ARMY NATIONAL GUARD
DG 415-5
GENERAL FACILITIES INFORMATION DESIGN GUIDE

NATIONAL GUARD BUREAU
INSTALLATIONS DIVISION
111 SOUTH GEORGE MASON DRIVE
ARLINGTON, VA 22204-1382

FOREWORD

This General Facilities Information Design Guide (DG 415-5) was published by the National Guard Bureau, Army Installations Division (NGB-ARI). DG 415-5 applies to all projects for new construction (including additions) as well as alterations to and rehabilitation and conversion of existing facilities. It is intended to assist the States, Possessions, design agencies, and design architect-engineer in gaining an understanding of the general functions and environmental considerations to address in the design and construction documents for the Army National Guard (ARNG) facilities that qualify for support from Federal funds. This design guide does not contain criteria but refers readers to sources of criteria in other publications that relate directly to the specific technical design requirements.

DG 415-5 contains functional and technical information common to all ARNG facilities. It should be used in conjunction with the design guide developed for the specific facility type to assist in the design process.

Distribution is limited. However, authorized users of the NGB Guard Knowledge Online (GKO), can obtain an electronic copy at (gkoportal.ngb.army.mil/C12/Installations) Design Guide Library site. All users are encouraged to submit comments and suggestions to improve this document by completing a DA Form 2028, “Recommended Changes to Publications and Blank Forms,” and sending it directly to:

National Guard Bureau
Installations Division
ARNG Readiness Center
111 South George Mason Drive
Arlington, VA 22204-1382

CONTENTS

CHAPTER 1

GENERAL INFORMATION

1-1 PURPOSE: PERFORMANCE DESIGN GUIDELINES

This General Facilities Information Design Guide (DG 415-5), along with the facility-type design guides (DGs 415-1 Readiness Centers, 415-2 Logistics Facilities, 415-3 Aviation Facilities and 415-4 Training Site Facilities), sets forth functional and technical design and planning guidance to use in the development of military construction (MILCON) projects.

1-1.1 Audience

These design guides are written for the design architect-engineer (A-E) who will be preparing design and construction documents as well as for construction and facilities management officers (CFMOs) and other Army National Guard (ARNG) personnel who will be planning, reviewing, and approving the facility design. It is the intent of the National Guard Bureau, Army Installations Division (NGB-ARI) to encourage the design A-E to design high-quality, user-friendly, functional, energy-efficient, and sustainable facilities using the latest engineering and construction industry standards.

To aid the reader, DG 415-5 includes the following:

- Appendix A, References, contains a detailed list of reference documents.
- Appendix B, Glossary, defines all abbreviations and acronyms used in this design guide as well as specialized terms that are used in this design guide.

1-1.2 Master Plan Compliance

Before project initiation, the CFMO should provide the design A-E with an approved working or preliminary master plan for the proposed facility site. The State Military Department should provide special instructions for any deviations from the master plan. The design A-E should consider sustainable material types and construction industry standards indicated in these design guidelines to establish the minimum project quality.

1-2 ROLE OF THE FEDERAL GOVERNMENT

Title 10 of the United States Code (U.S.C.) authorizes contributions of Federal funds to the States and possessions to provide facilities for the training and administration of Reserve components of the Armed Forces. NG PAM 415-12 establishes facilities allowances, and these design guides provide the design and construction performance recommendations governing such contributions from Federal funds that the NGB Chief administers. Each such contribution is subject to the terms of a Military Construction Cooperative Agreement executed specifically for providing designated facilities. These agreements are executed under authority granted in Title 10, United States Code, Chapter 1803, which states that all work “shall be done according to the laws of that jurisdiction and under the supervision of its officials, subject to inspection and approval

of the Secretary of Defense." The United States Property and Fiscal Officers (USPFO) are responsible for disbursement of Federal funds contributed toward the construction of State ARNG facilities projects.

1-3 NATIONAL GUARD BUREAU POLICY

NGB-ARI has specific policy regarding the types of buildings and installed equipment eligible for Federal support in ARNG facilities, as outlined in the following paragraphs.

1-3.1 Technical Instructions Criteria

Where specified guidelines are not set forth herein or in the program documents, design criteria in NGR 415-10, NG PAM 415-12, Unified Facilities Guide Specifications and MIL-STD 3007 apply for all MILCON projects.

1-3.2 Construction and Equipment Materials Criteria

The materials and equipment allowances are to be considered the maximum allowable using Federal contributions toward construction costs. Use of the full maximum allowances is permissible rather than mandatory because local conditions may justify the actual facility constructed.

A project's DD Form 1390/91documents the approved scope and Federal share for each component of the project, and the CFMO may not design or construct beyond this level without receiving NGB-ARI approval or an amended funding document.

1-3.3 Federal Support

In order for an ARNG facilities project to qualify for Federal support, the materials and equipment incorporated, built-in, or installed shall be submitted and approved by NGB-ARI at or prior to Final Design (95%).

1-3.4 Non-Federal Funds

These design guides do not preclude the use of non-Federal funds to provide materials, equipment, or features of higher quality than suggested, provided that the Federal share of the operating and maintenance cost does not increase. The cost of such improvements, however, must be clearly determinable as separate bid items or specified as a contractor's option. If the amount of higher-quality features, equipment, materials, and space not Federally supportable is unusually large and makes separate bidding impractical, the State and the Federal government (NGB-ARI) must negotiate an agreement to establish the limitations of the Federal share of the overall project construction costs. This is usually expressed as a percentage of the total construction cost.

1-3.5 Equipment Not in Contract

Portable furniture and equipment may not be supported by Federal construction funds. Examples are desks, chairs, tables, stools, map cases, unattached shelving, fire extinguishers, coats of arms, State seals, memorial plaques, entrance door mats, and waste receptacles.

1-3.6 **Performance Focus**

NGB-ARI encourages the use of contractor's options and performance-type specifications as a means of ensuring procurement of the most economical system or component. The materials and methods of construction proposed for use on a given facility must have been used on a sufficient number of State facilities to establish a documented record of performance.

For functional area flexibility, the design A-E may increase or decrease individual functional areas by exchanging a percentage of the area between functions as per NG PAM 415-12, Chapter 1-7. However the total net functional area may not exceed that authorized for the facility unless it is funded with other than Federal funds.

1-3.7 **Accessibility**

All ARNG facilities shall be designed and constructed in accordance with Public Law 90-480, the Architectural Barriers Act (ABA) of 1968, as amended. The document that sets standards as a result of this law is the Uniform Federal Accessibility Standards (UFAS). These standards primarily address projects in the Federal sector or projects built and leased with Federal funds. Currently, UFAS applies to all ARNG projects.

After the Americans with Disabilities Act (ADA) of 1990 were enacted, the U.S. Access Board under the Department of Justice has regularly updated the ADA Accessibility Guidelines (ADAAG). These guidelines address projects in the private sector (places of commercial accommodation and commercial facilities) and the public sector (State and local government facilities). Currently, ADAAG applies to all ARNG projects.

New guidelines, which combine UFAS and ADAAG into one unified standard, were published in the *Federal Register* in July 2004 and became effective on September 21, 2004. This unified standard, the Americans with Disabilities Act and Architectural Barriers Act Accessibility Guidelines, was created under 36 CFR, Parts 1190 and 1191. This rule contains a separate scoping document for ADA facilities, a scoping document for ABA facilities, and a joint technical section referenced by each scoping section. Refer to the summary of the new guidelines in the July 23, 2004, *Federal Register*, which contains a detailed description and background information. ARNG intends to apply this unified standard in lieu of the separate ADAAG and UFAS.

As noted in the preamble to the UFAS, the basis for the first accessibility standards adopted by the Federal government and most State governments was ANSI 117.1, Accessible and Usable Buildings and Facilities. This code has been recognized by the private sector and the Council of American Building Officials, and is the accessibility code referenced in the International Building Code (IBC). Because ARNG projects follow a statewide building code in many instances, this code may apply when referenced by the adopted model statewide building code. The design A-E is directed to compare the accessibility codes and use the more stringent one. The new, unified Americans with Disabilities Act and Architectural Barriers Act Accessibility Guidelines may reduce the potential for conflicts with other regulations developed by State agencies.

1-3.8 Hazardous Materials Abatement

The design A-E will need to comply with all U.S. Environmental Protection Agency (EPA) reference documents. The design A-E shall also consult with the CFMO to determine any special State and local requirements.

1-3.8.1 Asbestos Removal

Before facility buildings are programmed or planned for alteration, rehabilitation, and addition, a survey should be undertaken to establish the amount, location, and estimated cost of asbestos removal. A letter should be sent from the CFMO to NGB-ARI to indicate that there is an asbestos problem and that authorization to do an asbestos survey and design for removal is urgently needed because asbestos has to be removed prior to any construction.

The cost of asbestos removal should be included as an item in the program and funding documents. The cost of the survey and asbestos removal is 100 percent supportable by Federal funds for all functional areas authorized in the Federal project requirements. If only a portion of an existing building requires alteration or rehabilitation, all the asbestos in the building must be removed before beginning the alteration or rehabilitation phase of the project. If emergency repairs (such as re-insulating a boiler) are needed after asbestos removal, the asbestos removal portion of the project should include the repair cost.

1-3.9 Value Engineering Studies and Life Cycle Cost Analysis

The State is encouraged to contract the services of a Certified Value Specialist (CVS) to lead the value engineering study (VES) to ensure that design solutions are cost effective. The VES also serves as a means of identifying opportunities for substitutions during the design process, should the project exceed budget requirements, while still maintaining the level of quality performance expected.

The VES should to be accomplished early in project development once the design concept and the building systems have been initially defined. Each item in the VES should be clearly defined by narrative and drawing, and the cost savings should be shown with related calculations. The specific, formally documented VES recommendations should be incorporated in the Preliminary (35-50%) Design milestone design review submission to NGB-ARI. Before proceeding with project development beyond the Preliminary milestone, all VES decisions should be made regarding which recommendations to implement immediately and which to consider contingent items to incorporate if costs continue to exceed budget. The VES should be a 3-day limited workshop since the site has been selected by the State prior to the design phase. The VES Workshop should adhere to the 5-step methodology and approach prescribed by the Society of American Value Engineers (SAVE) International.

An integral part of the VES process is life cycle cost analysis (LCCA), which is a systematic means of evaluating the entire building initial, energy, operation and maintenance cost over an extended period of time. A formal LCCA should be used to compare system alternatives. This process requires caution because the recommended system may increase the facility initial cost above the approved programmed funding amount.

1-3.10 Signage and Graphic Standards

All signage and graphics at a facility should comply with requirements of the State Military Department; General Services design standards or industry standards. If the proposed facility is located on an U. S. Armed Forces military installation, local signage standards should be followed.

1-3.11 Project Scheduling Requirements

(NGB-ARI will provide form)

1-3.12 Warranty Requirements

NGB-ARI requires that products and systems have warranty provisions according to industry standards. The following list identifies the majority of these elements that may occur in an ARNG facility.

DIVISION 2 – SITE CONSTRUCTION
- Water Distribution System
- Packaged Sewage Pumping Station
- Irrigation Systems
- Seeding, Sodding, Plants, and Planting

DIVISION 3 – CONCRETE
- Concrete Surface Sealer
- Glass Fiber-Reinforced Concrete

DIVISION 4 – MASONRY
- Brick Masonry

DIVISION 5 – METALS
- Shop Applied Metal Finishes

DIVISION 6 – WOOD AND PLASTICS
- Laminated Wood Construction
- Polymer Surfacing Materials

DIVISION 7 – THERMAL AND MOISTURE WATERPROOFING
- Waterproofing
- Water Repellent Coatings
- Cementitious Dampproofing
- Exterior Insulation Finish System
- Fireproofing
- Roofing
- Metal Siding and Wall Panels
- Fluid Applied Deck Coatings
- Flashing and Sheet Metal
- Roof Hatches
- Joint Sealants

DIVISION 8 – DOORS AND WINDOWS

Steel Doors and Frames
Wood Doors
Glass Door Assemblies
Aluminum Storefront and Windows
Wood Windows
Skylight Systems
Finish Door Hardware
Glass and Glazing
Curtain Wall Systems

DIVISION 9 – FINISHES
Exterior Studwall System
Ceramic and Quarry Tile
Terrazzo
Acoustical and Other Specialty Plaster Finishes
Wood Flooring
Resilient Flooring
Carpet and Carpet Tile
Fluid-Applied Seamless Flooring
Wall Coverings

DIVISION 10 – SPECIALTIES
Markerboards and Tackboards
Toilet Partitions
Access Flooring Systems
Demountable Partitions
Toilet and Bath Accessories

DIVISION 11 – EQUIPMENT
Window Washing System Equipment
Dock Levelers and Lifts
Food Service Equipment
Detention Equipment
Shooting Range Equipment

DIVISION 12 – FURNISHINGS
Architectural Casework
Window Shades
Entrance Mats

DIVISION 13 – SPECIAL CONSTRUCTION
Prefabricated Wall and Partition Systems
Prefabricated Radio Frequency Shielding Enclosure
Pre-Engineered Buildings

DIVISION 14 – CONVEYING SYSTEMS
Elevators

DIVISION 15 – MECHANICAL
- Plumbing Fixtures and Pumps
- Gas and Vacuum Systems
- Fuel Oil Systems
- Chillers
- Cooling Towers
- Steam Generators
- Unit Heaters
- Packaged Air-Handling Units
- Exhaust Fans
- Fiberglass Reinforced Plastic Ductwork
- Energy Management and Control System

DIVISION 16 – ELECTRICAL
- Wiring Devices
- Lighting Fixtures
- Uninterruptible Power Supply Systems
- Standby Power Generator Systems
- Battery Powered Systems
- Fire Alarm System
- Monitoring and Security Control Systems

1-3.13 **Performance Specifications**

The Unified Facilities Guide Specifications (UFGS) with technical notes is available to the A-E design team via the Whole Building Design Guide website at (www.wbdg.org/ccb/browse_org). However, the A-E is encouraged to suggest areas where a creative solution could be better managed through a performance-based specification for that particular element. Given the dual role of many ARNG facilities, the need for flexibility could become a driver for a creative solution using this method. Such a method could be considered in the following situations:

- Where the desired systems have not evolved to standardized configurations or solutions from manufacturer to manufacturer, or where no alternatives are similar enough that a prescriptive method could be used without inadvertently excluding all other variations of the system desired. Examples are a new integrated system for automated vehicle wash racks, a specialized type of paint removal system, or even a large-scale paint spray system or other industrial-based process.

- Where it is desirable, because of complexity or for other reasons, to delegate the responsibility for designing and integrating a particular system to an industry specialist. An example of this is crane systems.

Careful coordination is required to define the performance-based requirements, criteria, and tests for a particular attribute or system.

The design standards for finishes in ARNG facilities favor a more flexible set of recommendations and parameters for finish performance. The design A-E should continue this flexible approach in the design process, working from a palette of finishes that meet these requirements and criteria. This flexible approach may be extended to the specifications process for finishes, where the requirements and criteria can be well defined.

1-3.14 Operation and Maintenance Design Priorities

Important aspects of the design of all Army National Guard facilities are the selection of maintainable finishes and the provision of access or placement of building equipment and other fixed elements. The following are ways to address concerns in the design process:

- Select finishes based on the durability requirements related to the use of the space.
- Specify slip-resistant floor materials and finishes where water can be tracked in.
- Position heating, ventilation, and air conditioning (HVAC) and other mechanical and electrical components that are located above the ceiling and require servicing within easy reach from below to avoid the need for a service lift and major ceiling disassembly.
- Allocate adequate clearances for the servicing and replacement of large pieces of building mechanical and electrical equipment.
- Provide for ready access to wells and containment systems for inspection.
- Consider the use of a low-power traction elevator system that is competitive in cost with hydraulic units, and consider a machine room that can fit inside the hoistway.
- The designer should specify Total Building Commissioning when programmed in the DD Form 1390/91 funding document at 1% primary building cost.

1-3.15 Applicable Codes and Standards

The references list in Appendix A pertains to national standards. In some instances, a State may have more stringent requirements. The CFMO should provide in writing for the design A-E all categories of State regulations that exceed national standards.

1-3.16 Fire Protection

Fire protection guidelines follow:

- Incorporate efficient and cost-effective fire protection and detection systems in all ARNG facility designs.

- Comply with the requirements for all building space types presented in the International Building Code and National Fire Protection Association (NFPA) standards and with criteria presented in UFC 3-600-01 Fire Protection Engineering for Facilities. Also address State and local requirements that are more stringent than these sources.

- Ensure that the municipal water supply pressure and capacity or independent means (including storage tanks) comply with the water source requirements of the fire suppression systems.

- Provide adequate water source, sprinkler, emergency generator, and alarms systems capacity to accommodate limited building expansion on site.

- Include the means of egress, with all related calculations. Maintain the proper dimensions of all means of egress during detailed design.

- Identify all rated separations, and ensure that all building systems components at these separations support the rating.

- Coordinate smoke evacuation systems with the HVAC design.

- Adequately isolate and vent areas with highly combustible products, including the petroleum, oils, and lubricants (POL) storage.

- Ensure that the antiterrorism/force protection (AT/FP) standoff barrier components include access for fire-fighting apparatus.

- Telecommunication/Information Technology spaces must comply with the above codes for a primary system, a secondary Halon alternative clean agent fire extinguishing system maybe used.

1-3.17 **Occupational Health and Safety**

1-3.17.1 **General Information**

The U.S. Department of Labor, Occupational Safety & Health Administration (OSHA) Standards for General Industry in 29 CFR Part 1910 and DA PAM 40-503, Industrial Hygiene Program, requires that ARNG provide a safe and healthy workplace for its employees. All Readiness Centers with Indoor Firing Ranges, Logistics and Aviation Maintenance facilities must have an Industrial Hygiene (NGB-ARS-IH) technical review prior to construction. Personal protective equipment (PPE) and administrative procedures are only interim measures for controlling occupational hazards. The following paragraphs address other measures.

1-3.17.2 **Noise and Vibration Reduction**

Noise-induced hearing loss is one of the most common occupational hazards. Currently, ARNG uses PPE as the main means of preventing hearing loss; however,

engineering controls would be more effective. Mechanical equipment rooms contribute most of the high noise and vibration levels in buildings. The design A-E should take great care when locating these spaces to avoid adjacencies with incompatible noise tolerances. Mechanical equipment mounted rigidly to the supporting structure produces excessive vibration levels. The design A-E shall select vibration isolation methods to eliminate these problems. For equipment applications the designer should reference ASHRAE Handbook of Fundamentals.

1-3.17.3 **Indoor Air Quality**

The design of the building HVAC and exhaust systems must include indoor air quality features to ensure a safe environment. The design A-E should follow American National Standards Institute/American Society of Heating, Refrigerating and Air-Conditioning Engineers (ANSI/ASHRAE) Standard 62.1-2004, which recommends the minimum outdoor air rates for buildings, and the American Conference of Governmental Industrial Hygienists (ACGIH) Industrial Ventilation Manual for recommended practices related to specific exhaust and ventilation systems design.

A combination ventilation and exhaust system needs to be designed for the specific occupancy and process within each area to meet the indoor air quality standards. The design A-E should establish temperature, humidity, and ventilation criteria for each space and should design special exhaust hoods where necessary. Although specific humidity criteria may not be published for many areas, all conditioned spaces should be designed to maintain not higher than 50 percent relative humidity (RH).

Consideration must be given to air quality in storage rooms and similar spaces. Although these areas are not normally occupied, they may require ventilation, temperature, and/or humidity control to prevent damage to stored material and provide an acceptable environment for personnel using the room.

Air-handling unit (AHU) design should minimize mold and mildew growth inside the units. AHUs should have a filter bank (prefilters @ 30% and final filter @ 85% efficient) base on *ASHRAE Standard 52.1-1992 Atmospheric Dust-Spot Efficiency* rating to prevent dust collection on coils, and drain pans should be properly sloped and provided with condensate traps to eliminate standing water in the units. AHUs should not be operated during construction without proper filters in place, and all filters should be replaced at turnover to the ARNG.

1-3.17.4 **Location of Air Exhaust and Intake**

Exhaust air discharges and vents must be located at a proper distance from intakes to prevent cross-contamination and must be in a location which does not expose people or other buildings to hazardous discharge. Outside air intakes must also be located to minimize induction of vehicle exhaust and other site contaminants; in addition, they must be located and protected as prescribed by antiterrorism requirements. The design A-E should follow the recommended guidelines of ACGIH and local building codes.

1-3.18 **Energy Efficiency**

It is important to emphasize building envelope, mechanical and electrical systems efficiency as referenced in *UFC 3-400-01, Design: Energy Conservation*. An LCCA is to

be performed to evaluate at least two proposed mechanical systems. The US Green Building Rating System (LEED-NC), discussed in Paragraph 3-2 and ANSI/ASHRAE/IESNA Standard 90.1-2004, will be used to evaluate the building energy efficiency.

The building envelope, mechanical and electrical systems must be designed in accordance with ANSI/ASHRAE/IESNA 90.1-2004 or the State energy codes. The efficiency of motors, boilers, chillers, and other mechanical equipment must conform to the requirements of ANSI/ASHRAE/IESNA 90.1-2004. The use of air-side or water-side heat recovery systems should be considered where they can be applied effectively.

ARNG buildings are frequently occupied on irregular schedules, with many areas used only on weekends and/or at night. Therefore, the mechanical systems should be zoned so that heating, cooling, and ventilation can be reduced in portions of the building when they are unoccupied.

1-3.19 **HVAC System Quality**

When selecting mechanical equipment and designing systems, the A-E should strive for a system that will provide low maintenance and long life while providing a quality indoor environment. The use of rooftop packaged AHUs should be minimized because of their relatively short life and the inconvenience of servicing them. Double-wall AHUs are generally more robust and more easily maintained. Stainless steel condensate drip pans and cooling coil casings extend the life of an AHU and provide a cleaner surface, which reduces growth of mold and mildew. The designer should use ASHRAE Handbooks of Fundamentals, HVAC Applications and HVAC Systems and Equipment as guidance.

On larger installations, hydronic cooling utilizing a central chiller plant should be investigated in lieu of packaged direct expansion (DX) cooling, which typically is more maintenance intensive. The design A-E should avoid using steam for heat distribution as the boiler and piping system are more difficult to maintain than hot water. Direct-fired warm air furnaces and unit heaters typically require more maintenance and have a shorter life than hydronic systems; they should be used only in small installations where a central system is not practical.

1-3.20 **Geotechnical Investigation**

Site selection and Federal support shall conform to NGR 415-5, Chapter 4. Based on a visual observation of the site and knowledge of the local area, an appropriate number of soil borings should be made to determine the nature and consistency of subsurface soil conditions. Additional borings are warranted if the results are inconclusive or insufficient for the foundation and pavement design. The Site Survey Report, to be prepared in accordance with NGR 415-5, must include the results of the investigation of the selected site. The CFMO and NGB-ARI use the completed Soil Bearing Capacity Declaration (NG PAM 415-5, Appendix G) to gauge the adequacy of the site and thus determine whether to grant Federal funds for construction of the facility at that particular location. This declaration should include the actual allowable design soil bearing capacity.

1-3.21 **Bid Format Information**

Two types of formats may be used for bidding:

- All Bid Formats are located in NG PAM 415-5, Appendix L.

Separate bids must also be obtained for the Intrusion Detection Systems and Interior Intrusion Detection System equipment-in-place, maintenance repair, and other support items to identify the funding support when provided from different accounts or to identify varying proportions of Federal/State cost sharing. Although the bids may be lump sum for each item, the quantity and unit of measure for each should be included, where practical, showing the magnitude of work required.

The bids of all authorized items (including site preparation and the IDS) are to be totaled before listing additive and/or alternative items that are to be supported with other than Federal funds. A written description of each bid is also to be provided to define the scope of work associated with the bid amount.

In addition, unit price bids should be obtained for the various types of work that may have to be increased or decreased during the period of construction, or when the unit cost of work must be utilized to determine the cost of work in excess of authorized amounts (such as excess foundation walls, exterior walls, and interior partitions).

1-3.22 **Commissioning Buildings and Systems**

Total building (enhanced) commissioning is recommended for all ARNG MILCON projects for new construction and major renovation. Fundamental Commissioning of Building Energy Systems is a prerequisite for LEED-NC and Enhanced Commissioning is a one (1) point credit.

The total cost allowed for this activity will be 1% of the Primary Facility Cost as a line item on an approved DD Form 1390/91 Funding Document. This cost allowance includes the services of an Independent Commissioning Agent.

Commissioning Defined:

- Commissioning is the systematic process of ensuring through documented verification that all building systems perform interactively according to the documented design intent and the owner's operational needs. (NG Pam 415-5, Chapter 14) Published 31 July 2003.

- Commissioning is the testing, operation and demonstration efforts to verify the intended design as reflected in the contract documents has been achieved in the installed construction. (USACE ER 1110-345-723, Systems Commissioning Procedures: http://www.hnd.usace.army.mil/techinfo) Published 31 July 1995.

- Commissioning is a quality assurance process for buildings from pre-design through design, construction, and operations. It involves achieving, verifying, and documenting the performance of each system to meet the building's operational needs within the capabilities of the documented design and

equipment capacities, according to the owner's functional criteria. (ASHRAE Handbook, HVAC Applications Chapter 42, New Building Commissioning: http://www.ashrae.org) Published 2003.

Commissioning with respect to the U. S. Green Building Council Leadership in Energy and Environmental Design for New Construction and Major Renovations (LEED-NC), Energy & Atmosphere;

- EA Prerequisite 1: Fundamental Commissioning of the Building Energy Systems are required for all ARNG MILCON projects. The intent is to verify that the building's energy related systems (Mechanical/HVAC/Electrical) are installed, calibrated and perform according to the owner's project requirements, basis of design and construction documents. There is no additional cost to the design Architect-Engineer firm for this documentation it is part of the design submittal requirements as stated in NGR 415-5, Chapter 7 Designing MCNG Projects (NG Pam 415-5, Chapter 11, Design Document Submittals).

- EA Credit 3: Enhanced Commissioning, this commissioning process begins early during the design process and execute additional activities after systems performance verification is completed. This requirement is referred to as Total Building Commissioning and will be funded as stated in NGR 415-5, Chapter 8-5 and documented in NG Pam 415-5, Chapter 14.

CHAPTER 2

ANTITERRORISM/FORCE PROTECTION

2-1 GENERAL INFORMATION

Any building or portions of buildings routinely occupied by 11 or more DoD personnel with a population density greater than one person per 430 ft^2 requires the minimum antiterrorism/force protection measures. Compliance with the U.S. Department of Defense (DoD) Minimum Antiterrorist Standards for Buildings (UFC 4-010-01) is not an option. However, the individual State's AT/FP officer's recommendations to the adjutant general determine the level of protection required (the degree to which assets are protected against injury or damage from an attack) at the specific site.

After the acceptable level of protection has been determined, appropriate protective strategies are identified. The strategies may be in the form of planning actions, which could include the reorganization of buildings, addition of site elements, and reorientation of roadways. During the design process, the design A-E shall conduct all protection analysis as described in DA PAM 190-51, DOD Security Engineering Publications UFC 4-020-01FA, UFC 4-020-02FA, UF 4-020-03FA and UF 4-020-04FA. For some protective strategies, the design process may include identification of multiple scenarios or alternatives for achieving the required level of protection. All alternatives should undergo a suitability analysis, which takes into account factors that may limit the feasibility of the concepts. Potential future expansion of the new facilities should be considered in the analysis. Factors limiting effective AT/FP strategies may consist of physical, resource, and political constraints such as land area restrictions.

2-2 DESIGN CONSIDERATIONS

2-2.1 Design Constraints

Design constraints are based on appropriate levels of protection in compliance with AR 190-13, AR 415-15, AR 435-13 and UFC 4-023-03 to provide proper planning, evaluation, application, design, installation, and construction of facility enhancements for physical security and antiterrorism. Limit airborne contamination by effectively designing HVAC systems to reduce potential for chemical, biological and radiological agents from being distributed throughout the building. Provide a mass notification system to notify building occupants of threats and possible responses to reduce the risk of mass casualties.

2-2.2 Standoff Zones

The most significant consideration affecting costs can be the standoff zones. The exclusive standoff zone is the controlled area surrounding a structure, into which only

service and delivery vehicles are allowed. Barriers define the perimeter of this controlled area. The barriers are set at a standoff distance sufficient to reduce the blast effect of a vehicle bomb.

The nonexclusive standoff zone is the controlled area that is used in conjunction with an exclusive standoff zone but provides less restrictive land use. Cars (but not trucks) may be granted uncontrolled access into a nonexclusive standoff zone. The barriers that define the nonexclusive standoff zone perimeter are set at a standoff distance sufficient to reduce the blast effects of a truck bomb detonation on the protected structure.

2-2.3 Site Planning and Landscape Design

Land use planning should take into account the areas associated with proposed force protection measures in the calculation of total project land area requirements. Implementing the appropriate force protection measures at the planning stage can preclude the need for piecemeal and costly security enhancements later in the process. Force protection objectives must be balanced against other planning objectives, such as efficient use of land and resources, and must take into account the existing physical, programmatic, and fiscal restraints. A zoned protection system should be used, beginning at the site parameter and moving to the interior of the building or the location of the most critical assets. Higher-risk areas are generally those with large concentrations of personnel, such as administration and assembly areas.

2-2.3.1 Topographical Considerations

Elevated sites generally enhance surveillance of the surrounding area, while low-lying areas can increase the effects from biological and chemical weapons.

2-2.3.2 Facility Arrangement

When possible, facilities that are functionally compatible and have similar threat levels should be clustered. This reduces the required perimeter area to be protected, limits access points to serve multiple facilities, and promotes compact security areas. However, the practical benefits of clustering facilities must be balanced against the survivability benefits of resource dispersal in the event of an attack. The arrangement of buildings into complexes that have strongly delineated boundaries and are oriented to enhance the surveillance opportunities creates a “defensible space” that can be protected more efficiently than scattered buildings.

2-2.3.3 Vehicular Access and Circulation

Limiting the opportunities for aggressors to get close to buildings with vehicles is the first line of defense. Ways to achieve the minimum standoff distance from vehicle circulation or parking include creating a buffer zone using design features such as landscape elements and bollards. However, the design must address site access and circulation for fire department apparatus and other emergency vehicles. The site circulation should be designed to prevent high-speed approaches by vehicles. The vehicle entrances should be offset from the major areas of high-risk concentration, and higher-risk resources should be in a location that is remote from primary roads.

2-2.3.4 Site Perimeter Vehicle Inspection

At facilities requiring vehicle inspection or controlled access, the design considerations are as follows:

- Provide space for inspection and waiting in line at the site access point, with adequate protection from inclement weather.
- Incorporate design features that are appropriate with regard to the threat assessment (see paragraph 4-1.2) and prevent vehicles from breaching the perimeter before being inspected.
- Whenever possible, accommodate commercial, service, and delivery vehicles by providing a separate, designated entry that preferably is distant from higher-risk resources.
- Locate driveup or dropoff areas away from large glazed areas of the building to minimize the effects of an explosive blast.

2-2.3.5 Site Lighting

Effective, uniform site lighting levels should be provided at a minimum of 0.50 foot-candle (FC) across the site and supplemented with additional focused lighting at vehicle and pedestrian entrances. Site lighting should be evaluated and designed in accordance with IES-NA. The lighting design should be coordinated with the closed-circuit television (CCTV) system, motion detection (NGB-ARI Delite System) and other means of surveillance to optimize their effectiveness.

2-2.3.6 Site Signage

Confusion over site circulation, parking, and entrance locations can weaken site security. Therefore, signs should be provided to properly orient all who are coming to the site. Signage should include on-site directional information, parking, and cautionary signs for visitors, employees, service vehicles, and pedestrians.

2-2.3.7 Landscaping

Landscaping design can enhance or be a detriment to the security design. Such elements as earth berms and trees can provide barriers, but all landscape features should be carefully designed to coordinate with site surveillance when the plants are fully grown. Landscape plantings can be used to conceal above-ground utility systems, but utilities should be installed underground when possible.

2-2.3.8 Architectural and Engineering Building Systems Design

The specific requirements for AT/FP are described in detail in UFC 4-010-01and UFC 4-023-03, Design of Buildings to Resist Progressive Collapse.

CHAPTER 3

SUSTAINABLE DESIGN AND DEVELOPMENT

3-1 GENERAL INFORMATION

Sustainable Design and Development (SD&D) includes the design, construction, and operation of buildings to reduce negative impacts on the environment, improve the health and comfort of the building occupants, and reduce operating costs while improving building performance. SD&D requires a multi-disciplinary approach that incorporates a wide range of strategies and objectives set in *Executive Orders, EO 13101, Greening the Government through Waste Prevention, Recycling, and Federal Acquisition and EO 13123, Greening the Government through Efficient Energy Management* into the design and construction process. *The Department of the Army and National Guard Bureau, Installations Division sustainable design and development goal for all projects is a U. S. Green Building Council Leadership in Energy and Environmental Design-New Construction & Major Renovations Version 2.2 (LEED-NC 2.2) Green Building Rating System of Silver. All ARNG MILCON projects will be "Self-Certified" using the A-E Design Team, CFMO, Commissioning Agent and Prime Construction Contractor.*

3-1.1 Self-Certification Process

The Self-Certification Process: The design A-E Firm will assemble a SD&D Design Team (Architect, Mechanical, Electrical and Civil Engineers) along with the CFMO and Commissioning Agent (CxA) early in the process to agree on what points they will attempt to attain within the project budget.

During the design phase the SD&D Design Team will document the process by using the USGBC Green Building Rating System, LEED-NC 2.2 along with the required Design Document Submittals (NG PAM 415-5 Chapter 11) and Design Guide DG 415-5 Appendix C to tract and report progress in Planning Resource for Infrastructure Development and Evaluation (PRIDE). The CFMO will input into PRIDE at the Concept, Preliminary and Final submittal phase the LEED-NC rating points.

Certification Process Design Phase: ARI-DE (Chief) will review the Final (95%) submittal package to concur or non-concur with the CFMO Certification prior to Bid authority. At this time the CFMO with support from the SD&D Team responds to comments regarding why a LEED-NC Silver was not achieved (budget, LCCA, first cost, etc.)

Final Certification Construction Phase: The Construction Team (CFMO, Title II A-E, CxA and Prime Construction Contractor) will maintain accurate records and documentation regarding the Green Building Process as follows:

- CxA Reporting: Prepare monthly reports to SD&D Design Team, CFMO, Title II A-E and the Prime Contractor regarding sustainability issues and recommendations to achieve a LEED-NC Silver rating.

- Contractor Value Engineering Change Proposal (VECP): The entire SD&D Design Team, CFMO, Title II A-E and the CxA must review and comment on all Contractor VECP prior to the Contracting Officer acceptance.

- Sustainable Sites: Construction Activity Pollution Prevention, Erosion and Sedimentation Control, Limit Site Disturbance, Waste Management and Protection of Habitat.
- Contractor Material/Equipment Submittal Review/Approval: CFMO, Title II A-E and Cx Agent.
- Contractor Test/Verification Measures: CFMO, CxA and Quality Control/Quality Assurance Team.
- Project Closeout Phase: CFMO submits NGB Form 593-R to NGB with annotation in PRIDE of LEED-NC final rating points.

3-2 GREEN BUILDING RATING SYSTEM

The design Architect-Engineer should use the Green Building Rating System LEED-NC, developed by the U.S. Green Building Council (USGBC). The LEED-NC rating system is based on compliance with a series of prerequisites and credits to obtain a score within categories of recognition. Five principal categories of sustainable design, which also support other Federal goals in energy and environmental initiatives, have been identified using LEED-NC as a central organizing system:

- Sustainable site design
- Protection and conservation of water
- Design for energy efficiency and consideration of alternative sources of energy
- Optimization of the environmental life cycle of materials
- Enhancement of indoor environmental quality

The following outlines the major objectives and sample strategies for each of these sustainable design categories:

3-2.1 Sustainable Sites

Objectives:

- Promote natural areas.
- Minimize impacts on the site and surroundings.

Sample Strategies:

- Encourage alternative means of transportation.
- Protect from wind and water erosion.
- Use highly reflective paving and roofing materials.
- Use a vegetative roof surface for stormwater management.
- Restore damaged habitat.
- Brownfield Redevelopment (Urban) to conserve greenfields.

3-2.2 Water Efficiency

Objectives:

- Reduce the municipal water supply and treatment burden.
- Allow water to return to the water table.

Sample Strategies:

- Landscape with native plants.
- Use water-efficient, low-flow fixtures.
- Design for rainwater catchment systems.
- Use gray water systems for landscape irrigation.
- Use biological wastewater treatment systems.
- Explore the applications of Waterfree Urinals

3-2.3 Energy & Atmosphere

Objectives:

- Optimize energy efficiency.
- Commissioning Fundamental and Enhanced Building Energy Systems.
- Encourage renewable and alternative energy sources.
- Support international ozone protection protocols.

Sample Strategies:

- Orient the building appropriately.

- Use a highly reflective Energy Star roof.
- Explore Green/Vegetated roof systems
- Specify highly efficient HVAC equipment without the use of chloro-fluorocarbons (CFC) or hydro-chloro-fluorocarbons (HCFC) chemicals.
- Provide occupant controls for all spaces.
- Use photovoltaics and renewable energy sources.

3-2.4 Material & Resources

Objectives:

- Use materials with minimum environmental impact.
- Reduce and manage waste.

Sample Strategies:

- Conduct on-site recycling.
- Implement a construction waste management plan.
- Minimize toxins in materials.
- Specify certified wood and bio-based materials.
- Use biological wastewater treatment systems.
- Specify recycled content.

3-2.5 Indoor Environmental Quality

Objectives:

- Eliminate the sources of indoor pollution.
- Provide for thermal comfort of occupants.
- Provide for occupant connection to outdoors.

Sample Strategies:

- Conduct on-site recycling.
- Limit indoor air pollutants.

- Specify low-emitting materials.
- Incorporate lighting controls.
- Create a natural indoor environment.

3-3 FEDERAL GOALS

3-3.1 Energy Policy

The sustainable design should meet or exceed the efficient energy management goals and objectives stated in Executive Order (EO) 13123. Building energy efficiency goals must meet or exceed ASHRAE Standard 90.1-2004, Energy Standard for Buildings Except Low-Rise Residential Buildings. The Energy Policy Act of 2005 amends the National Energy Conservation Policy Act and recommends a 2%/ year energy reduction starting 2006 through 2015 or 30% below ASHRAE Standard 90.1-2004.

3-3.2 Environmental Initiatives

The sustainable design must meet or exceed the waste prevention, recycling, and Federal acquisition goals and objectives stated in EO 13101 with guidance in UFC 1-900-01, Selection of methods for the Reduction, Reuse, and Recycling of Demolition Waste and Unified Facilities Guide Specification Sections, UFGS-01355, Environmental Protection; UFGS-01572, Construction and Demolition Waste Management; UFGS-02220, Demolition.

3-3.3 Environmentally Preferred Products

Environmentally preferred products (EPPs) reduce effects on human health and the environment. Products are designated as EPPs after a product assessment based on their raw materials source, production, manufacturing, packaging, distribution, disposal, and recyclability. All selected materials are also required to meet industry standards for durability and cost effectiveness based on an LCCA. The comprehensive guidelines can be obtained at (epa.gov) website.

3-3.4 Facility Equipment

All facility equipment, materials, and operating systems should be based on consideration of the lowest life cycle cost analysis (LCCA) and AR 11-27, the State's energy code, ETL 1110-3-491, and the latest energy and environmental industry standards.

3-4 SPECIFIC APPLICATIONS

3-4.1 General Goals

All facility equipment, materials, and operating systems should be based on the lowest life cycle cost considerations, AR 11-27, the State's energy code, ETL 1110-3-491, and the latest energy and environmental industry standards.

3-4.2 Passive Solar Energy Conservation

The design and orientation of functional areas should in new construction and where feasible in major additions/renovations, make use of the principles of passive solar

energy design. Specific passive solar features, however, must be justified on a life cycle cost basis, demonstrating a payback in 20 years or less in order to obtain Federal support. Buildings should be located to best utilize the winter sun day-lighting and warmth, prevailing winds for ventilation, and natural landscape. Refer to *UFC 3-440-03N, Passive Solar Buildings* for design guidance.

3-4.3 Plantings

Landscaping and planting should be integrated appropriately into the design to provide shade from summer sun and to block winter winds. All landscape features should be adequately described for cost estimating proposes. All plant selections must coordinate with all antiterrorism force protection (AT/FP) goals of the site.

Landscaping can reduce direct sun from striking and heating up building surfaces. It can reduce reflected light carrying heat into a building from the ground or other surfaces. The shade created by trees, along with the effect of grass and shrubs can also reduce air temperatures adjoining the building and provide evaporative cooling. The landscape design should also incorporate water conservation principles.

3-4.4 Building Envelope

The building envelope consists of all architectural elements that define the exterior shell of the building. All heated and cooled building roof assembly must have a calculated *U-factor (1/Rt) of 0.025 and wall assembly must be 0.038 Btu/h/SF/F*. Features include the following:

3-4.4.1 Wall and Roof Insulation

The design of the exterior envelope should optimally promote energy-efficient performance guidance in the 2005 Edition ASHRAE Handbook of Fundamentals. In doing this, the design should show that it satisfies the mechanical/HVAC calculations for envelope values submitted at the 35 percent level of design completion.

3-4.4.2 Doors and Windows

Openings should be sized and located to balance energy conservation and the need for natural daylight. High-performance windows with efficient insulated glazing should be considered *(RE: Efficient Windows Collaborative @ www.Efficientwindows.org)* yet carefully matched to the wall thermal performance level based on HVAC heat load calculations for envelope values, including solar gain. Air infiltration should be carefully analyzed and reduced wherever possible.

3-4.4.3 Vestibules

Air locks or vestibules should be provided at the main entrance and at all corridor exits leading to privately owned vehicle (POV) parking if the facility is located in a climatic zone with a design temperature less than 20 °F.

3-4.4.4 Earth Embankments and Berms

Embankments and berms may be used where appropriate, provided such usage does not involve an excessive amount of retaining wall type of construction. Federal support is not authorized for retaining wall construction at the toe of the embankment (for example, where the toe of the berm is above the adjacent finished grade).

3-4.4.5 Weather Stripping and Caulking

Weather stripping and caulking shall be used to reduce air infiltration.

3-4.4.6 Building Configuration and Mass

To reduce heating and cooling costs, the building shape should result in as low an exterior surface and mass as practical and economical.

3-4.4.7 Selection of HVAC Equipment

Interior environmental equipment should be selected based on energy efficiency, including fuel sources. The use of variable air volume (VAV) system, ground source heat-pump systems, in-floor radiant heating and central heating/cooling plants for multiple facilities must meet the lowest life cycle cost for owning and operating.

3-4.4.8 Standard HVAC System Features

Standard HVAC system features to provide, at a minimum, are as follows:

- A Utility Monitoring and Control System (UMCS) per UFGS-13801) or programmable timer with the capability to preset the appropriate temperature level for occupied and unoccupied usage of the various zones.
- Provide Digital Utility Metering at all buildings for water, natural gas, and electric in accordance with the Energy Policy Act of 2005 and DOE/EE - 0312 Guidance for Electric Metering in Federal Building (www.eere.energy.gov/femp).
- A temperature sensor to automatically shut off the heating system when the outside temperature reaches 65 °F
- Door closers, where justified, on exterior and interior doors
- Operable (manual) windows
- Low-leakage dampers

3-4.4.9 Optional System Features

HVAC system features to consider, if economical, include the following:

- Multiple boilers
- Destratification fans in assembly halls
- Exhaust hoods that supply 80% untempered makeup air through an outer jacket of the kitchen exhaust hood (to exhaust only a limited amount of heated room air)

3-4.4.10 **Domestic Hot Water**

Domestic hot water heating plants should use natural gas, electric and supplemental solar panels where feasible. Other features should provide the following:

- Flow restrictors in shower heads
- Low-flow aerators in kitchen and lavatory faucets
- Separate water heaters for kitchen and small toilet areas serving full-time occupancy
- Outdoor temperature reset control for the water-heating systems may vary water temperature inversely with outdoor temperature.
- Solar water heating panels should be used where economically feasible.

CHAPTER 4

COMMON FUNCTIONAL SITE DESIGN GUIDELINES

4-1 SITE ANALYSIS EVALUATION

4-1.1 Site/Area Suitable for Building Construction

The geotechnical investigation, the facility master plan development, and the conceptual-level site analysis process with regard to sustainable site goals should provide information clearly delineating the extent of the site area that is suitable for building construction in the initial phase of development and potential future expansion.

4-1.2 Compliance with Threat Assessment Criteria

All building complex designs should clearly indicate, to scale, the configurations of the exclusive and nonexclusive standoff perimeters on designated site plan drawings. Areas of potential building expansion should be considered when establishing standoff perimeters.

4-1.3 Urban Brownfield Redevelopment Site Selection

Select Urban Brownfield sites early in the master planning and site selection process for MILCON projects in the State/Adjutant Generals Long-Range Construction Plan (LRCP) to allow time for remediation. The U. S. Environmental Protection Agency (EPA) supports the States Brownfield and Voluntary Response Programs and their Voluntary Cleanup Programs (VCP) that promote cleanup and reuse. To review each State VCP reference EPA Brownfield State and Voluntary Response Programs at (www.epa.gov/cgi-bin/epaprintonly.cgi).

4-2 STORMWATER POLLUTION PREVENTION

4-2.1 Stormwater Management Practices

The best management practices currently used in stormwater quality control includes wet and dry ponds, infiltration trenches, porous paving, and oil-grit separators. These practices have certain limitations and drawbacks. Therefore, the design A-E should carefully analyze their functional benefit and cost impact before incorporating them into the project.

Design goals are to minimize stormwater runoff by maximizing the infiltration of rainwater into groundwater and to reduce the concentration of undesirable chemicals in both groundwater and surface waters. The key to these efforts is to minimize the nonporous surface areas, which is consistent with sustainable goals for reducing the heat sink effect on site.

4-2.2 Bioretention Ponds

Bioretention ponds may be used at most ARNG facilities. These small, inexpensive, and somewhat isolated improvements combine the absence of paving (which allows ponding and eventual infiltration of water) with the uptake and chemical conversion of

some pollutants by bacteria adsorbed onto the roots of selected plant species. Often, these bacteria are the best method to reduce the concentration of nitrogenous chemical species and phosphates in surface water.

4-2.2.1 Standard Reference for Small Watersheds

The standard reference, TR-55, Urban Hydrology for Small Watersheds, contains technical calculations for bioretention ponds. TR-55 serves to determine the amount of storage required to mitigate the impact of urbanization, including parking lots.

4-3 REQUIRED PAVED AREAS

Three Army National Guard facilities require large expanses of paved areas:

- Mobilization and training equipment sites (MATES)
- Combined support maintenance shops (CSMS)
- Army aviation support facilities (AASF)

Rigid concrete pavement is authorized for all parking surfaces. However one option is to maximize the use of crushed stone or hardstand in lieu of pavement at maintenance facilities for ground vehicles. This material permits rainwater infiltration and recharge into the groundwater. Its usefulness decreases to the extent that the ground is compacted prior to emplacement, because the compacting reduces porosity and therefore permeability to rainwater. At AASF facilities, however, crushed stone is not an option, given the justified concern over rotor and prop wash kicking small particulates such as stones or dust into aircraft engines. For AASF Aircraft parking a resin modified pavement surfacing material maybe specified (UF-02746)

4-4 FUEL STORAGE AND DISPENSING SYSTEM

Any fuel storage or dispensing facility must be designed in accordance with guidance in MIL-HDBK-1022A and with the State's Department of Environmental Quality, EPA, and local regulations. Fuel storage may be either above or below ground. Above-ground storage tanks should be concrete encased. Placement of tanks in proximity to buildings should take into account fire protection codes, including NFPA 30, or should be fire-rate tanks accordingly. Fuel-dispensing units for the direct fueling of ground vehicles should be in accordance with standard MIL-848-2 and should have an output capacity no greater than 26 gpm. The pump should be located in the dispensing unit rather than the dispensing tank. Special approval is required for high-speed, large-capacity units involving multiple dispensing systems and a pump located in the tank. The pump should be located in the dispensing unit rather than in the dispensing tank. In addition to fueling individual vehicles, the system must be equipped for bottom-loading tank trucks and trailers. The system should meet all Federal, State, and environmental regulatory requirements.

In accordance with AR 70-2, all plans for new construction, modification, or upgrading of petroleum facilities containing fuel purchased with Federal funds must be submitted prior to bidding for review and technical assistance to:

U.S. ARMY PETROLEUM CENTER (APC)
Facilities and Operations Division
8725 John J. Kingman Road, Stop 6421
Fort Belvoir, VA 22060-6241

Questions related to fuel-dispensing systems can be answered by calling the APC at:

- (703) 767-0646 or DSN 427-0646
- (703) 767-0648 or DSN 427-0648

4-5 CONTROLLED WASTE-HANDLING FACILITY

The controlled waste-handling facility should be a separate building constructed of noncombustible materials. It should be in close proximity with flammable/combustible storage and bulk POL storage. As a hazard, it should be located at the appropriate distance from other buildings in accordance with fire safety and building codes applicable for the State, such as NFPA 30 and the IBC. The facility should be within a secured compound and located to minimize the impact of contamination by accidental surface runoff. A prefabricated structure may be used. A 6-ft-high chain link fence or permanent partition should be designed within the enclosure to separate the various types of controlled waste. The latest Federal and State environmental agency waste management requirements for controlling waste should be followed.

A single-point grounding system shall be used to ground flammable materials in metal containers. It should be wired in series to the ground point, with an anchor bolt installed in the concrete floor for each separate, segregated area within the enclosure. Fire protection systems, explosion relief construction, air conditioning, and heating are not authorized unless required by the type of waste stored. Adequate ventilation should be provided at the edge of the concrete slab and the walls to prevent spontaneous combustion of escape fumes from material storage containers. If the roof is flat or nearly flat, a continuous ridge vent or other roof-top ventilation should be provided.

The controlled waste-handling facility should have one personnel door, one 6-ft-wide by 10-ft-high overhead coiling door for forklifts, and one 6-ft-wide by 8-ft-high overhead coiling door for non-forklift operations. The floor should be constructed of reinforced concrete and must have a chemical and moisture-resistant seal (such as an epoxy-based system) with liquid-tight, chemical-resistant joint sealants at any floor joints. It should have a spill/leak containment raised edge. The slab reinforcement design must resist cracking to prevent leaks in the floor containment membrane and to support the loads from stored materials. The design A-E must comply with environmental regulations regarding containment sump capacity.

4-6 COVERED (ENCLOSED), UNHEATED VEHICLE AND PARTS STORAGE

Covered, unheated vehicle storage and parts spaces should be sized according to the program documents. The facility should have one personnel door, one 6-ft-wide by 10-ft-high overhead coiling door for forklifts, and at least one overhead coiling door for vehicular operations, with additional vehicle doors as the size of the facility dictates.

Doors must be sized for vehicle access according to vehicle clearance requirements, and protection for door edges should be provided.

4-7 COVERED STORAGE AREA

Covered storage areas should be sized according to the program documents. Vertical maneuvering clearance should be 14 ft clear height, measured at the one-third point of the underside of the lowest sloping roof structural elements. The covered area may be enclosed when indicated in the program documents. The design should incorporate a super-flat reinforced concrete slab suitable for high-stack forklift traffic and load support.

4-8 WASH PLATFORMS FOR VEHICLES/EQUIPMENT

Wash platform sizes depend on the type of vehicles to be washed. Generally, the minimum standard-sized platform is 25 ft by 40 ft. Wash platforms should be equipped with settling basins prior to discharge to trap grit, and with an oil and grease interceptor in accordance with all environmental requirements in Federal, State, and local codes. The water supply should be sufficient to provide a flow of 40 gpm at 40 psi at each hydrant.

4-9 BULK POL STORAGE

Consolidated above-ground, liquid bulk storage of new petroleum, oils and lubricants generally requires temperature and ventilation control. It should be next to the Controlled Waste Handling areas and close to the Flammable/Combustible Storage area; but isolated from all other shops and storage rooms.

4-10 FLAMMABLE MATERIALS STORAGE

Consolidated storage of bulk solid flammable materials (not fuels). It is generally unheated, and requires ventilation. It should be next to the Controlled Waste Handling areas and close to Bulk POL Storage, but isolated from other shops and storage rooms.

The flammable materials storage (FMS) building may be a separate prefabricated metal building or constructed of concrete masonry units (CMU) or the same material as the main building as long as the design meets all Federal, State, and local codes, regulations, and ordinances. If designed as part of the main building, the FMS should have an exterior door and may have an interior automatic self-closing noncombustible fire door, and the entire storage area must be surrounded by a liquid-tight 4 in. high curb. A roof- or wall-mounted exhaust fan and a wall or door louver near the floor should be provided to prevent hazardous vapor from accumulating within the area. If the FMS is located in a separate building it is generally not heated and is considered a Class 1, Division 1 hazardous location for electrical work. The net floor area can be obtained from the approved program documents. The FMS may be equipped with metal shelves. No floor drain is to be provided. If the interior area is to be separated for item or organizational control, an industrial wire mesh partition may be provided.

CHAPTER 5

COMMON FUNCTIONAL PLANNING AND BUILDING DESIGN GUIDELINES

5-1 FUNCTIONAL PLANNING RELATIONSHIPS

All functional site and building design components should respect fundamental planning relationships that optimize efficient operations at Army National Guard facilities.

Each facility-type design guide, used in combination with this document, includes specific information related to the topics discussed in the following paragraphs.

5-1.1 Proximity

All program functions listed in NG PAM 415-12 for each facility type have priorities of functional proximity to one another. Some should be adjacent because of functional co-dependence, and others isolated because of incompatibility.

Each facility-type design guide includes adjacency matrices related to all functions to be located in the facility. In addition, functional relationship diagrams, which delineate each function in proportional scale, are included to assist the design A-E. These diagrams are not intended to establish conceptual design direction but to assist in the functional comprehension process.

5-1.2 Expandability

The location of those functions with the greatest potential for future expansion warrants careful consideration. Such functions should be placed either at the building perimeter, allowing incremental growth in a new addition, or adjacent to flexible use areas that can be converted into additional dedicated functional space. Facility expansion should be considered in establishing AT/FP standoff zones. All designs should accommodate 25% expansion without affecting the initial AT/FP standoff zones.

5-1.3 Special Environmental Requirements

Unique space environmental factors to consider during the space planning process include:

- Height requirements
- Noise and vibration isolation
- Requirements for utility support
- Public versus secure spaces
- Code-required fire separations

5-1.4 Access to Natural Light

The location of classrooms and open administrative areas should maximize exposure to natural light.

5-1.5 Service Efficiency

Common service functions, including toilet facilities and mechanical and electrical rooms should be grouped horizontally and vertically. The design should provide adequate space for servicing and replacing mechanical and electrical equipment. Where possible in new construction and major renovation locate mechanical/electrical rooms on outside walls to allow unrestricted equipment service and replacement activities.

5-2 GENERAL BUILDING CIRCULATION

The circulation area authorization in the program documents is for interfunctional use only. The individual functional space allowances include intrafunctional circulation. The designer should layout the building spaces in the most efficient manner with the smallest ratio of circulation space/occupied space.

5-2.1 Direct Routes

Circulation areas should provide direct access to functional spaces without the use of offsets or elaborate circulation patterns.

5-2.2 Corridor Width

Corridor width should be based on the anticipated use but should not exceed 6 ft, unless required by the calculated exit width as determined by building codes (or NFPA 101). The minimum clear width is governed by means of egress sections of these codes.

5-2.3 Lobby Requirements

The building should have only one lobby that is easily observed from the adjacent functions.

5-2.4 Vertical Circulation

Stairways should be strategically located adjacent to corridors. Elevators are authorized for all two-story facilities to allow access and freight handling between floors. Stair placement must be evaluated as part of the means of egress travel distance limits, dead-end limitations, and exit discharge requirements in the codes.

5-3 APPROPRIATE BUILDING MATERIALS

The Army National Guard has extensive experience resulting in lessons learned relative to the durability of both interior and exterior building materials. Exterior building materials should comply with the performance guidelines presented in Chapter 6, Common Architecture and Engineering Technical Guidelines. Each facility-specific design guide contains tables of generic architectural interior finish materials. These represent performance level expectations; alternatives with the same characteristics may be considered for use.

5-4 HVAC, ELECTRICAL, AND TELECOMMUNICATIONS SYSTEMS

During the entire development of the building design, it is important to maintain a focus on the design intent related to fundamental environmental, electrical, and communications systems. Emphasis should be on indoor air quality, energy, efficiency, flexibility of needs, and adaptability for future technological advancement. The size of the mechanical, electrical, and telecommunication room(s) depends on the geographic

location as well as the amount and size of the actual equipment needed to provide the heating, ventilation, and air conditioning (HVAC), electrical, and telecommunications support for the entire building. The floor plan layout, drawn to scale and showing the required equipment, should justify the actual floor space required. The building mechanical, electrical, and telecommunications equipment should be housed in separate rooms with direct outside access where possible. The telecommunications room should be environmentally controlled to protect the equipment from overheating.

5-5 FACILITY MAINTENANCE AND CUSTODIAL AREA

The facility maintenance and custodial area should be located on an outside wall to allow direct access for taking equipment and supplies in and out for maintenance and upkeep. The design may include wood or metal shelving attached to the floor and installed along one wall. One custodial room may be provided per floor. Each should have one mop sink, shelving on the wall, and a wall-mounted broom and mop rack.

5-6 REGIONAL CONSIDERATIONS

ARNG facilities are constructed in very diverse climates. The design A-E must research the proposed materials and systems in detail to verify their appropriateness, particularly related to the building envelope. Consideration should include durability to the elements and availabilities, particularly in remote locations. Reference *UFC 3-440-05N, Tropical Engineering* for ARNG Tropical Regions for (Southern Florida, Hawaii, Guam, Virgin Islands and Puerto Rica) planning, design and construction. Reference UFC 3-130-07 Arctic and Subarctic Construction for Buildings for ARNG Cold Regions facilities.

5-6.1 Mechanical Systems

In tropical and semi-tropical climates, mechanical cooling should be considered in storage areas as well as occupied portions of the building. Regions that experience long periods of high humidity may require dehumidification, not only for human comfort but also to avoid damage to stored equipment and supplies. Analysis should be performed before airside economizers are selected, as they are frequently not cost effective in hot, humid climates. Intense sun may justify external sun shades on windows. Mechanical system protection from tropical storms should be considered.

In extremely cold climates, heating is required in almost all building areas. Special attention must be given to the potential freezing of pipes located in outside walls, stairways, or any unoccupied area. Outside air intakes and exhaust outlets must be protected from snow accumulation. Intakes ducts and coils must be designed to avoid ice accumulation and to dispose of water resulting from melting ice. Glycol solution should be used in preheat coils to avoid coil freezeup, and special care must be exercised to ensure proper mixing of outside and return air at AHU inlets. Some form of perimeter heating, such as baseboard radiation, should be considered. Standby boilers, pumps, and other equipment should be provided to prevent building freezeup in the event of major equipment failure.

5-6.2 Architectural Considerations

Observation and recognition of the reasons for certain materials being favored locally assists the design A-E in evaluating materials that are intended to reflect this knowledge. The design A-E is encouraged to adopt the same practical approach to

selecting materials that reflect the community environment. The design A-E is cautioned to avoid introducing materials inappropriate to a climatic region.

The following are some examples of impacts on design resulting from environmental and climatic extremes:

- Ground moisture content, which may have an impact on slab design and elements below grade
- Dew point/condensation management in extremely cold climates or in spaces that change from conditioned to unconditioned based on use (and thermal breaks in insulated window units to prevent condensation/frost in cold climates)
- The position and type of the air retarder, vapor retarder, waterproofing, and damproofing in exterior walls and roofs in climatic extremes
- Perimeter below-grade insulation in extremely cold climates
- Piled (plowed) snow and ice against the perimeter of the building, and de-icing chemicals and water/slush ice tracked inside
- Fenestration and other shading considerations in very hot climates
- Alkaline content of soils, which may have an impact on concrete and reinforcement
- The effect of extreme temperature differentials on movement isolation and movement control joints, particularly masonry
- Drifting snow against edges of the building in cold climates, along with snow loads on the roof related to structural design

5-6.3 Areas of Seismic Extremes

Structural engineering design requirements for areas of seismic extremes are provided in the International Building Code, Structural Design and UFC 3-310-03A Seismic Design for Buildings. In addition, the design A-E should ensure that ceilings and ceiling-hung/structurally supported elements are braced, particularly in assembly areas, and that elevator hoistways have proper tolerances.

5-6.4 Areas of Wind Extremes

In areas subject to extreme wind conditions, structural design should be based on the most stringent requirements of the IBC or local building codes and regulations. The design A-E should consider persistent wind effects in cold climates on door entries, door closer operation, and glazing unit design.

5-7 COMMON FACILITY FUNCTIONAL AREAS

The following functions have the same design guidance for inclusion in all facility types.

5-7.1 Break Room (Area)

The break room space should be conveniently located for the majority of the building occupants and contain a vending area. The location needs to be acoustically isolated or remote from areas needing a quiet environment. It should include vending machines plus tables and chairs in the amount appropriate to the size of the facility.

5-7.2 Toilets and Showers

The approved program documents should indicate the number of designated males and females in order to proportion the authorized space appropriately. The appropriate plumbing code should be used to determine the specific number of each type of plumbing fixtures.

5-7.3 Physical Fitness Area

The physical fitness area is used on a daily or weekly basis for physical training and requires construction to withstand the impact of furnished exercise equipment. The area should be located at an appropriate distance from administrative and classroom functions for acoustical reasons. The physical fitness machines and equipment are classified as portable equipment to be purchased through standard supply channels, not with Federal construction funds.

5-7.4 Mail Room

Mail room is a facility operated by or for the National Guard/Department of Defense (DOD) for the receipt and delivery of mail for military units or other authorized organizations and agencies by entities outside the National Guard/DoD. This does not include mail rooms that receive mail distribution that was initially received at a central DOD mail handling facility.

Mail rooms in inhabited facilities should comply with the minimum design standards as addressed in the Unified Facility Criteria (UFC) 4-0101-01. The following are some of the minimum anti-terrorism design standards for mail rooms addressed in the UFC 4-010-01:

- Locate mail rooms on the perimeter of the building.
- Locate mail rooms as far from heavily populated areas of the building and critical infrastructure as possible.
- Ensure that mail rooms are well sealed between their envelopes and other portions of the buildings in which they are located to limit migration into buildings of airborne chemical, biological, and radiological agents introduced into mail rooms.
- Provide separate, dedicated air ventilation systems for mailrooms to ensure airborne chemical, biological, and radiological agents introduced into mailrooms do not migrate into other areas of buildings in which the mailrooms are located.
- Provide dedicated exhaust systems within mailrooms to maintain slight negative air pressures with respect to the remainder of the buildings in which the mailrooms are located so that the flow of air is into and contained in the mailrooms.

CHAPTER 6

COMMON ARCHITECTURE AND ENGINEERING TECHNICAL GUIDELINES

ORGANIZED BY Construction Criteria Base, Unified Facilities Guide Specifications (UFGS) (USACE, NAVFAC, AFCESA & NASA) Whole Building Design Guide: (www.wbdg.org/ccb/browse_org.php.)

SECTION 1 CIVIL, SITE, AND LANDSCAPE DESIGN

Division 1 GENERAL REQUIREMENTS

Sustainable Site Development Goals

The major site development objective is to preserve the character of the site by retaining natural features such as ground slopes, drainage patterns, trees, and other natural vegetation to the greatest extent possible. The design A-E should analyze the site to locate and orient the building and other structures so they are compatible with natural site features, sun orientation, and prevailing winds. The overall site design should conserve energy, allow easy access to public roads and utilities, and support the most efficient operation. Careful consideration should be given to future expansion of the facility during development of the initial design.

Division 2 SITE CONSTRUCTION

Sustainable Site Preparation

Site preparation should include the work for demolition and clearing, grubbing, stripping, stockpiling topsoil, excavation, and rough grading. It should not include the excavation and backfilling required for foundation walls and footings nor the finish shaping and proof rolling of the subgrade under pavements and floor slab construction. The subgrade should be such that the cut and fill are roughly balanced to provide the most economical site preparation. If required, demolition should include removal of all surface features in conflict with the new construction as well as underground utility lines and structures. The design A-E shall prepare a suitable stormwater pollution prevention plan (SWPPP) and obtain the National Pollution Discharge Elimination System (NPDES) permit during the construction and post-construction phases in accordance with local requirements.

UF-01355A: Environmental Protection

UF-01356A: Storm Water Pollution Prevention Measures

UF-01572: Construction and Demolition Waste Management

UF-01670: Recycle/Recovered Materials

UF-02220: Demolition

UF-02226: Removal and Salvage of Historic Building Material

UF-02231: Clearing and Grubbing

UF-02300: Earthwork

UF-02315N: Excavation and Backfill

UF-02318: Test Fill

UF-02370 **Soil Surface Erosion Control**
During the construction phase, the appropriate control measures (such as straw bales silt fence, sediment traps, sediment basin, and other approved practices) shall be employed to minimize erosion in order to comply with the latest environmental and State requirements.

Utilities - General Information
All building utility service lines should be underground where possible. The design A-E should verify that all utility services will be available at the site when the intent is to connect with or extend an existing municipal system. The design A-E shall comply with and obtain approval with respect to all municipal requirements. The contract documents should stipulate that the contractor is to coordinate with local utility companies on the division of work to the extent necessary to ensure that when the facility is complete, all utility services will be connected and operational without further cost. The Federal share of the total cost of all utility service connections must not exceed 15 percent of the Federal share of the building cost. Exposed utility components and light standards may have bumper guards or posts if a location outside the vehicle traffic area is not feasible. Emergency power may be provided when sewage lift stations are necessary. The length of the service line for each utility is limited to the distance of the shortest run from the point 5 ft outside of the building to the property line adjacent to the public right-of-way.

UF-02510 **Water Distribution**
Ductile-Iron pipe and fittings, PVC, Type K copper for a line size of 2 in. or less in diameter or an equivalent pipe should be used for the service connection, unless specific circumstances require the use of some more expensive material. If a public water system is not available in the general area, a well may be utilized if consistent with the requirements of the local authority having jurisdiction. Line extensions 6 in. or more in diameter should be ductile iron or plastic.

UF-02510 **Fire Protection Site**
The design A-E should consider the size of the structure, type of construction, and exposure to fire hazard that the structure creates or receives from nearby buildings. The fire apparatus access requirements should be considered as well as the exterior fire rating of nearby buildings on site and the building being designed. Except in cases of conflict with State requirements, exterior fire protection should be in conformance with NFPA and UFC 3-600-01 Fire Protection Engineering for Facilities.

UF-02531 **Sanitary Sewage Systems**
Piping should be vitrified clay, concrete, corrugated metal, PVC, or of equivalent quality and cost, unless special circumstances require the use of a more expensive material. The sewer should be gravity type. If a municipal system is not available in the general area, a packaged sanitary treatment system or septic system may be utilized.

UF-02551N **Natural Gas Distribution**
Normally, natural gas is the fuel of choice if available at the site. Piping material should be vinyl clad Schedule 40 black steel or thermoplastic gas pressure pipe and fittings conforming to American Society for Testing and Materials (ASTM) D2513.

Stormwater Retention Basin
The design should separate normal stormwater sheet flows (from roofs or other areas) from possible contaminated stormwater sheet flows (occurring at military and POV parking areas). Non-contaminated flows should be designed to run off downstream from contaminated sheet flows. Contaminated sheet flow management (including retention basins, grit interceptions, and oil-water separators) is authorized for Federal support if required by the approved SWPPP and the NPDES permit (based on 1-hr rainfall during a 10-year event and on the local limitations thresholds imposed on such effluents).

Privately Owned Vehicle Parking
The authorized amount of paved area for circulation and parking is based on 35 yd^2 per parking space. If on-street parking is available, the area allocation may be reduced to the size of the parking space meeting local zoning ordinances. Paint striping may be used to define individual parking stalls, but stalls shall not have identification marking except for the physically disabled if a competitive employee position is authorized. Concrete curbs may be used around the pavement edges. Security fencing normally shall not be provided for this area.

Additional Paved Area Requirements
The design A-E should incorporate additional areas of pavement for vehicular access to a wash platform or fuel-dispensing facility, or both, if authorized, in the military parking or storage area. A security fence should enclose these additional areas of pavement along with the platform or fuel facility, or both.

UF-02741 Bituminous Concrete Pavement

UF-02746 Resin Modified Pavement Surfacing Material

UF-02752 **Access Roads and Entrance Roads**
The design A-E should consult the approved program documents for the authorized amount of paved area. The number of square yards of pavement stated in the approved program documents is only approximate; the actual amount will be as needed to provide the shortest runs possible when considering site conditions and economical locations of the building, dock(s), parking, and existing roads. The primary access or entrance road may be 24 ft wide, with rigid or bituminous concrete curbs, provided that

an underground drainage system is avoidable. Secondary access roads, service drives, and circulation lanes in parking areas are limited to a width of 20 ft.

The design should provide an adequate turning radius based on the types of equipment driven or towed. Secondary access roads and service drives should not have curbs unless dictated by the most economical storm drainage solution. The authorization of paving for the parking areas includes paving for circulation lanes.

UF-02754 **Pavement Standards**
A rigid pavement section should consist of a 6-in. or 8-in. concrete slab with shrinkage or temperature-welded wire mesh steel. The 6-in. thickness applies to wheeled vehicles, and the 8-in. thickness applies to tracked vehicles. Generally, concrete should be placed directly on a compacted subgrade, unless existing soil conditions dictate an aggregate base (a thickness of 6 in. maximum). An alternative to the rigid pavement section is to use roller-compacted resin modified pavement. If the design A-E determines that local soil conditions necessitate a more costly paving section, special justification is required before Federal support can be obtained for the additional paving cost.

UF-02751 **Military Vehicle Parking Pavement Requirements**
The design A-E should consult NG PAM 415-12 for the area and type of paving to provide for military vehicle parking. The area includes space for parking the vehicles and circulation. The paving should consist of Portland cement concrete, and the design should be based on soil conditions and on the maximum loads anticipated but should in no case be less than a 4,000-lb wheel load and 40-psi tire pressure.

UF-02761 **Fuel Truck Parking**
Fuel truck parking containment is required and overhead protection is allowed. When more than one fuel truck is authorized, a spacing of 10 ft should be maintained between vehicles when parked.

UF-02754 **Trash Container Pad**
A concrete pad may be provided at an appropriate location for storage of a truck-operated trash container. The selected location may take into account the ease of access by building users, visibility, and access for dumping and removal (the location generally is not inside the fenced compound). Screening may consist of walls or plantings.

UF-02770 **Concrete Sidewalks**
Walks connecting the primary and secondary building entrances to the parking area(s) and to the main vehicular access points may be of concrete. The maximum width may be 6 ft, except at the main entrance/flagpole location, where it may be 10 to 15 ft. The total area should not exceed the amount authorized in the program documents without prior approval from the Military Department or the CFMO. A concrete pad may be provided at exit doors, but connected sidewalks are not always required.

UF-02811 **Irrigation Sprinkler System**
If an irrigation system is proposed, it should be in the landscape budget. The designer should select an efficient landscape to reduce potable water consumption by using native or adapted plants, captured rainwater or grey water systems.

UF-02821A **Security Fencing Chain-Link**
The security-type fence must be a six feet high, nine gauge, chain-link metal fabric with a twelve inch high, three strand four point barbed wire 45 degree anti-climbers to enclose the secured areas. Vehicle gate(s) may be swinging or rolling type. The following areas should be provided with security fencing: military vehicle parking; fuel storage and dispensing system; service and access aprons; aircraft parking; wash platform; lubrication and inspection rack; covered, unheated storage; cannibalization area; and loading ramp. Fencing should be located no more than 5 ft from the edge of the paved areas unless safety or security demands a greater distance.

UF-02915 **Plantings Exterior**
Plantings should include the furnishing and planting of new trees, shrubs, ground cover (other than sodding or seeding), irrigation systems, fertilizing, mulching, staking, erection of temporary barriers, watering, and general maintenance operation required to establish healthy growth after transplanting.

UF-02921 **Fine Grading and Seeding**
The area within the limits of construction should be fine graded and seeded to provide proper site drainage and erosion control. The limits of construction should be clearly indicated on the project plans, and any damaged surface cover outside of this limit must be restored to its previous condition. The bottoms of drainage swales or ditches and embankment slopes steeper than 1 ft vertical to 4 ft horizontal should have sod instead of seeding. Banks steeper than 1 ft vertical to 3 ft horizontal should be stabilized with ground cover plants or with 3 in. of crushed aggregate. Steep slopes should be held to the absolute minimum and selected only when most economical. Importation of topsoil is authorized if the existing topsoil is insufficient to provide adequate cover.

UF-02930 **Landscaping**
The design A-E should include plantings as an integral part of the project planning and should clearly indicate the location, size, and quantity on the plans for bidding purposes. The planting design shall be simple and orderly, using a minimum of plant types and materials for framing and background aesthetics of the building and the screening of service areas, parking areas, and other objectionable views. Solar orientation, plantings, and berms should all be considered during early stages of design. Plant and tree selection should provide permanent low-maintenance vegetation appropriate to the location. Selected plant material shall be of local, hardy species that are tolerant of site-specific conditions. The design A-E should consider adjacent structures to prevent adverse impact. Trees should be carefully selected and located to prevent clogged gutters and drains from leaves and seeds and blocked sewer lines from root infiltration. Topsoil should be 4 in. thick unless there is a surplus from on-site project excavation grading.

In addition to aesthetic values, landscaping provides an opportunity to enhance the energy efficiency of the facility. Refer to Chapter 3, Sustainable Design.

SECTION 2 STRUCTURAL ENGINEERING DESIGN

GENERAL REQUIREMENTS

General Information

The structural system of the building should consist of noncombustible materials or heavy timber-type construction. The construction should generally be of open-web steel joists or prefabricated light-gage steel trusses supported on masonry bearing walls, tilt-up concrete, or steel wide-flange beams or joist girders and columns. Pre-engineered metal buildings are acceptable where economically feasible.

Structure Height

The design A-E should keep the building heights to a minimum to reduce construction and operating cost. The interior height from the finished floor to the bottom of the roof structure system (or upper floor structure) should not exceed the limitations stated in each facility-type design guide (plus or minus 4 in. to accommodate masonry courses). Where the roof structure is sloping, the clearance is to be measured at the lower end of the one-third point of the triangle formed by the sloping roof arrangement. Care shall be taken to maintain the maximum authorized clearance at the one-third point. To accomplish this when longer spans are required, the design A-E can reduce the slope. The limit of the slope reduction is the minimum that the manufacturer recommends in order to achieve a roofing system that is warranted for 15 to 20 years.

Seismic Design Considerations

The design and construction of all new buildings located in areas of high probability of seismic activity must be in accordance with the International Building Code Section 1910, Seismic Design Provisions.

Division 3 CONCRETE

UF-03200A **Concrete Strength**

Compressive strength should generally be 2,500 to 3,500 psi at 28 days after placement, unless a stronger concrete is justified by the unique technical requirements for a building type and identified in the facility-type design guide. All concrete related work must be in accordance with the latest recommendations of the American Concrete Institute. For extreme conditions such as cold climates, deicing chemicals and sulfate-containing solutions refer to the International Building Code Chapter 19.

UF-03300A **Foundations**

Bearing wall foundations may be CMU (with the core filled and grouted) or reinforced concrete foundation walls on continuous concrete spread footings as a standard. (The standard for columns is spread footings.) Special foundations include wood, steel, or concrete piles; concrete grade beams may be used if required by the soil investigation survey and justified by a Declaration of Uniformity of Area Soil Conditions. The top of the interior bearing wall and column footings should generally be 6 to 8 in. below the

bottom of the floor slab. The bottom of the exterior bearing wall and column footings should be just below the maximum frost depth or 1 ft 6 in. below the outside finished grade, whichever governs. Footings should be lower where required for plumbing and other underground utilities, including risers at the column footings. For entrances in cold climates, the design A-E may consider the use of foundations or grade walls under concrete stoops (which are almost flush with the bottom of the doors) to prevent door interference due to upward displacement of the stoop by frost action.

UF-03300A **Slab on Grade**
The slab should be poured in a single layer, with non-galvanized shrinkage and temperature steel placed at mid-point of the slab thickness on no more than 6 in. of granular base, and surfaced with a standard troweled finish. Generally, a 4 in. slab thickness and temperature-welded steel wire mesh are adequate except for special areas and uses indicated in the individual facility-type design guides. Instead of welded wire mesh, the design A-E may consider fibrous concrete. A steel angle or other type of protection may be used to protect the concrete edge of a vehicle access door threshold.

SECTION 3 ARCHITECTURAL DESIGNS

GENERAL REQUIREMENTS

Where described in these design guides and reference publications, the standards for material quality and construction are the minimum required to support Federal funding for a project. The use of contractor options and performance-type specifications is encouraged. The building must be of noncombustible construction, and all materials must have a flame spread rating of 25 or less in accordance with ASTM E84. Refer to AR 190-51, Appendix D, for the physical security requirements for functional areas storing or having special tools, equipment, or repair parts.

Division 4 MASONRY

UF-04200 **Parapet Walls**
Parapet walls, up to a maximum height of 18 in., are authorized. Where parapet walls are constructed of CMU, they should have a one-piece truss-type (industry standard) horizontal reinforcing element every second or third course. Vertical reinforcing should be used in seismic zones to comply with the applicable building code. The design A-E should pay special attention to eliminate differential expansion compared with walls below as indicated by movement in control joints.

UF-04200 **Exterior Walls**
Where masonry is used in exterior walls the material may be face or common brick with CMU backup forming a bearing wall. A concrete tilt slab or other suitable system can be provided if the cost is equal or less. For non-cavity wall construction with CMUs at the exterior, the design A-E should consider whether a moisture-resistant film or other barrier would assist in moisture control (with a non-bond-breaker type of barrier) and whether to permit or reduce moisture movement.

Division 5 METALS

UF-05500 **Miscellaneous Metals**
Lintels may be steel angles, masonry, or precast masonry units. The concrete edge of vehicular door openings shall have a steel angle or a similar type of protection.

UF-05055A **Corrosion Resistance**
The design must prevent corrosion and electrogalvanic activity under all dissimilar metal-to-metal and metal-to-alkaline material conditions.

Division 6 WOODS AND PLASTICS

UF-06100 **Wood Roof Support**
The roof system should normally consist of a lightweight, noncombustible type of construction. As an alternate, the structural system may be of heavy timber-type construction (defined as a minimum of 2-in.-thick decking and 6-in. by 8-in. minimum-size joists, purlins, and beams) when proven to be more economical than steel construction and where permitted by the building code.

Division 7 THERMAL AND MOISTURE PROTECTION

UF-07214/07220 **Insulation**
The exterior walls, penetrations, and roof should be insulated to reduce the heat transmission U-factor and energy cost in accordance with the State Energy Code or ANSI/ASHRAE/IESNA Standard 90.1-2004.

UF-07212 **Batt Insulation**
The installation of batt insulation above suspended ceilings is not recommended due to the likelihood of creating a condensation problem. However, the roof insulation may be installed below the roof deck if this does not create a potential condensation problem.

UF-07240 **Slab Perimeter Insulation**
Perimeter insulation should be provided for slab-on-grade floors to reduce the U-Factor to the same as that of the exterior wall insulation. The insulation should be arranged to prevent an uninsulated gap at the wall and floor juncture.

UF-07500 **Roofing Systems**
The roof system should normally consist of a lightweight, noncombustible type of construction. The roof construction may be any of the following:

- A composite built-up roof
  (3-ply minimum and 4-ply maximum glass fiber felts)
- A single-ply membrane roof (ethylene propylene diene monomer [EPDM], ballasted, partially or fully adhered, or mechanically fastened)
- A standing seam metal roof

All roofing systems should be of a quality to have a 15- or 20-year warranty. Proposals to use other roofing systems or slopes exceeding 3 in. per foot must be justified by an economic analysis. Walking treads may be provided if required to maintain roof-mounted equipment. Drainage should be toward the perimeter of the roof, with a minimum slope of ¼ in. per foot, into scuppers and downspouts discharging onto grade. Calculations of roof slope should allow for roof-supporting member sag to reduce ponding. Refer to the National Roofing Contractors Association [NRCA] Roofing and Waterproofing Manual.

UF-07550 **Bituminous Roofing**
Where selected, built-up bituminous roof systems should be applied over rigid insulation for heated buildings. Metal decking with the appropriate corrosion protection on both sides may be used as the supporting substrate for insulated and uninsulated roof applications. The appropriate base sheets recommended by the manufacturer must be used for insulated roof applications. Condensation and the location of the dew point (such as at soffits) must be considered to prevent occurrence at the decking or the bitumen bond. Two-in. wood decking may be used as an alternate for such special conditions.

UF-07530 **Elastomeric Membrane Roofing**
The same recommendations apply as for built-up bituminous roofing.

UF-07416 **Sheet Metal Roofing**
If standing seam metal roofing is selected, the authorization generally is for the less costly system using a galvanized or aluminized, painted metal roofing supported by metal purlins. The appropriate thickness of fiberglass batt insulation should be placed under the metal roofing and over the top of the purlin.

Roof Restraint Protection
Protection for service staff on the roof should consist of either an extension of the parapet, guardrails, or a tie-off system. The local OSHA office can provide the ruling on the appropriate method. Refer to OSHA standards regarding walking–working surfaces in 29 CFR 1910.21–1910.23 and regarding fall protection in 29 CFR 1910.23(c)(1)(c)(3) and 29 CFR 1910.132(a).

Division 8 DOORS AND WINDOWS

UF-08110 **Exterior Doors**
All exterior doors, including rollup doors entering into heated or air-conditioned areas, should be insulated. Exterior doors providing access to storage rooms for tool and repair parts and to supply rooms should be hollow metal with fixed pin hinges of suitable weight on a hollow metal frame. Main entrance doors and those connecting directly to POV parking areas may be incorporated into a vestibule, particularly in areas of climatic extremes. If the entrance doors lead to a major administrative area, they may consist of commercial-grade aluminum and glass store front systems. Secondary doors, which are generally for emergency egress only, should not be fitted with glass panels, transom glass, or sidelights for security reasons. Where required by code, panic hardware should be installed on all exterior exit doors. Only main entrance doors may have

concealed door closers; all other frequently used doors should have surface-mounted closers. Ball bearing hinges should be used only for high-frequency usage doors or where fire safety governs. Kick and push plates may be installed on frequently used doors.

UF-08110/08210 **Interior Doors**
Interior doors and frames should generally be hollow metal for durability. Kick and push plates may be installed on frequently used doors. Solid-core wood doors with a standard finish may also be used. Interior doors providing access to storage rooms for tool and repair parts and to supply rooms should be hollow metal with fixed pin hinges of suitable weight on a hollow metal frame. The use of wood doors is not encouraged in heavy traffic areas because wood is less durable than metal. Interior doors may be recessed when the occupant load, as identified by the building code, requires a door to swing outward into the direction of egress. Doors may have surface-mounted door closers. Closers are required by code at fire-rated doors.

Motor-Operated Doors
Motor operation is authorized for vehicle maintenance workbay doors, warmup bays, hangar doors, and the most frequently used United States Property and Fiscal Office (USPFO) warehouse and direct support logistics (Class IX) overhead supply doors. Motor-operated overhead doors are not authorized for vehicle storage buildings, but chain-operated overhead doors may be used.

Door Sizes
Personnel doors may be 3 ft 0 in. wide by 7 ft 0 in. high. Double-leaf doors should generally have an astragal. The maximum width of the vehicle maintenance rollup door is 28 ft 0 in.; a door width of 20 ft 0 in. or less should be selected if possible, because wider doors usually cause more maintenance problems and heat loss in cold climates.

UF-08342/08371 **Logistics Maintenance/Hangar Doors** Steel sliding of vertical lift fabric doors may be used.

UF-08581 **Window and Glazing Types**
Generally, windows should be manually operated. Glazed openings susceptible to accidental human impact should be designed in accordance with the applicable IBC, Consumer Product Safety Commission (CPSC), or similar code safety requirements in model building codes. In considering the use of high-performance glazing, the design A-E should carefully match the solar gain/heat loss values and thermal performance levels including solar gain. Force protection issues must also be considered in the glazing design at locations where exposure to threat is indicated. Such glazing units and restraint systems in insulated units are a significant cost issue. The needs for natural daylight, thermal efficiency, value, and security should be balanced. Security window sash and bars may be used only at ground floor locations of supply and repair parts rooms and warehouses.

UF-08600 **Skylights and Clerestories**
The design A-E should consider a limited amount of skylights in a day-lighting scheme. Where high walls exist, clerestory windows shall be used instead of skylights to provide

adequate natural light. Lobbies, warehouses, and interior windowless areas may have skylights.

UF-08710 **Door Hardware**
Door locks should be heavy-duty mortise type, except that doors to rooms containing an arms vault shall have Government Series 86 (ANSI A115.1) dead bolt locks (Federal Specification FF-H-105). Offices and other non-security-type areas should have standard commercial passageway locks. For safety reasons, lock sets and locks normally should not be installed on interior stairways or toilet room doors. The needs for life safety, force protection, and access control should be coordinated in the selection of hardware. In locations where doors potentially can be used as a means of egress for assembly use groups, the design A-E should avoid inadvertently controlling doors in the direction of egress with delayed-release locking devices.

Division 9 FINISHES

UF-09720 **Basic Interior Finishes**
All facility-type design guides include tables for generic interior finishes appropriate for use within each room or space.

UF-09510 Acoustical Ceilings

UF-09650 Resilient Flooring

UF-09680 Carpet

UF-09900 **Painting and Coatings**
The painting of exterior galvanized metal surfaces (gutters, downspouts, and flashing) is authorized where such surfaces are exposed to view from the ground. All exterior aluminum doors, window frames, and trim may be anodized (clear or bronze). Wood windows, doors, and trim, as well as non-galvanized or unfinished steel windows and doors, may be painted. Baked-on colors are authorized instead of anodized finish on aluminum or steel commercial-grade doors and windows.

Division 10 SPECIALTIES

UF-10100 **Bulletin and Tack Boards**
A standard manufactured bulletin or tackboard with a cork surface laminated to a backing board and a clear anodized aluminum frame (flush mounted) is authorized. The board should be permanently affixed to the wall with vandal-proof fasteners.

UF-10100 **Marker Boards**
A marker board with a standard color, appropriate finish, clear anodized aluminum tray, and frame (flush mounted) may be provided. The board should be permanently affixed to the wall with vandal-proof fasteners.

UF-10153 **Toilet Partitions**
Toilet partitions should be of steel, with a baked enamel finish or plastic laminate, for durability. Partitions should be anchored to solid reinforcement in the walls, and should

be supported overhead and secured to the floor (including miscellaneous metal bracing above the ceiling.)

UF-10430 **Exterior Signage (Free-standing or Building Mounted)**
Building identification signs are authorized for all projects. The sign may be free-standing building mounted or independent letters may be mounted directly on the exterior building surface. It should be located in direct view of the public, facing a main thoroughfare or public street. The facility name letters should be a maximum of 12 in. high, and the State name followed by "ARMY NATIONAL GUARD" should be a maximum of 8-in.-high letters.

UF-10440 **Interior Signage**
Room signs may be made of aluminum or plastic material. Letters or numbers should be no larger than 1 in. in height. Preference should be given to pre-manufactured systems that have interchangeable components. Signs may be made of aluminum, steel, plastic, or other appropriate materials of equivalent cost.

UF-10505 **Lockers**
Lockers should be raised on a base above the floor. A full-length wood bench, anchored to the floor, should be placed between each parallel group of lockers. In selecting hardware, the design A-E should coordinate the needs for access control. Lockers should be deep enough, tall enough (single tier), and wide enough for required equipment and clothing to be stored. Lockers are to be secured with padlocks furnished separately.

Division11 EQUIPMENT

UF-11030 **Vaults**
The area of the vault can be obtained from the approved program documents. Generally, no vaults should be designed with less than 300 ft^2 of space. Vaults should be designed and constructed in accordance with AR 190-11. Conduit for the intrusion detection, telephones, and electrical systems should be provided by the design A-E. If a modular vault constructed of precast panels meets or exceeds the security requirements in AR 190-11, it may be bid as an additive alternate to the constructed-in-place vault and the less expensive vault should be selected. A vault should not be placed on an exterior wall.

Vault Wall Construction
Vault walls shall, at a minimum, consist of 8-in.-thick reinforced concrete. Anchor rings should be installed along the inside walls to facilitate the securing of arms racks. As an alternate, a 3/8-in.-thick by 2-in.-wide hardened steel bar located continuously around the inside wall, with anchor rings welded to the bar, may be used to facilitate the securing of arms racks.

Vault Floor Construction
The vault floor should consist of a 6-in. reinforced concrete slab. If the floor is the ceiling for a room below, the slab shall be a minimum of 8 in. thick. The vault door

threshold must be level with the adjoining floor to allow easy movement of pallet jacks and other wheeled items.

Vault Ceiling

The vault ceiling should be a minimum 5-in.-thick concrete slab. If the ceiling is the floor for a room above, the slab should be a minimum of 8 in. thick.

Vault HVAC

The vault should be provided with a (Z-type) vent for emergency ventilation. The design A-E should provide for a minimum of four air changes per hour of supply air from a central HVAC unit into the vault, and the air should exhaust directly to the outside. The design A-E should also specify a packaged dehumidifier. The dehumidifier condensate floor drain should be located outside of the vault. Canvas-type flexible duct connections should be used to eliminate vibration, and ducts should terminate with security grilles and registers at the interior surfaces.

UF-11020 **Vault Doors**

Vault doors are to be rated as GSA Class V, without a day gate, and provided as described in Federal Specification AA-D-600B.

UF-11025S **Security Safe**

A security safe that is permanently installed (mechanically secured to the floor or wall) may be provided within the vault to store weapon parts and other highly sensitive items.

UF-11161 **Loading Docks**

In addition to the docks authorized for the data and parts vans and trailers, a loading dock should be provided in the receiving and shipping area of the Class IX operation. The dock should be of sufficient length to provide space for a minimum of three trucks simultaneously loading or off-loading supplies. The dock should be 15 ft deep to provide the required space for forklift operations, approximately 4 ft high, and covered with a roof. Each of the truck docking spaces should be equipped with a mechanical self-leveling dock leveler. One of the truck loading and off-loading dock spaces should have an enclosure equipped with an air seal to close the gap between the enclosure and truck body. If operational requirements make it necessary (that is, if the outside heating design temperature is 15°F or cooler), a heated air curtain should be provided at one or two doors (but not at the door with the enclosure). Rubber, neoprene, or wood dock bumper blocks should be included. Stairs to the dock(s) should be provided as required. The dock(s) should have an access ramp no wider than 10 ft to provide forklift access to the dock. The lighting illumination level on the dock should be 30 FC.

Division 12 FURNISHINGS

UF-12495S **Window Coverings**

Operable blinds or shades may be provided in administrative and shop areas except workbays. Blackout shades and blinds should be installed in any functional areas where training or briefings may occur, including the break and assembly or safety briefing areas.

Division 13 SPECIAL CONSTRUCTION

UF-13703N **Intrusion Detection System (IDS) General Information**
The Electronic Security Program Office (NGB-ARI-FM) has selected three (3) IDS for protection of Federal assets and arms, ammunitions, and explosives (Ademco Vista 128 Panel; FBI XL4 Panel; IST/EUROPLEX 2064NG Panel). An IDS shall be installed in each facility containing an arms and/or ammunition vault. The system shall consist of a Commercial IDS furnished by the Federal government and installed by the contractor or State. The IDS shall include the following:

UF-13703N **Vault Pre-Entry Area**
The space providing access to a vault should have the following:

- One ultrasonic motion sensor directed at the vault door
- An ultrasonic motion processor
- Balanced magnetic switches on all doors and operable windows
- A time delay device with timer and duress capability

UF-13703N **Arms Vault Protection/Commercial IDS**
The arms vaults should have the following controls and related equipment:

- A balanced magnetic switch on the door
- Passive ultrasonic sensors throughout (vibration sensors where ultrasonic noise levels prevent the use of passive ultrasonic sensors)
- A passive ultrasonic processor
- A data transmission system located in the control unit connected to a dedicated telephone line for monitoring

UF-13120 **Pre-Engineered Structures**
Pre-engineered structures may be used for the following if they meet functional requirements:

- Controlled waste-handling facility
- Covered (enclosed), unheated vehicle and parts storage
- Covered storage areas

If required, shelving and access metal ramps affixed to the structure may be purchased as part of the unit. These structures are to be attached to a concrete slab, and the electrical power line is to be hardwired to the electrical control panel of the structure. The same electrical and mechanical service requirements need to be met as in conventional construction.

UF-13210 **Above-Ground Storage Tanks**
Above-ground storage tanks may be either single-walled steel or doubled-walled fiberglass-reinforced plastic. The tanks should be designed and installed in accordance with the American Petroleum Institute standards and NFPA 30, Section 2. If it is possible for the liquid contents to flow onto adjacent property or into a public waterway, tanks exceeding 500 gallons in size should be surrounded by a liquid-tight dike equipped with a drain sump, drain pipe, locked-type gate valve, and minimum of two tank grounds. All vegetation should be cleared from within the dike area. The dike area may be made liquid tight by lining the dike with neoprene, rubber, clay (such as bentonite), concrete, or some other impermeable material, whichever is cost effective.

UF-13216 **Underground Storage Tanks**
Underground storage tanks (USTs) (with a concrete hold-down pad and anchor straps, if required by wet soil conditions) shall be designed and installed in accordance with 40 CFR Parts 280 and 281; NFPA 30, Section 2; and/or State and local codes, whichever is more stringent. The USTs should be double-wall construction of either steel or fiberglass reinforced plastic, whichever is the least costly. (The steel tank is the standard; the fiberglass tank may be bid as an additive alternate.) Steel tanks should be coated with either a coal tar or epoxy and should be cathodically protected or coated with glass fiber-reinforced polyester resin. The USTs should be monitored between the outer and inner shells by means of a leak detection system with an audible alarm and indicator lights.

Underground piping should be of steel or nonmetallic materials. Steel piping shall be cathodically protected. Steel piping and fittings should be primed and protected with pressure-sensitive organic plastic tape or coated with the same material as used to coat the tank. Double-wall piping may be used.

UF-13211 **Fuel Storage Tanks (Compresses Gases)**
When fuel oil or liquefied petroleum gas (LPG) is selected, a 30-day supply is authorized for the capacity of the storage tank. Fuel storage facilities shall conform to all applicable Federal, State, and local vapor emission and water pollution control (spill planning) regulations. Either above- or underground fuel tanks are authorized.

UF-13856 **Carbon Monoxide Detectors**
Carbon monoxide detectors must be placed in all vehicle and aircraft maintenance workbays to create an alarm condition to activate second stage exhaust/ventilation system.

UF-13851A/UF-13859 **Fire Alarm/Detection and Mass Notification System**
An automatic fire alarm and detection system must be designed and installed in accordance with NFPA-72 and UFC 3-600-01, with a connection to the supporting fire-

fighting unit. However, combined smoke and heat detectors (UL approved, with both smoke- and heat-detecting capability) should be installed in all billeting areas, including corridors. The smoke-detecting component should sound a local alarm confined to the fire-affected room(s), while the heat-detecting component should be connected to the building alarm system. Detectors should be spaced at not more than 30 ft on center and 15 ft maximum between a door and a detector. A Mass Notification System is required in any inhabited facility in conjunction to the Fire Alarm and Detection System. The system must be UL listed and Factory Mutual approved for the intended use.

UF-13930A **Fire Protection**
An automatic sprinkler system with a fire alarm signaling system should be designed and installed. The system shall meet the requirements of the IBC, UFC 3-600-01 Fire Protection Engineering for Facilities and NFPA 13 and NFPA 72 of the National Fire Codes. Buildings must be of noncombustible construction meeting IBC or Uniform Building Code (UBC) Type I and II. Regardless of the construction type, any facility meeting any of the following criteria should be provided with an appropriate fire protection system:

- The area exceeds 15,000 ft^2.
- Operational impairment would reduce the operational readiness and responsiveness of the strategic or tactical defensive and offensive capability.
- The contents include direct war-fighting assets (combat aircraft or tactical vehicles).
- The facility and contents housing critical equipment requiring a long lead time to replace that have a high monetary value with a replacement cost or value exceeding $5.0 million.

UF-13955A **Fire Protection System (AFFF)**
Aqueous Film-Forming Foam should be used for Army Aviation Support Facilities helicopter maintenance hangars.

Division 14 CONVEYING SYSTEMS

UF-14240 **Hydraulic Elevators**
The majority of ARNG facilities are not more than three stories in height; therefore, hydraulic elevators should be used in compliance with TI 810-90.

UF-14636N **Top-Running Overhead Cranes**
(Reference DG-415-2 and DG 415-3 requirements)

SECTION 4 MECHANICAL AND PLUMBING SYSTEMS DESIGN

Division 15 MECHANICAL

General Information

Mechanical systems should be designed in accordance with the latest recommendations of ASHRAE Handbooks and Standards and the ACGIH Industrial Ventilation Manual. Ductwork for heating, cooling, and exhaust should generally be overhead instead of underground, and should be minimized to the shortest runs possible. All ductwork should be of sheet metal, and designed and constructed in accordance with handbooks and standards by ASHRAE and the Sheet Metal and Air Conditioning Contractors' National Association (SMACNA). Plumbing systems should be designed and installed in accordance with the International Plumbing Code, American Society of Plumbing Engineers (ASPE) Data Book and the State/Local Plumbing Codes.

UF-15700S HVAC System Sizing

The system components should be selected to maintain an inside winter design temperature of 68 °F during the heating season except in storage rooms, maintenance training workbays, and the weapons vault, where the design temperature should be 55 °F. Summer inside Design Temperatures should be 78 degrees F and 50% RH maximum and 30% RH minimum. To the greatest extent possible, the areas designated for part-time occupancy should be on separate zones from those having full-time occupancy. Exterior design conditions must be in accordance with UFC-3-400-02, Engineer Weather Data and ASHRAE Handbook of Fundamentals.

UF-15070A Seismic Bracing

In all regions where the building design must comply with seismic force resistance, the design A-E should provide bracing and anchoring of interior and exterior mechanical piping and equipment for protection from damage. Bracing and anchoring should be designed and installed in accordance with UFC 3-310-03A, Seismic Design for Buildings and ASHRAE Application Handbook.

UF-15083S Ductwork Insulation

All heating and cooling system supply and return air ductwork should be externally insulated following the latest recommendations of the Midwest Insulation Contractors Association (MICA) National Commercial & Industrial Insulation Standards and ASHRAE Standard 90.1-2004. Internal insulation should be used only on exhaust ducts. Return and exhaust ducts do not require insulation within conditioned areas. Direct lining should not be used in supply ducts.

UF-15085S Piping Insulation

Heating, cooling, and plumbing piping should be insulated in accordance with ASHRAE Standard 90.1-2004 or the State Energy Code. Waste and drainage piping should be insulated with a sealed vapor barrier where condensation may occur. Insulation type should be as indicated in related ASTM standards. Insulation application should be in accordance with MICA Standards.

UF-15050S **Piping Systems Support**
The materials for piping supports should be in accordance with Manufacturers Standardization Society (MSS) SP-58, SP-69, and SP-89. The design A-E should provide a pipe flow diagram showing all sizes, flow rates, valves, coils, vessels, and pumps. Typical piping details for coils, vessels, and pumps should be part of the contract drawings to support the test and balance contractor and maintenance staff.

UF-15003S **Pipe Labeling**
Piping systems should be labeled for identification purposes. Where painting is authorized, the pipe exposed to view may be painted to match adjacent surfaces. Piping should be labeled to indicate the fluid and direction of flow.

UF-15120S **Piping Specialties**
The following should be provided:

- Thermometers at the inlet and outlet of hot water boilers, heat exchangers, and major AHU coils
- Thermometers at the outlet of domestic water heaters
- Pressure gauges at the inlet and outlet of HVAC pumps and at hydronic system water makeup points
- Strainers at the inlet of pumps

UF-15106S **Domestic Water Piping**
Domestic water piping should be insulated Type M copper for hot and cold service, with heat-free solder.

UF-15102S **Sanitary Waste and Vent Piping**
Sanitary waste lines for above-grade and venting service should be cast iron soil pipe Schedule 40 PVC or copper alloy drain, waste, or vent (DWV) tubing. All below-grade sanitary waste lines under the building should be cast iron soil pipe.

UF-15400 **Storm Drainage Piping**
Storm drain pipes shall be Schedule 40 PVC for conductors and cast iron soil pipe for below-grade service. Interior roof drains discharging onto grade are authorized for large roof areas but must be coordinated with the civil storm drains and regulations. Interior roof drains discharging into underground piping systems are authorized in areas where the heating design temperature, as determined from the 97.5 percent column in UFC-3-400-02, is (+) 10°F dry bulb or less. Federal support is also authorized for the underground piping system in these areas. The design A-E should provide roof relief scuppers in accordance with the plumbing code where parapets surround the drainage area.

UF-15190A **Fuel Piping**
Gas and fuel oil piping should be Schedule 40 black steel or Type L copper tubing. (Steel fuel oil piping should have welded joints.) Fuel-dispensing output capacity should

not exceed 26 gpm. Special approval is needed for high-speed, large-capacity units involving multiple dispensing systems and a pump located in the tank.

UF-15410S **Plumbing Fixtures**
Water closets should have self-closing valves, flushometers, and low-flow-type fittings for water conservation. The number provided should be based on the International Plumbing Code (IPC) or the State plumbing code, whichever is most stringent. Floor-mounted or wall-hung tank-type fixtures of vitreous china shall be specified where water pressure is a factor. Flush valve fixtures may be used where the required water pressure is available.

UF-15410S **Lavatories**
Countertop lavatories should be provided in female toilet rooms, and either countertop or wall-hung units should be provided in male toilet rooms.

UF-15410S **Showers**
The amount of showers should meet the requirements of the IPC, the State code, or NG PAM 415-12, whichever is more stringent.

UF-15410S **Mop Sink**
Each occupied building should have a minimum of one janitorial closet with a mop sink per floor.

UF-15410S **Water Coolers**
Water cooler drinking fountains are authorized in barracks, educational facilities, medical clinics, dining facilities, training site headquarters, all unit headquarters buildings, and any other location where required by an applicable code. They should not be recessed unless they would cause a safety hazard or unless recessing is required to meet Federal, State, and/or local codes.

UF-15120S **Eye Wash and Deluge Shower**
An eye wash and deluge shower, equipped with an audible alarm that is activated when they are operated, should be installed in any area where personnel could be accidentally exposed to harmful wastes in accordance with ANSI Standard Z358.1-2004. The alarm should be located where workers outside of the immediate area can hear it and respond. The location of the eye wash and deluge shower should allow easy access from any point in the facility (10 second walk). Floor drains are not recommended. Tempered water is required to be between 70-95 degrees F.

UF-15102S **Exterior Wall Hydrants**
Freezeless anti-siphon wall hydrants should be provided no closer than 100 ft apart on the exterior walls of a building.

UF-15514N **Hot Water Heaters**
Separate point-of-use water heaters, instead of circulating pumps and piping, may be provided for remotely located toilet areas.

UF-15532 **Heating Systems**
An LCCA must be performed. It should address the initial construction cost and annual operating and maintenance cost, calculated in discounted dollars, for each proposed system. The analysis should clearly indicate which system has been selected, and if it is not the lowest-cost option, a justification should be presented.

UF-15741N **Heat Pumps Water/Ground Source**
Water source heat pumps may be used if justified by the LCCA. Heat pumps provide efficient operation, especially where electric resistance heating is the only other viable option. Heat pumps permit zoned temperature control and allow temperature to be set back on a room-by-room basis when spaces are unoccupied.

UF-157565A **Infrared Radiant Heaters**
Infrared radiant heaters using oil or natural gas for fuel may be used for vehicle workbays and for shipping and receiving areas of warehouses.

UF-15562A **Energy Sources**
The selection of the energy source for the heating system is part of the LCCA process which establishes the most cost-effective alternative available in accordance with the provisions of AR 420-49. The viable alternatives include:

- Fuel oil
- Natural gas
- LPG
- Electricity
- Solar
- Geothermal

If fuel oil is the primary source, an above-ground storage tank or an underground storage tank (with double-wall containment and monitoring wells) may be installed. If natural gas is the primary fuel, the boiler may be equipped with dual fuel burners and an interior pipe line to the exterior building wall (but not a storage tank) to facilitate possible future conversion to the use of fuel oil as the energy source availability and economics dictate.

UF-15864N **Pollution Control**
Heating systems are subject to Federal, State, and local air pollution control regulations. Generally, heating systems are regulated based on the fuel source and design heat input in British thermal units (Btu) per hour. If the heat input exceeds a regulated limit, an air permit may be required for construction.

UF-15510S **Boilers Heating Systems**
If a boiler is chosen as the most economical system, a hot water unit is more economical to operate than a steam unit. Boilers may use coal, natural gas, or oil, to be determined based on the appropriate fuel selection procedures. Two heating boilers may be selected, provided that the output capacity of each boiler would not exceed two-thirds of the design heating load. Hot water heating systems generally are economical in cold weather climates and should not be considered for warmer climates unless an LCCA proves them to be the most cost effective. Chemical treatment of water should be used where analysis indicates it is necessary.

Mechanical Ventilation
Mechanical ventilation systems for summer operation of non-air-conditioned areas should provide a minimum of four air changes per hour. The minimum air changes per hour for interior heat control should be based on the internal heat gain. The minimum air change per hour for dilution ventilation and exhaust should be as recommended by the ASHRAE handbooks, the ACGIH Industrial Ventilation Manual, and OSHA Standards for General Industry. Special exhaust systems are required as identified in each facility-type design guide. Mechanical ventilation should be provided in all climates during the summer and winter seasons.

UF-15690A **Air Conditioning Systems and Evaporative Cooling**
Mechanical air conditioning or evaporative cooling for personnel comfort shall be in accordance with AR 420-49, Chapter 7, Air Conditioning and Refrigeration. Spaces to be air conditioned should be consolidated to the maximum extent feasible and efficiently zoned within the system design. Central station air handling or packaged units with 35% efficiency filter banks should be used to the maximum extent possible. Independent units of the appropriate size should serve small, remotely located spaces. HVAC equipment should be located in indoor mechanical equipment rooms wherever possible to facilitate maintenance and extend equipment life.

System Sizing HVAC
The system components should be sized to maintain a summer indoor design temperature of 78 °F with a maximum RH of 50 percent and a winter indoor design temperature of 68 °F and 35% RH based on an outside design temperature as designated in ASHRAE Fundamental Handbook and UFC-3-400-02 Design Engineering Weather Data for the project location.

UF-15751N **Desiccant Dehumidification Equipment**

UF-15845A **Energy Recovery Systems**

UF-15865S **Filters-HVAC Systems**

UF-15901N **System Controls Direct Digital**
A system of direct digital controls should be used to maintain the interior temperature at the design level during periods of occupancy and at lower temperatures (40 to 50 °F) as appropriate when unoccupied. Pneumatically operated systems may be used as an extension of an existing system.

UF-15951/13801 **Energy Management & Control System**
Utility monitoring and control systems should be used to conserve energy by providing a capability to preset the appropriate temperature levels for unoccupied periods. An outdoor temperature-sensing control located near the mechanical room should be provided to automatically shut off the heating system when the outdoor temperature reaches or exceeds 65 °F for more than 24 hours. The outdoor temperature-sensing control should have a convenient manual override.

SECTION 5 ELECTRICAL AND COMMUNICATION SYSTEMS DESIGN

The electrical and communication systems design should consist of safe and economical power distribution, lighting, communication, and fire alarm and signaling systems meeting present requirements and anticipated future growth. The design should meet requirements of NFPA, applicable codes, and Unified Facilities Criteria.

Division 16 ELECTRICAL

General Information

UF-16375A/13110A **Exterior Electrical Design**
Direct burial cable marked with above-ground indicators at appropriate intervals should be used to the maximum practical extent. Conduit should be limited to those sections passing under paved areas unless the local electric company policy is to install all underground service in conduit. Lighting and power loads should be served at the highest voltage practicable. The design A-E should specify primary power at three-phase, 480Y/277 volts and use a dry-type transformer to obtain 208Y/120 volts where required.

UF-16375A **Service Line**
The secondary power supply line should be sized adequately to accommodate any future projected demand. The electrical power to such items as fuel-dispensing systems and lubrication and inspection racks is included under this item. Extension of the primary power supply line, substations, and transformers should be the financial responsibility of the locality or State, except when a proposed building is located on Federal property. Generators must be provided for Readiness Centers, Aviation Maintenance Facilities and USPFO/Warehouse buildings only, the designer must provide the necessary auxiliary equipment.

- A quick power disconnect
- An automatic transfer switch (manual w/o generator provided)
- Fuel oil and diesel piping from the storage tank
- An 8-ft by 16-ft by 6-in. reinforced concrete pad near the main power service

UF-16402 **Interior Electrical Design**
The design for the electrical systems should include provisions for safe and economical electrical distribution, lighting, communications, and signaling systems that meet present requirements and anticipated future growth. The electrical power distribution system should be designed to meet all requirements of UFC 3-520-01 and NFPA 70.

UF-16070A **Seismic Bracing**
The design A-E should provide bracing and anchoring of electrical conduit, cable trays, and equipment to protect them from damage due to seismic forces where the regional requirements dictate. Refer to UFC 3-310-03A, Seismic Design for Buildings and the International Building Code for guidelines regarding seismic bracing requirements.

UF-16145S **Wiring**
Wiring (including conduit for future communications), junction boxes, and plug-in receptacles may be selected for use in a grid arrangement above the suspended ceilings in large open administrative areas. This is to be used in conjunction with "telephone power pole" systems or conventional wall and/or floor pedestal outlets. Wiring and conduit may be labeled or tagged for circuit identification but should not be painted. Electrical metallic tubing or rigid conduit should be used where required by code. The administrative areas, corridors, lobby, toilets, classrooms and library, learning center, food preparation and scullery area, and physical fitness area should have concealed conduit, which may also be used throughout the facility.

To reduce overheating of the neutral conductor due to harmonic currents caused by switchmode power supplies in computer equipment, the neutral of multi-wire branch circuits should be sized at 175 percent of the phase conductors. The oversized neutral will occur at multi-wire branch circuits, which may have computer equipment connected. Using the oversized neutral has two benefits over separate circuits: 1) reduced cost because of decreased wire and conduit quantities; 2) reduced voltage drop because a three-phase voltage drop is less than a single-phase voltage drop and the oversized neutral has less voltage than the code minimum neutral.

UF-16402 **Electrical Receptacles**
Electrical receptacles should be provided in accordance with tables included in the appendices of each facility-type design guide. Emergency power receptacles shall be red in color.

Electrical Power
The interior electrical system should be designed for the most efficient and economical distribution of power, using the highest voltage consistent with the load served. A three-phase, 208Y/120-volt system should generally be the minimum, with consideration given to the use of a 480Y/277-volt system where loads are sufficient to justify it.

Primary Electrical Service
Primary electric service shall be provided underground from the nearest pole to pad-mounted, three-phase transformers located near the exterior of the mechanical equipment room or load center.

Secondary Electrical Service
Secondary electric service from transformers to the building shall also be underground. If metering is required, the electric meter should be placed on the secondary service side rather than the primary service side. Digital Meters should be provided to each building.

UF-16263A/UF-16410A **Emergency Generators/Automatic Transfer Switch**
Generators should be placed away from areas averse to noise and fumes, to include fresh air intake louvers. Reference NFPA 110, Standard for Emergency and Standby Power Systems. An Emergency Power Generator and Automatic Transfer Switch must be provided for every Readiness Center, Army Aviation Support Facility and USPFO/Warehouse.

UF-16065S **Ground Fault Protection**
Ground fault provisions should be in accordance with NFPA 70. Ground fault protection may be used for all receptacles where power tools will be used.

UF-16370A **Service Distribution**
Service and distribution equipment exceeding 600 volts should be metal enclosed and manually operated, with fusible load-interrupter switches or power circuit breakers. Low-voltage services should have power circuit breakers or fusible disconnect switches.

UF-16402 **Interior Distribution**
The electrical system design should include the most efficient and economical distribution of power, using the highest voltage consistent with the loads served. A three-phase, 208Y/120-volt system is generally the minimum, with consideration given to the use of a 480Y/277-volt system where loads are sufficient to justify it.

UF-16228S/13100A **Lightning and Surge Protection**
The design A-E should specify a lightning protection system for any building located in an area with a high lightning probability using the risk assessment calculation specified in *NFPA 780, Standard for the Installation of Lightning Protection Systems, Appendix H*. Power line surge protection equipment should be specified at the main service panel, mid-building panel, and any dedicated electronic or computer equipment service panel.

UF-16446S **Power Panels**
Power panels, telecommunications equipment, and electrical equipment should be located in secure areas free from environmental extremes of temperature, dust, and humidity. Power panels may not be placed in storage rooms or janitor closets.

UF-16510 **Interior Lighting Systems**
The lighting system design objectives are to economically provide lighting levels for efficient working conditions and effective nighttime vision for security and safety. The lighting system should be designed according to the Illuminating Engineering Society of North America (IESNA) Lighting Handbook and NFPA 70 National Electric Code.

UF-16511S **Interior Fixture Types**
Except in high bay maintenance and classified areas, standard energy-efficient fluorescent light fixtures should be used. Fluorescent lighting may be used in high bay maintenance areas to supplement the metal halide lamps. Parabolic louver fixtures or indirect lighting should be provided in room areas with computer or monitor screens. The design A-E should take the maintenance and inventory cost of lamps and ballasts into consideration when selecting fixture types. T-8 fluorescent lamps and high-efficiency electronic ballasts should be used to achieve a 0.85 Watts/SF lighting power density.

Interior Lighting Intensity Level
Lighting levels should conform to the foot-candle levels established for the individual functional areas as specified in the facility-type design guides. If required, portable lighting equipment purchased through standard supply channels should provide special supplementary localized lighting of higher intensity. All interior lighting should be designed in accordance with IES-NA Standards.

UF-16520 **Exterior Lighting Systems**
Lighting should be provided on site at the following locations:

- At entrances to the site and building(s)
- Along sidewalks from parking areas to building entrances
- At military vehicle and POV parking
- Around the entire building perimeter
- At other areas as required for safety and security
- At flag poles

Lighting fixture types should be selected and placed to minimize intensity off site. The lighting for military vehicle parking should illuminate 30 to 40 ft of the area outside the fenced area where M-1 tanks are stored, if that area is within the facility property line.

UF-16512S **Exterior Fixture Types**
High-pressure sodium vapor or metal halide vandal-resistant lenses should be specified. When motion detectors are used in conjunction with security lighting, lights should have the capability to activate instantly. After movement within the area discontinues, the lights should remain on for 15 minutes.

Exterior Lighting Intensity Level
A minimum illumination intensity of 0.50 FC should be provided over the entire site. Existing street lighting should be taken into account in the design computations. The design A-E should make sure that the entire exterior of the facility is adequately illuminated for safety and security without undue glare falling on neighboring properties

or landing aircraft. Lighting of fuel-dispensing facilities is authorized at an intensity of 20 FC at 3 to 4 ft above finished grade.

UF-16510 **Explosion-Proof Fixtures**
Lighting fixtures and electrical service located in classified areas (Class I, Division 1 and 2) should be designed and constructed to meet the requirements of the National Electrical Code (NEC), Article 500.

UF-16535S **Emergency Egress Lighting**
Dual-purpose fluorescent fixtures with internal battery backup at appropriate locations including corridors, hallways, stairs, and fire exit egress should be considered as an alternative to dedicated emergency battery units (EBUs). Such fixtures generally would be the most economical alternative and would not require any special circuitry. Dual-purpose fixtures incorporate battery backup units and continue to function during power outages. If only EBUs are used, they shall be hardwired rather than the plug-in type.

UF-16536S **Exit Signs**
Either illuminated or non-illuminated exit signs should be provided in accordance with applicable codes. Exit signs shall be the light-emitting diode (LED) type.

UF-16528A **Lighting for Infrared Scanning**
Designated lighting should be equipped with a sensor that illuminates the fixture(s) when the infrared scanning device detects motion. The lighting system may be equipped with an override switch that activates all perimeter lights on demand.

UF-16710 **Communications**
Conduit and cable should be provided for all components determined by the DOIM.

UF-16720N **Telecommunications and Cable Requirements**
At the programming stage of the project, the CFMO should coordinate with the State Director of Information Management (DOIM) to determine the entire telephone and data communications system to be installed. Telecommunications cabling includes voice, video, and data in a single integrated plant. The cabling should be installed in accordance *with Interim Guidance from U S Army Information Systems Engineering Command, Technical Guide for Installation Information Infrastructure Architecture Technical Guide for 13A, dated August 2003; DRAFT UFC 3-580-02, Telecommunications Systems Inside Plant Planning and Design dated June 2004* ; and the Telecommunications Industry Association (TIA)/Electronic Industries Alliance (EIA) 568A and 569-A Standard. Service at the facility should consist of a buried cable with sufficient pairs of wires to accommodate present and future requirements. In the construction drawings and specifications, the design A-E should specify the following as “contractor furnished and installed”:

- The system's outside trenching, plastic conduit, and cable to the terminal board, which is located in or near the mechanical or electrical room
- The cable trays

- Outlet boxes
- Wiring, including associated fittings, connectors, terminal strips, and similar devices needed to install the cable
- The cabinet mounting board

UF-16713N **Fiber Optic Cable**
The DOIM should consider a fiber optic outside cable even though the telephone company's primary cable is not a fiber optic cable. The fiber optic cable would still allow for connection to a conventional telephone system inside the building.

UF-16720N **Telephone Outlets**
A maximum of one CAT- 5E telephone outlet should be provided at each of the following locations:

- Independent offices
- Approximately 70 ft^2 of open administrative area
- Each supply and repair area
- Outside the vault door to facilitate Commercial IDS testing
- Technical library, Classrooms and Training Areas
- Lobby (public telephone)

UF-16145S **Power for Microprocessors**
As long as an adequate number of electrical outlets are provided in areas where microprocessors are to be used, and the circuitry is properly designed to accommodate the anticipated loading, there should be no need for special dedicated circuit wiring for computer use. An exception is the Read Clear All Scalers (RCAS) server and printer location.

UF-16792A **Antenna Base and Lead-In**
Where one or more of the functional areas at the facility are authorized, a ground-mounted antenna system (either through the terrestrial directional antenna or other sources) with a concrete base and a conduit (with pull wire) leading into the building should be provided. If an antenna mast is roof mounted, a roof-mounted base, mounting brackets, guy cable tie-down, and conduit may be provided as part of the construction. Detailed coordination between the design A-E, the Military Department, and the user are necessary to identify the exact requirements.

UF-16721 **Public Address System**
Conduit, wiring, and equipment may be installed for the public address system as part of program requirements. This system should be audible throughout the buildings of the complex and at a reasonable distance outside in order to contact personnel whose

exact location is not known. Generally, the unstaffed outbuildings do not require this system; if they do, NGB-ARI requires an approved justification.

CHAPTER 7

SUPPLEMENTAL SUBMISSION REQUIREMENTS

(To be determined and developed As Required)

CHAPTER 8

FUNCTIONAL QUALITY ASSURANCE

8-1 MILESTONE COMPLIANCE ASSURANCE

To verify that all functional and performance goals are being accomplished in the project development process, the design review directives checklists in Appendix C should be used in the review exercise performed at the 10 percent, 35 percent, and 95 percent design and documentation submission milestones for each facility type (refer to the facility-type design guide for additional, unique design review directives). These reviews are not intended to be an all-inclusive technical analysis related to design criteria. That responsibility belongs to the State and should be accomplished prior to submission of the documents to NGB-ARI at the milestones. The main focus of the NGB-ARI review shall be on effective incorporation of functional requirements that are both general and unique to the different types of facilities.

8-2 DESIGN REVIEW DIRECTIVES FORMAT

The design review directives are arranged to address the following:

- General project coordination issues
- General issues pertaining to each discipline
- Specific functional issues pertaining to each discipline

Many of the checklist items refer directly to the related technical guidance information in Chapter 6, Common Architecture and Engineering Technical Guidelines, by indication in the left margin. Others make reference to SPiRiT/LEED-NC compliance and related industry standards.

8-3 REVIEW TASKS

Each review task is written in the form of a directive. This format describes the task to be accomplished to ensure compliance with the functional design intent and adequacy of the information related to the requirements of the milestone submission.

APPENDIX A

REFERENCES

The following lists criteria in the form of regulations and industry standards to use in designing ARNG facilities in addition to the references listed in the facility-type design guides. The design A-E should use the current applicable edition of all references.

GOVERNMENT PUBLICATIONS:

1. Executive Office	EO 13101, Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition. EO 13123, Greening the Government Through Efficient Energy Management.
2. U.S. Army Corps of Engineers (USACE)	ETL 1110-1-177, Use of Resin modified Pavement. DG 1110-3-122, Design Guide for Interiors. FORSCOM Access Control Points ETL 1110-3-481, Containment and Disposal AFFF Solution. ETL 1110-3-484, Aircraft Hangar Fire Protection Systems. ETL 1110-3-485, Fire Protection for Helicopter Hangars. ETL 1110-3-491, Sustainable Design for Military Facilities. General Instruction Building and Army Continuing Education System Standard Design Criteria. UFC 3-600-01, Fire Protection for Facilities Engineering, Design, and Construction. TI 810-90, Technical Instructions – Elevator Systems. Technical Instructions – Structural Design

		Criteria for Buildings. TI 800-01, Design Criteria. TI 809-04, Seismic Design for Buildings. TI 810-90, Elevator Systems. Training Centers – ARNG/USAR Facilities Standards Booklet.
3.	U.S. Green Building Council	USGBC Green Building Rating System LEED-NC
4.	Army National Guard (ARNG)	NGR 415-5, Army National Guard Military Construction Program Development and Execution. NGR (AR) 415-10, Army National Guard Facilities Construction. NG PAM 415-12, Army National Guard Facilities Allowances. NGR 5-3, Army National Guard Training Centers (Management).
5.	U.S. Department of Agriculture, Natural Resources Conservation Service (formerly the Soil Conservation Service)	TR-55, Urban Hydrology for Small Watersheds. http://www.wcc.nrcs.usda.gov/water/quality/cost.html
6.	Department of the Army	AR 11-27, Army Energy Program. AR 190-11, Physical Security of Arms, Ammunition and Explosives. AR 190-13, The Army Physical Security Program. AR 190-51, Security of Unclassified Army Property (Sensitive and Nonsensitive), Appendix D. AR 415-15, Army Military Construction Program Development and Execution. AR 420-49, Utility Services.

	Army Regulation (AR) 425-15.
	DA Form 2028, Recommended Changes to Publications and Blank Forms.
	DA PAM 190-51, Risk Analysis for Army Property.
	TM 5-853-1, Security Engineering Project Development.
	TM 5-853-2, Security Engineering Concept Design.
7. Department of Defense (DoD)	MIL-HDBK-1022A, Petroleum Fuel Facilities.
	UFC 1-200-01, Design: General Building Requirements.
	UFC 3-600-01, Fire Protection Engineering for Facilities.
	UFC 4-010-01, DoD Minimum Antiterrorism Standards for Buildings.
	UFC 3-400-01, Design: Energy Conservation.
	UFC 3-410-01FA, Design: Heating, Ventilating, and Air Conditioning.
	UFC 3-400-02, Engineering Weather Data
	UFC 3-440-03N, Passive Solar Buildings
	UFC 3-440-05N, Tropical Engineering
	UFC 3-520-01, Electric Design Interior Electrical System.
	UFC 3-570-06, O&M Cathodic Protection Systems.
	UFC 3-580-02, Telecommunications Systems Inside Plant Planning and Design.
	UFC 4-023-03, Design of Buildings to Resist Progressive Collapse

8. Department of Energy, Federal Energy Management Program (FEMP)	Business Case for Sustainable Design in Federal Facilities.
9. U.S. Department of Health and Human Services, National Institute for Occupational Safety and Health (NIOSH)	Publication No. 2002-139, Guidance for Protecting Building Environments from Airborne Chemical, Biological, or Radiological Attacks.
10. U.S. Department of Labor, Occupational Safety & Health Administration (OSHA)	29 CFR Part 1910, Occupational Safety and Health Standards. OSHA Standards for General Industry, Walking – Working Surfaces, 1910.21–1910.23. Fall Protection in General Industry, 29 CFR 1910.
11. Uniform Federal Accessibility Standards (UFAS)	Handbooks and standards.
12. Department of Energy (DOE)	FEMP (Business Case for Sustainable Design Construction in Facilities; Interagency Working Group).
13. U.S. Environmental Protection Agency (EPA)	Comprehensive Procurement Guidelines, www.epa.gov EPA 832-R-92-005, Stormwater Management for Construction Activities**:** Developing Pollution Prevention Plans and Best Management Practices. 40 CFR Part 280, Technical Standards and Corrective Action Requirements for Owners and Operators of Underground Storage Tanks (UST) and Part 281, Approval of State Underground Storage Tank Programs.
14. U.S. Department of the Navy	TM 6290.99-1, Indoor Firing Range Industrial Hygiene Technical Guide. UG-2030-SUR, User's Guide on Security Glazing Applications. TR-2111-SHR, Planning and Design Considerations for Incorporating Blast Mitigation in Mailrooms, Loading Docks, and

	Entrances. TDS-2079-SHR, Planning and Design Considerations for Incorporating Blast Mitigation in Mailrooms.
15. Architectural and Transportation Barriers Compliance Board	36, CFR, Parts 1190 and 1191, Americans with Disabilities Act and Architectural Barriers Act Accessibility Guidelines Americans with Disabilities Act (ADA), 42 U.S.C. Sec. 12101 et seq. Public Law 90-480, Architectural Barriers Act of 1968.
16. ------	Federal Specification AA-D-600B, Door, Vault, Security.
17. ------	Specification FF-H-105.
18. ------	Title 10 U.S.C., Armed Forces.

NON-GOVERNMENT INDUSTRY STANDARD PUBLICATIONS:

1. American Concrete Institute (ACI) American Society of Mechanical Engineers (ASCE), and The Masonry Society (TMS)	ACI 530/ASCE 5/TMS 402-92, Building Code Requirements for Masonry Structures and Commentary. ACI 318-02, Building Code Requirements for Structural Concrete and Commentary.
2. Air Conditioning and Refrigeration Institute	Standards.
3. American Institute of Steel Construction (AISC)	Specification for Structural Steel Buildings (Allowable Stress Design and Plastic Design). Load and Resistance Factor Design (LRFD) Specification for Structural Steel Buildings.
4. American Boiler Manufacturers Association (ABMA)	Handbooks and standards.

5. American Iron and Steel Institute (AISI)	North American Specification for the Design of Cold-Formed Steel Structural Members and Commentary. Standard for Cold-Formed Steel Framing – Truss Design.
6. American Conference of Governmental Industrial Hygienists (ACGIH)	Industrial Ventilation Manual.
7. American Institute of Architects (AIA)	Handbooks and standards.
8. American National Standards Institute (ANSI)	ANSI A115.1, Steel Door and Steel Frame Preparation for Mortise Locks for 1-3/8 In and 1-3/4 In Doors Standard Specification. ANSI A120.1, Safety Requirements for Powered Platforms for Building Maintenance. ANSI B31, Code for Pressure Piping. ANSI/ASHRAE Standard 62.1-2004, Ventilation for Acceptable Indoor Air Quality.
American National Standards Institute/ Builders Hardware Manufacturers Association (ANSI/BHMA)	Handbooks and standards.
9. American Petroleum Institute	Standards.
10. American Society for Testing of Materials (ASTM)	ASTM D2513, Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings. ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
11. American Society of Civil Engineers (ASCE)	Handbooks and standards.

12. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)	Standard 90.1-2004, Energy Standard for Buildings Except Low-Rise Residential Buildings. Standard 62.1-2004: Ventilation for Acceptable Indoor Air Quality Standard 55-2004: Thermal Environmental Conditions for Human Occupancy Handbooks of: Fundamentals; HVAC Applications; HVAC Systems and Equipment; Refrigeration
13. American Society of Mechanical Engineers (ASME)	Boiler and Pressure Vessel Code.
14. American Society of Plumbing Engineers (ASPE)	Handbooks and standards.
15. Associated Air Balance Council (AABC)	Handbooks and standards.
16. Consumer Product Safety Commission (CPSC)	Window Glazing Standard
17. Illuminating Engineering Society of North America (IESNA)	Lighting Standards.
18. Institute of Electrical and Electronic Engineers (IEEE)	Handbooks and standards.
19. International Code Council (ICC)	International Building Code. International Mechanical Code. International Plumbing Code.
20. International Conference of Building Officials (ICBO)	Uniform Building Code.
21. International Fuel Gas Council	International Fuel Gas Code (IFGC). Handbooks and standards.
22. Manufacturers Standardization Society (MSS)	SP-58, SP-69, SP-89, Pipe Hangers and Supports.
23. Midwest Insulation Contractors Association (MICA)	National Commercial & Industrial Insulation Standards.

24. National Fire Protection Association (NFPA)	National Fire Protection Handbooks. NFPA 10, Fire Extinguishers. NFPA 13, Installation of Sprinkler Systems. NFPA 30, Flammable and Combustible Liquids Code. NFPA 70, National Electric Code. NFPA 72, National Fire Alarm Code. NFPA 78, Lightning Protection Code. NFPA 90A-02/90 B-02, Installation of Air Conditioning, Ventilation and Warm Air Heating Systems. NFPA 101, Life Safety Code.
25. National Roofing Contractors Association (NRCA)	Roofing and Waterproofing Manual (http://www.nrca.net/technical/manual/default.asp
26. International Plumbing Code	Building Code
27. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)	Handbooks and standards (duct construction).

28. Steel Deck Institute (SDI)	Specifications and Commentary.
	Diaphragm Design Manual.
29. Steel Joist Institute (SJI)	Standard Specification and Load Tables.
30. Telecommunications Industry Association (TIA)/Electronic Industries Alliance (EIA)	568A Standard.
31. U.S. Green Building Council	Leadership in Energy and Environmental Design (LEED™) Building Rating System.

APPENDIX B

GLOSSARY

B-1 ACRONYMS AND ABBREVIATIONS

AABC	Associated Air Balance Council
AASF	Army Aviation Support Facilities
ABA	Architectural Barriers Act
ABMA	American Boiler Manufacturers Association
ACGIH	American Conference of Governmental Industrial Hygienists
ACI	American Concrete Institute
ADA	Americans with Disabilities Act
ADAAG	ADA Accessibility Guidelines
A-E	Architect-Engineer
AFFF	Aqueous Film Forming Foam
AHU	Air Handling Unit
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
AR	Department of Army Regulation
ARNG	Army National Guard
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASPE	American Society of Plumbing Engineers
ASTM	American Society for Testing and Materials
AT/FP	antiterrorism/force protection
AWI	Architectural Woodwork Institute

BHMA	Builders Hardware Manufacturers Association
Btu	British thermal unit(s)
CBR	California bearing ratio
CCTV	closed-circuit television
CFC	chloro-fluorocarbons
CFMO	construction and facilities management officer
CFR	Code of Federal Regulations
CPSC	Consumer Product Safety Commission
CSI	Construction Specifications Institute
CSMS	Combined Support Maintenance Shops
DA	Department of the Army
DG	Design Guide
DoD	(U.S.) Department of Defense
DOE	(U.S.) Department of Energy
DOIM	Director of Information Management
DWV	drain, waste, or vent
DX	direct expansion
EBU	emergency battery unit
EIA	Electronic Industries Alliance
EO	Executive Order
EPA	(U.S.) Environmental Protection Agency
EPDM	ethylene propylene diene monomer
EPP	environmentally preferred product
ETL	Engineer Technical Letter
F	Fahrenheit
FC	foot-candle(s)
FEMP	Federal Energy Management Program
ft	foot or feet
FTP	file transfer protocol
gpm	gallons per minute
HCFC	hydro-chloro-fluorocarbons
hr	hour(s)

HVAC	heating, ventilation, and air conditioning
IAQ	indoor air quality
IBC	International Building Code
ICBO	International Conference of Building Officials
ICC	International Code Council
IDS	Intrusion Detection System
IEEE	Institute of Electrical and Electronic Engineers
IEQ	indoor environmental quality
IESNA	Illuminating Engineering Society of North America
IFGC	International Fuel Gas Code
IMA	(U.S. Army) Installation Management Agency
in.	inch(es)
J-SIIDS	Joint Services Interior Intrusion Detection System
lb	pound(s)
LCCA	life cycle cost analysis
LED	light-emitting diode
LF	linear foot/feet
LPG	liquefied petroleum gas
MATES	mobilization and training equipment sites
MICA	Midwest Insulation Contractors Association
MILCON	military construction
MIL-HDBK	Military Handbook
MSS	Manufacturers Standardization Society
NCRA	National Roofing Contractors Association
NEC	National Electrical Code
NFPA	National Fire Protection Association
NGB-ARI	National Guard Bureau, Installations Division
NG PAM	(Army) National Guard Pamphlet
NGR	National Guard Regulation
NIOSH	National Institute for Occupational Safety and Health
NPDES	National Pollutant Discharge Elimination System
NRCA	National Roofing Contractors Association
OSHA	Occupational Safety & Health Administration

PAM	Pamphlet
POL	petroleum, oils, and lubricants
POV	privately owned vehicle
PPE	personal protective equipment
psi	pounds per square inch
PVC	polyvinyl chloride
RCAS	Read Clear All Scalers
RH	relative humidity
SDI	Steel Deck Institute
SJI	Steel Joist Institute
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SPiRiT	Sustainable Project Rating Tool
SWPPP	stormwater pollution prevention plan
TI	Technical Instruction
TIA	Telecommunications Industry Association
TM	Technical Manual
TMS	The Masonry Society
TR	Technical Release
UBC	Uniform Building Code
UFAS	Uniform Federal Accessibility Standards
UFC	Unified Facilities Criteria
UL	Underwriters Laboratories
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code
USPFO	U.S. Property and Fiscal Office
UST	underground storage tank
VE	value engineering
VOC	volatile organic compound
yd	yard(s)

B-2 SPECIALIZED TERMS

exclusive standoff zone	the controlled area surrounding a structure, into which only service and delivery vehicles are allowed
level of protection	the degree to which assets are protected against injury or damage from an attack by an aggressor
Life Cycle Cost Analysis (LCCA)	a systematic means of evaluating the building energy and conditioned space systems for practicality by measuring initial cost against beneficial use over an extended period of time
nonexclusive standoff zone	the controlled area that is used in conjunction with an exclusive standoff zone but provides less restrictive land use
SPiRiT	Sustainable Project Rating Tool. A Sustainable Design and Development self-assessing system designed to help achieve facilities that meet the needs of current missions and accommodate future missions in a sustainable cost-effective, environmentally friendly manner.

APPENDIX C

DESIGN REVIEW CHECKLISTS

Table 6-1. Design Review Directives

	GENERAL COORDINATION ISSUES	SUBMISSION		
		CONCEPT (10%)	PRELIMINARY (35%)	FINAL (95%)
	SITE DEVELOPMENT			
	A complete site survey report has been provided.	■		
1-3.20	Soil Bearing Capacity Declaration and Declaration of Uniformity of Soil Conditions (if applicable) have been provided for the current development and areas of future expansion.	■		
4-2.0	Storm water permit and pollution prevention plan have been obtained/approved.	■	■	
	ARNG Environmental Checklist and Record of Consideration have been reviewed, and a record is included in the narrative.	■	■	■
	An Environmental Impact Statement has been completed and approved by the governing agencies.	■		
	FUEL-DISPENSING SYSTEMS			
	Size of concrete pad and slab design comply with standards.			■
	Utility connections meet capacity required based on check of criteria.			■
	Spill containment provisions are adequate to meet requirements.			■
	Capacity of fuel tanks meets authorized requirement.		■	■
	WASH PLATFORM			
4-8.0	Size of concrete pad and slab design comply with standards.			■
	Water drainage and effluent disposal meet environmental requirements.			■
	Water service is adequate based on check of calculations.			■
	MAINTENANCE			
	Vehicular maintenance areas and equipment comply with environmental criteria and OSHA requirements.			■

Table 6-1. Design Review Directives

GENERAL COORDINATION ISSUES	SUBMISSION		
	CONCEPT (10%)	PRELIMINARY (35%)	FINAL (95%)
1-3.17.1 Safety provisions for the building equipment maintenance area comply with OSHA requirements, including roof perimeter restraints when rooftop equipment is part of the mechanical, electrical, and communications systems.			
Site and building construction materials and details meet the project specific levels of antiterrorism and force protection.			

Table 6-1. Design Review Directives

ACCESSIBILITY REQUIREMENTS		SUBMISSION		
		CONCEPT (10%)	PRELIMINARY (35%)	FINAL (95%)
1-3.7	The site and building design comply with accessibility requirements for the following conditions based on check of the plans and the narrative.			
	Path of travel to the building, including drop-off areas		■	■
	Building entrances including doors and vestibules		■	■
	Horizontal circulation throughout the building, excluding maintenance areas		■	■
	Emergency egress routes			■
	Toilet, shower, and locker facilities		■	■
	Drinking fountains			■
	Public telephones			■

Table 6-1. Design Review Directives

SITE AND CIVIL ENGINEERING	SUBMISSION		
	CONCEPT (10%)	PRELIMINARY (35%)	FINAL (95%)
SITE / CIVIL - SUPPORTING DOCUMENTATION			
Based on review, the site survey information includes all exisitng vegetation, topography, floodplains, rights-of-way, and utility connections at the site perimeter, and all dimensioning is complete.			
Based on review of the Geotechnical Report, adequate soil testing has been done within the proximity of the building construction, including potential areas of expansion.			
Declaration of Soil Bearing Capacility and Decalaration of Uniformity of Soil Conditions have been signed and included with the Geotechnical Report.			
State code and environmental regulations have been identified and are being followed as described in the narrative and code analysis.			
The Environmental Impact Statement requirements are being followed in the design.			
SITE / CIVIL - GENERAL			
Calculation confirms that the authorized amount of parking is being provided.			
Review of the site plan indicates antiterrorism standoff areas are in compliance with the project-specific threat assessment and allow for potential future expansion by review of the site plan.			
Check of the site plan indicates security perimeters are clearly defined and have no breaches.			
SITE / CIVIL - SUSTAINABILITY			
SPiRiT Review of the narrative confirms that all site design sustaniable goals have been clearly defined and are realistic within the project budget. (Support documentation for the SPiRiT program is being developed and included in documentation at each milestone as the project progresses.)			

Table 6-1. Design Review Directives

SITE AND CIVIL ENGINEERING		SUBMISSION		
		CONCEPT (10%)	PRELIMINARY (35%)	FINAL (95%)
SITE / CIVIL - BASIC DESIGN				
2200	Cut and fill calculations have been provided; based on review, they reflect balance, or the amount of off-site material required or on-site material removed has been determined.			
2200	General review of proposed final design grading reflects no extremes in topography, and retaining walls are indicated as necessary.			
2370	Based on check of the specifications, erosion control has been adequately addressed.			
2500	Based on review of the narrative and indications on the perimeter of the site survey, all available utilities have been indentified; they are of adequate size to support the new project based on appropriate calculations.			
2500	Based on review of related details, adequate protection of utility elements on grade is provided.			
2500	Based on review of the site plan, utility lines from connection at the site perimeter to the building(s) are the shortest practical distance.			
2501	The fire protection water loop is provided with hydrants placed as required by the local jurisdiction, and is confirmed in writing.			
2630	Based on review of the drawings and narrative, storm drainage design includes a retention basin with support calculations or a stormwater permit for off site drainage.			
2750	Pavement standards have been incorporated into the specifications and cover all conditions for drives, parking, walkways, and site structures.			
SITE / CIVIL - LANDSCAPING				
2810	Irrigation and landscape plans are coordinated for adequate sprinkler coverage based on plan overlay.			
2890	Facility signage meets standard and is adequate for all site entry points based on check of the site plan and specifications.			
2930	Landscape species are appropriate for the local environment based on related information included in the design narrative.			

Table 6-1. DESIGN REVIEW DIRECTIVES

SITE AND CIVIL ENGINEERING	SUBMISSION		
	CONCEPT (10%)	PRELIMINARY (35%)	FINAL (95%)
SITE / CIVIL - COST ESTIMATING			
Based on review of the cost estimate, all of the items in the following categories required in the project design have been adequately addressed:			
Site preparation and demolition			
Site improvements and landscaping			
Site utilities			
Connecting tunnels and bridges			
Other site systems			

Table 6-1. Design Review Directives

STRUCTURAL ENGINEERING	SUBMISSION		
	CONCEPT (10%)	PRELIMINARY (35%)	FINAL (95%)
SEISMIC DESIGN CONSIDERATIONS			
1102 An evaluation of the building configuration (plan and massing) related to transfer of seismic loads has been done and is included in calculations and narrative.			
Building expansion joints and/or seismic joints are shown on floor plans.			
FOUNDATIONS			
3051 Any development restrictions or other recommendations of the geological investigation have been followed to including building size and location on site.			
3051 The foundation system is in compliance with the Geotechnical Report and takes into account expansive soils, corrosive soils, and any other special characteristics.			
SLAB ON GRADE			
3052 Floor slabs on grade are being designed based on the recommendations of the Geotechnical Report as described in the narrative.			
GENERAL REQUIREMENTS			
Live loads have been selected to suit any special requirements of the project based on review of the calculations and narrative.			
Review of the narrative indicates that equipment having excessive noise and/or vibration has been identified, and proper structural isolation is incorporated into the design.			
Blast and progressive collapse studies have been included and explained in the narrative.			
Provision of floating slabs to mitigate equipment noise and vibration isolation requirements are identified.			
The design includes compliance with regard to accommodating maintenance equipment, and when the building is 40 ft or			

Table 6-1. Design Review Directives

STRUCTURAL ENGINEERING		SUBMISSION		
		CONCEPT (10%)	PRELIMINARY (35%)	FINAL (95%)
	higher, details at the building perimeter are provided for service equipment supports.		■	■
	Structural systems have been coordinated with fire resistance requirements and protection is identified in the narrative.		■	■
SPiRiT	Specifications call for recyclable products in concrete and cement mixes to the maximum extent allowable, and to the maximum available in structural steel.		■	■
	Structural design has incorporated support for crane systems in maintenance areas.		■	■
	The cost estimate has been checked for inclusion of all structural system components.	■	■	■

Table 6-1. Design Review Directives

ARCHITECTURAL DESIGN		SUBMISSION		
		CONCEPT (10%)	PRELIMINARY (35%)	FINAL (95%)
GENERAL DESIGN CONSIDERATIONS				
	Based on review of the space program and floor plan layouts, all program requirements are incorporated with optimal functional relationships.			
	Areas with incompatible noise and/or vibration tolerances are remote from one another or are segregated by neutral building elements.			
SPiRiT	The building orientation is in accordance with the site analysis and energy modeling.			
SPiRiT	The building massing configuration and envelop design are in accordance with the related architectural characteristics in the energy analysis model that is used to set the annual energy budget.			
	Building entry and circulation routes are in accordance with security assessment requirements.			
	Functional expansion capabilites have been thoroughly analyzed.			
	Custodial and designated facility storage areas have been sized and located appropriately, including direct loading dock access.			
	Dimensions are adequate for vehicular circulation at all service dock areas based on check of the accommodation of the largest vehicles anticipated.			
SPiRiT	Open office areas are not isolated from exposure to natural light by continuous perimeter enclosed functions.			
	A formal vertical transportation study has been performed by a specialist, and the results are reflected in the narrative and the building design.			
	Appropriate methods of access to the roof for servicing equipment are provided and approved in writing by facilities management.			
OSHA	Provisions are included for the method of compliance with OSHA Standard 29 in CFR 19.66 and ANSI A120.1 for accommodating maintenance equipment servicing when a building is 40 ft or higher.			

Table 6-1. Design Review Directives

ARCHITECTURAL DESIGN		SUBMISSION		
		CONCEPT (10%)	PRELIMINARY (35%)	FINAL (95%)
	All acoustic performance requirements are met, and the method of achieving them is described in the narrative.			
	Expansion joints needed due to the length of the building and configuration are determined by a structural engineer and indicated on the architectural plans.			
SPiRiT	All interior pollutant-generating sources (copy rooms, janitor closets, chemical storage areas, etc.) are isolated with separate outside exhaust and slab-to-slab partitions.			
	All exterior finishes have been defined in the narrative, details, and cost estimates.			
8500	Based on calculations and the narrative, glazing systems are designed as low conductive thermal barriers.			
	All interior finishes have been defined in detail in the finish schedules.			
8710	All required hardware types are identified in the schedule.			
	Power, data, and telecommunications connectivity at workstations and in meeting areas meet capacity and flexibility requirements.			
	Building fire protection standpipe system is included on the drawings.			
	Blast-resistant materials, systems, and details are integrated into the building perimeter with regard to the project-specific threat assessment.			
	Review of details and specifications indicate that buildings in areas with severe weather conditions have entry mats integrated with grills or grates and drainage systems in vestibules.			
	Dock levelers or scissor lifts are provided to accommodate various truck bed heights in the drawings and specifications.			

Table 6-1. Design Review Directives

ARCHITECTURAL DESIGN		SUBMISSION		
		CONCEPT (10%)	PRELIMINARY (35%)	FINAL (95%)
SPiRiT	Performance requirements for testing thermal resistence of the building envelop construction (thermal graphic imaging) have been incorproated into the specifications.			
10440	Review of details and specifications indicate that a comprehensive signage and graphics program has been developed based on a thorough review of paths of travel including all interior conditions, and meets standards.			
SPiRiT	Forrest Stewartship Council principles and criteria are met for specified wood products.			
SPiRiT	Paints and coatings comply with Green Seal standard based on review of specifications.			
SPiRiT	Adhesives and sealants comply with VOC content limits described in SPiRiT guidelines.			
NCRA	Roofing design and penetrations follow standards based on specifications and detail references.			
SMACNA	Flashing details follow standards.			
	The architect has confirmed, based on diagrams, that servicing and parts replacements can be accomplished within the dimensional limits of equipment rooms.			
	Based on the narrative, a minimum roof slope of 1/50 is provided and that the architect has coordinated this requirement with the structural engineer.			
	Based on review of details and specifications, dock areas are protected from extreme climatic conditions by overhead rolling doors and dock seals where appropriate.			
	Based on check of the specifications, overhead-supported toilet partitions are being used throughout the facilities.			
AWI	Based on specification requirements, all architectural woodwork is designed according to the AWI Quality Certification Program.			
	Suspended ceiling bracing is is incorporated where seismic zones dictates and related details are included in the drawings.			

Table 6-1. Design Review Directives

ARCHITECTURAL DESIGN		SUBMISSION		
		CONCEPT (10%)	PRELIMINARY (35%)	FINAL (95%)
SPiRiT	Based on specification, carpet systems meet or exceed the Carpet and Rug Institute Green Label Indoor Quality Test.			
	Based on review of reflected ceiling and equipment plans, ceiling access to equipment above is through lay-in ceiling systems to the maximum extent possible.			
	Cost estimate includes all architectural components.			
10100 10670	All requirements for specialties including markerboards, tackboards, and shelving are included in the documents.			

Table 6-1. Design Review Directives

MECHANICAL ENGINEERING		SUBMISSION		
		CONCEPT (10%)	PRELIMINARY (35%)	FINAL (95%)
GENERAL DESIGN CONSIDERATIONS				
SPiRiT	The design target for annual energy budget has been determined and the mechanical design is in accordance with related modeling of the architectural design.	■	■	
	Utility service availability has been determined and outlined in the narrative.	■		
	The narrative identifies acoustic and/or vibration isolation needs for spaces near HVAC equipment.		■	
	The extent of sub-metering required has been determined in writing.		■	
SPiRiT	SPiRiT sustainability and energy conservation goals have been defined and continually reviewed for compliance.	■	■	■
	Functional layouts of architectural plans have been assessed to optimize efficient air handler zones, and zones are aligned separately between fully occupied areas and partially occupied areas.		■	
	Equipment will be located above the 100-year floodplain.		■	
SPiRiT	The building automation system will follow SPiRiT recommendations.		■	■
	Based on calculated service clearances and pathway dimemsions, adequate room is provided for major equipment replacement.		■	■
	Based on confirmation in writing, the facilites engineering staff has the training and expertise to maintain and operate the proposed HVAC systems and controls.		■	
	High maintenance equipment for every system has been described in the narrative.		■	■
	Based on description in the narrative, optimum flexibility is designed into the systems for classrooms, meeting spaces, and assembly halls.		■	■
	HVAC equipment will not be visable from the exterior of the building.	■	■	
SPiRiT	Effective methods for providing off-hour HVAC operation have been defined and are included in the narrative.		■	■

Table 6-1. Design Review Directives

MECHANICAL ENGINEERING		SUBMISSION		
		CONCEPT (10%)	PRELIMINARY (35%)	FINAL (95%)
	Based on Life Cycle Cost Analysis, HVAC alternatives have been considered.		■	
	The limits imposed by value engineering decisions are clearly identified in writing.		■	
	An air flow balance for off-hours of operation has been calculated.			■
	The level of plant equipment redundancy has been established by the A-E and facility maintenance staff and is reflected in the preliminary equipment schedule and the narrative.			■
SPiRiT	A detailed preliminary Commissioning Plan, including requirements for implementation strategy, has been incorporated into the narrative and specification language.			■
SPiRiT	Economic viability of all SPiRiT credits is checked and updated at each phase.	■	■	■
	Description in the narrative indicates compliance wiith all seismic zone requirements for stabilizing equipment will be done.			■
	Provision is made for appropriate access to service equipment that cannot be maintained from ground floor level.			■
	Based on placement on the site plan drawings, underground or above-ground mounted storage tanks will not be located close to buildings, railroad trackss, or roads.		■	■
	Service agreements and appropriate durations are incorporated into the specifications, and a list of all necessary provisions is included in the narrative.			■
	Specifications call for all necessary training and a thorough spare parts list under each related category, and indicate the extent of the requirements provided as a list in the narrative.			■
	An analysis has been performed to verify the need of water treatment for boilers, humidifiers, and cooling towers; and if required, it is addressed in the specifications.			■
1-3.12	All warranty requirements for mechanical equipment are included in the respective specification sections, and all the specifc warranties are listed in the narrative.			■

Table 6-1. Design Review Directives

MECHANICAL ENGINEERING		SUBMISSION		
		CONCEPT (10%)	PRELIMINARY (35%)	FINAL (95%)
	Based on lisitng in the narrative, building automation system control and monitoring points meet minimum requirements.			
SPiRiT	Specifications contain instructions to bidders for documentation and product literature necessary to support the SPiRiT goals.			
	Cost estimate includes all mechanical system components.			

Table 6-1. Design Review Directives

PLUMBING ENGINEERING		SUBMISSION		
		CONCEPT (10%)	PRELIMINARY (35%)	FINAL (95%)
SPiRiT	The potential for gray water use is described in the narrative.		■	
	A metering strategy to effectively monitor water consumption from an overall efficiency standpoint is used and described in the narrative.		■	
	Water service, santitary drainage, and storm drainage calculations are completed and summarized in the narrative.		■	
	Domestic water heating approach (storage, instantaneous, circulated, points-of-use) has been determined and included in the narrative.		■	■
	Preliminary water pressure has been determined, and the narrative describes whether pumping will be necessary.		■	
	Requirements for sewage ejectors and/or sump pumps are identified in the narrative.			■
	Pipe and insulation materials have been identified in the specifications.			■
SPiRiT	The intent to meet or exceed water conservation standards is economically viable based on cost analysis.		■	
	Toilet fixture count is adequate for occupancy and accessible accommodation is being provided by standard as indicated in the narrative.	■	■	
	Geotechnical Report has been reviewed, and provision is included for foundation and/or underslab drainage system as indicated in the narrative and specifications.		■	■
	Specifications provide for grease interception and/or recovery for kitchen fixtures and drains.			■
	Based on check of specifications, fuel storage tanks are provided with leak detection and alarm.			■
	Natural gas meter and service pressure regulator are protected from vehicular damage, foundation settlement, and vibration by applicable methods indicated in the narrative.			■
	Cost estimate includes all plumbing components.	■	■	■
	Pipe sizes are coordinated with utility connections by check of the site survey information.			■

Table 6-1. Design Review Directives

ELECTRICAL		SUBMISSION		
		CONCEPT (10%)	PRELIMINARY (35%)	FINAL (95%)
SPiRiT	Commitments to energy management have been established including lighting controls and energy monitoring systems, and are indicated in detail in the narrative.			
	Based on analysis in the narrative, all existing building electrical systems and power source(s) are adequate for expansion or renovation loads.			
	Requirements for cathodic protection have been determined from the Geotechnical Report, and if needed are defined in the narrative.			
	All special equipment power requirements are identified by listing in the narrative.			
	Utilility rebate programs have been investigated for availability and apllicability.			
	The narrative indicates that adequate service and expansion space has been provided at major equipment locations.			
	The electrical system is being designed with adequate spare capacity by listing in the narrative.			
	Statement in the narrative indicates that all electrical equipment is located above the floodplain.			
	All lighting control conditions are defined in the narrative.			
	The site lighting design minimizes lighting intensity off site by incorporating directional fixtures at the perimeter.			
	UPS is provided in the electrical requirements for critical service items listed in the narrative.			
	Lightning protection requirments have been defined in the narrative.			
	A separate green, insulated equipment ground conductor has been incorporated into all feeder and branch circuits by specification.			
SPiRiT	Mercury-free transformers and lamps are being specified.			

Table 6-1. Design Review Directives

ELECTRICAL		SUBMISSION		
		CONCEPT (10%)	PRELIMINARY (35%)	FINAL (95%)
	Emergency generators have adequate ventilation and are located away from HVAC air intakes; and sound and/or vibration isolation is provided.			
	Based on check of schedules, panels have at least one circuit breaker per 200 ft^2 of coverage in office areas.			
	Based on check of schedules, panelboards have adequate spaces and spares.			
SPiRiT	Daylighting sensors are called for on the building perimeter and included in the specifications.			
	The building automation system includes the requirements and has the capacity to monitor normal, emergency, and uninterruptible power; mechanical systems and controls; fire detection and suppression; security systems; lighting; communication equipment; gas; and exhaust.			
	Receptacles placed for cleaning are located in all open spaces and corridors.			
	Based on check of diagrams and floor plans, electrical service has been provided for all related site elements including lighting and security systems.			
	One emergency receptacle has been placed in each electrical closet, communications equipment room, mechanical room, and electrical equipment room.			
	Cost estimate includes all electrical system components.			
	Lighting power budget calculations have been provided if required by the energy code.			
	Door schedule indicates special items, including fire alarm hold open, security devices, and power-operated doors.			
	There is clear indication of division of work between building contractor and utility company.			
	Battery-powered lights have been provided in the generator and switchgear rooms.			
	A minimum of 10% spare breakers in panelboards have been provided.			

Table 6-1. Design Review Directives

ELECTRICAL	SUBMISSION		
	CONCEPT (10%)	PRELIMINARY (35%)	FINAL (95%)
All quantities of outlets, spacing, and type meet program requirements.			
Based on review, lighting calculations meet energy code			
Based on check of drawings, location of structural foundations and and electrical ductbanks are not in conflict.			
By check of schedules, all lighting type and space illumination levels meet program requirements.			
By check of schedules and code requirements, all emergency lighting requirements are met.			

Table 6-1. Design Review Directives

FIRE PROTECTION	SUBMISSION		
	CONCEPT (10%)	PRELIMINARY (35%)	FINAL (95%)
All Federal, state, and local codes and amendments are included in the narrative.	■	■	
The local water supply has sufficient capacity for future expansion of the fire protection system.	■	■	
Fire access roads are not in conflict with future building plans on the proposed site, and access is provided 24 hours a day when the roads are behind security barriers.		■	
The emergency generator has been specified with extra capacity for future loads as described in the narrative.			■
Water tank sizes have extra capacity for future expansion as described in the narrative.			■
UL assembly numbers, compartmentalization, rated walls, and penetration conditons are indicated on the drawings.			■
Based on check of the specifications, the fire alarm system includes capacilty for future expansion.			■
Dimensional check shows that the location of major fire protection equipment, to include fire pumps is accessible for service.			■
Fire extinguishers and/or cabinets are located on the plans.			■

APPENDIX D

FIGURES/LIST

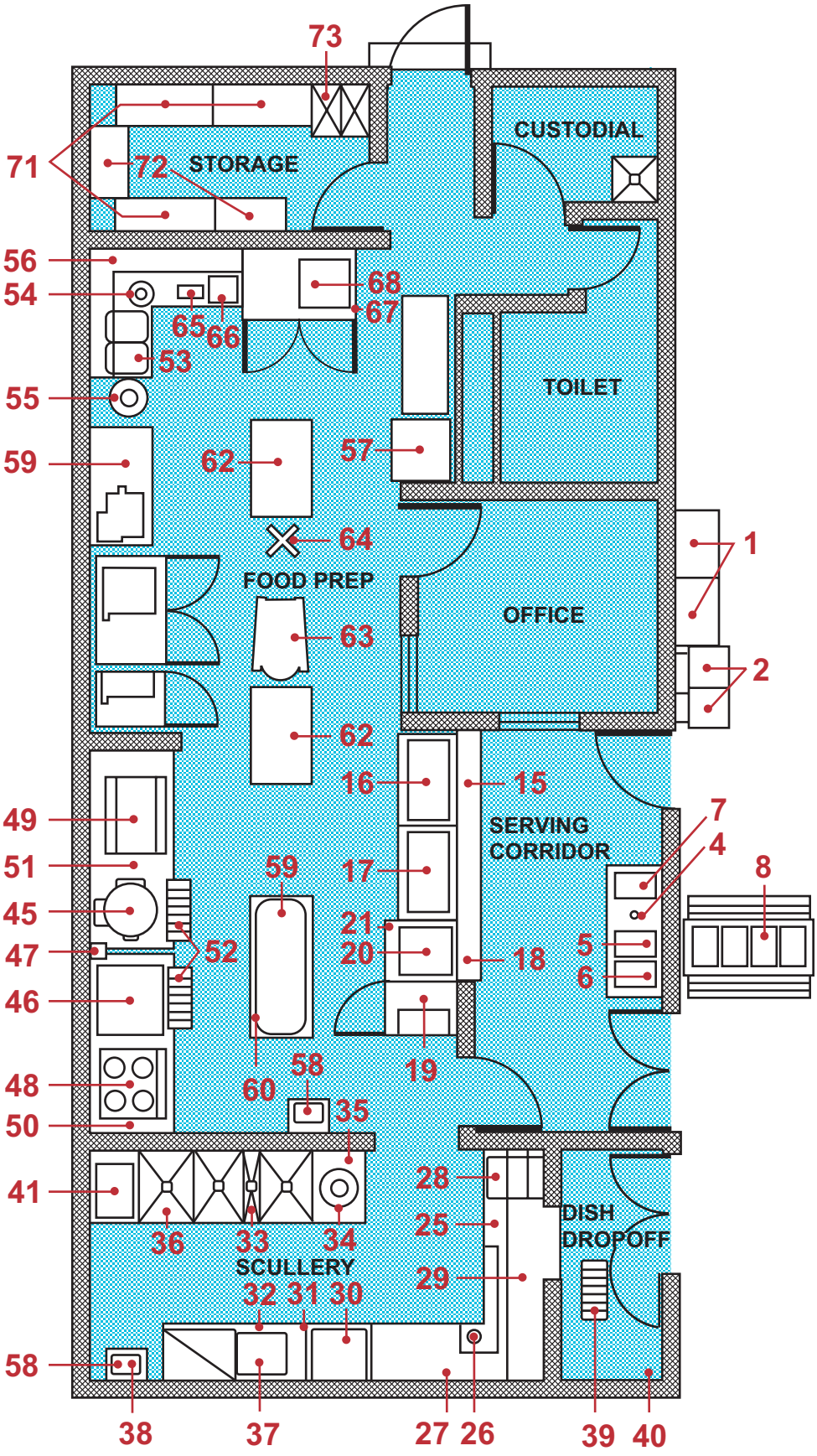

Figure 1. Small Kitchen Equipment Layout

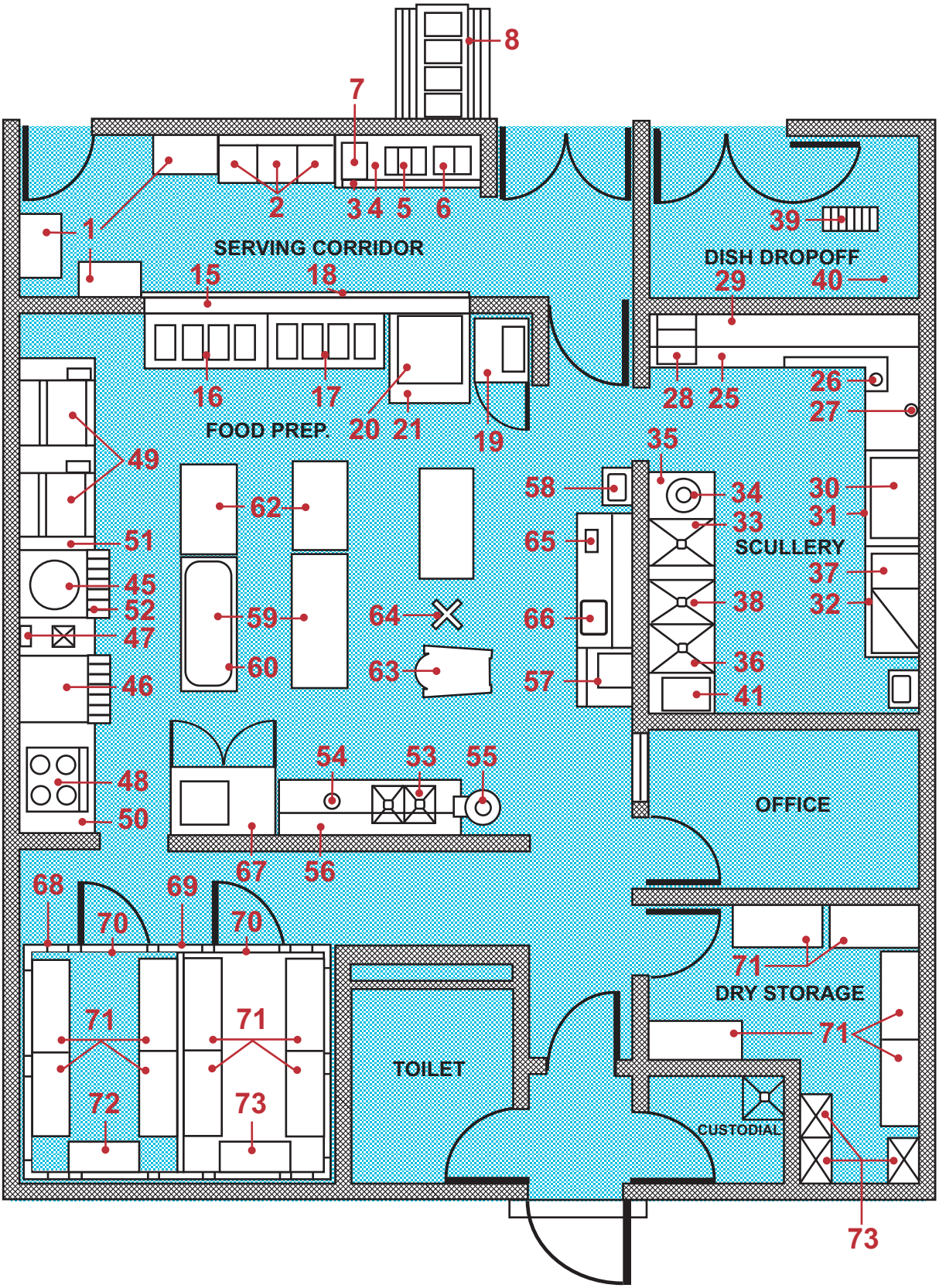

Figure 2. Large Kitchen Equipment Layout

Self-Serve, Beverage, Salad, and Dessert Areas:

1 Dispenser Regular -Service Tray and Silverware
2 Dispensers - Tableware
3 Stand - Drinks
4 Water Cooler
5 Dispenser - Juice
6 Urn - Coffee
7 Ice Dispenser
8 Cold Food Counter
9 to 14 Not Used

Serving Line Area:

15 Serving Counter
16 Cold Pan (Drop-in)
17 Hot Food Table (Drop-In)
18 Tray Slide
19 Food Warming Cabinet
20 Griddle
21 Exhaust Hood
22 to 24 Not Used

Scullery Area:

25 Soiled Dish Table
26 Garbage Disposal
27 Spray Assembly
28 Soaking Sink
29 Wall-Mounted Shelf
30 Dishwashing Machine
31 Exhaust Hood - Dishwasher
32 Dish Table
33 Pot and Pan Sink
34 Garbage Disposal
35 Spray Assembly
36 Water Heater - Under Sink
37 Water Heater
38 Exhaust Hood - Over Sink
39 Floor Trough
40 Spray Assembly
41 Water Heater
42 to 44 Not Used

Kitchen, Storage, and Refrigeration Areas

45 Steam Kettle - Jacketed
46 Frying and Braising Pan
47 Water Meter
48 Heavy Duty Range
49 Baking and Roasting Oven
50 Exhaust Hood
51 Exhaust Hood
52 Floor Trough
53 Vegetable Preparation Sink
54 Garbage Disposal
55 Vegetable Peeling Machine
56 Wall-Mounted Shelf
57 Ice Machine
58 Hand Sink
59 Food Preparation Table
60 Kitceh Utensils Rack
61 Not Used
62 Food Preparation Table
63 Food Mixing Machine
64 Mixer Stand
65 Can Opener
66 Meat Slicing Machine
67 Frozen Food Cabinet
68 Refrigerator
69 Refrigerator (Not in Small Kitchen)
70 Plastic Strip Doorway Closure (Not in Small Kitchen)
71 Shelving
72 Wall Lockers
73 Hand Shelf Truck
74 Air Curtain Machine (Fly Control)

Food Service Equipment List