring reference back to earlier design analysis. Review and approval of final design drawings and specifications will be done concurrently with the review and approval of the final design analysis.

d. Drawing Modifications. When modifications of project drawings are authorized, as set forth in Appendix C of this regulation, the design analysis for the changed conditions will be added to the design analysis and the revision date or dates noted.

3. Disposition and Reference Copy. The final design analysis with revisions and the as-built drawings will be transferred to the using service after acceptance of the project. A reference copy of the design analysis will be retained separately by the design agency for possible use in adapting the project design to another site or in evaluating lessons learned. Reference copies of the design analysis will be retained by the design agency for at least two years after the beneficial occupancy date (BOD) of the project.

- PART 2 -

DESIGN REQUIREMENTS AND PROVISIONS

1. Civil.

a. General Parameters. Examples of general civil parameters that need to be addressed are:

(1) Site boundaries controlled and uncontrolled access, limits (boundries) of contaminated soil and/or ground water, and total area.

(2) Topography and soil drainage characteristics.

(3) Results of geotechnical explorations, laboratory and field testing; soil and rock elevations, classifications and characteristics; and groundwater elevations.

(4) Special considerations, such as dynamic loading, expansive soils, permafrost or dewatering, and precautions during construction.

(5) Prevailing winds, sun angles, design temperatures and precipitation.

(6) Existing structures, parking, vegetation, open spaces and outdoor recreation areas. Functional relationships relative to adjacent facilities, exclusion zone, or decontamination facilities.

(7) Disposition of major utilities, transportation arteries and access roads to include other planned projects by title, fiscal year and line item number.

(8) Proposed facilities, buildings, support buildings, parking, access roads, service areas, utilities and helipads.

(9) Former use, demolition responsibilities and location (with justification) of borrow pits, disposal areas and contractor plant areas, including HTRW wastes.

(10) Local construction practices, availability of materials, labor and skills, and use of industrialized components.

(11) Installation compatibility, and future use considerations.

(12) Permit requirements, as applicable.

(13) Contaminant characteristics and final treatment parameters

(14) Treatment facilities startup.

(15) Any other civil parameters necessary for special project designs.

b. Functional and Technical Requirements. Examples of civil related functional and technical requirements that need to be addressed are:

(1) Orientation of elements of the project to conserve energy and to reduce site preparation.

(2) Exterior functional areas, relationships and space allowances for operational, storage and support activities.

(3) Accessibility for handicapped (physically impaired or disabled) persons.

(4) Grading, storm drainage and irrigation.

(5) Landscape design and planting.

(6) Exterior signage and outdoor furnishings.

(7) Area and sign lighting.

(8) Sidewalks, retaining walls, fencing, traffic controls and barriers.

(9) Parking, access roads, including haul roads for transport of hazardous material for disposal, and access for service and emergency vehicles, to include paving design, and railroads and airfields.

(10) Service areas for pick-up and deliveries, bulk waste storage or disposal and exterior utility elements (transformer, chillers, etc.).

(11) Building set-backs, spacing of structures and maximum walking distances.

(12) Exterior utility support systems, to include fire protection water and storm drainage.

(13) Heliport and airfield clear approach and landing.

(14) Heliport and airfield illumination, and marking.

(15) Treatment equipment layout and operational flexibility.

(16) Operation, maintenance, and staffing levels at treatment facilities.

(17) Material selection for monitoring and extraction well construction and associated discharge piping.

c. Design Objectives and Provisions. Examples of civil related design objectives and provisions that need to be addressed are:

(1) Vehicular and pedestrian circulation patterns.

(2) Landscape preservation, composition and perception.

(3) Functional relationships of buildings and support facilities, to include off-site facilities and areas impacting on the site design.

(4) Barrier-free design for handicapped (physically impaired) persons.

(5) Utility support and isolation.

(6) Economy of construction and the operations and maintenance of the project relative to life-cycle cost effectiveness in accordance with TM 5-802-1, ER 1110-1-1300, ER 1110-3-1300, and/or ER 1110-3-1301.

(7) Future expansion, if applicable.

(8) Economy of construction and procurement, and life-cycle cost effectiveness in accordance with TM 5-802-1, ER 1110-1-1300, ER 1110-3-1300, and/or ER 1110-3-1301.

(9) Instrumentation requirements at treatment facilities.

(10) Evaluation of construction materials.

d. Calculations. The calculations for civil design elements, such as those listed below, will utilize metric units. If the project is permitted to use inch-pound (IP) units, the calculations shall be performed in normally accepted and recognized IP units.

(1) Soil bearing capacities, settlement analysis, slope stability, erosion control, lateral earth pressures and frost design.

(2) Road, paving, grading and storm drainage design.

(3) Landscape design irrigation systems, if applicable.

(4) Parking allowances for civilian, military and visiting personnel, handicapped (physically impaired) persons and organizational equipment.

(5) Verification of the adequacy of existing and planned utility systems required for complete project support.

(6) Sizing of domestic water and fire protection systems.

(7) Sizing of waste-water collection systems, to include maximum flow rated in liters per second for waste-water and sewage, and the total flow per day.

(8) Railroad design, if applicable.

(9) Cost comparison of competitive designs and materials, in terms of both construction costs, acquisition costs, and life-cycle costs in accordance with TM 5-802-1, ER 1110-1-1300, ER 1110-3-1300, and/or ER 1110-3-1301.

(10) Estimated cost of construction.

(11) Treatment equipment sizing and selection

(12) Treatment facility mass balances for all major process streams.

(13) Aquifer parameter determination, fluid (ground water or air) production rates and/or velocities, extraction/injection well spacings, filter pack design, and documentation of modeling used in system design.

e. Coordination with Installation or Outside Agencies. Coordination should include, but not be limited to:

(1) Siting in accordance with the Major Army Command (MACOM) approved installation master plan.

(2) Utility service capacities and central plant support.

(3) Water supply and sanitary discharge, including on-site treatment plant discharge.

(4) Demolition and debris disposal.

(5) Fire fighting support.

(6) Bulk trash and non-hazardous waste disposal procedures.

(7) Signage makeup and maintenance.

(8) Construction and other permits, as applicable.

(9) Safety siting approval for explosives-handling facilities as required in AR 385-60 for coordination with the DoD Explosives Safety Board, if applicable.

(10) Waste Manifesting.

2. Environmental.

a. General Parameters. Examples of general environmental parameters that need to be addressed are:

(1) Completed Environmental Impact Assessment (EIA) checklist covering the air, water and noise effects of the project on the site and adjacent sites. This is often already completed by the installation, but validation by the design agency or contract Architect-Engineer (A-E) is required.

(2) Identification of wildlife and plants that are adversely impacted by the placement and operation of the project on the site. Rare or endangered species must be identified and

specifically reported.

(3) Maps indicating wetland designations on the site or adjacent sites affected by the project or the construction of the project.

(4) Archeological preservation, to include cemetery identification.

(5) Ground water and waterway locations.

(6) Pollution prevention and control measures during construction and the operation of the project.

(7) A comprehensive environmental permit/regulation analysis which addresses air, water, solid and hazardous waste as appropriate. Examples include Clean Water Act operating permits, storm water and point source discharge permits, hazardous waste storage and treatment permits, emergency planning and community right-to-know (EPCRA) and state and local environmental permits and related issues.

(8) Health and Safety Design Analysis (HSDA) in accordance with ER 385-1-92.

(9) Air Pathways Analysis (APA) in accordance with EP 1110-1-21.

(10) Data Quality Objectives (DQOs) for cleanup verification/process performance chemical sampling and analysis developed in accordance with EM 200-1-2.

(11) Media-specific cleanup levels on ARARs or acceptable residual risk calculations.

(12) Contaminant-specific ambient air action levels for health protection of offsite human receptors.

(13) Substantive elements of the Quality Assurance/Quality Control (QA/QC) program to be utilized in generation of any chemical analytical data. (Refer to ER 1110-1-263 for QA/QC program elements).

b. Functional and Technical Requirements. Examples of environmental related functional and technical requirements that need to be addressed are:

(1) Project orientation relative to environmentally sensitive areas on or adjacent to the site.

(2) Site modification and storm water runoff affects on ground water, waterways and wetlands.

(3) Discharges relative to the affects on the immediate environs.

(4) Sound and vibration control.

c. Design Objectives and Provisions. Examples of environmental related design objectives and provisions that need to be addressed are:

(1) Functional relationship of the project to the environment.

(2) Roadway and parking areas storm water runoff effects.

(3) Utilities placement relative to environmentally sensitive areas.

(4) Economic aspects for environmental protection measures and methods.

(5) Future expansion possibilities affects on the environs.

(6) Economic aspects of construction and procurement, and life-cycle cost effectiveness in accordance with TM 5-802-1, ER 1110-1-1300, ER 1110-3-1300, and/or ER 1110-3-1301.

(7) For HTRW remediation designs, an evaluation of remediation goals (i.e., projected endpoints) as they relate to proposed remediation goals and the remedial design.

d. Calculations. The calculations for environmental design elements, such as those listed below, will utilize metric units. If the project is permitted to use IP units, the calculations shall be performed in normally accepted and recognized IP units.

(1) Erosion control protection measures and methods.

(2) Ratio of the paved areas and the building area relative to the total site area.

(3) Storm water runoff.

(4) Air, water, HTRW and sanitary discharge, and impacts on receiving media.

(5) Pollution abatement systems and their scopes.

(6) Cost comparison of competitive designs and materials, in terms of both construction costs, acquisition costs, and life-cycle costs in accordance with TM 5-802-1, ER 1110-1-1300, ER 1110-3-1300, and/or ER 1110-3-1301.

(7) Estimated cost of construction.

e. Coordination with Installation or Outside Agencies. Coordination should include, but not be limited to:

(1) Validation (check) of the approved siting relative to the designated areas of the installation for preservation and pollution protection requirements.

(2) Federal, state, and local governmental approvals as required for wetlands and other environmental protection laws.

(3) Storm water runoff.

(4) Air, water, HTRW, and sanitary discharges.

(5) Sediment and erosion control during construction.

3. Architectural.

a. General Parameters. Examples of general architectural parameters that need to be addressed are:

(1) Purpose, functions and capacities of the project.

(2) Desired image or visual appearance to include the design of the exterior and interiors of the building, refer to Engineer Regulation (ER) 1110-345-122 regarding interior design.

(3) Number of civilian, military and visiting personnel to use the project.

(4) Types of activities, equipment and vehicles involved.

(5) Anticipated life of the functions to be accommodated.

(6) Type and method of construction; permanent, temporary or relocatable.

b. Functional and Technical Requirements. Examples of architectural related functional and technical requirements that need to be addressed are:

(1) Functional areas, occupant capacities and space allowances.

(2) Exterior and interior finish materials, to include textures, colors and damage resistant.

(3) Equipment, furniture and furnishings, to

include all items required regardless of funding; refer to ER 1110-345-122 regarding funding distinctions.

(4) Directional, informational and motivational signage.

(5) Accessibility for handicapped (physically impaired) persons, barrier free design, and provisions for blind vending areas operated by State agencies.

(6) Energy conservation, to include solar energy applications and energy use budget goals.

(7) Occupational safety and health.

(8) Sound and vibration control.

(9) Interior parking and service areas.

c. Design Objectives and Provisions. Examples of architectural related design objectives and provisions that need to be addressed are:

(1) Adaptation of the building to the size, shape and orientation of the site, to include benefits from natural warming and cooling effects afforded by the site.

(2) Organization of functional spaces to establish workable adjacency relationships.

(3) Building layout to establish convenient circulation flows for people, services, materials and equipment, to include evacuation during emergencies.

(4) Consolidation of spaces into sound-compatible zones and protective construction zones, to include fire, storm and fallout.

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

(6) Types of construction materials, architectural systems and finishes, to include the basis for their selection.

(7) Composition of masses and spaces, and architectural details to reflect the desired image, and the scale and nature of the activities involved.

(8) Perception of the building details and volumes. Specific provisions made, to include an identifiable sequence of viewing positions for experiencing the architectural and interior design.

(9) Building expandability and changeability.

(10) Energy conservation.

(11) Acoustical design.

(12) Enhancement of materials and systems operations and maintenance.

(13) Economy construction and procurement, and life-cycle cost effectiveness in accordance with TM 5-802-1.

d. Calculations. The calculations for architectural design elements, such as those listed below, will utilize metric units. If the project is permitted to use IP units, the calculations shall be performed in normally accepted and recognized IP units.

(1) Net room areas, occupant capacity and gross building areas. Categorize these areas and capacities under administrative, operational, storage and support requirements.

(2) Ratio of exterior window and room area, where applicable.

(3) Thermal conductance values for each

building section, which should be selected in coordination with the mechanical engineer design professional to satisfy life cycle cost and energy conservation requirements.

(4) Estimated annual unit energy consumption, which is, in coordination with the mechanical engineer, to determine the design energy use and compliance with the energy use budget.

(5) Acoustics, if applicable.

(6) Roof drainage.

(7) Estimated cost of construction.

(8) Cost comparison of competitive designs and materials, in terms of both construction costs, acquisition costs, and life-cycle costs in accordance with TM 5-802-1.

e. Coordination with Installation or Outside Agencies. Coordination should include, but not be limited to:

(1) Blind vending area operations.

(2) Make-up of signage.

(3) Government-furnished furniture and equipment.

(4) Occupational safety and health, as required.

(5) Operations and maintenance support.

4. Structural.

a. General Parameters. Examples of general structural parameters that need to be addressed are:

(1) Foundation characteristics based on geotechnical survey and subsurface investigation.

(2) Conditions related to possible seismic events, wind, storms and blast.

(3) Size of areas and volumes to be inclosed, and floor loads.

(4) Permanency of construction and expediency of erection.

(5) Apparent competitive structural systems in view of local constructibility parameters to include potential use of building systems fabricated off of the site.

(6) Need for fallout protection or shelter space in accordance with the Installation's Army Survival Measures Plan.

b. Functional and Technical Requirements. Examples of structural related functional and technical requirements that need to be addressed are:

(1) Allowable settlement soil bearing capacity and pile loads, as applicable.

(2) Dead, live, wind, snow and seismic design loads.

(3) Allowances for future loads or expansion.

(4) Dynamic loads, to include weapons effects, as applicable.

(5) Design methods; allowable working stress or strength (load factor).

(6) Design stresses; allowable unit stress or yield stress of materials.

(7) Deflection, to include maximum limits.

(8) Nuclear radiation (fallout) protection.

c. Design Objectives and Provisions. Examples of structural related design objectives and provisions that need to be addressed are:

(1) Foundation design as required by foundation or soil characteristics.

(2) Bay sizes and module spacing for functional requirements and economy.

(3) Seismic protection, to include symmetrical configuration of framing system, where applicable.

(4) Type and fabrication or construction of structural system, to include the basis for selection for at least three competitive systems.

(5) Speed of erection.

(6) Fallout protection or shelter space potential.

(7) Economy of construction and procurement, and life-cycle cost effectiveness in accordance with TM 5-802-1.

d. Calculations. The calculations for structural design elements, such as those listed below, will utilize metric units. If the project is permitted to use IP units, the calculations shall be performed in normally accepted and recognized IP units.

(1) Wind, snow, seismic and dynamic loads, as applicable.

(2) Shears, moments and axial loads, to include stress analysis diagrams and torsional effects, where applicable.

(3) Deflection of members and walls.

(4) Type and sizing of foundations, structural members and connections.

(5) Uplift and stability of the structure.

(6) Expansion and crack control.

(7) Construction or erection limitations.

(8) Structural adequacy of existing structures, where applicable, to account for new functional loads or new criteria.

(9) Fallout protection factors as required, or to identify Protection Factor (PF) 40 and above shelter spaces. Include single line plans showing the location of shelter areas and minimum PF rating.

(10) Cost comparison of competitive designs and materials, in terms of both construction costs, acquisition costs, and life-cycle costs in accordance with TM 5-802-1.

(11) Estimated cost of construction.

e. Coordination with Installation or Outside Agencies. Coordination should include, but not be limited to:

(1) Construction or erection limitations.

(2) Need for fallout shelter space.

5. Mechanical.

a. General Parameters. Examples of general mechanical parameters that need to be addressed are:

(1) Temperature extremes and other impacts of climate such as wind, precipitation, sun angles and humidity.

(2) Apparent competitive mechanical systems relative to fuel alternatives, energy use budgets and environmental impacts.

(3) Indoor environmental conditions

including temperatures, humidity, pressurization, ventilation and exhaust requirements.

(4) General Heating, Ventilation and Air Conditioning (HVAC) zones and occupant capacities.

(5) General toilet and sanitation zones, and occupant capacities.

(6) Water supply pressure.

(7) Existing or planned sanitary sewer capacities.

(8) Toxic or hazardous pollutant sources.

(9) Functions and occupancies requiring mechanical lifts, elevators and cranes.

(10) Special waste and drainage systems such as acid waste.

(11) Energy sources and capacities including heating and chilled water distribution, gas distribution, and fuel storage.

(12) Building and related mechanical system commissioning.

b. Functional and Technical Requirements. Examples of mechanical related functional and technical requirements that need to be addressed are:

(1) Design temperatures.

(2) Heating and/or cooling (air conditioning), and humidity control.

(3) Mechanical ventilation (air circulation) and special exhausts.

(4) Energy conservation, to include solar and recovery systems.

(5) Total energy and selective energy systems.

(6) Standby heating and cooling, and emergency environmental systems.

(7) Toilet fixture allocation.

(8) Hot and cold water systems, to include recovery systems.

(9) Heating and chilled water distribution, gas distribution and special liquid storage and distribution systems.

(10) Compressed air and vacuum production components.

(11) Sanitary waste and vent piping.

(12) Acid waste and chemical piping, and neutralization.

(13) Coordination with the connection to site utilities.

(14) Mechanical lifts, hoists and elevators.

(15) Control of airborne-polluting substances within the project.

(16) Control of polluting substances from energy systems.

(17) Treatment and disposal of toxic and/or polluting substances within the project.

(18) Accessibility and features for handicapped (physically impaired or disabled) persons.

c. Design Objectives and Provisions. Examples of mechanical related design objectives and provisions that need to be addressed are:

(1) Impacts and benefits from natural warming and cooling effects afforded by the site and coordination with passive solar design.

(2) Zoning of HVAC by occupancy.

(3) Heating and/or cooling system life cycle cost design, to include the basis for selection of the system. Provide an analysis of each competitive system.

(4) System expandability and feasibility.

(5) Energy conservation.

(6) Vibration and noise isolation and control.

(7) Consolidation of toilet and sanitation facilities.

(8) Supply and waste piping systems.

(9) Connection to utilities.

(10) Mechanical lift, hoist, crane and elevator designs.

(11) Control of polluting substances.

(12) Enhancement of systems operations and maintenance.

(13) Economy of construction and procurement, and life-cycle cost effectiveness in accordance with TM 5-802-1.

(14) Provisions for building and related mechanical system commissioning, and the testing adjusting and balancing of mechanical systems.

d. Calculations. The calculations for mechanical design elements, such as those listed below, will utilize metric units. If the project is permitted to use IP units, the calculations shall be performed in normally accepted and recognized IP units.

(1) Heating and cooling design loads. Computerized calculations will indicate the basis of all input data.

(2) Estimated annual unit energy consumption (see architectural).

(3) Determine the design energy use and compliance with the energy use budget.

(4) Energy recovery systems.

(5) Total energy and selective energy studies.

(6) Complete system and unit capacities, indicating the dimensions of all equipment.

(7) System vibration and noise isolation and control, safety, security and fire protection.

(8) Allocation of toilet and other fixtures.

(9) Maximum flow rates in liters per minute [gallons per minute] for hot and cold water, and the total flow per day.

(10) Size of hot and cold water supply systems, to include storage tanks inside the building and the supply of water for fire protection.

(11) Size of heating and chilled water distribution, gas distribution, fuel storage, and special liquid, compressed air and vacuum systems.

(12) Size of waste water and sewage drainage systems inside the building.

(13) Sizing of mechanical lifts, hoists and passenger and service elevators. Indicate the peak hour capacities for passenger elevators.

(14) Energy system pollution abatement.

(15) Disposal systems for toxic and/or polluting substances within the project.

(16) Outside air, ventilation and exhaust air design.

(17) Supply, return and exhaust air duct sizing, and pressures.

(18) Acoustic analysis including system noise isolation and reduction.

(19) Safety, security and fire protection and suppression.

(20) Building and related mechanical system commissioning, and the testing, adjusting, and balancing of mechanical systems.

(21) Surge analysis of closed loop systems.

(22) HVAC control system parameters and constraints.

(23) Cost comparison of competitive designs and materials, in terms of both construction costs, acquisition costs, and life-cycle costs in accordance with TM 5-802-1.

(24) Estimated cost of construction.

e. Coordination with Installation or Outside Agencies. Coordination should include, but not be limited to:

(1) Total energy and selective energy planning.

(2) Operations and maintenance support.

(3) Indoor environmental requirements including temperatures, humidity, and outside and exhaust air requirements.

(4) Type, number, schedule and activity level of occupants.

(5) Equipment to be installed along with utility requirements, environmental requirements, and heat release.

(7) Requirements for mechanical lifts, hoists, cranes, and elevators.

6. Electrical.

a. General Parameters. Examples of general electrical parameters that need to be addressed are:

(1) Type of occupancies.

(2) Specialized functions and equipment.

(3) Communications support.

(4) Electrical characteristics of the power supply.

(5) Adequacy of the existing system supporting the project site.

b. Functional and Technical Requirements. Examples of electrical related functional and technical requirements that need to be addressed are:

(1) Point of interface between the existing electrical system and the system to be constructed needs to be defined.

(2) Load characteristics including connected load, demand load, diversity factors, power factor, load profiles, nonlinear loads, transformer(s) peak loading and load growth provisions.

(3) Basis for selection of primary and secondary distribution voltages.

(4) Overhead and underground exterior distribution; voltage drop, interrupting requirements, physical characteristics of the circuits including types of conductors, ampacity of service, feeder and branch conductors, pole line and duct bank, conduit, or direct buried equipment characteristics.

(5) Illumination levels, to include general and task lighting, and visual qualities of lighting requirements .

(6) Low and high system voltage.

(7) Low and high voltage switching.

(8) Loads and load factors, to include allowances for future loads.

(9) Installation and equipment standards.

(10) Emergency lighting, distribution, security, communications and standby generation systems.

(11) Power, lighting, communications and security for site elements.

(12) Communications, to include call systems.

(13) Electronic clock systems.

(14) Electronic security, surveillance and Intrusion Detection Systems (IDS).

(15) Audio visual systems, to include central television (TV) systems.

(16) Energy conservation and energy monitoring.

(17) Power generation.

(18) Electromagnetic protection (EMP).

(19) Explosion-proof connections in hazardous environments.

c. Design Objectives and Provisions. Examples of electrical related design objectives and provisions that need to be addressed are:

(1) Electrical feeder and distribution systems.

(2) Spare capacities.

(3) General illumination and task lighting coordinated with interior layouts, safety and security requirements.

(4) Relamping and adjustments.

(5) Nonlinear loads and harmonics.

(6) Communications systems.

(7) Emergency power generation and distribution.

(8) Energy conservation.

(9) Enhancement of systems operations and maintenance, to include systems flexibility.

(10) Economy of construction and procurement, and life-cycle cost effectiveness in accordance with TM 5-802-1.

d. Calculations. The calculations for electrical design elements, such as those listed below, will utilize metric units. If the project is permitted to use IP units, the calculations shall be performed in normally accepted and recognized IP units.

(1) Maintained lux [Foot candle (FC)] levels in all areas. Where areas are similar in size and usage, only a typical calculation is required.

(2) Individual circuit and system loads

tabulated in amperes for each panel board or switchboard.

(3) Transformers, generators, switchboards and feeders indicating all demand, diversity, and ambient-temperature or conductor-grouping factors considered in the selection of equipment or conductor sizes.

(4) Cost comparison of illuminating, power and communication systems.

(5) Nonlinear loads and harmonic contributions, kilowatt rating of transformers, etc.

(6) Ground fault and its circuitry protection.

(7) Selective system protection.

(8) Voltage-drop on all service and feeder circuits, and on worst-case branch circuits supplied by each panel board and switchboard.

(9) Weight, dimensions and electrical characteristics of each major item of equipment supported by manufacturer's names, and catalog and model numbers.

(10) Cost comparison of competitive designs and materials, in terms of both construction costs, acquisition costs, and life-cycle costs in accordance with TM 5-802-1.

(11) Estimated cost of construction.

(12) Short circuit calculations.

(13) Electromagnetic Protection.

e. Coordination with Installation or Outside Agencies, i.e., electrical utility company, and the Installation's electrical distribution organization. Coordination should include, but not be limited to:

(1) Telephone system requirements and availability.

(2) Central TV.

(3) Power requirements of the installation's service and cleaning equipment of the installation.

(4) Provost Marshal or police response to IDS alarms.

(5) AR 190-13 for Army physical security, IDS design approvals, when required.

(6) Incorporation of maintenance and commissioning requirements of the Installation.

(7) Intrusion Detection System (IDS) Center of Expertise, Huntsville Engineer Technical Center, for design assistance.

(8) Utility Monitoring and Control System (UMCS) Center of Expertise, Huntsville Engineer Technical Center, for UMCS/EMCS design assistance.

7. Fire Protection and Life Safety.

a. General Parameters. Examples of general fire protection parameters that need to be addressed are:

(1) Types of occupancies.

(2) Hazard classification of specific areas and list of hazards.

(3) Specific criteria; standards and codes.

(4) Type of construction.

(5) Type of fire protection.

(6) Water supply.

b. Functional and Technical Requirements. Examples of fire protection related functional and technical requirements that need to be addressed are:

(1) Fire resistance of building components, to include floor and ceiling assemblies, exterior and interior walls, permanent partitions, shafts, and location of fire separation walls and partitions.

(2) Allowable floor area and building height in accordance with the Uniform Building Code (UBC) based on occupancy classification, construction, separations and fire suppression or protection.

(3) Exit requirements in accordance with NFPA 101, Life Safety Code (LSC). The design and analysis must address exit types, required exit widths, maximum travel distance for exiting, dead-end distances and common exit paths of travel limitations, arrangement of exits, remoteness of exits, discharge from exits, illumination of exits and exit marking.

(4) Flame spread and smoke development rating of interior finishes and insulations.

(5) Building access for local fire department fire fighters.

(6) Building separation and exposure protection.

(7) Smoke control methods.

(8) Automatic extinguishing systems.

(9) Fire alarm evacuation systems.

(10) Fire detection systems.

(11) Fire hydrants and standpipes.

(12) Water supply, to include new or additional water storage, pumping, and/or water distribution mains.

(13) Special hazards and methods for protection.

c. Design Objectives and Provisions. Examples of fire protection related design objectives and provisions that need to be addressed are testing and field investigation reporting requirements:

(1) Water flow tests at the point of connection for sprinklered buildings.

(2) Existing water supply.

(3) Existing fire hydrants.

(4) Existing fire alarm reporting system information for connection of new fire alarm systems.

(5) Economy of Construction and procurement, and life-cycle cost effectiveness in accordance with TM 5-802-1.

d. Calculations. The calculations for fire protection design elements, such as those listed below, will utilize metric units. If the project is permitted to use IP units, the calculations shall be performed in normally accepted and recognized IP units.

(1) Complete exit requirement calculations based on the LSC.

(2) Allowable floor area and building height calculations based on UBC.

(3) Water supply calculations indicating the adequacy of the design to meet sprinkler and hose stream flow demands. Calculations must be based on residual and static pressures and flow data obtained from water flow tests.

(4) Sprinkler calculations to determine water flow and pressure demands.

(5) Fire alarm system calculations for elements such as, wire sizing, battery, and alarm annunciator sound level.

(6) Complete hydraulic design calculations for detailed sprinkler and Aqueous Film Forming Foam (AFFF) system designs.

(7) Layout and sizing of special fire extinguishing systems, such as carbon-dioxide, halon, and AFFF (low pressure foam system).

e. Coordination with Installation or Outside Agencies. Coordination should include, but not be limited to:

(1) Fire fighting support, to include tie-ins with local fire department alarm and communication systems.

(2) Adequacy of water supply, to include flow tests.

(3) Inspection and testing of systems performance.

(4) Obtain the specific fire alarm type(s), fire protection and central reporting requirements of the Installation's Fire Marshall/Chief.

8. Physical Security.

a. General Parameters. Examples of general physical security parameters that need to be addressed are:

(1) Mission of the project.

(2) Size of the site.

(3) Installation threat statement.

(4) Anticipated aggressor tactics.

(5) Personnel and materials being protected.

(6) Activities performed.

(7) Security forces available.

b. Functional and Technical Requirements. Examples of physical security related functional and technical requirements that need to be addressed are:

(1) Defensible site layout.

(2) Securable building layout.

(3) Resistance to aggressor penetration.

(4) Vandal-proofing.

(5) Intrusion denial.

c. Design Objectives and Provisions. Examples of physical security related design objectives and provisions that need to be addressed are:

(1) Maximum security.

(2) No detraction from mission.

(3) Cost effective security features.

(4) Provisions for expansion.

(5) Efficient security zoning.

(6) Maximum use of standard designs.

(7) Economy of construction and procurement, and life-cycle cost effectiveness in accordance with TM 5-802-1.

d. Calculations. The calculations for physical security design elements, such as

those listed below, will utilize metric units. If the project is permitted to use IP units, the calculations shall be performed in normally accepted and recognized IP units.

(1) Time for aggressor to penetrate.

(2) Time for security force to respond.

(3) Power requirements for security systems.

(4) Protective lighting intensities.

(5) Costs.

e. Coordination with Installation or Outside Agencies. Coordination should include, but not be limited to:

(1) Conformance to the installation security plan.

(2) Appropriate local police agencies regarding patrol and alarm responses.

(3) Signal office regarding security communications.

(4) Security office regarding any AR 380-5 for classified material protection requirements.

(5) Protective Design Center of Expertise (Omaha District Engineer Office).

(6) Intrusion Detection System Center of Expertise, Huntsville Engineering and Support Center, for design assistance.

(7) Installation military police regarding any Army physical security of arms, ammunition and explosives, protection requirements.

(8) Intrusion detecting system approval in accordance with Army physical security criteria, when required.

(9) Installation medical office regarding any AR 190-50 requirements.

(10) Facility user regarding any automation security requirements.

- PART 3 -

OPERATION AND MAINTENANCE (O&M) PROVISIONS

1. Using Service Responsibilities For O&M. The following are using service responsibilities for O&M that should be considered by the design agency during the design development process:

a. Control Responsibilities.

(1) Parking allowances and assignment.

(2) Pavement and floor loadings.

(3) Spare parts, equipment, consumables, and miscellaneous storage.

(4) Energy use.

(5) Site access restrictions.

b. Service Responsibilities.

(1) Access-egress maintenance.

(2) Landscape maintenance.

(3) Snow and ice removal.

(4) Housekeeping, trash collection and disposal.

(5) Signage.

(6) Mail handling, shipping and receiving.

(7) Food service and supply.

(8) Health (dispensary) and sanitation.

(9) Reproduction (copy) service.

(10) Vending (state blind agencies and others).

(11) HVAC systems.

(12) Electrical and communications services.

(13) Security and fire protection.

(14) Shop support.

(15) Plumbing systems.

(16) Lifts, hoists, cranes, and elevators.

(17) Compressed air and vacuum systems.

(18) Fuel storage and dispensing systems.

(19) Industrial gas systems.

(20) Treatment facility operation and maintenance.

(21) Residuals disposal and manifesting.

(22) Permit compliance monitoring.

(23) Extraction/injection remediation system maintenance.

(24) Worker safety and occupational health.

2. Provisions For O&M Enhancement and Cost Reduction. The following are provisions for O&M enhancement and cost reduction that should be considered by the design agency during the design development process:

a. Control Related.

(1) Preventive overloading factors.

(2) Food service efficiency maximizers, preparation, serving, seating and dish washing.

(3) HVAC efficiency maximizers; sub- and main plant.

(4) Lighting efficiency maximizers, intensities and switching.

(5) Communications efficiency maximizers.

(6) Elevator efficiency maximizers.

(7) System expandability and flexibility.

b. Service Related.

(1) Below-grade flood protection.

(2) Above grade solar, water, and wind protection and resistance.

(3) Finish materials, textures and colors.

(4) Window washing provisions.

(5) Provisions for cleaning equipment.

(6) Vibration and expansion contraction controls.

(7) Energy conservation and pollution control measures.

(8) Access to mechanical systems; HVAC, elevators, plumbing, process and special equipment.

(9) Provisions for building and system recommissioning and testing, adjusting and balancing of mechanical, electrical and communications systems.

(10) Relamping and lighting relocation.

(11) Electrical distribution allowance for future loads.

(12) Emergency power system testing, and monitoring power quality.

(13) Vandalism and intrusion resistance.

(14) Confined spaces reduction/elimination or identification.

(15) Toxic or hazardous pollutant sources and exposure potentials.