TINKER AIR FORCE BASE
FACILITY STANDARD

2020 Edition

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Part 1: Project Procedures

Defense Information Systems Agency: Building 3900

1. Executive Summary

1.1. Introduction

The Tinker AFB Facility Standard (referenced hereafter simply as the Standard) identifies the minimum requirements for construction quality and life safety features for *all* real property improvements and for *all* equipment installation projects executed on Tinker Air Force Base.

All projects which permanently attach equipment to real property via hard-wired electrical connections and/or structural anchorage, such as systems furniture installation, hydraulically-operated crane assembly, or repair of existing similar components, shall also be subject to compliance with this Standard.

All work encompassed within these categories shall be identified hereafter by the word *project* or *projects* as appropriate to the context.

All individuals or companies who provide design and/or construction services for execution of projects on the Base shall be identified hereafter by the word *Contractor*.

1.2. Office of Primary Responsibility (OPR):

The Standard is maintained and annually updated under the authority of the 72 ABW/Base Civil Engineer [72 ABW/CE]. All questions and recommendations for improvement to this document shall be directed to the 72 ABW/CE via 72 ABW/CE workflow; 72abw.ce.workflow@us.af.mil

1.3. Application of the Standard

The Standard applies to Military Construction Projects (MCP or MILCON), Simplified Acquisition of Base Engineering Requirements (SABER) projects; Multiple Award Construction Contract (MACC); Indefinite Delivery/Indefinite Quantity (IDIQ) contracts; Utility Energy Service Contract (UESC) delivery orders, Service contracts, Performance Oriented Construction Activity (POCA) projects, Contract By Requestor (CBR) projects, Self Help projects, and AFCEC GSA Contracts. Requirements contained herein shall be applied to all design and/or construction services affecting real property and/or equipment within Tinker AFB, whether designed by 72 ABW/CE, the US Army Corps of Engineers (USACE), DLA, HPO, AAFES, NAVFAC, private design consultants, private construction companies, or any other person or business.

1.4. How to use the Standard

Requirements of the Standard shall be incorporated to design documentation beginning with pre-design and pre-construction services including programming, design analyses, and site planning phases of project designs. The Standard shall be the basis by which all CE approval of projects for Base execution shall be granted or denied.

1.5. TAFB 72 ABW/CE as the Authority-Having-Jurisdiction

All design and construction services executed for the US Air Force and/or any of the Federal organizations residing within TAFB are subject to the review, approval, and inspection of the Base Civil Engineer (BCE) as the local Authority-Having-Jurisdiction. The TAFB Facilities Standard is the principal information source by which BCE project requirements are defined and administered.

1.6. BCE Project Submittal Requirements

As part of the project review process, both hardcopy and electronic documents shall be provided to the BCE by project designers for review prior to the completion of each design stage. All BCE review comments communicated to the project designer which implement requirements of the TAFB Facility Standard shall be incorporated in the Project design prior to the next design phase submittal and prior to issue of any/all drawings and specifications issued for construction.

1.6.1. All Project Drawings and Specifications, for each phase of design required for submittal, shall be delivered in digital format using AutoCAD and MS **Word for Windows** software for Specifications as identified in Chapter 5, CADD Requirements. The designer shall provide an unbound hard copy suitable for reproduction.

1.6.2. The schedule and number of design submittals shall be in accordance with the design documentation requirements of the project's contract.

1.7. BCE Function at TAFB

Located within a Federal military installation, the BCE performs the functions of capital improvement programming, urban planning, environmental management, civil and facilities maintenance, maintenance of roads and grounds, air field pavements, air field related lighting, barriers, provision and repair of municipal utilities, community services and fire protection.

2. TAFB Civil Engineering Records

2.1. Base Maps: TAFB maps in paper format are available from the following office**:**

Engineering Support Division
72 ABW/CE
Second Floor, Building 400
7535 5th Street
TAFB, OK 73145-9010

2.1.1. Electronic media records of base infrastructure and facility improvements are also available upon written request to the Office of 72 ABW/CE, also at the above street address or 72 ABW/CE workflow; 72abw.ce.workflow@us.af.mil

3. Design Criteria

3.1. Order of Project Requirements:

3.1.1. All projects shall comply with this Standard. All projects which permanently attach equipment to real property via hard-wired electrical connections and/or structural anchorage, such as systems furniture installation or hydraulically-operated crane assembly, are also subject to compliance with the Standard.

3.1.2. The term "Standard" shall be taken to mean both the body of requirements stated here as well as stated in the attachments and publications incorporated by reference.

3.1.3. The primary Building Code reference for Tinker AFB is the Unified Facilities Criteria (UFC) – **DoD Building Code (General Building Code Requirements)** UFC 1-200-01 latest edition.

UFC 1-200-01 defines the portions of the International Building Code that are to be used in conjunction with the related UFC publications.

3.1.4. Refer to **Part 3** and **Part 4** of this Standard for specific/additional design requirements for applicable projects.

3.1.5. Where mandatory references cite differing provisions for similar construction or life safety features, the Project shall then meet the most stringent requirement.

3.2. Construction Documents - Signed/Sealed requirement

All Contractors are required to have final construction documents signed/sealed by a Registered Architect, registered in the State of Oklahoma, unless the Code Use Group by size/stories/capacity is specifically exempt from the provisions of the State Architectural and Registered Interior Designers Act. Reference the July 1, 2010 Oklahoma State Architectural and Interior Designers Act (OS 59-46 .1, Paragraph 46 .21b) which requires final construction documents to be signed/sealed by a Registered Architect.

3.3. Design Publications incorporated by reference to the Standard

Project designers shall prepare design and construction documents in accordance with (IAW) the most current editions of the following publications as they apply to the project: Refer to the mandatory and advisory requirements incorporated-by-reference to the standard as listed below.

3.3.1. Code of Federal Regulations (CFR)
3.3.2. AF Military Handbook Series (MILHDBK)
3.3.3. AF Instruction Series (AFI)
3.3.4. AF Regulation Series (AFR)
3.3.5. AF Manual Series (AFM, AFMAN)
3.3.6. AF Handbook Series (AFH)
3.3.7. AF Pamphlet Series (AFP, AFPAM)
3.3.8. AF Engineering Technical Letter Series (ETL)
3.3.9. AF Engineering Guidance Letter Series (EGL)
3.3.10. AF Construction Technical Letter Series (CTL)
3.3.11. Department of Defense Design Guide Series (DOD)
3.3.12. Unified Facilities Guide Specifications (UFGS)
3.3.13. USACE Engineering Manual Series (EM)
3.3.14. Unified Facilities Criteria Series (UFC)
3.3.15. Airfield Striping, ETL 04-2 Standard Airfield Marking Schemes
3.3.16. UFC 3-260-1 *AIRFIELD AND HELIPORT PLANNING AND DESIGN*
3.3.17. UFC 3-530-01 *INTERIOR AND EXTERIOR LIGHTING SYSTEMS AND CONTROLS*

Most of the publications can be found at the following links:

http://www.wbdg.org/ffc/af-afcec/corporate-facilities-standards-afcfs

http://www.e-publishing.af.mil/

3.4. Model Building Codes and Construction Regulations

The most current edition of the International Code Council publications is hereby incorporated by reference to the Standard:

3.4.1. Code of Federal Regulations (CFR)
3.4.2. International Building Code
3.4.3. Uniform Plumbing Code; (Backflow Prevention)
3.4.4. International Plumbing Code
3.4.5. International Mechanical Code
3.4.6. International Fuel Gas Code
3.4.7. International Maintenance Code

Refer to UFC 1-200-01 for applicability and UFC governance.

3.5. Occupational Safety and Health Act / OSHA Regulations

OSHA Safety and Health Standards, as published in the CFR, USACE EM 385-1-1 Safety and Health Requirements Manual, and the Air Force Policy on Ozone Depleting Chemicals (ODC) regulate all construction practices, systems operation, and maintenance on base.

3.6. National Fire Protection Association

All current National Fire Code, including **NFPA 101 Life Safety Code**, as published by the National Fire Protection Association (NFPA), apply to base projects.

3.7. Accessibility

The **Architectural Barriers Act (ABA)** is the governing standard for all projects.

3.8. Sources of Technical and Procedural Requirements

The United States Government has many agencies of technical support. The following list directs the project designers and engineers to access design and construction publications which may be incorporated-by-reference to the Standard.

Acronym Abbreviation	Federal Agency	Internet Address
USAF	United States Air Force	http://www.e-publishing.af.mil/
DOD	United States Department of Defense	http://www.dtic.mil/whs/directives/index.html
USACE	United States Army Corps of Engineers	http://www.usace.army.mil
AFCEC	Air Force Civil Engineer Center	http://www.afcec.af.mil
USGPO	United States Government Printing Office	http://www.access.gpo.gov
NAVFAC	US Naval Facilities Engineering Command	http://www.navfac.navy.mil
	Whole Building Design Guide	http://www.wbdg.org/

3.9. Responsibilities of the Contractor:

The Contractor shall be responsible for accessing or obtaining all required publications referenced above that are recommended, mandatory, or applicable to the project's design and engineering.

3.10. Model Variance from the Standard:

During the design and construction phases of TAFB projects, the Contractor(s) shall each be responsible, during their respective phases, to notify the project's Contracting Officer (CO) immediately of all project deficiencies relative to compliance with the TAFB Facility Standard and all other publications incorporated by reference hereto. The CO shall review the impact of all deficiencies to the original project scope and determine if a change in scope is warranted. Should a change in requirements be desirable on the part of the Government due to project limitations, written permission from the Office of the BCE is required.

4. Cost Estimating

4.1. General:

All cost estimates submitted in support of design and/or construction contracts for TAFB shall be based on costs of materials, equipment, and labor rates appropriate to the Oklahoma City area and shall be in full compliance with the current rule of the Federal Acquisition Regulations (FAR). All cost estimates shall be developed IAW UFC-3-740-05 *HANDBOOK: CONSTRUCTION COST ESTIMATING*.

4.2. Change Order Documentation

All estimates for change orders and the 8A Small Business Set Aside Program shall be prepared on AF Form 3052, Construction Cost Estimate Breakdown; and shall include labor hours, material, and bonding costs. The cost estimates for change orders and the 8A Program shall be presented with considerable detail.

5. Design Documentation Format

5.1. CE Recordkeeping

Drawings, specifications, renderings, and graphics which are provided in fulfillment of design and construction contracts shall meet the following requirements:

5.1.1. Geographical Information System (GIS) files shall be included for full design contracts which substantially change a facility footprint or install/replace substantial portions of utilities. GIS files shall include.

5.1.2. Data dictionary(s) shall follow current version of the Spatial Data Standards for Facilities, Infrastructure, and Environment (SDSFIE) (3.1.1) Standard. Preferred Datum is North American Datum 1983, Grid Oklahoma North #3501. Units shall be measured in US Survey Feet. If other data is used, the Contractor shall furnish a “read-me” file indicating datum, grid and working units. Utilities information shall include, at a minimum, the installation date, pipe sizes and pipe materials.

5.2. Dual Records

The Contractor shall furnish AutoCAD design files and PDF files of final drawings along with the hard copy final design plans.

When the Contractor requirement calls for as-constructed drawings, all hard copies, design sheet files and image files shall so state “AS-BUILT” and date(s) of revision.

Additionally, an electronic listing of drawings which detail Sheet Number, Sheet Sequence Number, Sheet Title, CADD file name, and Image File Name shall be provided in both hardcopy and electronic copy.

5.3. Delivery Media

Complete copies of all CADD data and files developed shall be delivered to the Government on electronic digital media at both construction-issue and as-built phases of the project. For projects with electronic digital files the electronic digital data and files shall be provided on either Read/Write optical disk (CDRW), or compact disc read-only memory (CD-ROM). CDRW and CD-ROM are the preferred media. The electronic digital media shall be in a format which can be read and processed by the Government’s target CADD system. See CADD file formats below.

5.3.1 The external label for each electronic digital media shall contain, at a minimum, the following information:

5.3.1.1 AF Project Number, Contract Number, Delivery Order Number (if applicable), and date of submission:
5.3.1.2 Type of submission (i.e. preliminary design, final design, or as-built);
5.3.1.3 Format and version of operating system software; i.e. WINDOWS 10.
5.3.1.4 Name and version of utility software used for preparation (e.g. compression/decompression) and copying files to the media; i.e. WIN ZIP.
5.3.1.5 Sequence number of the digital media;
5.3.1.6 Schedule of filenames (to be contained in a “text“ file on CD).

5.4. CADD File Formats

Before a CADD file is placed on electronic digital media to be submitted to 72 ABW/CE, the following procedures shall be performed;

5.4.1. Remove all extraneous graphics outside the border area and set the active parameters to a standard setting or to those in the Government-furnished seed file.

5.4.2. Make sure all reference files are attached without device or directory specifications.

5.4.3. Where compression is required, compress and reduce all design files using “PKZip” or other compatible file compression/decompression software approved by the Contracting Officer. If the file compression/decompression software is different from that specified above, then electronic digital media copy of the file compression/decompression software shall be purchased for 72 ABW/CE by the submitting consultant/Contractor and provided with the submitted media.

5.4.4. Include all files, both graphic and non-graphic, required for the project (i.e. color tables, pen tables, font libraries, line style files, cell libraries, user command files, plot files, etc.).

5.4.5. Make sure that all support files such as those listed above are in the same directory and that reference to those files does not include device or directory specifications.

5.4.6. Include all standard sheets (i.e., abbreviation sheets, standard symbol sheets, etc.) that are necessary to completely describe the project.

5.5. Documentation.

Document any fonts, tables, etc. developed by the A-E or not provided among the Government-furnished materials. The Contractor shall obtain Government approval before using anything other than the Government’s standard fonts, line-types, tables or cells/blocks.

5.6. Image Files.

Each finished drawing (sheet) shall have its own separate image file. The image file for each finished drawing shall be provided to the Government in Portable Document File (PDF) format.

5.7. CADD File Formats

Due to the fact many file formats are proprietary and not completely interchangeable; flexibility is required for file formats used. The following CADD file types may be furnished with the idea that context of information is maintained. The electronic format of all shall be in Autodesk AutoCAD 2013 or later.

5.7.1. AUTOCAD (DWG): Files in AutoCAD format shall NOT include XREFs or shape files as separate files, but rather be bound into the drawing furnished. Specific font files (shx) used by any add-on software shall be included with the text file mentioning their inclusion.

5.8. CADD Standards

When submitting drawings, designers shall follow the A/E/C CADD Standards (Release 6.0 or later) as published in the National CADD Standard. Also, the standards can be found at the web site https://cadbim.usace.army.mil. The A/E/C CADD standard contains supplemental materials and DOD specific requirements not addressed in the National CADD Standards. File structure, nomenclature and assignment of layers, levels and/or entities shall conform to those of the requesting organization. This information is to be provided by the Technical Representative of the Contracting Officer (TRCO).

5.8.1. Text index must be included on the media of the drawings as well as a description of the method of composition (attachment information).

5.8.2. Standard borders and cover sheets are provided at the CAD/BIM website https://cadbim.usace.army.mil. Border sheets are available in ANSI Standard A through E. A N S I - D size borders (22” x 34”) are the preferred size.

5.9. Specifications Formatting

Project designers shall submit all technical specifications to the 72 ABW/CE for review and compliance with project requirements. All specifications shall be formatted for desktop publishing in MS Word for Windows electronic format using the Unified Facilities Guide Specifications (UFGS) or SPECSINTACT.

5.10. Base General Requirements TAFB

Standard Specifications Section 00 70 00 (General Requirements) and Section 00 72 00 (Environmental Requirements) shall be incorporated without amendment to all minor Construction and all Repair Projects’ construction specifications. Military Construction Projects shall also incorporate Sections 00 70 00 and 00 72 00 with amendments as approved by 72 ABW/CE.

5.11. Additional Geographic Information Systems Data

For contract deliverables that also require/include GIS data and printed materials as part of the product, the Tri-Services Spatial Data Standards for Facilities, Infrastructure and Environment SDSFIE (release 2.0 or later) shall be the minimum standard to which the delivered product must comply.

5.11.1. GIS products must include a hard copy and electric copy in ESRI ArcGIS format version (9.1 – 10.2).

5.11.2. Any file structure and naming convention that falls outside the current SDSFIE specifications must be in accordance with, and be defined by, the requesting organization. This information should be provided by the Technical Representative of the Contracting Officer (TRCO). Geographic Datum, Projection System, and Working Units should also be provided by the TRCO.

5.11.3. If not otherwise indicated in the contract, any database material should be done in MS Access 2003 or later version. All products should be done in accordance with the current Operating System of Tinker AFB, i.e. MS Windows 10.

Part 2: Base Infrastructure

Satellite Image of Tinker Air Force Base

6. Utility Systems and Infrastructure on TAFB

6.1. Water Supply

The Tinker AFB domestic water distribution system is supplied by both groundwater wells and by connections to the Oklahoma City municipal system.

6.1.1. For most situations on TAFB, new fire hydrants must be flow tested and painted IAW NFPA Standard 291. Automatic fire protection sprinkler systems shall be served by the base domestic water distribution system IAW NFPA 13.

6.1.2. Important exceptions to the above requirement is Base Hangar facilities must conform to the requirements of UFC 4-211-01 *AIRCRAFT MAINTENANCE HANGARS*.

6.1.3. Well water is chlorinated at the pump or at the end of collection lines. Chemical analysis of the water may be obtained from the Base Environmental Management office upon request.

6.1.4. Corrosion control for all new water supply lines shall be provided as part of a project's scope.

6.1.5. Water usage shall be metered in accordance with Attachment C, *Tinker AFB Mechanical Standard*.

6.1.6. Contractor shall consult with and comply with the requirements of the TAFB Meter Management Group before installation of meter(s). New meters and replacement of existing analog meters shall, as a minimum, be provided with pulse counter which can communicate with AMRS system at Tinker. Daily data is required for a minimum of 90 days.

6.1.7. All Base equipment connections shall be designed and constructed to eliminate cross-connection and/or backflow hazards. Such connections include Heating Ventilating and Air Conditioning (HVAC) systems and automatic Fire Suppression Systems. Construct backflow prevention components respective of the degree of hazard. Follow the Uniform Plumbing Code (UPC) and AFI 32-1066 *Backflow Prevention Program* for design, installation, and maintenance requirements. (**Should obtain a copy for reference)

6.1.8. All landscape irrigation systems design and construction served by potable water systems shall include backflow prevention to protect the potable water supply.

6.1.9. All buildings or facilities equipped with a Siamese fire department water connection shall incorporate a reduced pressure principle back flow prevention device to protect the potable water supply.

Project specifications shall call for "approved" backflow prevention devices as required by AFI 32-1067 *Water and Fuel Systems* and the UPC.

6.2. Wastewater Treatment

Industrial wastewater is piped to one of the two treatment facilities located in Districts 2 and 5. Industrial wastewater is then treated by filtration and clarification processing. For projects which are large producers of industrial wastewater, the designer shall verify that the capacities of both the collection system and the treatment plant are adequate to respectively transport and treat the discharge. All base sanitary sewer wastewater is channeled to the Oklahoma City municipal system for treatment. .

6.2.1. Design contribution to existing sanitary sewer system shall be estimated at 30 gallons per capita per day.

6.2.2. Wastewater collection systems shall be designed IAW the Water Environment Federation and American Society of Civil Engineers Manual of Practice MOP FD-5/ASCE MOP 60 Gravity Sanitary Sewer Design and Construction.

6.2.3. Design requirements for drinking fountains, water closets, lavatories, showers, and laundry washers shall be based on building occupancy.

6.3. Piping, Utilities, and Manholes

No physical connections shall exist between sewer and water supply systems. Minimum construction precautions and separation distances to ensure against utility cross-contamination between water and sewer utility lines shall be maintained as identified below. Where these minimum practices cannot be provided, the

72 ABW / CE may prescribe additional construction measures to provide an equivalent measure of utility integrity and maintainability.

6.3.1. Sewer and water lines shall be located at least 10 feet apart horizontally. In utility projects where the bottom of the water pipe is at least 12 inches above the top of the sewer, the horizontal spacing may be a minimum of 6 feet.

6.3.2. Where conditions require a sewer to cross above a water line, the sewer shall be constructed of cast iron, steel or other pressure pipe for a distance of 10 feet in both directions from the crossing. Within these distances there shall be no occurrence of sewer pipe joints.

6.3.3. The earth cover for sanitary sewers shall be at least 30 inches deep to protect the pipe from superimposed live loads of ordinary traffic.

6.4. Sanitary Water Supply

All Base equipment connections shall be designed and constructed to eliminate cross-connection and/or backflow hazards. Such connections include Heating Ventilating and Air Conditioning (HVAC) systems and automatic Fire Suppression Systems. Construct backflow prevention components respective of the degree of hazard. Follow the **Uniform Plumbing Code/UPC** and **AFI 32-1067 3.3.4 Backflow Prevention Program** for design, installation, and maintenance requirements. (**Should obtain a copy for reference)

6.4.1. All landscape irrigation systems design and construction served by potable water systems shall include backflow prevention to protect the potable water supply.

6.4.2. All buildings or facilities equipped with a Siamese fire department water connection shall incorporate a reduced pressure principle backflow prevention to protect the potable water supply.

6.4.3. Project specifications shall call for "approved" backflow prevention devices as required by AFI 32-1067 and the UPC.

6.5. Sanitary Sewer Collection Systems

6.5.1. To ensure maintainability, the minimum size pipe allowed for base facilities shall be six inches diameter for housing connections and eight inches for all other facility connections.

6.5.2. Adequate manholes and clean-outs shall be provided for all collection piping for maintainability. Sanitary sewer manholes shall be provided at all changes in direction and at maximum intervals of 500 feet.

6.5.3. All sanitary collection systems shall be designed for gravity collection. Pressurized force main and lift station design for base sanitary sewers are prohibitive without the consent in writing of the 72ABW/CE. Where lift stations are permitted, their construction shall feature dual “ejectors pumps” fitted with controls for alternate cycling of lead pump function. Manual override of automatic cycling control shall be included.

6.5.4. Lift stations shall be designed to preclude bypass/overflow. Provide adequate sump storage for short power outages. Provide an electrical outlet and transfer switch to permit connection of an emergency power generator on large lift stations or where overflow/bypass can create a health hazard or pollution problem. An approved alternative energy power solution can replace the emergency power generator requirement.

6.5.5. Crossing potable water lines and sewage lines shall be installed in accordance with Water Environment Federation publication Gravity Sanitary Sewer Design and Construction.

6.6. Industrial Wastes

6.6.1. All facilities generating wastewater (other than sanitary sewage waste) shall be connected to the industrial waste (IW) sewer system. All new industrial wastewater connections which connect to a dual-wall IW collection main or to an existing lift station shall be dual-wall polypropylene pipe with a leak detection system compatible with the existing system. Wastes shall be identified, both in characteristics and quantities, in project design analysis, and compared to the capabilities of the receiving treatment plant.

6.6.2. Materials for industrial waste drains, sewers, tanks, pumps, and other features shall be carefully selected for suitability based on worst case expected waste characteristics. Once selected, these materials shall be clearly and thoroughly specified in project specifications. Material substitutions

shall be avoided to the greatest extent possible.

6.6.3. Where necessary, pretreatment at the source should be provided. This may include physical, chemical, or a combination pretreatment. Flammables and troublesome solids shall be removed at the source.

6.6.4. For projects which are large producers of IW, the designer shall verify that the capacities of both the collection system and the treatment plant are adequate to respectively transport and treat the discharge.

6.7. Oil Separators

Many small, proprietary oil/grease separators on the market do not provide adequate detention times nor have sufficient volumetric capacities to function properly. These devices shall not be used for base construction.

6.7.1. All oil separators shall have a submerged tee (or other submerged feature) as an outlet. This feature allows the separator to function as a two-stage separator, thereby preventing discharge of oils which pass to the outlet chamber. A tee may not be required if the two-stage-effect is provided by other means.

6.8. Storm Drainage System

All new facilities shall be designed so that the finished floor elevation (FFE) is above the 100-year flood elevation. Rainfall intensity shall be based on local intensity-duration-frequency data. The designer shall analyze the project's effects of increased watershed runoff before tying into an existing system at any particular location. If post-project runoff is projected to be greater than previously recorded, then post construction storm water controls shall be constructed to prevent increase of flood potential downstream.

6.9. Natural Gas Delivery Systems

All natural gas systems shall be installed in accordance with Unified Facility Criteria, International Fuel Gas Code, and American Gas Association standard.

6.9.1. All underground and natural gas distribution piping and accessories, including but not limited to fittings, valves, and accessories, shall be designed and rated for a minimum of 100 PSI minimum working pressure.

6.9.2. All underground natural gas pipes shall be buried at a minimum of 60" cover.

6.9.3. Preferred material for underground gas pipe are steel pipe for highly congested areas or High Density Polyethylene Pipe.

6.9.4. All underground natural gas piping shall be provided with trace wire.

6.9.5. All underground piping shall be provided with location tape at least 12" above pipe.

6.9.6. All natural gas lines that pass under roadways shall be sleeved. All sleeves shall be installed and vented in accordance with Oklahoma Department of Transportation (ODOT) requirements.

6.9.7. Natural gas usage shall be metered in accordance with Attachment C, *Tinker AFB Mechanical Standard*.

6.9.8. New meters and replacement of existing analog meters shall as a minimum be provided with pulse counter which can communicate with AMRS system at Tinker. Daily data is required for a minimum of 90 days. Contractor shall consult with and comply with the requirements of the TAFB Meter Management Group before installation of meter(s).

6.9.9. Reference the Tinker AFB Base Mechanical Standard for additional requirements.

6.10. Liquid Fuel Supply Systems

6.10.1. Pipelines and Hydrant Systems. All pipeline and hydrant system designs shall be installed in accordance with UFC 3-460-01 *DESIGN: PETROLEUM FUEL FACILITIES*. All designs shall ensure that maintenance personnel are able to physically perform routine tasks with tools and equipment readily available on Base. Items of consideration include:

6.10.1.1 Ensuring that parallel or crossing pipelines are at least one foot apart to permit repair and/or

equipment use in-between the pipes. Large diameter pipes require greater separation.

6.10.1.2 Providing hydrant outlet pits or equipment pits large enough for tool use in the pit while replacing or maintaining valves, flanges, pumps, nuts and bolts, and flange gasket replacement.

6.10.1.3 Assuring that sufficient flanges are installed to permit ease of pipe and equipment repair or replacement. For example, because pipe cutting or welding is not permitted in a pump house, flanges are required.

6.10.1.4 Providing sectionalizing valves in piping systems to shut down piping sections for repair, maintenance, and pressure testing.

6.10.2. Fuel Storage Tanks and Welding:

6.10.2.1 Dikes or basins around storage tanks shall be designed so that tank cleaning, maintenance, and repair equipment can be easily transported into the diked area. This includes providing clear access to the tank manholes without climbing over or under pipelines. Provide cathodic protection (CP) inserts in the concrete basin of the dike for CP testing.

6.10.2.2 Clearance shall be provided between parallel buried tank structures and between other structures to allow individual tank excavation and removal. Separation of adjacent tank installations shall accommodate the use of mechanized equipment in tank excavation, maintenance, removal, and replacement. Also, CP systems for a given tank structure shall be shielded from adjacent tanks where sufficient clearance is not provided.

6.10.2.3 All welding shall be performed by a welder certified IAW ANSI B31.1 or API 1104 codes. Welds shall be made and inspected IAW ANSI B31.8 requirements.

7. Exterior Signage

A consistent system of signage not only encourages smooth navigation of the base but is also an important tool in establishing unifying visual images for the precinct of the specific facility, for its larger planning district, and for the installation overall.

7.1. Standard Facility Signs

All exterior signage shall be developed and designed in accordance with UFC 3-120-01 *DESIGN: SIGN STANDARDS*. This document is accessible via the following hyperlink:
https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc/ufc-3-120-01

Design sign panel thickness and support columns as required to resist all imposed wind forces. Reflective sheathing shall conform to the requirements of Federal Specification LS300C, Type I, Table III, Reflectivity II and the **Manual of Uniform Traffic Control Devices** (MUTCD).

All exterior signs, except traffic control, shall be Spectrum Paint Cleveland Brown MP#80YR 09/163 with reflective white letters. The building number sign shall be Type B4 sign as stated in UFC 3-120-01

Exception: In the Navy Area Machine Blue shall be used for all sign fields. Reflective numbers and letters shall meet Federal Specification LS300C, Type I, Table III, Reflectively II and be Helvetica medium style.

All painted frames shall match as closely as possible 3M Company, Scotchlite, #3680-29, Russet Brown

Exception: In the Navy Area sign frames shall be painted Machine Blue to match sign fields.

Existing exterior signage that does not comply with base standards shall be replaced as needed, due to wear.

The AFMC logo and shield shall be used to establish corporate identity; however, use shall be limited to gate signs, selected towers, billeting, base operations and headquarters buildings.

7.2. Zip + 4 Program Implementation

The Zip + 4 program is a DOD directive mandating that Bases such as Tinker shall develop street addresses for all Base Facilities in addition to the long-time standard facility numbers. Questions about the program shall be directed to the Base Comprehensive Planner.

Office of the Base Planner
72 ABW/CEAO
7535 5th Street, Building 400
TINKER AFB OK 73145-9010
(405) 734-2074

7.3. Logos and Super Graphics

Painted logos, super graphics, and racing stripes are prohibited on the installation. All exterior signage proposals shall be submitted to the Base Architectural Compatibility Board and be subject to its review and approval.

7.4. Highway Standards and Traffic Control

The Air Force Sign Standard recognizes the importance of signage consistency between Base rights of way and those in the community to which they connect.

7.4.1. Highway Standards are defined as that group of signs which regulate Base traffic.

7.4.2. For design and construction of these types of signs refer to the Federal Highway Administration's Standard Highway Signs and Manual of Uniform Traffic Control Devices. These publications can be accessed at the following hyperlinks:

http://mutcd.fhwa.dot.gov/ (Manual of Uniform Traffic Control Devices)
http://mutcd.fhwa.dot.gov/ser-shs_millennium.htm (Standard Highway Signs)

7.5. Identification of Hazardous Storage

See Chapter 10 Life Safety, Paragraph 10.1 for the special signage requirements of hazardous materials storage occupancies.

8. Traffic Engineering

8.1. Traffic Considerations

The vehicle circulation system at TAFB provides primary means of movement of both people and materials throughout the Base. The infrastructure of roads, pedestrian systems, and open spaces links the individual structures on Base into a complete and functioning military installation.

8.1.1. Pedestrian and vehicle occupant safety are the first priorities in all roadway, parking lot, and sidewalk projects.

8.1.2. All sidewalks interrupted by vehicle rights-of-way shall feature barrier-free pedestrian crosswalk design, pavement marking and signage as recommended by the MUTCD.

8.1.3. Projects which include parking lot pavements shall also include traffic control signage, stall striping, crosswalk marking, and directional lane markers as part of the project scope of work.

8.1.4. Circulation and parking facilities shall conform to UFC 3-210-02.

8.2. Signage

Traffic facility signs shall comply with UFC 3-120-01 *DESIGN: SIGN STANDARDS*.

All traffic signage shall comply with those standards set forth in the **Manual of Uniform Traffic Control**

Devices (MUTCD) as published by the U.S. Department of Transportation and the Federal Highway Administration.

8.3. Parking

The Office of 72 ABW/CE is the authority for assigning reserved parking spaces. Parking requirements for new facilities shall be in accordance with **AFI 3-218, Tinker Supplement.**

8.3.1. A standard parking space is 9 feet wide by 18 feet long.

8.3.2. A standard motorcycle parking space is 4.5 feet wide by 12 feet long.

8.3.3. Parking accommodations for all Base facilities shall include an appropriate number of spaces designed and constructed in compliance with the Architectural Barriers Act (ABA) accessibility standard for DoD facilities.

8.3.4. The number of accessible parking spaces for each facility shall not be less than that set out in the ABA, but may be more as the need is identified by the resident organization of the subject project.

9. Environmental Regulations Compliance

9.1. Mandatory publications

Requirements of this section include but are not limited to those found in **AFI 32-1052 Facility Asbestos Management**, current edition.

9.2. Asbestos Containing Materials (ACM)

No ACM shall be used in work performed at Tinker AFB. Several facilities on Tinker AFB contain asbestos in the form of pipe insulation, boiler and tank insulation, wall and ceiling materials, floor tile, exterior siding, roofing, and flexible duct connectors. The Government will generally perform preliminary surveys to determine the presence of asbestos in facilities where work is to be performed.

9.2.1. In some cases the designer may be required to perform asbestos field surveys and testing to determine the extent of ACM present. All survey work shall be accomplished by a certified industrial hygienist or personnel trained and certified IAW federal, State of Oklahoma, and Air Force regulations. Field surveys shall fully describe locations, types (chrysotile, crocidolite, amosite, anthophyllite, tremolite, and actinolite) and quantities. Include percentage of asbestos and composition of material.

9.2.2. Submit documentation and certifications of personnel trained to take ACM samples to the CO prior to beginning asbestos surveys.

9.2.3. Submit samples for ACM testing to a certified laboratory. The designer shall submit to the CO the laboratory results and other pertinent information of samples sent for testing for ACM as soon as they become available.

9.2.4. Refer to TAFB Specification Section 00 72 00 Attachment 2 for abatement requirements. The designer shall be required to provide Scope and Location of Asbestos Containing Materials. All projects' construction documentation shall be coordinated through the 72d ABW CE Installation Environmental Management Branch (72 ABW/CEIE).

9.3. Lead-Based Paint

No lead-based paint shall be used in work performed at TAFB. The Government will generally perform preliminary surveys to determine the presence of lead-based paint facilities where work shall be performed.

9.3.1. In some cases the designer may be required to perform field surveys and testing to determine the extent of lead-based paint present. All survey work shall be accomplished by a certified industrial hygienist or personnel trained and certified IAW the applicable federal, State of Oklahoma, and Air Force regulations. Field surveys shall fully describe locations and quantities.

9.3.2. Submit documentation and certifications of personnel trained to take lead-based paint samples to the CO prior to beginning field surveys.

9.3.3. The designer shall submit to the project's CO the laboratory results and other pertinent

information of samples sent for testing as soon as they become available.

9.3.4. Refer to TAFB Specification Section 00 72 00 Attachments 3 and 3A for abatement requirements. All projects' abatement design drawings and specifications shall incorporate these Specifications. All projects' construction documentation shall be coordinated through the 72d ABW CE Installation Environmental Management Branch (72 ABW/CEIE).

9.4. PCB Filled Ballast and Universal Waste Lamps

Refer to TAFB Specification Section 00 72 00 Attachment 4 for abatement requirements. All projects' ballast and lamp abatement design drawings and specifications shall incorporate these specifications. All projects' construction documentation shall be coordinated through the 72d ABW CE Installation Environmental Management Branch (72 ABW/CEIE).

9.5. Historic Preservation

The Air Force and all tenant organizations residing within TAFB are bound to comply with all requirements of the National Historic Preservation Act and CFR 36 Part 800.

9.5.1. It shall be the responsibility of each project's Contractor to verify the need for 72 ABW CE Installation Environmental Compliance Section (CEIEC) review relative to historic preservation regulations. Project Contractors shall, when requested by 72 ABW/CEIEC, provide documentation as necessary to establish compliance with CFR 36 Part 800.

9.5.2. Projects which potentially affect any of the historic resources situated within the perimeter of TAFB shall be fully coordinated among the 72 ABW/ CEIEC, 72 ABW/CE, and the State Historic Preservation Office (SHPO).

9.6. Aging Facilities

9.6.1. There are many structures on TAFB that exceed 50 years of age.

9.6.2. Some of these structures have been classified as "significant" based on their integrity of architectural style and/or their relationship to historic events within American history.

9.6.3. These facilities may derive historical significance from Tinker Field's development during World War Two or even from later historic American events in response to the "Cold War".

9.6.4. All projects which affect TAFB facilities and grounds, whether or not they have been determined to be contributing or non-contributing resources of historical significance in American history, shall be coordinated with 72 ABW/ CEIEC. 72 ABW/ CEIEC Cultural Resource Manager will then determine the appropriate level of project review and whether consultation with the SHPO is necessary.

9.7. Base Historic Preservation Officer (BHPO)

9.7.1. 72 ABW/CEIEC Natural Infrastructure Management office is responsible for coordination of all historic preservation regulation compliance issues with the State of Oklahoma Historic Preservation Office (SHPO), 72 ABW/CE, and all appropriate agencies. The Tinker AFB Base Historic Preservation Office (BHPO) can be contacted at telephone (405) 734-4579 and at the following address.

72 ABW/CEIEC
7535 5th Street, Building 400
TINKER AFB, OK 73145-9010

9.7.2. All potential candidates for the National Register of Historic Places (NRHP) which are situated within TAFB shall be identified by the BHPO with the full consultation of the SHPO prior to formal nomination to the NRHP.

9.8. State Historic Preservation Officer (SHPO)

9.8.1. Throughout the State of Oklahoma, the Office of the State Historic Preservation Office (SHPO) is responsible for validating candidates for the National Register of Historic places. The SHPO acts in conjunction with the Federal Advisory Council on Historic Preservation (regional office-

Washington, DC) and is the sole authority in the approval of candidates for the National Register of Historic Places.

9.8.2. Once a facility has been identified as being eligible for the National Register of Historic Places, all projects which propose to repair or alter the interior or exterior of the facilities infrastructure in any way shall be reviewed and approved by the Cultural Resource Program Manager, 72 ABW/CEIEC, and concurred upon by the Oklahoma SHPO prior to execution of the project.

9.8.3. Design documents for potential construction projects must be submitted to 72 ABW/CEIEC Cultural Resource Program Manager for review and comment. Direct consultation with the SHPO is to be initiated only by 72 ABW/CEIEC Cultural Resource Program Manager. The time necessary for SHPO consultation varies with the resource and project scope.

9.9. Solid Waste Tracking

9.9.1. All non-hazardous solid waste shall be managed and accounted by Base construction Contractors in accordance with the Standard Specification Section 00 70 00 General Requirements for Construction on Tinker Air Force Base.

9.10. POL Storage Tanks

9.10.1. Mandatory publications: Requirements of the section include but are not limited to those found in AFI 32-7044 Storage Tank Environmental Compliance. Design criteria for storage tanks containing POL shall comply with technical design requirements of the UFC, applicable industrial standards and Federal, State and local regulations. To minimize the risk to human health or the environment, any new tanks installed on base will be aboveground with secondary containment or vaulted below ground. The materials of construction and designed storage conditions for all tanks are compatible with the materials stored.

9.10.2. Applicable Design Criteria:

a. UFC 3-460-01 *DESIGN: PETROLEUM FUEL FACILITIES*
b. UFC 3-460-03 *O&M: MAINTENANCE OF PETROLEUM SYSTEMS*
c. Title 40, CFR Part 112 SPCC Rule
d. Title 40, CFR Part 280 UST Rule
e. Applicable state and local regulations
f. AFI 32-7044, Chapter 2 Storage Tank Compliance
g. National Fire Protection Association (NFPA)
h. Petroleum Equipment Institute (PEI)
i. Steel Tank Institute (STI)
j. American Petroleum Institute (API)
k. National Electric Code (NFPA 70)
l. Occupational Safety and Health Administration (OSHA)

9.10.3. Standard Tank Designs:

a. STD 123-335-03 DoD Military Service Station and Factory Fabricated Tank Engineering Standard
b. AW 78-24-27 DoD Aboveground Vertical Steel Fuel Tanks with Fixed Roofs
c. AW 78-24-28 DoD Pressurized Hydrant Fueling System Type III
d. AW 78-24-29 DoD Pressurized Hydrant Direct Fueling System Type IV
e. AW 78-24-33 DoD Cut-N-Cover Standards
f. STD 121-122-01 USAFE/NATO, Airfield Standard Design US, Jet Fuel Storage Dispensing Systems for Tactical and Wide Body Aircraft

9.11. Affirmative Procurement Plan for TAFB

Project designs shall comply with the requirements of “Green Procurement Program for TAFB” https://www.epa.gov/greenerproducts/recommendations-specifications-standards-and-ecolabels-federal-purchasing

Part 3: TAFB Facility Design

The Gateway Dormitories looking north along Arnold Street

10. Life Safety Systems

10.1. Identification of Hazardous Systems and Materials Storage

10.1.1. The NFPA 704 Standard System for the Identification of the Hazards of Materials for Emergency Response shall be followed for signage of all hazardous storage occupancies and also for the temporary construction facilities in support of permanent project improvement contracts.

10.2. Anti-terrorism and Force Protection at TAFB

All base facility alterations and all new construction shall comply with the Unified Facilities Criteria UFC 4-010-01 *DOD Minimum Antiterrorism Standards for Buildings*. This document can be accessed at the following hyperlink: https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc/ufc-4-010-01

10.3. Analytical Design for Projects with High Design Basis Threat and/or Level of Protection

The UFC 4-020-01 *DOD MINIMUM ANTITERRORISM STANDARDS FOR BUILDINGS* shall be used for detail structural design analysis whenever project requirements are designated with specific **(DBT/LOP)** Design Basis Threat and/or Level of Protection.

11. Facility Programming

11.1. Mandatory References

Applicable to this section include but are not limited to current editions of the following:

Publication Number	Title
AFI 32-1024	Standard Facility Requirements
UFC 3-260-01	Airfield and Heliport Planning and Design

11.2. Facility Siting

Proper facility siting in accordance with TAFB land use plan and Executive Order 13693, *Planning for Federal Sustainability in the Next Decade* (published 19 Mar 2015), is critical to ensure that every effort is made to avoid incompatible land usage. *Implementing Instructions—Sustainable Locations for Federal* Facilities (published 15 Sep 2011) and *Guidance for Federal Agencies on Sustainable Practices for Designed Landscapes* (31 Oct 2011) provides recommendations to achieve this goal. The Base's Facilities Board, through the review and recommendation of the Facilities Board Working Group (FBWG) approves all siting requests for all new construction as well as for all projects which alter existing facility exteriors.

11.2.1. The review process of the FBWG can extend over the term of several agendas, so the importance of project siting to the prompt expedition of a project's approval process cannot be overestimated.

11.2.2. Written requests in the form of AF Form 332's shall be submitted by all organizations in need of project siting.

11.2.3. All submissions of 332's shall be delivered to the 72 ABW/CE Work Order Service Desk in Building 414.

11.3. Area Development Plans (ADP)

11.3.1. When proposed construction requires planning beyond the limits of a single facility, designers should pursue the creation of area development plans in order to facilitate thoughtful planning of the relationship facilities have with one another.

11.3.2. All Area Development Plans shall be consistent with and implement the goals of the TAFB General Plan and the TAFB Integrated Natural Resources Program (INRMP).

11.4. Air Installation Compatibility Use Zone (AICUZ)

11.4.1. The Tinker AFB AICUZ Study provides an assessment of noise levels and statistical analysis to determine aircraft Accident Potential Zones (APZ). The goal of the Study is to provide protection of the public and compatible development adjacent to the airfield.

11.4.2. Any project sited within proximity of the airfield shall assess, as part of the project design analysis, the noise contours of the Study and their impact to the completed project's mission and facility operation.

11.4.3. Project design analysis shall provide recommendations to 72 ABW/CE on how to eliminate and/or minimize potential sound abatement problems.

11.4.4. Construction of occupied facilities shall be avoided within all Accident Potential Zones.

11.4.5. Project Contractors who require access to the TAFB AICUZ Study shall contact 72 ABW/CE at the following address.

Architectural Compatibility Coordinator
72 ABW/CE
7535 5th Street
Tinker AFB, OK 73145

11.5. Tenant Organization Responsibility

It shall be the responsibility of each tenant organization residing within TAFB to be informed of and in compliance with their command design policies as well as the requirements of the **TAFB Facility Standard**

12. Barrier-Free Access

12.1. Handicapped Accessibility

It is the goal at Tinker AFB to create a Base environment that is accessible to all people.

12.1.1. TAFB policy is to not apply the UFAS Military Exclusion for facility accessibility. In this way optimum flexibility of use and occupancy can be maintained by 72 ABW/CE in regard to continuing development of TAFB missions and facilities.

12.1.2. Designers working on projects for existing facilities can review the Tinker Air Force Base ADA Survey 1998 available in the B400 offices of 72 ABW/CE. This is a detailed survey of 150 buildings citing facility deficiencies and ADA non-compliant construction as of 1998.

12.1.3. Excerpt findings of the study will be provided upon written request to the 72 ABW/CE Architectural Compatibility Coordinator.

12.1.4. Projects whose scope includes repair or alteration of existing TAFB facilities shall remove, whenever feasible, all architectural barriers to accessibility which are located within the limits of the project.

12.2. Uniform Federal Accessibility Standards (UFAS)

12.2.1. The ABA (Architectural Barriers Act) is the applicable standard pertaining to handicapped accessibility at TAFB. The ABA standardizes handicapped accessibility requirements in all Department of Defense facilities.

12.2.2. The ABA documents present uniform standards for the design, construction, and alteration of buildings so that physically handicapped persons will have ready access to them and use of them. Projects including maintenance repair and new construction scopes of work must comply with the Architectural Barriers Act (ABA).

12.3. Maintenance and Repair

12.3.1. If existing elements, space, essential features, or common area are altered, then each such altered element, space, feature, or area shall comply with the applicable provisions of the ABA.

12.3.2. All facilities that are eligible for listing in the National Register of Historic Places shall comply with the ABA accessibility requirements.

13. ARCHITECTURAL COMPATIBILITY PLAN

72ND AIR BASE WING CIVIL ENGINEER DIRECTORATE

13.1 Introduction

"The intention is not to limit creativity, but to aid the designer in reaching decisions consistent with the goal of this program and to create a unified AFMC image."

AFMC Facility Quality Program

The Tinker Air Force Base Architectural Compatibility Plan (ACP) shall serve as a guide to direct the creative design efforts of the architect, designer and planner toward a future unity of architectural expression throughout the communities of TAFB.

The ACP will provide guidance, both suggested and mandatory, to be applied in all aspects of exterior design. Due to current world events, the Department of Defense has imposed additional stringent force protection requirements that will impact both site and building designs. The implementation of these requirements is mandatory. The goal of the ACP is to provide design guidance so that the force protection elements are planned as an integral part of the project design.
Compatibility is accomplished through common design forms, details, materials, site features, and streetscapes.

The primary audience includes all businesses that provide design and/or construction services for execution of projects on Tinker Air Force Base.

Also included are installation leadership, programmers, designers, project managers, design agents, A/E consultants and constructors.

What is Architectural Compatibility?

Compatibility is generally defined as “capable of existing together in harmony, or to be consistent”. **Architectural Compatibility** results from designing and building facilities in harmony with their natural and man-made surroundings and environment.

Architectural Compatibility at (Historical) Tinker AFB

The USAF in an attempt to achieve Architectural Compatibility throughout all the AFMC bases created a **Base-Wide Paint Scheme**.

The exterior of all buildings on Tinker AFB were painted to match this color scheme. Only brick and clay tile walls were not painted.

Below is the current color number reference to the Base-Wide Paint Scheme:

Field Color:	Sherwin Williams SW 9102 Quinoa
Trim Color:	Sherwin Williams SW 7705 Wheat Penny
Accent Color:	Sherwin Williams SW 7520 Plantation Shutters

This paint scheme remains throughout TAFB today and it will continue to be a design element that ties the defined Architectural/ Planning Districts together. Although there are several painted buildings on TAFB, new building designs that include site-painted color schemes will be discouraged.

The **Base-Wide Paint Scheme** remains as a color tie between the new and the historic. New exterior wall colors shall be an integral part of the finish wall material and compatible color wise with the **Base-Wide Paint Scheme**. Refer to **Wall Systems** for recommended wall facing materials.

How to Use This Plan

Tinker AFB divided by several areas of functional activity.

The ACP defines these areas into eight Architectural/Planning Districts.

These districts were originally established as a boundary surrounding a community of buildings and/or site development of compatible functions.

This compatibility of function also influenced the Architectural compatibility of the district through the development and siting of buildings of similar massing, construction types and design.

13.2 The Architectural/Planning Districts for Tinker Air Force Base are as follows:

Visual District A	**38th Cyberspace Engineering Installation Group (CEIG) District**
Visual District B	**Airfield District**
Visual District C	**East Side Depot Maintenance District**
Visual District D	**North Side Industrial District**
Visual District E	**South Forty District**
Visual District F	**South East Side Munitions District**
Visual District G	**West Community District**
Visual District H	**South Side Depot Maintenance District**

38th Cyberspace Engineering Installation Group (CEIG)

District - Visual District A

Description and Map – This district is located one-half mile east of the base proper along 59th Street and is the home of the 38th Cyberspace Engineering Installation Group. The CEIG District contains administrative offices, educational facilities and several outdoor recreational areas. This area was an old dormitory community that once housed support personnel for TAFB.

The District is evolving from the old renovated wood-framed dormitories and board-formed concrete structures to a new community with its own architectural expression as visualized in the design of the 38th CEIG Headquarters Building #4064 and Administration Building # 4057. The simple exterior wall massing of brick and glass with a plaster architrave of these two buildings have re-defined the architectural direction of this District.

District A – Exterior materials and colors:

Walls:
Face Brick color - Oxford Brown by Acme Brick Co.
Plaster (EIFS) color -Sandalwood Beige # 112 by Dryvit

Roofs (Low slope)
White surface EPDM single-ply membrane – Re: Section 13.5

Roofs (Sloped)
Pre-finished Standing Seam
Color to match Sherwin Williams Bronzetone

Door and Windows
Baked coat finish to match Anodized Dark Bronze

Airfield District - Visual District B

Description and Map – This district is comprised of the airfield and the supporting facilities of airfield operations

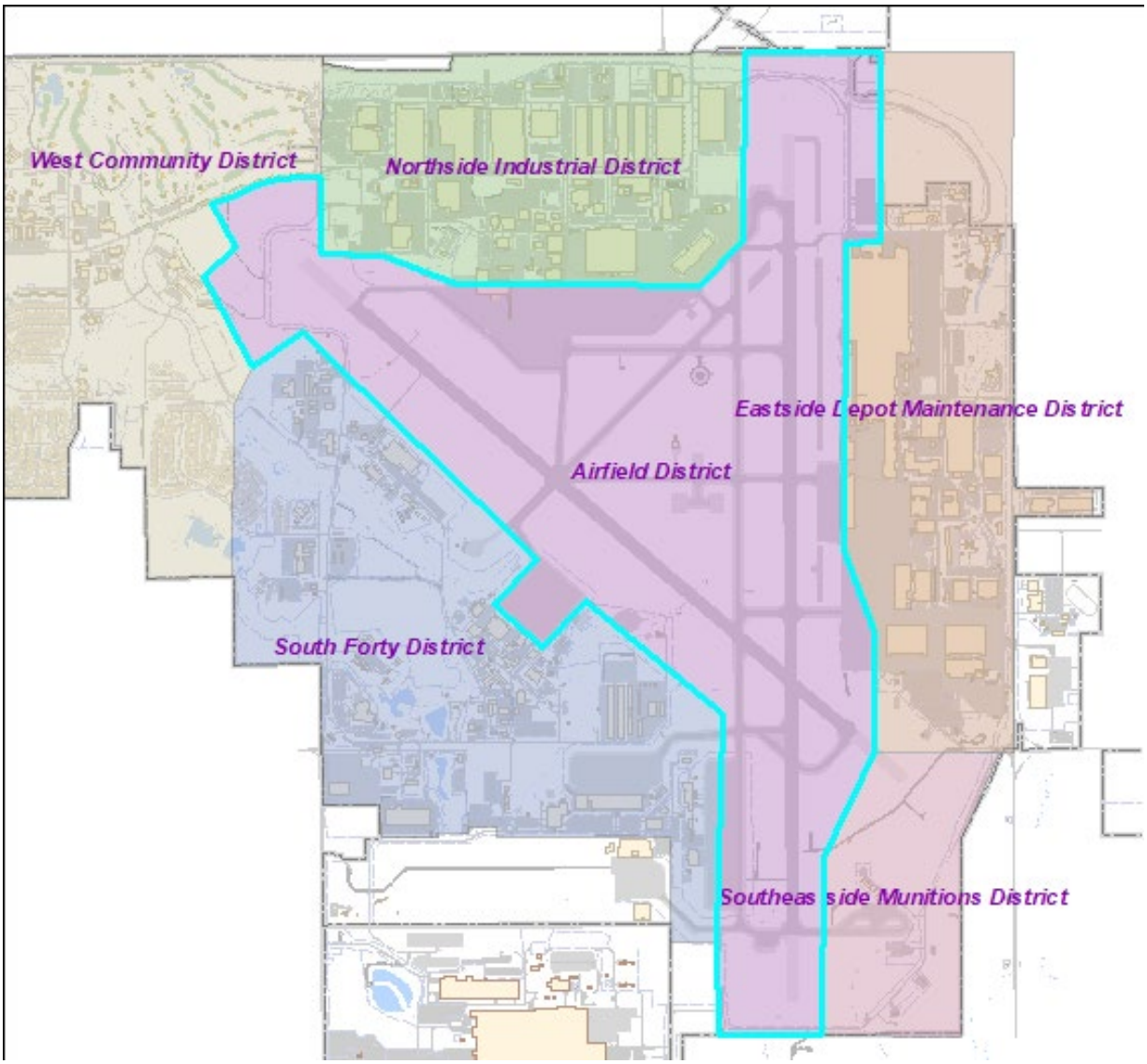
and maintenance activities located in adjacent districts and are surrounded by open space for safety and integrity. Refer to map (above).

District B – Exterior materials and colors:

Walls:
Face Brick color – French Vanilla by Acme Brick Co.

Door and Windows
Baked coat finish to match Anodized Dark Bronze

Roofs (Pitched)
Pre-finished Standing Seam
Color to match Sherwin Williams Bronzetone
Roofs (Low slope)
White surface EPDM single-ply membrane – Re: Section 13.5



Eastside Depot Maintenance District - Visual District C

Description and Map – This district contains the primary depot maintenance facilities for the Base. Most of the buildings in this district are massive warehouses and aircraft hangars, with Building 3001 housing most of the depot maintenance workload. This building, acquired in 1943, contains 2,702,040 square feet; is approximately 5/8 of a mile long, and encompasses approximately 53 acres under one roof. This facility dominates the district.

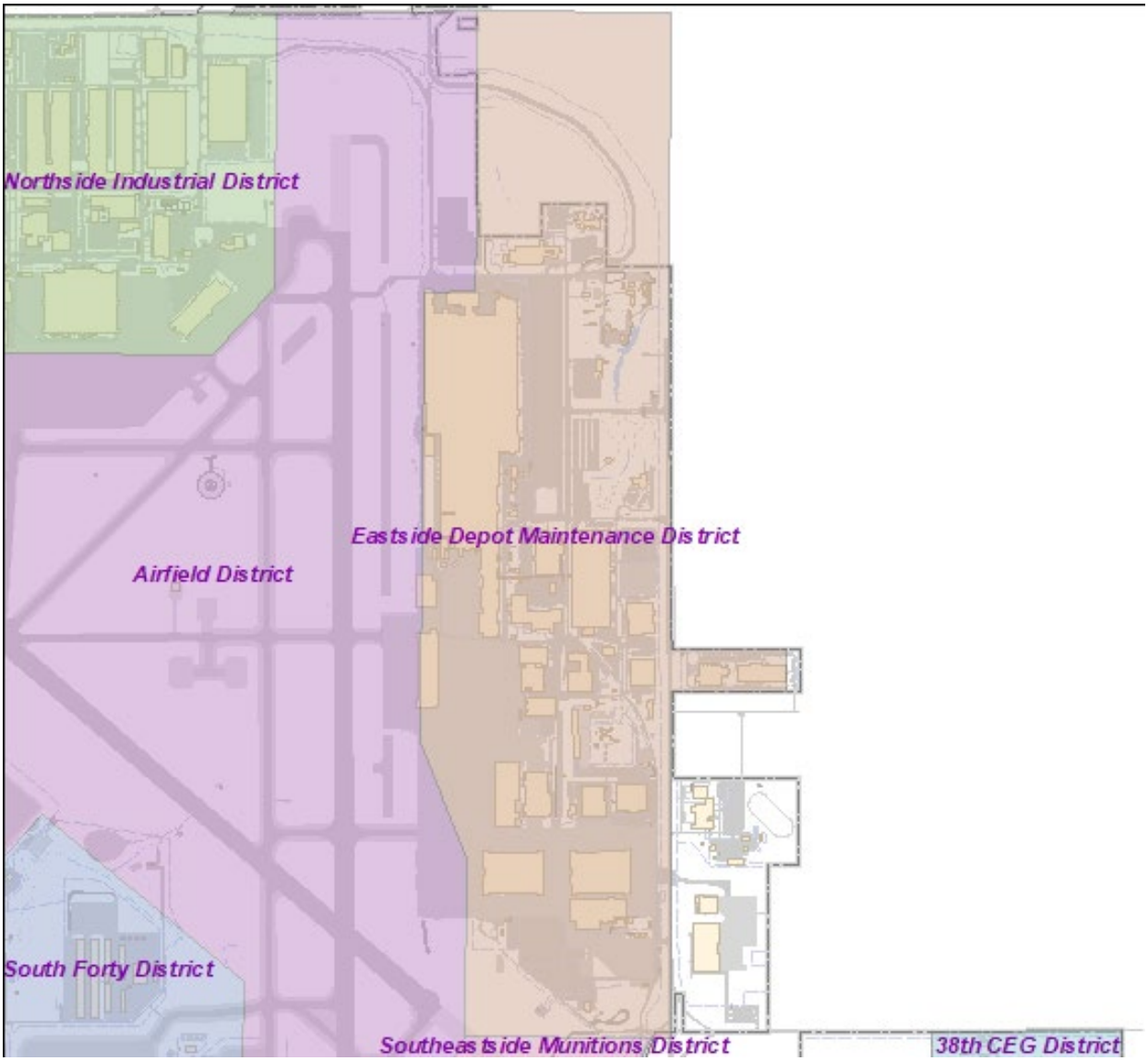
District C – Exterior materials and colors:

Walls
Face Brick color – Garnet by Acme Brick Co.

Door and Windows
Baked coat finish to match Anodized Dark Bronze

Roofs (Pitched)
Pre-finished Standing Seam
Color to match Sherwin Williams Bronzetone

Roofs (Low slope)
White surface EPDM single-ply membrane – Re: Section 13.5



Additional Exterior Materials

Brick: Color to match - Building 3001

Wall Cap: Pre-finished extruded aluminum coping – color to match or complement wall color.

Walls: Wall accent bands Plaster or cast stone to match cast stone color on Building 3001 or brick to complement surrounding brick color.

Pre-finished Metal Wall Panels: Use "MBCI" Rustic Red wall panels for additions and buildings adjacent to building 3001. All other metal wall panels to match or compliment Sherwin Williams SW 9102 Quinoa.

Note: Use only on large hangar type buildings where economics justifies the use.

Paint Colors (historical)
Base-Wide Paint Scheme + Sherwin Williams SW 6327 Bold Brick.

North Side Industrial District - Visual District D

Description and Map – This district contains a mixture of aircraft operation and maintenance uses, warehouse/industrial uses, administrative offices, community service and community/commercial land uses. The district is characterized by a variety of structure types due to the mixed development conditions.

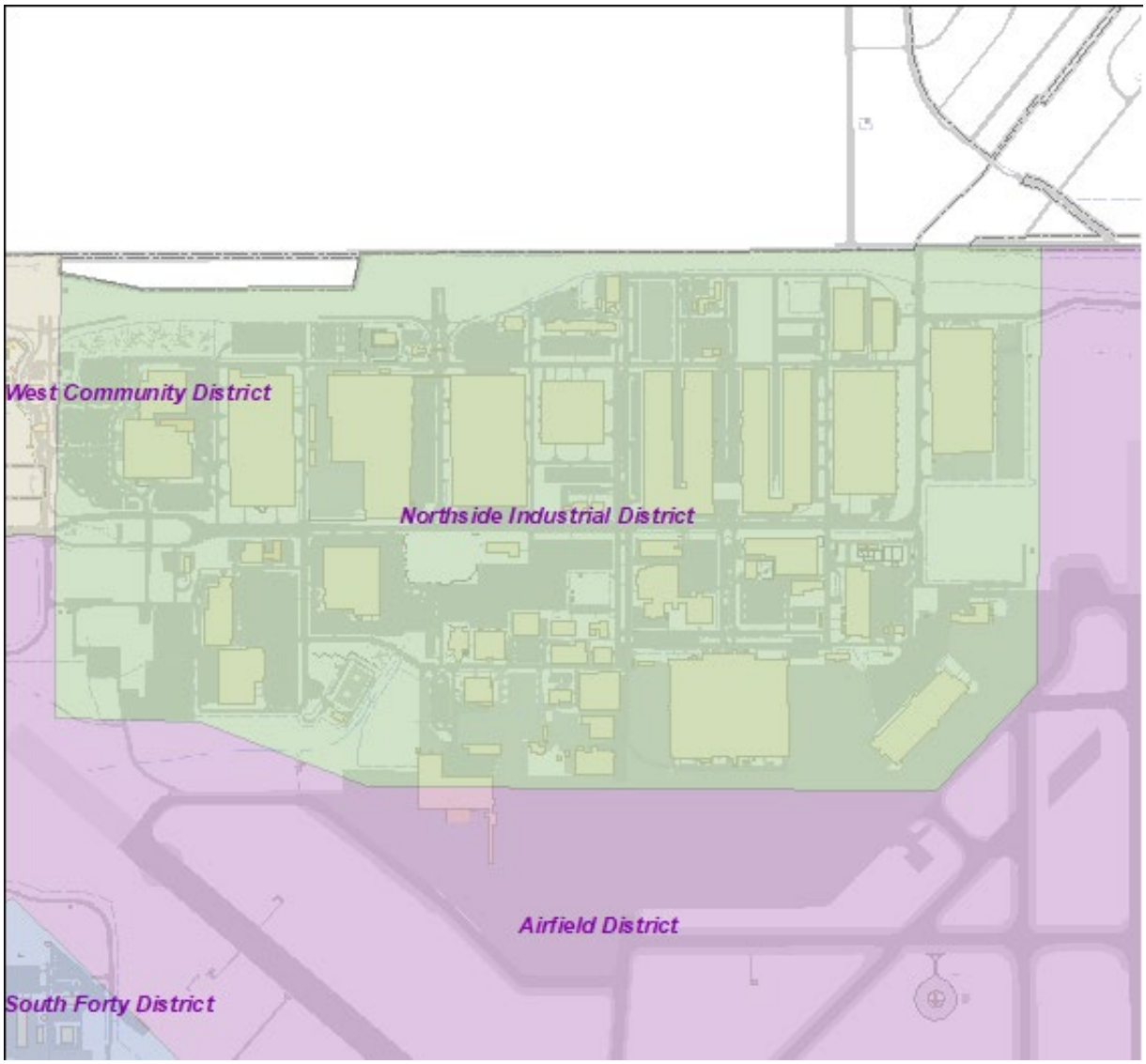
District D – Exterior Materials and Colors

Walls
Face Brick color – Royal Oak by Acme Brick Co.

Door and Windows
Baked coat finish to match Anodized Dark Bronze

Roofs (Pitched)
Pre-finished Standing Seam
Color to match Sherwin Williams Bronzetone

Roofs (Low slope)
White surface EPDM single-ply membrane – Re: Section 13.5



Visual District E – South Forty District

Description and Map – This district is spread out over a large expanse of land. The area contains a mixture of industrial, operations and maintenance, administrative offices, open space, and outdoor recreation land uses. This district also houses all Navy complexes. This district contains many lakes, streams, and other natural features that should be considered and integrated into any future design.

District E- Exterior Materials and Colors:

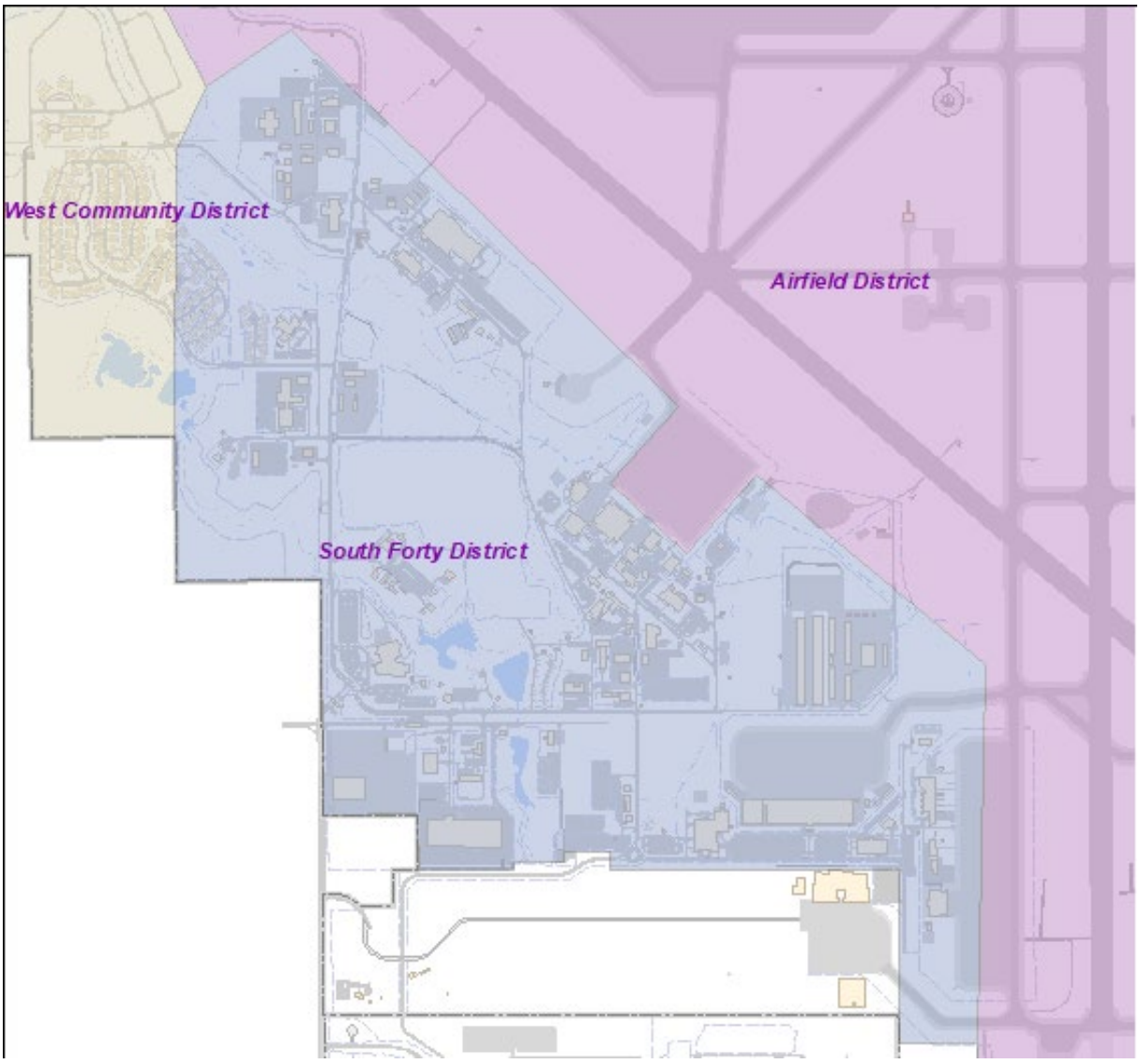
Walls
Face Brick color – French Vanilla by Acme Brick Co.

Door and Windows
Baked coat finish to match Anodized Dark Bronze

Roofs (Pitched)
Pre-finished Standing Seam
Color to match Sherwin Williams Bronzetone

Roofs (Low slope)
White surface EPDM single-ply membrane – Re: Section 13.5

Navy Complex - Paint
Base: Sherwin Williams SW 0054 Twilight Gray
Trim: Sherwin Williams SW 0048 Bunglehouse Blue
Accent: Sherwin Williams SW 7046 Anonymous



Visual District F – Southeast Side Munitions District

Description and Map – This district houses a munitions loading cargo pad extending from the main runway and a variety of munitions handling and storage structures. Most of this area is covered by quantity/distance explosive safety zones.

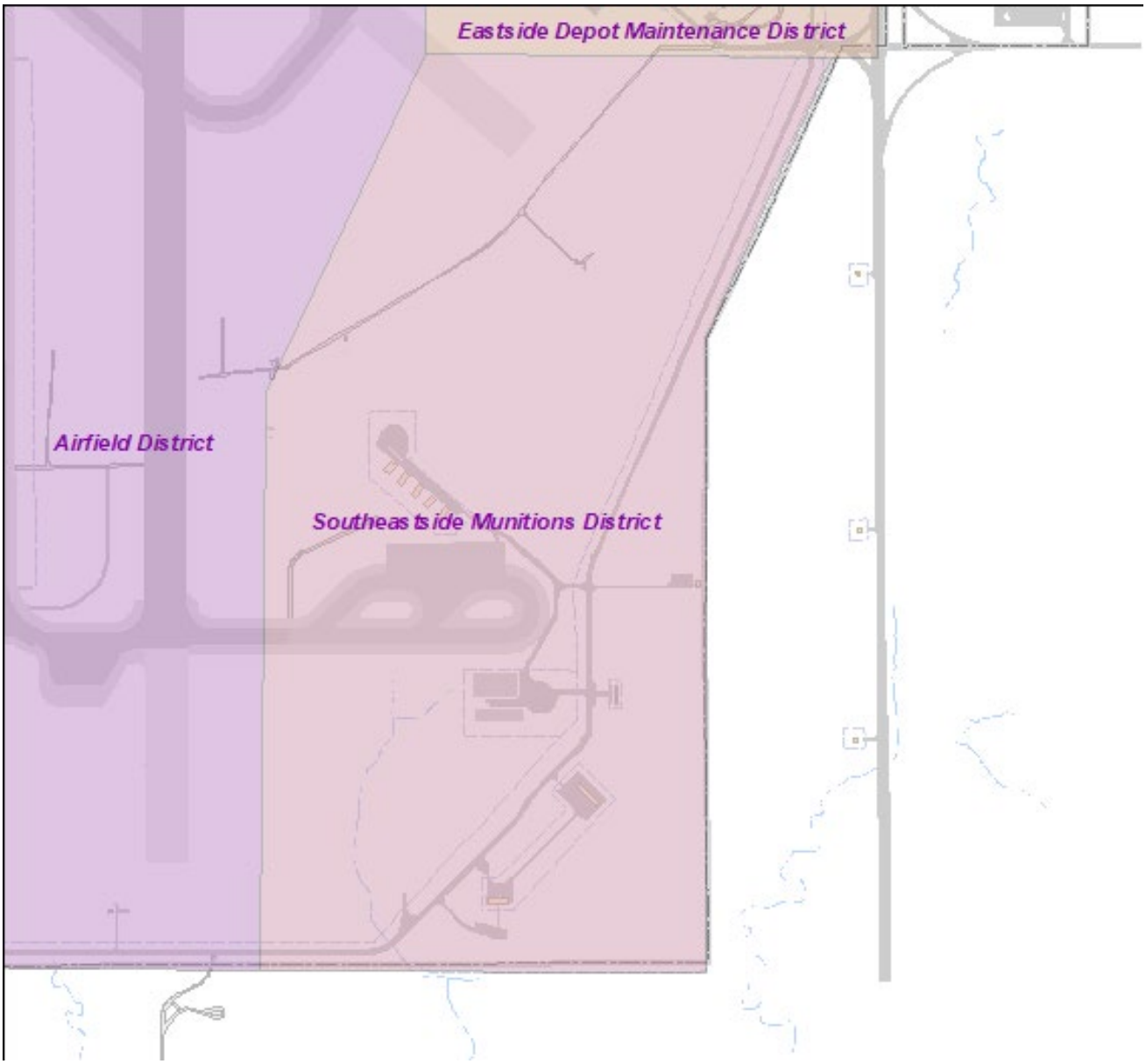
District F-Paint – Southeast Side Munitions District

Walls:
Face Brick color – French Vanilla by Acme Brick Co. or Steel Gray by Acme Brick Co.

Door and Windows
Baked coat finish to match Anodized Dark Bronze

Roofs (Pitched)
Pre-finished Standing Seam
Color to match Sherwin Williams Bronzetone

Roofs (Low slope)
White surface EPDM single-ply membrane – Re: Section 13.5



Visual District G – West Community District

Description and Map – This district houses a mixture of accompanied/unaccompanied housing units, indoor & outdoor recreation, community services and community commercial facilities, medical facilities necessary to serve the base residents. Several facilities are located within the clear zone of the crosswind runway.

8000 Area Walls:
Face Brick color – Golden Sunset by Acme Brick Co.

Dorms:
Base: (Field Color) – Sherwin Williams SW 9102 Quinoa
Accent: (Base Wainscot) – Sherwin Williams SW 7705 Wheat Penny
Trim: (Windows, Doors, Railings, Posts and frames) - SW Bronzetone

Roofs (Pitched)
Pre-finished Standing Seam

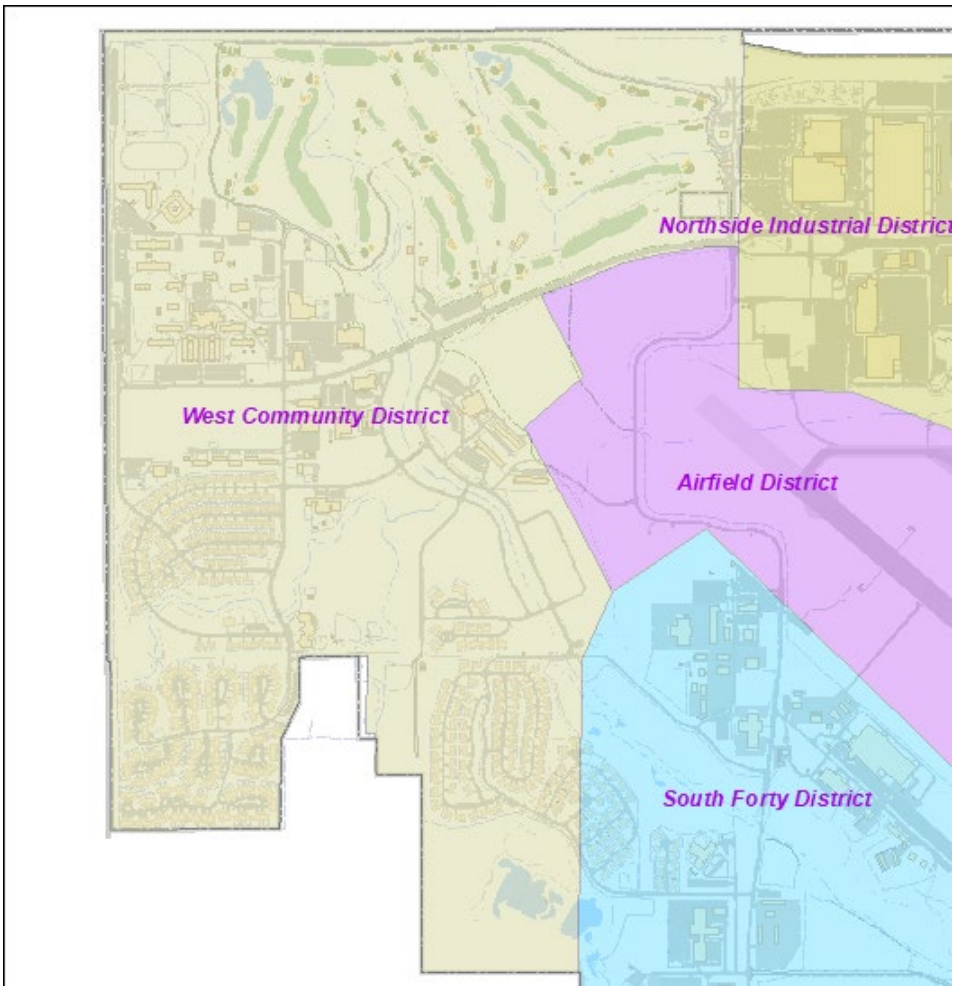
Roofs (Low slope)
White surface EPDM single-ply membrane – Re: Section 13.5

Door and Windows
Baked coat finish to match Anodized Dark Bronze

New Construction

Windows and Door Frames, Pavilions (exposed structure and metal roof system):
Kawneer Permanodic Anodized Finishes –Dark Bronze #40
Berridge Kynar 500 or Hylar 5000 – Aged Bronze

Note: Use of color numbers allows each print manufacture an equal opportunity to formulate as approved color match for any type of coating selected pending approval by the base AERP Architectural Engineering Review Panel. Color to match Sherwin Williams Bronzetone.



South Side Depot Maintenance District - Visual District H

Description and Map – This district contains Building 9001, the former GM Assembly plant and the developing KC-46A Depot Maintenance area. Building 9001 is the largest building on the Base, covering more than 3.2 million square feet. The KC-46A area will have two bay Depot Maintenance Hangar constructed first, followed by a single bay Depot Maintenance Hangar.

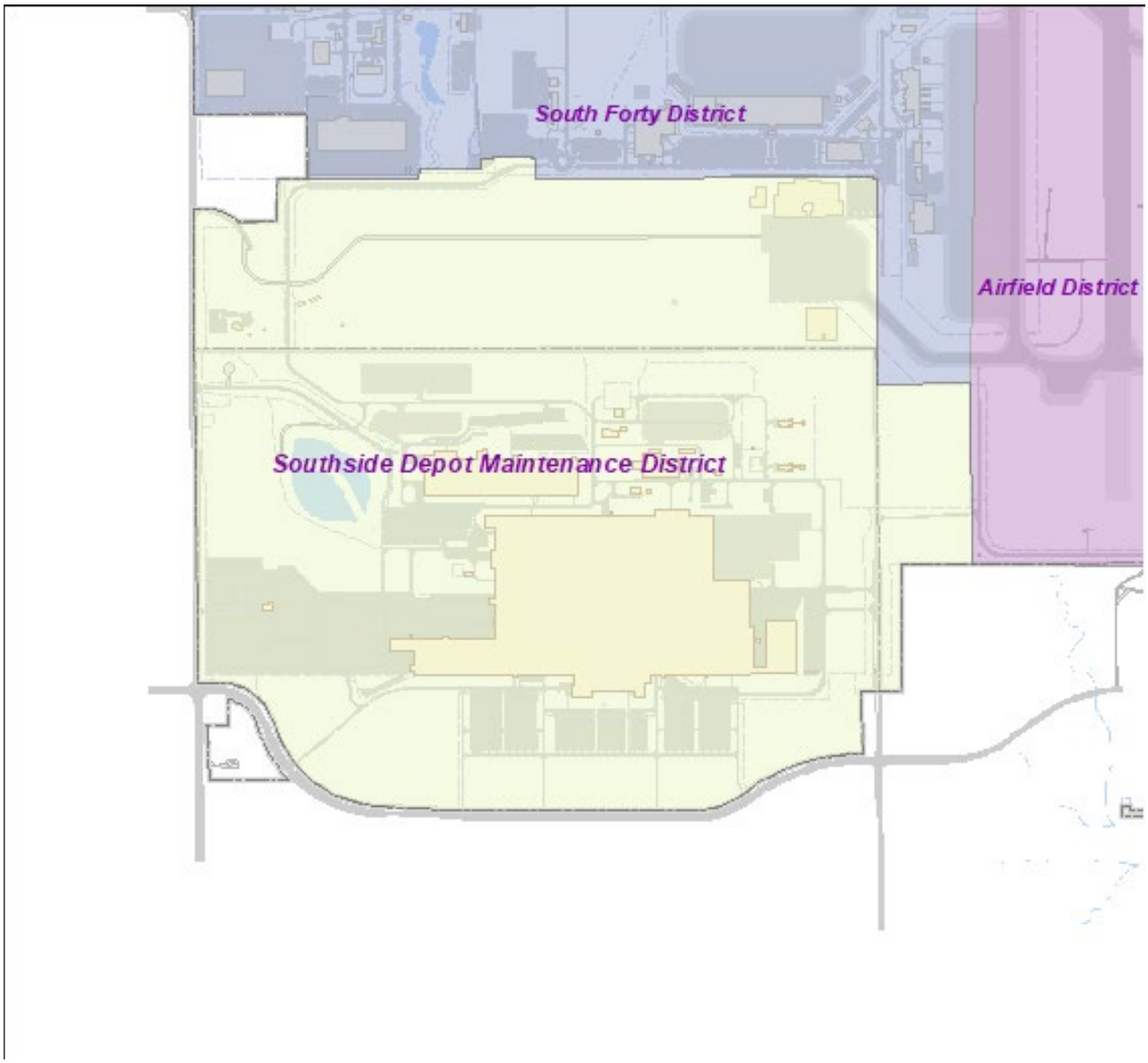
District H– Exterior materials and colors:

Walls
Face Brick color – Match B9001 Brick

Door and Windows
Baked coat finish to match Anodized Dark Bronze

Roofs (Pitched)
Pre-finished Standing Seam
Color to match Sherwin Williams Bronzetone

Roofs (Low slope)
White surface EPDM single-ply membrane – Re: Section 13.5



13.3 Building Design Standards

The requirements of this Architectural Compatibility Plan (ACP) shall be incorporated to project design beginning with the earliest phase appropriate to the project. For all projects, the ACP application begins with pre-design/pre-construction services of programming, design analysis, and site planning. The ACP shall be the basis for all 72 ABW/CE project approvals.

General and specific design standards for all buildings are included in the **Base-Wide** section of this ACP. Base wide standards shall be applied to all projects. The individual **Visual Districts** will provide additional and specific design guidance which will also apply.

The Implementation Section of the ACP outlines key elements to ensure success in designing and constructing excellent facilities. It discusses the traditional design process, highlights the importance of site analysis, and describes the role of the Architectural Engineering Review Panel (AERP). The implementation section defines methods to facilitate the coordination and approval of design submittals.

Finally, the Appendices, References, and Attachments provide additional information including an index; a list of building materials, site amenities, paint colors, and landscape materials; a checklist for the ACRB and project personnel. Follow the established standards found in this section except on building additions or alterations projects where existing materials palettes should be preserved. Use the Appendices in conjunction with the general text of the ACP as a quick reference to specific materials and color specifications.

13.3.1 Base-Wide

Design standards for building and supporting elements are outlined in this section. These standards encourage architectural compatibility through the use of common forms, materials, colors, and architectural details.

The first priority is to achieve architectural compatibility for Tinker Air Force Base as a whole. The second priority is compatibility within an architectural district or sub-area. Outstanding designs for individual buildings or facilities are the third priority. The goal is to design excellent facilities that satisfy all of these priorities.

Tinker AFB has several structures that are 50 or more years old. These structures have been classified as “significant” based on their integrity of architectural style and on their contribution to the history of Tinker AFB. Refer to site map of historically significant Facilities as shown elsewhere within this ACP.

The existing architecture depicts a predominant earth toned color palette. The following design standards are applicable to the entire installation, to both host and tenant organizations. They are based on the existing architecture and encourage contemporary adaptations of the vernacular.

Site planning and site development issues contribute significantly to the architectural context. Building setbacks and the scale and definition of space are fundamental to creating architectural compatibility and consistent façade designs. Features such as esplanades, promenades, parkways, plazas and courtyards create an organizing bond between buildings and the landscape. Achieving compatibility among buildings is essential in creating an Architecture of Community. Develop facilities with a common design theme and character to enhance architectural compatibility. Unity as opposed to conformity is the goal.

13.3.2 Style/Form

Scale - amounts to the relative size of things, and the scale of TAFB is large. Small facilities can be at odds with the scale of the aircraft hangars. Intricate detail on larger TAFB facilities can be overshadowed much like the simple majesty of the runway, and all of its supporting facilities.

13.3.3 Scale

Reduce the monumental appearance of large structures by developing smaller massing components along the ground plane. Recall a human scale in brick facades, belt courses, sills and coping.

13.4 Wall Systems

13.4.1 General

The Department of Defense made mandatory the planning, design and construction requirements as set forth in UFC 4-010-01, *DOD MINIMUM ANTITERRORISM STANDARDS FOR BUILDINGS*. The UFC 4-010-01

requires that all existing and new building wall systems shall meet the Antiterrorism Force Protection requirements of the UFC 4-010-01 as applicable.

13.4.2 Brick

Brick is a desired architectural finish throughout all districts, where applicable, due to its low maintenance needs and its durability. All brick shall be laid in a running bond, with minimum differing brick detail to provide an accent only. The designer shall submit proposed brick colors to the base Architectural Engineering Review Panel for approval. Designers shall give careful attention to matching brick and mortar color for all maintenance and repair projects as well as for new construction projects to assure compatibility with existing facilities. Tinker AFB has used several brick colors throughout the Visual Districts of the base and the AERP will be reluctant to approve additional colors. Refer to the individual Visual Districts for approved brick color for the district.

13.4.3 Architectural Precast Concrete Panels (APC)

APC includes both plant cast and site cast tilt-up panels. Architectural Precast Concrete (APC) panels are an acceptable exterior wall facing material only when used within Visual Districts where existing buildings have used APC panels in the expression of its elevations. Refer to Architectural Districts for Visual Districts allowing use of APC Panels.

APC panels with only a flat smooth finish will not provide an acceptable facing material finish for building elevations. Building designers are encouraged to visually reduce large flat wall areas by re-massing the wall through the use of rustication joints, accent textures, architectural details and color.

Note: The use of Precast Concrete panels as an exterior face material can offer a high blast resistance envelope for a building structure. Precast concrete panels also provides an excellent structural wall system with high blast resistance that can be finished with Brick or CMU veneer systems, or applied Plaster systems. Precast Concrete Panels are an acceptable building material.

13.4.4 Concrete Masonry Units (CMU)

CMU is an acceptable exterior wall facing material only when used within Visual Districts where existing buildings have used CMU in the expression of the elevations. Refer to Architectural Districts for Visual Districts allowing use of CMU. CMU shall be laid in a running bond pattern. Standard smooth finished CMU are not an approved exterior building facing material. Ground Face, Split Face, and Ribbed Split Face CMU can be used as accent bands within exterior elevations of CMU and Brick Masonry. Architectural CMU styles and color must closely match with the CMU of existing buildings within approved Visual Districts. When new CMU colors cannot be matched with existing block color then the Contractor is encouraged to stain block to match existing. Painted CMU is discouraged due to maintenance and general upkeep problems. Mortar color shall match the block color or block stain color.

Note: The use of CMU as an exterior wall facing material can offer a high blast resistance envelope to the building structure. CMU wall systems also provide an excellent structural wall system that other finish wall materials can be applied or veneered over.

13.4.5 Stucco (Exterior Wall Plaster Systems)

Preferred - Traditional three-coat stucco with the finish coat being synthetic-based plaster.

Optional - EIFS (Exterior Insulation Finish Systems)

Stucco and EIFS are **not** a desired wall finish due to maintenance needs and the adverse effects it has due to Oklahoma's weather. The use of this material must be approved through Tinker's Architectural and Engineering Review Board (AER). Stucco will only be used as an accent material to other surrounding or adjacent wall finish materials. However, where the architectural wall massing requires the use of large areas of stucco, the designer is encouraged to provide as a minimum a 30" high masonry wall base for protection from damage by ground equipment.

Note: Stucco finish system over metal stud framing is **not** a desirable exterior wall system due to its low blast resistance.

13.4.6 Prefinished Metal Wall Panels

Prefinished Metal Wall Panels are an acceptable exterior wall facing material only when its use is granted within an individual Visual District. Refer to Architectural Districts for Visual districts allowing use of Prefinished Metal Wall Panels. Limit use to special applications and large industrial facilities where other approved facing materials would either be too heavy or uneconomical for the application. Example: large repair hangar.

13.4.7 Wall Components

Integrate all mechanical, electrical, lighting, and other building components including downspouts into the overall architectural design. Utility components, such as speakers, cameras, and antennae should have their location clearly defined as part of the building design. Exposed conduits, cables, and piping on exterior walls are prohibited. All vents, louvers, grilles, and electrical boxes shall match the surrounding wall color in which they are mounted. Wall-mounted light fixtures must be part of the façade composition. Louvers shall be provided with bird screens.

13.4.8 Applied and Integral Colors

Joint sealants shall match the color of adjacent surfaces. Paint freestanding pipes and above-ground utility systems components Sherwin Williams #7520 Plantation Shutters when in a remote location.

13.5 Roof Systems

13.5.1 Configuration

HQ USAF has published policy directives for the conversion of flat roofs to sloped Prefinished Standing Seam Metal Roofing Systems.
This policy authorizes conversion of built-up roofs to sloped standing seam metal roof systems provided:

- The existing roof needs to be replaced due to its deteriorated condition.
- No functional space is added to the facility.
- The useful life of the facility exceeds the life-cycle economic analysis.
- The selection of the sloped roof system is justified as the most economical method on a life cycle economic analysis.
- Cost-effective repair of existing built-up roofs is the most significant factor driving the conversion to sloped roofs. Where conversion to sloped roofs is not cost-effective repairs, the existing roof shall be replaced with a low sloped roof system that meets the UFC 3-110-03 *ROOFING*.

13.5.2 Standing Seam Metal Roofing Systems (SSMR)

(SSMR) and Structural Standing Seam Metal Roofing Systems (SSSMR) are approved roof systems for use throughout the base. The approved prefinished standard base wide color is "Berridge Kynar" 500 – Aged Bronze unless noted otherwise within a specific Visual District.

Building roof slope where SSMR systems are used should be designed as a complement to the building elevation. However, SSSMR systems for large industrial buildings may be installed with the minimum slope

recommended by the roofing manufacturer.

The approved base wide panel for SSMR and SSSMR systems is 16” wide 24 gauge steel panel, unless the determined roof system is a low slope roof. Structural design will determine the panel widths and gauge for low slope roof SSSMR systems. When specified as a cool roof for sloped roofs 2:12 slope or greater the SRI (Solar Roof Index) must be 29 or greater.

13.5.3 EPDM Single-ply Membrane

EPDM (Ethylene Propylene Diene Monomer) is the preferred low slope roof system. 90 mil white surface membrane is the standard. Warranty shall be 30 year NDL (no dollar limit) with 2” hail warranty. Walk pads should be provided between roof access point and roof top equipment and around equipment.

13.5.4 Built-up Roofing (BUR)

BUR systems are not to be used on new buildings. BUR is to be used only to repair BUR on existing buildings.

13.5.5 Weldable Thermoplastic membrane

Polyvinyl Chloride (PVC) and Thermoplastic polyolefin (TPO) are the approved weldable thermoplastic systems. All Thermoplastic membrane systems must be 72 mil thick or greater, have a 20 year NDL warranty and must have an SRI of 78 or greater.

13.5.6 Parapets: Copings / Cap and Fascia

Kynar 500 or Hylar 5000 pre-finished 24 gauge or greater steel; limited painting will only be allowed with base approval through the AER meetings.

13.5.7 Fascia, Gutters, and Downspouts

Integrate fascia, gutters and downspout design and color(s) to complement architectural details and match or provide complementary color with that of the wall. Sheet metal shall be minimum 24 gauge steel with a PVDF (Kynar 500 or Hylar 5000) finish. Complementary color selection must be approved by AER.

13.5.8 Roof Vents and Elements

Minimize, consolidate and organize roof penetrations. Combine roof vents whenever possible and place them on the least visible slope of the roof. Do not use rooftop mechanical units unless mandatory; screen them when required.

13.6 Entrances

Entrances serve as the transitional element from exterior to interior and provide design opportunities to enhance the facility. The entrance should be the focal point on the façade with its size and architectural detailing used to delineate the relative importance of the building in the community.

13.6.1 General

Define access and the importance of a facility by emphasizing the entryway. Align site access so that the building entrance is clearly visible and highlighted as a prominent feature. Develop the scale of entrances to be consistent with the building using the base’s approved material palette.

13.6.2 Primary Entrances

Provide primary entrances with an overhead enclosure for weather protection. Use columns, arches, and other entrance features as appropriate for the vernacular style.

13.6.3 Secondary Entrances

Reflect the character of the building’s primary entrance at a smaller scale. Provide an overhead enclosure for weather protection.

13.6.4 Handrails and Guardrails

Handrails and Guardrails shall be finished with a powder-coated surface. Integrate handrail and guardrail designs with the facility design. Handrail/guardrail designs shall comply with the requirements of the Architectural Barriers Act (ABA). The approved base-wide color for handrails/guardrails is SW Bronzetone.

13.6.5 Service Entrances and Emergency Egress

Provide unobtrusive service entrances near service drives or parking areas. Weather protection may be excluded at doors used only for emergency access.

13.6.6 Loading Areas/Docks

Minimize visual impact with proper siting and access. Use walls to screen and separate loading docks areas.

13.7 Windows and Doors

13.7.1 Doors and Frames

Use regularly spaced windows to establish contextual rhythms. Window and door frames shall be dark bronze. Sealants applied adjacent to windows and doors should match the color of the frame.

13.7.2 Skylights

Develop clerestories or low profile skylights integrally with the building design.

13.7.3 Security Screens

Electronic security systems are preferred to physical screens or bars.

13.8 Ancillary Structures

13.8.1 General

Promote continuity in outdoor spaces and reduce visual clutter by designing compatible ancillary structures. All outbuildings should be of a consistent design, reflecting the character of the surrounding architecture. They shall follow the design criteria of the area, relying on the surrounding area for materials, color and details. Integrate the structure with landscaping.

13.8.2 Bus Shelters

Coordinate the placement of bus shelters with landscaping and other site elements.

13.8.3 Kiosks

Use to display community flyers for upcoming sales and events. Design kiosks with metal roofs, brick, and concrete details compatible with surrounding architecture.

13.8.4 Pavilions

Organize pavilions to create gathering areas with an internal focal point. Minimize the number of pavilions in the main Base area. Centrally locate pavilions between several facilities for multipurpose use.

13.8.5 Bike Storage Structures

Bike storage structures should match the materials of the adjacent facility.

13.8.6 Arbors / Trellises / Pergolas

Use arbors, trellises, and pergolas to integrate landscaping into community seating areas. Incorporate a place for notes and flyers when applicable. Design these elements with materials and details that are compatible with

the surrounding architecture. Incorporate these elements into the building designs when appropriate.

13.8.7 Seating Walls

Incorporate seating walls in plazas, courtyards, and high-use sites. Design wall caps and copings to accommodate seating or provide freestanding seating. Integrate seating walls with landscaping.

13.9 Landscaping

Use consistent landscaping to unify the base and enhance the appearance of individual facilities.

13.9.1 Maintenance

Select low maintenance plant materials. See Attachment “A” Tinker Native Landscaping Plant Material List for approved plant materials. Allow shrubs to mass naturally and avoid ornamental pruning.

13.9.2 Formal Planting

Use formal plantings along all primary roads, entrance gates and high visibility sites. Create formal planting by regular spacing and symmetrical layout. Provide accent plantings at main intersections to enhance the circulation network without blocking lines of sight. Consistent recurring plantings contribute to the Base’s identity.

13.9.3 Informal Planting

Use mixed species in an informal planting style for community facilities and residential settings. Design randomly spaced plantings and tree massing. Reinforce pedestrian routes with informal landscaping to add user appeal.

13.9.4 Ground Cover

Use turf in heavily used pedestrian areas, such as recreation fields, parade grounds, and formal lawns.

13.9.5 Edging

Separate and define all planting areas from sod areas with edging.

13.10 Screens and Enclosures

Screens and enclosures help to minimize the visual impact of undesirable features and provide separation and security where necessary. Both architectural and landscape screens – separately and in combination – can be applied to achieve visual continuity throughout the base

13.10.1 General

Locate utility components in the least visible area with adequate access to minimize the need for screening and enclosures. Ensure screens are high enough to conceal equipment, vending machines, and utilities.

13.10.2 Landscape Screens

Reduce the negative visual impacts of parking areas and other unsightly features with landscape screening. Where possible, use landscaping instead of walls for screening. Use a three-tier landscaped screen that combines ground covers, shrubs, and small trees. Use shrubs and landscaped berms to soften the impact of parking areas.

13.10.3 Walls

Use walls to screen utility equipment. If adjacent to a structure, coordinate with the facility's wall material and color.

13.10.4 Dumpster Enclosures

Locate dumpsters to minimize visual impact. For new facilities, construct enclosures as part of the building service area. Design enclosures to include planting areas and pedestrian access. Provide concrete pads and concrete access pads in front of enclosure.

13.10.5 Fencing

Fencing and screening on Tinker AFB is used primarily for security purposes and visual screening. Great care shall be given to screening considerations. Properly designed screens should not draw attention and should be used minimally.

13.10.6 Split Rail Fencing:

Cedar split-rail fencing is acceptable to separate natural and/or park-like areas from areas of higher maintenance. Fencing shall be 3-rail style, standard weight (also called jumbo weight) with posts 6.5' long; 18" minimum girth and rails 8' long; 12" minimum girth.

13.10.7 Chain Link Fencing:

This type of fencing is acceptable in the housing area and for perimeter security fencing.

13.10.8 Brick and Wood Fencing:

Wooden fences are acceptable for screening when used in conjunction with brick columns. The style, configuration, height, and finish shall be approved by the Base Architectural Compatibility Manager. Brick color shall match the district's color scheme. Each brick column shall have a cast stone or pre-cast concrete cap. For shorter lengths of fencing the brick shall not only be used as columns, but on at least the bottom 2' of the fence as well.

13.10.9 Brick and Wrought Iron:

Wrought iron with brick columns and brick at the bottom 2' shall be used when the fence is intended for minimizing accessibility to a site, and not primarily to screen an area. All fencing shall be at a height to visually screen all intended materials and equipment. If fence height exceeds 6'- 0", landscaping shall be employed to visually reduce the perceived height of the fence.

13.10.10 Force Protection

Observe force protection requirements, integrating physical measures with architecture. Integrate security walls with the building design. Use a combination of brick and wrought iron in walls, gates and screens.

13.11 Roads

13.11.1 Service Drives

Maintain a minimum 33-foot setback between the building and service drive. Minimize the visual impact of service drives through correct placement of drives and landscape screening.

13.11.2 Paving

Provide asphalt for most roadways. Provide concrete paving in loading areas and sites used by heavy vehicles. Use gravel for patrol and outlying roads.

13.11.3 Curb and Gutter

Provide concrete curbs and gutters for all roads and drives as required. For patrol roads and service drives in outlying areas, curbs and gutters may not be required.

13.12 Parking

13.12.1 General

Develop functional lots with clear circulation and a positive appearance that complements the facility. Provide a pleasant transition from the parking lot to the facility. Parking layout must address maintenance issues including safety and landscaping. Use a 90-degree parking configuration when possible. Coordinate layout for the light poles with the islands. Use the minimum number of light poles to provide the required illumination.

13.12.2 Setbacks

Maintain a 20-foot setback from streets where possible. Provide a 33-foot minimum separation between building and parking areas.

13.12.3 Reserved Parking

Where required, use curb mounted signs. Consolidate reserved parking into sections instead of having individual spaces.

13.12.4 Paving

Provide asphalt paving as the standard. Use concrete where required for heavy vehicles, motorcycle parking, and where fuel spills may occur.

13.12.5 Curb and Gutter

Use concrete curbs and gutters for parking areas. Asphalt curbs, wood timbers and precast wheel stops are prohibited.

13.13 Walkways and Paths

13.13.1 General

Develop a consistent pedestrian circulation system of walkways and paths to enhance the community environment. Connect bus shelters, outdoor pavilions, parks, and other pedestrian gathering sites into the overall circulation network.

13.13.2 Paving

Provide broom-finished concrete walks in all developed areas. Use an asphalt or crushed-fine surface for jogging and bike paths.

13.13.3 Walkway and Path Layout

Keep sidewalks back 6 to 10 feet from the curb where conditions permit. Design curvilinear paths in recreational areas, dorms, housing and open areas.

13.13.4 Ramps and Crosswalks

Construct concrete curb ramps with a parallel tooled joint pattern. Use flared curb ramps.

13.14 Signs

13.14.1 General

All signs shall comply with UFC 3-120-01 *DESIGN: SIGN STANDARDS*.

Signs are an important and positive element in the overall base appearance. Their purpose is to clearly communicate necessary or helpful information for directions, identification and customer service without adding visual clutter.

All traffic control signs shall comply with Better Military Traffic Engineering, SDDCTEA Pamphlet 55-17

Use concise, clear signing in accordance with Air Force Sign Standards. Minimize the number of signs used for each facility. Signs must be consistent in style, placement, color and language.

13.14.2 Color

All exterior signs shall be brown with reflective white letters, unless in the Navy Area, where machine blue shall be used. All painted frames shall match as closely as possible 3M Company, Scotchlite, #3680-29, Russet Brown, unless in the Navy Area to match the blue as existing. Existing exterior signage that does not comply with base standards shall be replaced as needed, due to wear.

13.14.3 Typeface

Use Helvetica Medium, upper and lower case, for primary information and Helvetica light for secondary information. For special identification signs used with community facilities, key intersections, and entrances, consider a serif typeface.

13.14.4 Identification Signs

Use these to identify installation entry gates, facilities, housing areas, and building numbers. Use monument signs at entry gates, headquarters, housing, and special facilities with ACRB approval. Facility identification signs are generally freestanding. Avoid mottoes or individual titles on identification signs.

13.14.5 Direction Signs

Use to identify highly frequented or special interest destinations and street names.

13.15 Site Furnishings

13.15.1 General

Site furnishings shall provide comfort and service to the users of the pedestrian system and outdoor spaces. The furnishings must be located in response to the need of users and have a consistency of design. Designers shall strive to achieve compatibility of site elements within each district. When no apparent consistency exists,

the designer shall coordinate material selection with the Base Architectural Compatibility Manager.

13.15.2 Seating / Benches

Provide seating along walkways, near building entries and in courtyards. There is an approved bench style available on GSA schedule. To meet TAFB standards purchase in brown.

13.15.3 Picnic Tables

There are approved picnic tables in both rectangular and hexagon shapes. These meet EPA guidelines and are available on the GSA schedule in recycled material. To meet TAFB Standards, purchase in brown.

13.15.4 Freestanding Planters

Minimize the use of freestanding planters, unless used as part of a security measure to define established setback distances from a facility.

13.15.5 Bike Racks

Place bike racks in accessible locations along established bike routes and nearby secondary building entrances. Use a bollard-style bike rack that can accommodate a minimum of two bicycles. Align bollards at sites to provide multiple racks.

13.15.6 Barbecue Grills

Limit built-in barbecue grills to recreational areas, dormitories, and fire stations. Use materials that complement adjacent facilities. Locate pedestal-mounted grills near pavilions, parks, and recreation areas for convenience and greater use.

13.15.7 Bollards

For force protection use an 8-inch diameter, concrete filled, steel pipe bollard with a domed top, minimum four feet high. The standard finish color is OSHA Yellow with 2 strips of 2” wide white reflective tape, 2” from the top and 2” between them. Embed pipe four feet in concrete footing unless bollard is located on airfield paving. In that case, provide ¾” thick base plate with four 5/8” wedge anchors embedded 5”.

13.15.8 Drinking Fountains

Use a vandal-resistant, winterized, surface-mounted, handicapped-accessible metal fountain.

13.15.9 Playground Equipment

Locate playground equipment at recreational areas, family housing areas, child development centers, and youth centers. Incorporate landscaping to provide shade and seasonal color. Provide safe play surfaces, such as Safe-deck. Provide adjacent seating for supervision. Use a consistent style throughout the base.

13.15.10 Flag Poles

Use a brushed aluminum pole, mounted on a concrete base.

13.16 Exterior Lighting

Exterior lighting is a system that has direct and indirect impacts on the visual qualities of the Base. During the day the fixtures and poles are visible. At night the light becomes dominant to provide safety and security and to enhance the visual character of the Base. The use of consistent lighting components and the reduction of overhead utilities will help unify the base appearance.

13.17 Site Utilities

13.17.1 Utility Lines and Structures

Place utilities underground and screen above-ground equipment to minimize their visual impact. Exposed

conduits, cables, and wires are prohibited. Construct underground utility system components as elements of any new or renovated facilities. When this is unfeasible, locate screened equipment on the least visible side of the building.

13.17.2 Fire Hydrants

Locate fire hydrants in accordance with NFPA 24 unless modified by UFC 3-600-01 *FIRE PROTECTION ENGINEERING FOR FACILITIES*. Maintain clearance around hydrants in accordance with NFPA 1 unless modified by UFC 3-600-01.

13.18 Visual District Standards

This is a long-term expression of a military installation's compatibility. Over time, buildings aggregate around a neighboring mission or function, and share functionality as well as utilities, materials, and colors. Their quality of design and construction become apparent with ensuing years of service. Facilities' adaptability and quality of preservation determine their importance in maintaining the visual image of TAFB districts among generations of personnel and commands.

13.18.1 Implementation

The ACP is a multipurpose tool that shall be used throughout the entire planning, programming, and design process, from inception to project completion for any project on Base.

The ACP is implemented by the Base Civil Engineer.

While architectural designers are the primary users of the plan, it must also be used by project managers, programmers, planners, engineers, maintenance and operations personnel, self-help personnel, SABER personnel, and the Architectural Compatibility Review Board (ACRB).

In the next three pages, key elements in the implementation process are highlighted.

Any items purchased for the exterior of buildings – including those purchased with impact cards – must conform to the colors prescribed in the ACP.

13.18.2 Key Elements

Adhering to key elements of the implementation process leads to success in designing excellent facilities that will be compatible with and a part of the whole community.

Distribute the ACP.
Establish the Architectural Compatibility Review Board (ACRB).
Hire good designers.
Respect the General Plan.
Process proper submittals.
Cross-reference all planning and design documents to the ACP.

13.18.3 Distribute the ACP

Distribution of the plan should be as wide as possible. On Base, provide copies to commanders of all major units and tenants, the Civil Engineering Directorate, branch chiefs, Base architect, and community planner. Provide copies to the major command and headquarters representatives. The Public Affairs Office maintains extra copies for general distribution, distinguished visitors, and other guests.

13.18.4 Architectural Engineering Review Panel

The AERP is the installation approval authority for all designs and visual features on the installation.

The AERP is organized by the Base Civil Engineer (BCE). The BCE is the chairperson unless otherwise assigned. Members include the Base architect, community planner, chief engineer, and others as determined by the chairperson. The Base architect reviews designs regardless of AERP involvement. The AERP meets as required or as a subgroup of the installation Facilities Board (FB). Most projects, regardless of size are approved by the AERP. The chairperson makes the determination on review requirements. Design projects are submitted to the AERP by the Base-assigned project manager. Project managers are encouraged to submit

projects to AERP early in the design progress.

13.18.5 Respect the General Plan

All new projects must agree with the goals and objectives outlined in the installation master plan to ensure that the siting of new projects is compatible with adjacent facilities.

13.18.6 Process Proper Submittals

All design projects are reviewed by the AERP. This includes Requirement Documents, Concept Design and Final Design submittals. Submittals shall include all the required information and data at the appropriate times and the process shall allow adequate review time.

13.18.7 Requirements Document

In the initial submittal, the A-E defines with the help of the AF the requirements for the project. It may explore potential solutions, but more importantly, it includes bubble diagrams depicting the relationships of major functional elements and site/facility development options. This submittal is reviewed by the AERP.
Each submitted package will include the following:

Scope/Programming Requirements
Project Description
Goals and Objectives
Sub-area Development Plans
Site Inventory/Site Analysis
Spatial Relationship Analysis (i.e. relationship to site)
Adjacent Facilities and Project Site Photos
Site Inventory/Site Analysis includes but is not limited to, vehicular traffic patterns, view, climatic conditions, environmental safety, utility constraints, and geographic conditions.

13.18.8 Bird Nesting Prevention

Refer to Appendix F for Bird Proofing Facilities.

13.18.9 Concept Design

This submittal must include adequate information to fully describe the project design, allowing customers/clients to easily comprehend the proposed solution. The goal is to achieve AF customer understanding and approval early in this process. Multiple submittals may be required for large or complex projects. Generally, completion of the concept design requires two submittals. The initial submittal presents a conceptual approach to the solution, while the final submittal presents a refined and more detailed design. These submittals shall be design presentation documents rather than construction documents. Develop a site plan, floor plans, roof plans, and building elevations concurrently to ensure the proposed solution is a comprehensive design. Floor plans must be developed with consideration of the site and building massing.

The AERP reviews the packages as part of the concept development process. If the initial submittal is rejected, or there are significant concerns or comments, a resubmission is required prior to proceeding to the next design stage.

Each submittal will be comprised of a complete comprehensive package including:

Concise Verbalized Design Concept
Systems Description
Adjacent Facilities and Project Site Photo
Site Plan and Floor Plan(s)
Roof Plan
Composite Elevations
Mechanical / Electrical Communications Entrances and Equipment Locations and configurations
Building Sections
Massing Sketches or Perspective Sketches
Cost Estimate

13.18.10 Final Design

The final design shall demonstrate that the project remains consistent with the approved concept design. It includes highly developed drawings that further refine and detail the visual and functional quality of the design. Each submittal will be comprised of a complete comprehensive package that includes, without being limited to:

Formal Colored Rendering
Material / Color Boards (interior and exterior)
Catalog Cuts (photos)
Design Analysis
Cost Estimate
Construction Documents

13.18.11 Contract Documents (CDs)

Contract Documents must include comprehensive drawings in AutoCAD and specifications to ensure that a project can be constructed to meet all the requirements and standards defined by the ACP and review directions given by the AERP. All mechanical and electrical drawings must be consistent with the architectural drawings.

13.18.12 ACRB Project Checklist

All projects and service contracts are to be reviewed by the ACRB using the checklist included in this guide. The Base project manager is responsible for providing the design checklist to the ACRB for completion.

13.19 Project Checklist

Project Checklist

This checklist applies to all projects large and small including self-help projects. Before building, purchasing, or installing items, the project manager will submit the following documentation for review and approval by the Architectural Compatibility Review Board (ACRB). Large projects requiring professional design services must submit this form along with the design package at each phase of the project. The list of items below the phase title is representative of what must be submitted at each phase. Project continuation is contingent on phase approval. Smaller projects not requiring full design services must submit project documentation as designated by the ACRB chairperson. All projects must comply with the ACP standards as verified by this checklist and the ACRB, unless a specific exception is approved by the chairperson.

Project Title: _____

Project Number: _____ **Project Address:** _____

Submitted by: _____

ACP Provided to Designer? ☐ **Yes** ☐ **No**

Programming Documents Reviewed by ACRB? ☐ **Yes** ☐ **No**

REQUIREMENT DOCUMENTS

- ☐ Scope
- ☐ Goals
- ☐ Site Inventory / Site Analysis
- ☐ Coordinated with Subaru Development Plans
- ☐ Coordinated with Other Planning Documents and Policies
- ☐ Preliminary Solutions Allow for Full Compliance of ACP (design not finalized until concept design complete)
- ☐ Project Description
- ☐ Objectives
- ☐ Adjacent Facilities Photos
- ☐ Future Project Considerations
- ☐ Other: _____

CONCEPT DESIGN

Building

- ☐ Style / Form
- ☐ Proportions
- ☐ Wall Systems
- ☐ Lighting
- ☐ Entrances
- ☐ Scale
- ☐ Materials
- ☐ Details
- ☐ Signs
- ☐ Windows / Doors
- ☐ Massing
- ☐ Colors
- ☐ Ancillary Structures
- ☐ Roof Systems

Site Development

- ☐ Siting
- ☐ Lighting
- ☐ Furnishings
- ☐ Setbacks
- ☐ Signs
- ☐ Landscaping
- ☐ Utilities
- ☐ Screens / Enclosures
- ☐ Future Expansion Considered

Circulation

- ☐ Roads
- ☐ Lighting
- ☐ Parking
- ☐ Paths / Walks
- ☐ Signs
- ☐ Landscape
- ☐ Other: _____

FINAL DESIGN

- ☐ Final design remains consistent with approved concept design and elements listed above
- ☐ Materials / Color Board (interior and exterior)
- ☐ Rendering
- ☐ Catalog Cuts
- ☐ Architectural Details
- ☐ Landscape Development
- ☐ Construction Documents
- ☐ Fascia / Gutters / Downspouts
- ☐ Cost Reduction Proposal (if necessary) Comply with ACP
- ☐ Coordinated with Other Planning Documents and Policies
- ☐ Coordination of Mechanical and Electrical Elements
- ☐ Other: _____

JUSTIFICATION FOR NONCOMPLIANCE

Explain: _____

_____

_____

_____

Design Does Not Comply with ACP Standards

By: _____

Date: _____

14. Interior Design

14.1. Program Components

A holistic approach to facility design should be taken to be seen as a balance between physical requirements and aesthetic ambiance so that occupant needs can be met. A comprehensive Interior Design Policy achieves this by improving quality of life, increasing productivity and protecting the health, safety, and welfare of facility occupants. Comprehensive Interior Design (CID) shall encompass the entire facility's interior environment to include not only furnishings and artwork but also structural interior design (SID) components such as building finishes, cabinetry, window treatments, graphics, signage, furniture, lighting, artwork and plants. Comprehensive Interior Design shall be an integrated part of the programming and design criteria used for the design, construction, and maintenance of all TAFB facilities.

14.1.1 The goal of this Chapter is to ensure that the interior appearance of each facility is based on well-established design standards and integrated design effort on the part of the designer.

14.1.2 TAFB interior design references UFC 3-120-10 *INTERIOR DESIGN*.

14.1.3 Further assistance may be obtained from the Tinker AFB CID Manager:

72 ABW/CE
Office of CID Manager
7535 5th Street
Building 400
Tinker AFB, OK 73145
(405) 734-2869

14.2. Specifications

Unified Facilities Guide Specification (UFGS) standard specification shall be used for all finishes.

http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs

14.3. Interior Finish Guidelines

Ease of maintenance is a critical factor in selection of interior finishes. TAFB policy is to use durable and low maintenance finishes appropriate for the function of the space. Neutral colors with medium-range muted or subdued accents shall be used for all SID finishes, except in certain MWR and distinguished visitors (DV) areas, where it is acceptable to introduce primary accents through artwork, furnishings and plants.

14.4 Carpet Policy

14.4.1 Air Force Furnishing Commodity Council (AF FCC) established a standardized set of carpet requirements with Tier I (pre-approved product vendors) and Tier II (installation vendors). The 72 ABW CE office will follow the guidelines for Tier I contracts and has created a Blanket Purchase Agreement for Tier II vendors. This is a mandatory-use policy for the procurement of carpet for Air Force installations.

14.4.2 All carpet tile specified for installation on Tinker Air Force Base shall be Solution/space dyed nylon for maximum range of color selection, and shall feature permanent stain resistant technology refer to ETL 07-4 AF for further information and specifications.

14.4.3 All work shall be performed by Contractors/installers who are CFI Certified Floorcovering Installers (International Certified Floorcovering Installer Association) or manufacturer's approved installers.

14.4.4 Foremen on the jobsite must be "Certified C-II Minimum". Install all carpet in accordance with the installation guidelines set forth by the manufacturer and/or the guidelines set forth in CRI 104 -2002, Standard for Installation Specification of Commercial Carpet.

14.4.5 Provide a soil walk-off area for carpet in entry area and elevators- it will collect dirt before it reaches the carpeted area.

Note: It is Tinker's preference to restrict the use of carpet as a floor finish. The Designer, in the selection of floor finishes, shall give consideration to: appropriateness, occupancy duration, space,

acoustical needs, durability, maintainability, environmental impact, and life cycle cost.

14.4.6 Standard Carpet Policy allows patterned carpet only, regardless of area size, except in those facilities/areas indicated below:

- Medical facilities
- Computer areas
- Chapels and religious facilities Designated DV areas, or transient quarters

14.5 Suspended Ceiling Systems

Conference Rooms:

General requirements: Good acoustics, Humiguard plus performance, non-sag, anti-mold, anti-mildew, anti-bacterial, 30 year warranty (when used with Armstrong suspension systems).

Cirrus 584 2'x2'x ¾" Tegular edge mineral fiber.
NRC: .70
CAC: 35
Light reflectance: .86

Reception Areas:

General requirements: Upscale visual, good acoustics, Humiguard plus performance, non-sag, anti-mold, anti-mildew 30 year warranty (when used with Armstrong suspension systems).

Ultima 1910 2'x2'x3/4" Tegular Edge mineral fiber.
NRC: .70
CAC: 35
Light reflectance: .90

General Use Areas:

General requirements: Upscale visual, modest price, Humiguard plus performance, non-sag, anti-mold, anti-mildew 30 year warranty (when used with Armstrong suspension systems).

Dune 1774 2'x2'x5/8" Tegular Edge mineral fiber.
NRC : .50
CAC: 35
Light reflectance: .83

Restroom/ Locker Rooms:

General requirements: Humiguard Max superior resistance to sagging in high humidity conditions including standing water and outdoor applications. (Suspended Ceiling Systems in Restrooms/ Locker Rooms are not recommended. Can only use with Base Approval)

Fine Fissured Ceramaguard 608 square edge mineral fiber
NRC: .55
CAC: 40
Light reflectance: 82%

NRC – Noise Reduction Coefficient – Overall Sound
CAC – Ceiling Attenuation Class – Airborne Sound

14.6 Standard Restroom Design and Finishes

14.6.1 Standard Restroom (all occupancies other than Factory occupancy)

14.6.2 Refer to UFC 3-420-01, *PLUMBING SYSTEMS* for fixture requirements per occupant type and number. This UFC provides guidance in the design of plumbing systems, together with the criteria for selecting plumbing materials, fixtures, and equipment and is applicable to all elements of the Department of Defense (DoD) charged with planning military construction.

14.6.3 Note: Occupants under labor union contract may require toilet room facilities designed to meet

requirements as set forth in latest OSHA 1910.141.

14.6.4 Paint – Furrdowns – Sherwin Williams – Extra White SW-7006 –eggshell / Promar 200

14.6.5 Paint – Doors & Trim – Sherwin William - Cityscape SW 7067 – Alkyd Enamel Satin

14.6.6 Countertop - Corian Platinum solid surface

14.6.7 Cabinetry - Plastic Laminate – Wilsonart Windswept Pewter 4795-60

14.6.8 Toilet Partitions – HDPE – Floor-Mount Overhead Braced Scranton –-Glacier Grey

14.6.9 Wall Tile – Dal-Tile – Desert Gray – X714 – Matt

14.6.10 Wall grout – Custom Building Products Prism 546 Cape Gray (conforms to ANSI 118.7

14.6.11 Floor Tile – Crossville – Graphite / slate – 12" x 12" Cut tile for base

14.6.12 Thin set –Custom Building Products FlexBond - conforms to ANSI A118.15

14.6.13 Floor Grout – Custom Building Products Prism conforms to ANSI 118.7 - #19 Pewter 3/16" grout joint

14.6.14 Tile Installer Qualifications: Company performing the tile work shall have a minimum of five years documented experience. Installer is required to be a member of the National Tile Contractors Association (NTCA) or a member of the Tile Contractors' Association of America (TCAA). Installer to employ certified installers or installers recognized by the US Department of Labor as Journeyman Tile Layers. Provide a layout plan, prior to starting work. When installing ceramic tile cove base use the flush installation method.

14.7 Toilets in Industrial Areas (All areas on the base other than administrative spaces):

14.7.1 All floors shall be low VOC epoxy non slip surfacing.

14.7.2 All walls shall be fiberglass faced gyp board, with Fiberglass Reinforced Panel (FRP) to ceiling height, with all appropriate trim pieces, inside, outside, and bullnose, coved base to produce a sanitary installation.

14.7.3 All ceilings shall be fiberglass faced gyp board with flat finish, with stainless locked access doors to valves.

14.7.4 All partitions shall be stainless steel or solid phenolic plastic, floor supported, overhead braced.

14.7.5 All countertops shall be solid phenolic plastic, or artificial stone, with flush Vitreous China (VC) lavatories.

14.7.6 All mirrors shall be stainless framed individual units.

14.7.7 Life cycle cost consideration should be given to blade style (Dyson) hand dryers.

14.7.8 Urinals shall have integral infra-red operation mounted to the unit, not separate from the urinal.

14.7.9 Lavatories shall have infra-red operation.

14.7.10 All wall and ceiling coatings shall be antibacterial.

14.8 Toilet Room Accessories

14.8.1 Toilet Paper Dispensers – Kimberly-Clark #09551 Dual Jumbo Roll Tissue Dispenser.

14.8.2 Paper Towel Dispensers – Kimberly-Clark #09990 SaniTouch universal roll towel dispenser.

14.8.3 Soap Dispensers – GoJo #5255-06 2000 Foam soap dispenser, and if required, GoJo 7500 Pro 5000 grit soap dispenser.

Note: The above items are provided by service contract to the Base.

14.8.4 Sanitary Napkin Receptacles – AJ Washroom Accessories #U582 Surface Mounted Stainless Steel #4 Satin finish.

14.8.5 Toilet Seat Cover Dispensers – Gamco TSC-1 Toilet Seat Cover Dispenser, Stainless Steel #4 satin

finish.

14.8.6 Utility Shelf & Hook Strip – AJ Washroom Accessories #UJ30B Stainless Steel #4 Satin Finish.

14.8.7 Grab Bars – AJ Washroom Accessories #UG3 Stainless Steel #4 Satin Finish.

14.8.8 Trash Receptacles – Gamco #WR-12 Stainless Steel #4 Satin Finish with top, 21 gallon capacity, or if recessed is required Bobrick B-3644.

14.9 Air Force Facility Guidelines for Interior Design

The Air Force has designated facilities into Groups 1-4 organized by the type of use; the visual character and detailing of systems, materials and finishes in Group 1 facilities may be more refined than those in Group 2. Group 2 may be more refined than Group 3. Group 4 is for residential applications and is not covered in this standard.

Facility Groups by Type:

14.9.1 Facility Group 1 – High Visibility Buildings

Design high-visibility buildings using features, materials and details that represent Group 1 as the most prominent facilities on an Installation. Create an architectural character using refined detailing, but avoid excessive ornamentation.

- Headquarters
- Wing/Group
- MAJCOMs
- Numbered Air Force
- Name/Numbered Division
- Unified Combatant Commands
- Entry Control Facilities
- Chapels
- Hospitals and Clinics

AFCFS

Acceptable Range of Facility Designs

Group 1 - Interiors

Too Elaborate

Ensure that daylighting and other features are life cycle cost effective. Avoid unnecessarily complex patterns and elaborate materials. Access to private outdoor balconies from personal offices is discouraged.

Acceptable Range

Provide open-plan configurations for office, administrative, operational and related activities and spaces for maximum flexibility. Use more durable long-lasting finishes in core areas for walls, ceilings, floor coverings and built-in casework reflecting Group 1. Limited focus areas may receive material and detailing accents.

Underdeveloped

The visual character and detailing of systems, materials and finishes in Group 1 facilities should be more refined than those in Groups 2, 3 and 4.

14.9.2 Facility Group 2- Professional Image Buildings

Provide building designs that are less prominent than Group 1. Create a visual character that represents a professional image using moderate detailing; avoid excessive use of architectural features and extravagant materials.

- Squadron Operations
- Alert Crew Facility
- Base Operations
- Civil Engineer Administration Facility
- Weather Squadrons
- Air Passenger Terminal
- Air Traffic Control Tower
- Flight Simulators
- Educational/Training Facilities
- Administration Facilities
- Dormitories
- Lodging
- Enlisted Personnel Dining Facilities
- Community Facilities
    - Recreational Facilities
    - Fitness Centers
    - Clubs
    - Libraries
    - Theaters
    - Youth Centers
    - Golf Clubhouses
    - Child Development Centers
    - Bowling Centers
    - Family Camps
    - Outdoor Recreation Equipment Rental
- Skills Development / Auto Hobby Shops / Carwash

AFCFS

Acceptable Range of Facility Designs

Group 2 - Interiors

Too Elaborate

Avoid elaborate designs, features and details that compete with Group 1. Large monumentally scaled lobby spaces are discouraged.

Acceptable Range

Design interiors that are less prominent than Group 1. Create a visual quality using moderate detailing to reflect Group 2; avoid excessive use of design features and extravagant motifs.

Underdeveloped

Relate the visual quality of finishes to Group 2; visual character and detailing of systems and materials should be less refined than those in Group 1, but must present a professional appearance. Avoid unorganized elements and clutter.

14.9.3 Facility Group 3 – Highly Durable Buildings

Provide building designs using highly durable materials and modest detailing to endure heavy wear and frequency of use. Understated architectural features and simplified detailing may be used at main entrance facades.

- Hangars
- Petroleum Ops Bldg
- Aircraft/Helicopter Maintenance Facilities
- Vehicle Maintenance Facilities
- General Purpose Maintenance Shops
- Civil Engineer Shops
- Supply and Storage Facilities
- Warehouse Facilities

AFCFS
Acceptable Range of Facility Designs

Group 3 - Interiors

Too Elaborate

Provide an appropriate visual character and detailing of systems, materials and finishes in Group 3 to reflect industrial use and that is less refined than Group 2. Avoid decorative permanently built-in elements and accents

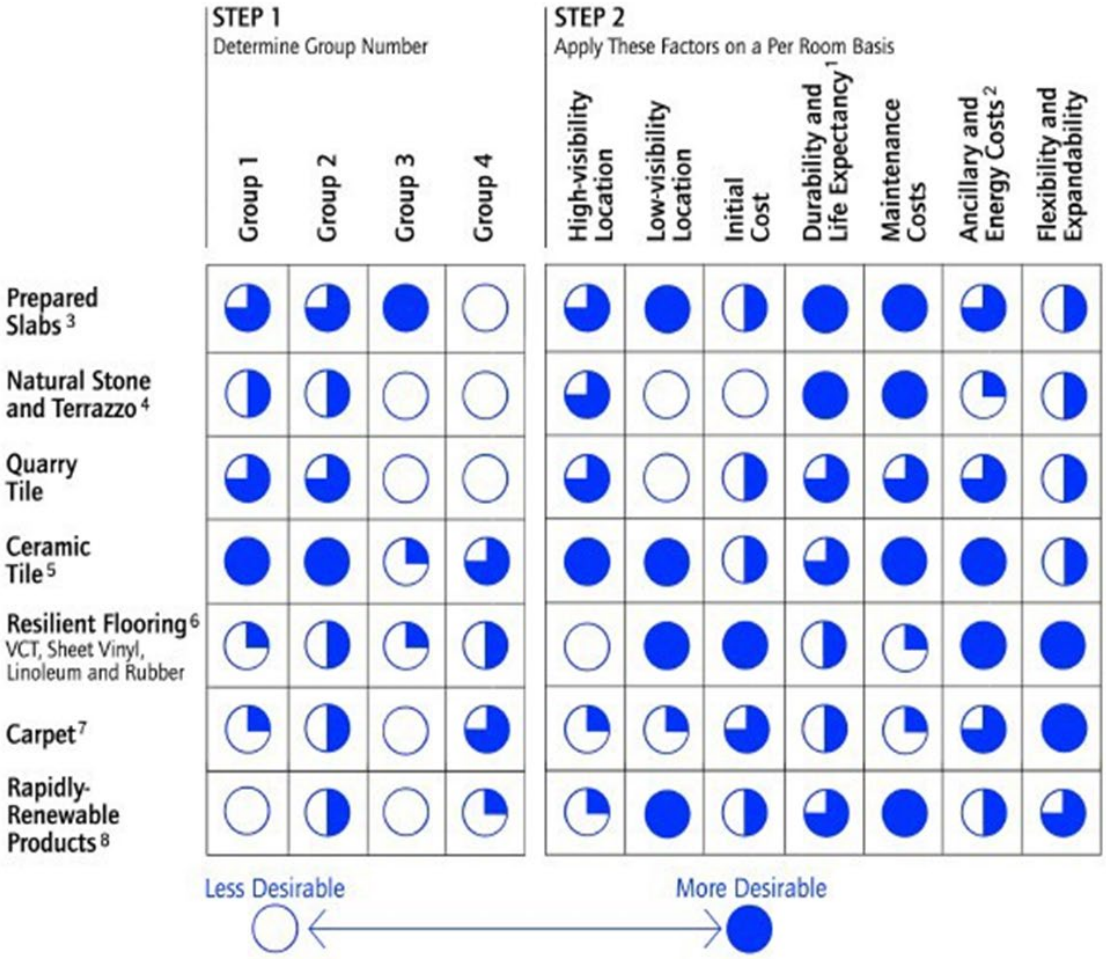
Acceptable Range

Provide highly durable interiors with modest detailing to endure heavy wear and frequency of use. Understated architectural features and simplified details may be used at main entrance lobbies.

Underdeveloped

Ensure economical, easily cleanable and low maintenance features and elements without compromising a professional appearance. Avoid uncoordinated elements and clutter. Do not paint exposed equipment, piping, etc. bright colors, but match the color of the roof (or floor) decking.

Floors Standards Chart



Material selections must include appropriate regional and climatic considerations, availability of qualified trades, and energy use associated with material production and transportation. All selections must comply with Installation Facilities Standards (IFS).

[1] Include durability considerations in the Life Cycle Cost Analysis
[2] Consider costs of other systems required by the material; consider materials that contribute to energy efficiency
[3] Stained or ground-and-polished concrete slabs are permitted in Group 1 and 2 and high-visibility locations; sealed concrete slabs are preferred for Group 3 facilities
[4] Terrazzo is permitted only in high-traffic areas subject to extreme wear and when life-cycle cost effective
[5] Tile is preferred in high-traffic and wet locations only
[6] Rubber flooring (sheet goods and tile) is preferred for stairs and special applications such as fitness areas; linoleum may be used in break rooms
[7] Carpet may be broadloom or tiles; tiles are evaluated for flexibility
[8] Bamboo and cork may be used in low-traffic areas; wood (considered "rapidly-renewable" by some industries) may be used in gymnasiums and in Family Housing; linoleum may be counted as a "rapidly renewable" material

14.10 Design Proposals

14.10.1 All project interior design proposals shall be IAW all requirements of the Standard and be subject to the review and approval of the TAFB Comprehensive Interior Design Manager, 72 ABW/CE.

14.10.2 Use the Standard format for both Comprehensive Interior design (CID) and Structural Interior Design (SID) submittals. All color boards and FFE shall be submitted according to UFC 3-120-10 *INTERIOR DESIGN* format.

14.11 Color Boards

14.11.1 Material warranties and product maintenance information shall comply with ETL 89-2 Standard Guidelines for Submission of Facility Operating and Maintenance Manuals.

14.12 Installation of Artwork and Signage

14.12.1 Artwork and signage shall be a coordinated part of all CID design packages. Interior signage shall be coordinated throughout the building, allowing for updates and changes as building functions move. Interior signage policy can be found in the AFMC Interior Finish Guidelines, which provides guidance for the selection and placement of interior signage as part of CID. Signage and specifications shall be included in all comprehensive interior design packages for AFMC facilities.

14.12.2 Artwork and wall hangings shall be integrated into each design. Coordinate the subject of the artwork, frames and matting to create a consistent visual image. Include all waste receptacles, clocks, coat storage, drinking fountains, coffee, vending, and food equipment.

15. Systems Furniture

This policy is intended to provide our customers with procedures for the development of systems furniture projects on Tinker AFB. The procedures within this document will ensure the best possible cradle-to-grave management of systems furniture projects allowing full response to customer needs, enhancing end products and providing customer satisfaction. **Reference UFGS 12 50 00 Furniture Systems.**

15.1. TAFB Systems Furniture Policy

For the purpose of this policy, systems furniture will include panel supported furniture systems and desk supported furniture systems. A systems furniture project whether considered an “add-on” to an existing project/area or an initial project, including purchase and installation, re-configuration, or maintenance contract shall follow this policy regardless of funding source.

Goals: The primary goal of this policy is to reduce the costs of facilities. It does so by providing a more space and cost efficient alternative to conventional furniture systems while keeping with Quality of Life Initiatives. Organizations can use interior design questionnaires as a starting point to analyze their requirements. See questionnaires attachment.

15.2. Factors to Consider

Factors that contribute to work areas which positively affect worker job satisfaction and performance include:

15.2.1 Coordination or a sense of order which comes from well-coordinated colors and styles as well as properly sized, efficient storage and adequate work space.

15.2.2 Convenience, including access to utilities, ease of contact with others, and layout of workstations and auxiliary areas.

15.2.3 Comfort, both physical and psychological, including noise levels, color, ergonomics, and interior climate.

15.2.4 Corporate image and self-image with ranges of furnishing types and sizes to create a hierarchy of office work stations consistent with the organizational structure.

15.3. Responsibilities

All systems furniture projects shall be reviewed by and coordinated with 72 ABW/CE prior to any contracting activity. The project review shall include electrical/power requirements, communications support, impact on HVAC systems, 101 Life Safety Code compliance, ABA (Architectural Barriers Act) compliance, and the Base CID (Comprehensive Interior Design) Program.

15.4. CID Manager

All systems furniture projects shall be coordinated with the base CID Program Manager during the project development stage.

15.5. Workstation Costs

You may reference AFCEE Interior Design Guide, chapter 3 for a cost estimating guide.
For general planning purposes a budget figure of $5,000 on average for a standard workstation including a task chair can be used. This figure is based on Air Force FY 2019 costs, so an appropriate inflation figure should be added for subsequent years, (approx. 3%). The figure does not include freestanding furniture or files because they are not part of the systems furniture components and must be ordered separately.

15.6. Space Criteria

The application of space criteria and guidance provided in this document complies with **AFMAN 32-1084**, and applies to all administrative facilities.

15.7. Terminology

Administrative Facility - A building or portion of a building in which the administrative affairs of a military establishment are conducted.

15.7.1 Net Floor Area. The total area in the building, less space taken up by outside walls, interior partitions, stair towers, elevator shafts, toilets, basements unsuited for office use, permanent hallways and corridors, machinery or equipment used for heating or ventilating the building, machinery or equipment used for furnishing light and power for building, water supply equipment and elevator machinery.

15.7.2 Net Office Area. The net floor area less administrative support space and special purpose space, and other miscellaneous rooms not used directly as office space. Net office area consists of net workstation area plus circulation in open office spaces.

15.7.3 Net Workstation Area. The net office area used for an individual workstation. The net workstation area is measured to the centerlines of surrounding workstation panels and to the face of any fixed walls defining the workstation

15.7.4 Administrative Support Space. Support areas usually required in an administrative office such as rooms for central files, office conferences, mail handling, reproduction, coat rooms and break areas.

15.7.5 Special Purpose Space. Used to describe space which may be required to meet special needs; for example: auditoriums, conference centers, training rooms, drafting rooms, rooms housing automatic data processing (ADP) equipment, telecommunications, cafeterias, laboratories, libraries, and shipping and receiving rooms. It can also include unique areas within the work area such as a drafting table that are not generally included in administrative space allocations. This space may be included in an administrative area when justified by operational requirements. There are no specific space limitations for special purpose space.

15.7.6 Manned Workstation. Workstation which will be occupied and used as an individual's primary work place. This applies whether the individual is a full-time or part-time employee.

15.7.7 Unmanned Workstation. A workstation that will be occupied and used as an individual's secondary place of work. Examples would be workstations used for printers or other ADP equipment which are shared by a number of individuals on a temporary basis.

15.7.8 Traditional Office. An office using conventional floor supported furnishings.

15.8. Space Allowances

AFMC has waived requirement to 42 net sq ft for manned workstations for up to 25 percent of the total number of manned workstations on a project. Any variance to this requires a letter of exception to be routed through FM, 72 ABW/CE, and HQ AFMC, in turn. (See following exhibit for required content for letter of exception).Unmanned workstations such as computer workstations or reservist's workstations that are used occasionally for specific functions can be 36 net sq ft if enclosed by panels or less if they open onto a hall or into a common space. Worker satisfaction can be directly tied to workstation size. Only use these minimum sizes where space requirements become an overwhelming constraint and there is no other way to solve it. Maintain a minimum of three feet from unmanned areas to adjacent panels or furniture.

15.8.1 The following table is taken from AFMAN 32-1084 Facility Requirements and illustrates the

allowable net floor area per person in administrative facilities.

Item	Net Office Area	Administrative Support Space	Building Net Floor Area
Traditional Office	90 sq ft	40 sq ft	130 sq ft
Pre-wired Workstations	68 sq ft	40 sq ft	108 sq ft

15.9. Project Development

It is critical that qualified professionals are involved in the development of systems furniture packages. If qualified professionals are not involved, the customer will probably end up with unnecessary components or a lower quality package that does not satisfy their needs. Because the initial work use interview is the most critical and important phase of any systems furniture project, it is required that the Base CID Manager be involved in developing all systems furniture projects. The attached questionnaires can be a reference point.

15.9.1 The initial interview of the customer by the project designer shall cover the following topics as a minimum:

15.9.2 Adjacencies of personnel based on work process?

15.9.3 Traffic patterns?

15.9.4 Conference needs (formal and informal)?

15.9.5 Storage needs (individual and common)?

15.9.6 Machine support areas (FAX, copier, etc.)?

15.9.7 Reference materials, supplies, and other common use areas?

15.9.8 Seating?

15.9.9 Waiting areas and guest seating (individual and common)?

15.9.10 Telephone/networking requirements?

15.9.11 Lighting and power requirements?

15.9.12 Computer support requirements?

15.9.13 Requirements for confidentiality?

15.9.14 Security requirements (secure areas, safes, etc.)?

15.9.15 Flexibility for future personnel changes (up-front planning when possible)?

15.9.16 Budget limitations?

15.9.17 Schedule for design and delivery/installation?

15.9.18 Staging/storage areas required for installation?

15.9.19 Unusual requirements, special equipment support, stand-alone furniture to be supported within a system furniture setting (such as drafting boards), etc.?

15.10. Materials and Color:

Choose materials that are durable and will withstand years of abuse. Use plastic laminate work surfaces except in private executive (two- and three-letter) offices, where wood laminates can be used. Extravagances such as overly large workstations, luxury finishes, extra components, etc. are prohibited. All supporting free-standing furnishings, files, cabinets, etc. shall be metal in a coordinated color (except within executive offices where wood can be used to match the work surfaces). Chairs, panels, & tack surfaces shall be covered with heavy-duty tested, stain resistant fabrics. Predominantly earth toned or neutral color schemes are preferred, with coordinated mid-range color accents.

15.11. Life Safety:

Avoid mazes and labyrinths. Provide a straight forward circulation pattern that makes visual sense as you walk through it. People become disoriented in complex spaces, especially in a fire where toxic fumes fill the air. On a practical level, they're difficult and confusing to find your way around, especially to the firefighter or rescue worker. Systems furniture projects shall follow the NFPA 101 provisions.

15.11.1 The minimum aisle, corridor or passageway shall meet requirements set forth in NFPA 101 dependent upon new or existing occupancy type.

15.11.2 Travel distance, common paths of travel and dead end corridors shall meet requirements set forth in NFPA 101 dependent upon new or existing occupancy type.

15.11.3 Proposed workstation layouts shall be coordinated with Base architectural personnel to ensure compliance with UFC and NFPA criteria. Plans submitted for review shall be scaled drawings clearly showing area architectural features and workstation layouts.

15.12. Electrical Requirements:

All facilities' systems furniture electrical installations shall be in accordance with the current version of the Tinker AFB Base Electrical Standard. Please refer to this Standard's Attachment B.

15.13. Standard Operating Policy for Systems Furniture Planning, Purchase, and Installation

1. Organizations and Base users visit with their vendors and make arrangements to purchase the new systems furniture.
2. The vendor then visits the job site to become familiar with the existing furniture lay-out versus the new lay-out. Vendor's site visit should include survey of the locations of all existing electrical panel boards.
3. The vendor should get in touch with the electrical contractor who is to connect the electrical circuits to the proposed electrical service panel board.
4. The vendor then provides the electrical contractor with a drawing (plan view) of the existing and new systems furniture layouts.
5. The electrical contractor then determines from which existing panel board and which circuits are providing power to the existing furniture lay-out. The electrician should take note of how many circuits will be available in each panel board after electrical demolition is completed. The electrician should also take note that connecting to any existing panel board that is not in NEC compliance shall not be allowed.
6. The electrician should then take the proposed new system furniture lay-out and lay-out the new proposed branch circuits. The new circuitry shall be designed in accordance with the current Tinker AFB Base Electrical Standard.
7. After the electrician has done all his/her homework the results of findings should be directed back to the furniture vendor who will then relay the findings back to the user.
8. The user will then submit AF Form 332 and request a power study. The user will also attach a copy of all proposed plans and findings to the 332.
9. Once the 332 is processed it will be sent to 72 ABW/CE for further evaluation. Also a CE inspection of electrical hookups etc. needs to be included even when organizations go directly to a local vendor for design and installation services. A 332 work request must be submitted for contract by requestor services in order to ensure compliance with all Life Safety Codes and Base Civil Engineering requirements.

Benefits to be derived from the above procedure:

a. Vendors of new systems furniture will be able to provide base users with a more realistic cost for completed systems furniture installations.
b. The electrical evaluation of the proposed new systems furniture request will be processed in a more expeditious manner.
c. Greater facility usability and satisfaction among base customers.
d. Electrical engineering man-hours saved which are otherwise spent trying to gather electrical data.
e. Ensures Life Safety Code requirements are adhered to.

15.14. Construction Submittal Requirements

Detailed shop drawings and product data shall be submitted for approval by the 72 ABW/CE prior to any contracting activity or installation of systems furniture for all facilities located on TAFB.

15.14.1 Shop drawings shall include systems furniture layout plans, to scale, and a complete schedule of equipment and electrical and electronic devices planned for use in each work station.

15.14.2 Shop drawings shall indicate clearly, via conventional drafting symbols, the number of circuits planned to serve each work station planned and include conduit routing, all junction boxes' locations and their sizes, the number of conductors in each circuit, and their individual wire sizes. An Electrical Symbols Legend shall be provided to ensure consistent meaning of the drawings among Contractor, customer, and 72 ABW/CE.

15.14.3 Submittals shall include the system furniture manufacturers' catalog product data and specifications, which are clearly marked to indicate which type of system and products are proposed. Furniture systems' appearance, color, finish materials, construction details, and testing laboratory certifications shall also be provided as part of each project's construction submittal.

15.15. Maintenance

Window walls should be used as corridors when possible and be kept free of panel hung furniture to allow access to windows for fresh air and light. Do not block air handling units. Workmen must be able to get to mechanical, electrical, and telephone equipment, and all doors and windows to perform maintenance. Keep furnishings interior to the room and away from walls as much as possible. If you must place furnishings along walls, use freestanding panels instead so they can be moved easily.

15.16. Circular Systems

There are several circular types of systems furniture available on the market, such as the Resolve System. These types work well in large areas but create circulation problems and wasted space in smaller and irregular-shaped areas. Put simply, a circular system requires space around them to work well. Avoid these types of systems in all but the largest open office plans. Even then, look at them carefully. There is probably a more conventional system that will fill the requirements better.

15.17. Panels

Panels shall not exceed 66 inches in height for general office areas. Higher panels shall be reserved for directors' offices, along high-use corridors, security areas, noisy machine, and break areas, or at breaks between major organizations. The higher panels cut air circulation and light and tend to have a negative psychological effect, creating a trapped, "closed-in" feeling. In areas where conferences will take place or noise is a real problem, or in high security areas, consider floor to ceiling walls, conventional construction or modular, in lieu of panels. Workstation panels shall comply with the interior finish combustibility criteria that apply to stationary partitions and walls.

15.18. Lighting

Minimize glare, especially at computer terminals. Provide both general area lighting and task lighting at the workspace. Consider lighting as part of new systems furniture layouts please reference Attachment B section 3.7 and UFC 3-530-01 *INTERIOR AND EXTERIOR LIGHTING SYSTEMS AND CONTROLS*.

15.19. Acoustics

Utilize as much sound absorbing material as possible. In extreme cases, "white noise" or "husher" systems can be introduced to counteract other sounds.

15.20. Power and Communications

The following power and communications requirements shall be met:

15.20.1 Surface mounted conduit and power poles are unsightly and generally indicate poor coordination of electrical and communications requirements. Early and thorough coordination by CE and the Communications Group, with the user, is essential. Use flat cable installations instead of power poles where possible. These systems require a great deal of coordination. If not installed in the proper locations, electrical and communication cords end up being run along the floor and create

a safety hazard.

15.20.2 For secure communications and power, red (secure) requires a minimum three foot separation from black (non-secure) lines and are usually required to be in an exposed raceway along the tops of panels. Early coordination is the key to avoiding an unsafe and unsightly condition. Please reference Attachment B – Tinker AFB Base Electrical Standard.

15.21. Ergonomics

Systems furniture is designed to fit the natural variations in human proportions. All work surfaces and chairs be should be adjustable so they can provide back support and be adjustable for individuals. These requirements for variability should be worked into the statement of work and specifications for the furnishings, and be pre-programmed as much as possible. This includes the height of the work surfaces for each individual. This is difficult, however, so standardization of work surface heights initially is understandable. Be sure to make these types of adjustments part of any maintenance contract so users who are experiencing difficulty due to the work surface placement can have the problem corrected.

15.22. Accessibility

Program Access for People with Disabilities. The following guidelines are set forth by the **Uniform Federal Accessibility Standards**, (UFAS), and include requirements for the design of accessible office environments. It is desirable to exceed these requirements where feasible. Five percent (5%) of the total number of workstations in an office area and not less than 1 fully accessible workstation shall be provided in all systems furniture projects. UFAS does not permit the assumption that no person with a disability can do the job required; therefore, no accessible workstations are needed. Drawings are provided at the end of this document to illustrate the requirements listed below. Any questions regarding UFAS compliance and interpretation should be directed to the Architectural Compatibility Coordinator at 734-2868.

15.22.1 Circulation: Within office space, provide an entry/exit approach to all common use areas. Exit/entry approach is not required to other employee workstations. Common use areas shall be totally accessible and include but are not limited to copy areas, mail areas, conference rooms, kitchens, and break areas.

15.22.2 Wheelchair Passage Width: Minimum clear width for single wheelchair passage shall be 36 inches. Minimum clear width for two wheelchairs is 60 inches. Minimum door width shall allow for a minimum 32 inch clear passage.

15.22.3 Wheelchair Turning Space: The space required for a wheelchair to make a 180-degree turn is a clear space of 60 inches in diameter. Where hallways and aisle ways are less than 60 inches wide, T-spaces or intersecting 36 inch wide hallways shall be provided and designed into office circulation to provide turn-around areas.

15.22.4 Clear Floor Space for Wheelchairs: Seating spaces provided for wheelchair users at tables, counters, or work surfaces, shall allocate clear floor space. The minimum clear floor space required to accommodate a single, stationary wheelchair occupant is 30 inches by 48 inches. The minimum clear floor space for wheelchairs may be positioned for a forward or parallel approach to a table, counter, or work surface object. No more than 19 inches underneath a work surface or table may be counted as part of the clear floor space. In addition, seating provided at tables, counters, and work surfaces must also allow a knee space of at least 27 inches high, by 30 inches wide, and 19 inches deep.

15.22.5 Relationship of Maneuvering Clearance to Wheelchair Spaces. One full unobstructed side of the clear floor or ground space for a wheelchair shall adjoin or overlap an accessible route or adjoin another wheelchair clear floor space. If a clear floor space is located in an alcove or otherwise confined on all or part of three sides, additional maneuvering clearances shall be provided.

15.22.6 Forward Reach. If the clear floor space only allows forward approach to an object, the maximum high forward reach allowed shall be 48 inches. The minimum low forward reach is 15 inches. In systems or conventional furniture applications, forward reach requirements extend to overhead storage units or cabinets, file cabinets, and task light switches.

15.22.7 Side Reach. The maximum high side reach allowed shall be 54 inches and the low side reach shall be no less than 9 inches above the floor.

15.22.8 Work Surface Heights. Tops of tables and work surfaces shall be mounted between 28 and 34 inches. Work surfaces include laboratory stations, study carrels, tables, typing stands, ADP stations, drafting tables and other surfaces designed for the performance of specific tasks. The actual mounting height will depend on the individual's size and type of work being performed. Aprons, drawers, or keyboard trays which often encroach upon the knee space below counters and work surfaces shall be installed at a minimum of 27" from the bottom of the apron or drawer to the finished floor. File or drawer pedestals located underneath a work surface shall allow for clear toe space. Full height pedestals are not allowed unless they are on wheels and mobile.

15.23. Typical Workstations and Components

Standardize workstations as much as possible. Do not customize workstations except at the three- and two-letter office level. Flexibility is a major consideration in using systems furniture. Customizing defeats the purpose of using systems furniture to create a flexible environment. Create a hierarchy of spaces from the clerk/secretary level to office worker to various supervisory levels based on workstation size and additional components such as guest chairs and freestanding meeting tables. The following includes basic elements for systems workstations.

15.24. The basics of each workstation should include:

15.24.1 Panels (powered and non-powered)

15.24.2 Pedestal or drawer units with lock

15.24.3 Drawers: 1 general use (6 inch), 1 file drawer (12 inch), 1 pencil drawer (3 inch).

15.24.4 Primary work surface with a pencil drawer (24 inch by 48 inch minimum)

15.24.5 Secondary work surface for computer (30 inch by 36 inch minimum)

15.24.6 Overhead storage bins with flipper doors and locks. Include dividers and a task light mounted to the underside of the bin for at least the main work surface.

15.24.7 Paper flow organizers, either freestanding or mounted below an overhead bin.

15.24.8 Tack boards (preferably 2 behind main work surface)

15.24.9 Ergonomic seating

15.24.10 Coat hook

15.24.11 Name plate holder

15.24.12 Electrical outlets for computer, task light(s), and other general power uses as specified by the user, but no fewer than minimum required by the Base Standard for Building/Utility Electrical Distribution Systems

15.24.13 Ergonomic Keyboard and Mouse Tray

15.24.14 Countertop/transaction counter (most secretarial counter at 42 inches high, receptionists can go to 48 inches high)

15.24.15 Trash receptacles

15.25. Loose Furniture that may need to be supported within a workstation:

15.25.1 Individual conference tables

15.25.2 Side or guest chairs

15.25.3 Additional storage bins or cabinets

15.25.4 Trash receptacles

15.26. Additional items

15.26.1 File cabinets

15.26.2 Executive peninsula work surface

15.26.3 Wayfinding signage

15.26.4 Shelving

15.26.5 Storage cabinets

15.26.6 Framed artwork

15.26.7 Plants and planters

15.26.8 Common coat racks

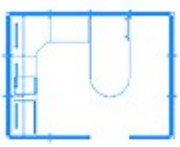
15.26.9 Office equipment (copiers, printers, FAX, etc.)

15.26.10 Mission unique equipment

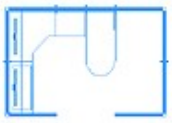
15.27. Sample Workstation Layouts and Clearances

The following pages include sample drawings and parts listing for various types of system furniture layouts. They are for use as a starting point for design. The hierarchy of sizes and spaces shown is typical for most office arrangements and shows a good delineation between workstations to accommodate a typical organizational structure. Adjust these as required to fit the individual user's needs but don't sacrifice standardization and flexibility. It is critical to plan for the ever-changing requirements of administrative spaces by making them as similar to one another as possible. Standardization promotes "briefcase moves", which should be the norm in administrative spaces.

15.27.1 Attached Typical Work Station Illustrations are as follows:

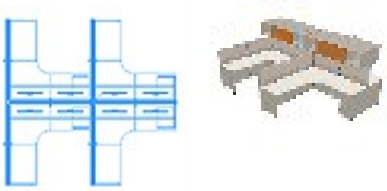


15.27.2 Typical Division Chief Work Station

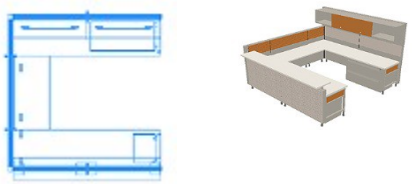


15.27.3 Typical Branch Chief Work Station

15.27.4 Typical Staff Work Station

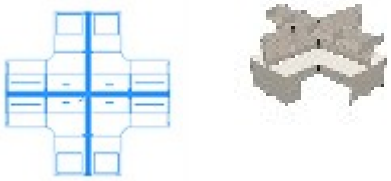


15.27.5 Typical Staff Work Station (Reduced Size)

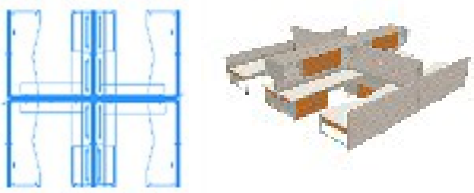


15.27.6 Secretarial Work Station #1

15.27.7 Typical Secretarial Work Station #2



15.27.8 Computer Work (not manned)



15.27.9 Typical Engineer/Architect/Drafting Work Station

15.27.10 Refer to ABA Accessibility Standards at the following link:

https://www.access-board.gov/guidelines-and-standards/buildings-and-sites/about-the-aba-standards/aba-standards

15.28 DEPARTMENT QUESTIONNAIRE INSTRUCTIONS

Objective is to collect information on the facility's operational requirements relating to furniture, fixtures, and equipment not attached to the building and shared by all organizations within the facility. The list only includes the most common FF&E. If these choices do not meet your needs, enter your requirements on separate attached sheets.

- Reception Areas: Describe seating capacities and arrangements required, equipment, and miscellaneous requirements.
- Conference Rooms: Describe seating capacities and table arrangements required, equipment, and miscellaneous requirements.
- File Rooms: Indicate types, sizes, and quantities in lineal feet. Include whether the material requires fireproofing, security, etc.
- Store Rooms: Indicate type of storage requirements (supplies, paper, boxes, equipment) Indicate quantity in lineal feet, size of storage, and whether the material requires fireproofing, security, etc.
- Work Room: Indicate type of equipment and storage requirements including types, sizes and special situations.
- Equipment: indicate type, quantity, sizes, electrical and HVAC requirements
- Miscellaneous items: Indicate type, quantity, sizes.
- Comment Sections: This is a special section for identifying any unusual requirements within the department, including ADA requirements, security, etc. Describe any significant future changes that might affect the types and quantity of people working within the unit and the types of effect that they will have.
- Attachments: Attach manufacturers' literature for special equipment requirements. Attach additional comments that cannot be accommodated herein.

15.29 INDIVIDUAL QUESTIONNAIRE INSTRUCTIONS

Objectives of the personnel questionnaire are to identify and to approximate all personnel spaces, furniture, fixtures, and equipment requirements *not* attached to the building within each department. In order to understand the adjacencies between individuals, the designer requests each department submit an organization chart of all personnel with the department.

Space Type: Identify whether the work area corresponding to each job category is private, semiprivate or open using the abbreviation P for private, SP for semiprivate and O for open space.

Meetings: Identify the number of visitors' chairs needed within the work space for meetings, the average number of meetings per week and those that are confidential.

Telephone: Identify average number of incoming and outgoing calls and those that are confidential.

Electrical: Identify types of office equipment at each individual work station. This is used to identify the number and types of receptacles required. Mark an "x" under the required types of office machines. For equipment not listed, mark an "x" under others and note under comments column. If there are any special wiring requirements, note under comments column.

Display: Identify width and height of large display materials that are required within the work space. Note special types of materials under comment column.

Shelving: Identify lineal inches of each required type of shelving under the specified depth. For extra deep shelving, identify quantity under others column and note the depth under comments column.

Filing: Identify lineal inches under each required type of filing. Note special files, security and fireproofing requirements under comment column.

Storage: Identify lineal inches under storage for general purpose storage such as business forms and stationery storage. Note special types and bulk sizes under comment column.

Comments: Identify any special conditions corresponding to each job category and/or personnel such as ADA requirements, security, etc.

Attachments:

- Attach manufacturers' literature for special equipment requirements. Attach additional comments that cannot be accommodated herein.
- Attach copies of the questionnaire for departments containing more than fourteen personnel.

16. Energy Conservation Requirements

Facilities shall include those energy conservation design features which can be economically justified. Principal considerations are building envelope and mechanical systems design and operation to minimize the use of fossil fuels per ASHRAE 90.1

For additional requirements refer to T.A.F.B. ***Base Mechanical Standard*****.** (Please refer to Attachment C of this Standard.)

Part 4: Engineering Systems Requirements for Facilities

Occupational Health Facility TAFB

17. Civil Engineering Requirements

17.1. Traffic Control

The designer shall incorporate the following statements, as applicable, in project specifications for Traffic Control:

17.1.1 "Contractor shall maintain at least one lane of traffic open at all times on all two-lane streets, roads, and driveways and two lanes, one in each direction, open on all four-lane streets and driveways unless otherwise directed by the Contracting Officer (CO). The Contractor shall provide all required barricades and warning devices when working on roadways and streets and devices shall be IAW Manual on Uniform Traffic Control Devices."

17.1.2 All truck traffic entering Tinker AFB shall use the truck gate (gate 33) at SE 59th and Air Depot.

17.1.3 Haul Route: The Contractor shall use the haul route as shown on the plans.

17.1.4 Utility Crossing Roadway: "In order to minimize traffic disruption, utilities shall be bored under paved surfaces whenever possible. Wherever boring is impractical, street crossings shall be limited to three (3) days maximum for any utility crossing roadway (includes trenching compaction

and replacement of existing pavements). Contractor shall provide steel matting sufficient to carry traffic loading over excavated area. No more than one half of the trafficable road surface can be removed from service by Contractor utility crossing or road boring operations at any one time."

17.2. POV Parking Spaces

POV vehicle parking shall comply with UFC 3-210-02.

17.3. Curb and Gutter

17.3.1 All curb construction shall be of Portland cement concrete and be of integral 6" Barrier Curb-and-gutter design. Curbing design shall comply with Architectural Barriers Act (ABA) accessibility standard for DoD facilities.

17.3.2 Minimum width of the curb and gutter shall be 24 inches.

17.3.3 Minimum thickness of the gutter shall be 6 inches and shall match the thickness of the adjoining paving where of greater thickness.

17.4. Pavements

17.4.1 **Airfield Pavements**

17.4.1.1 All airfield pavements shall conform to the requirements of UFC 3-260-02 *PAVEMENT DESIGN FOR AIRFIELDS* for a Modified Heavy Airfield.

17.4.1.2 All Type A, B and C Traffic Areas shall be Portland Cement Concrete (PCC).

17.4.1.3 Type D, Traffic Areas may be either PCC or Asphalt Cement.

17.4.1.4 Shoulders and Overruns shall be Asphalt Concrete.

17.4.2 **Non-Airfield Pavements**

17.4.2.1 All non-airfield pavements shall conform to the requirements of UFC 3-250-01 *PAVEMENT DESIGN FOR ROADS AND PARKING AREAS*.

18. Landscape Requirements

Landscaping on Tinker AFB encompasses not only the layout of plantings, but also takes into account pedestrian environments such as plazas and courtyards, recreational natural areas, site furnishings, lighting, and fencing. A well-executed design contributes greatly to the environmental and visual quality of TAFB.

18.1. Sustainable Land Design

The goal of landscaping and vegetation management on Tinker Air Force Base is to "Develop and manage the natural and urban landscape to provide a safe, attractive, functional, maintainable, and ecologically sound environment that is in character with the Oklahoma/Texas Plains and Central Great Plains eco-regions" as set forth in the **Tinker Air Force Base Integrated Natural Resources Management Plan (INRMP).** An important component plan of the INRMP is the TAFB Green Infrastructure Plan which provides a comprehensive vision and guiding principles to managing natural areas and other green space on TAFB.

18.2. Regulatory Bases of Design

This shall be accomplished by, as a minimum, implementing requirements of:

a. Presidential Memorandum, *Environmentally and Economically Beneficial Practices on Federal Landscaped Grounds* (April 26, 1994),
b. Presidential Memorandum, *Creating a Federal Strategy to Promote the Health of Honey Bees and Other Pollinators* (June 20, 2014)
c. *Guidance for Federal Agencies on Sustainable Practices for Designed Landscapes* (October 31, 2011), to include addendum *Supporting the Health of Honey Bees and Other Pollinators* (October 2014)

d. Executive Order 13693, *Planning for Federal Sustainability in the Next Decade* (March 19, 2015),

18.3. The preliminary stone material working list has been developed as a collaborative effort between CEAN and 72ABW/CENM and is as follows:

Stone material is divided into three categories: field stone to cover large areas, accent stone, and boulders. A maximum of two types of gravel stone and one color boulder are recommended for consistency and maintainability. Color schemes are suggested following the TBFS architectural districts.

18.4. Field Stone:

18.4.1 Cherokee Red River Rock- recommended for ALL architectural districts (A-F) with Green Limestone or Granite for accent and either Moss or Limestone Boulders

18.4.2 River Rock off white/beige- recommended for South Forty Visual District E and Limestone Boulders

18.4.3 "Dolomite" (Red) stone- recommended for Eastside Depot Maintenance District C with dark granite as accent and either Moss or Prague Boulders

18.5. Accent stone:

18.5.1 Green Limestone

18.5.2 Granite gravel as accent color (bronze)

18.6. Boulders of various sizes:

18.6.1 Limestone

18.6.2 Prague

18.6.3 Moss

18.7. Others previously used:

18.7.1 Red lava rock (import)- limited use

Other gravel/boulder combinations not outlined above will require approval prior to ordering of material.

Larger size gravel stone (2" and up) are recommended for ramp side frontage to minimize fod issues and for pedestrian traffic areas. Larger size gravel can more easily conceal leaves for maintainability purposes.

Boulders should be buried 1/3 to ½ below grade not just dumped on the ground.

Minimum depth of 4" of gravel stone (smaller than 2") shall be installed. Larger gravel stone (2" and up) will require 6" in depth.

Industrial/Commercial grade filter fabric must be used to serve as weed barrier, and should be lapped up against curbs and boulders to prevent weeds from coming through on the edges.

[For areas where mulch will be used, the recommended material is Grade A Cypress Bark Mulch that does not wash away as easily and has good color retention capabilities.]

The Colorado Department of Local Affairs sponsored a best practices manual for the City of Lafayette and proposed a set of eight principles for smart planting that are "not imperative but still important to ensure healthy plant growth, reduce water waste and increase cost savings over time." (p.2) These principles are:

Principle #1 – Plan and design landscaping comprehensively.
Principle #2 – Evaluate soil and improve, if necessary.
Principle #3 – Create practical turf areas.
Principle #4 – Use appropriate plants and group according to their water need.
Principle #5 – Water efficiently with a properly designed irrigation system.
Principle #6 – Use organic mulches to reduce surface evaporation of water and weeds.
Principle #7 – Practice appropriate landscape maintenance.
Principle #8 – Preserve existing landscape and natural areas.

Considering that each site is different, principle no. 1 above is consistent with UFC 3-201-02 *LANDSCAPE ARCHITECTURE* where the developed landscape areas must follow a definitive and deliberate design planting process. This "design process closely parallels all successful problem-solving methods, and consists of three basic steps: analysis, concept and implementation. " (p.58)

- The analysis step identifies functional areas that greatly assist in plant material location and selection.
- Then the concept thinks in terms of general plant sizes and character and provides plant choices with commanders, nursery personnel, customers, facility users and other landscape professionals.
- And the implementation communicates elements of the final design on the planting plan.

18.8. Recommended Plantings

18.8.1 Where cost effective, as defined Presidential Memorandum, *Environmentally and Economically Beneficial Practices on Federal Landscaped Grounds* (April 26, 1994), and to the maximum extent practicable, plant materials used for landscaping on TAFB shall be native (varieties/subspecies and select, Tinker-approved cultivars of native species are acceptable) to the local region.

Local region is defined as:

a. Central Oklahoma/Texas Plains and Central Great Plains eco-regions as defined in Oklahoma's Biodiversity Plan: A Shared Vision for Conserving Our Natural Heritage, 1996

b. Prairie and Great Plains Region as defined in An Annotated List of the Ferns, Fern Allies, Gymnosperms and Flowering Plants of Oklahoma, 1994

18.8.2 Although not exhaustive, the plant materials which are listed in Attachment A include many trees, shrubs, vines, grasses, and wildflowers approved for planting on TAFB.

18.8.3 Change paragraph to read: Designers are cautioned that many of these native plants may not be readily available, or not available in the numbers required, from nurseries at the time of a given project's schedule for planting. Broad regional searches may be necessary to locate plant materials. Or, if plants are unavailable, they should be contract-grown to meet contract specifications.

18.8.4 Upon written request, the TAFB natural resources function (72 ABW/CEIEC) will provide a list of potential plant sources.

18.8.5 All trees and shrubs for planting on TAFB shall comply with the current edition of ANSI Z60.1 and the TAFB Urban Forestry Management Procedures.

18.9. Hard Landscape Features

Where possible, stone and boulder features that will be used for landscaping shall be native to the Oklahoma region. If strip Hackett stone be used, it shall be naturally-occurring and blue-brown to light purple in color.

18.10. Protection and Re-Use of Existing Vegetation

18.10.1 Protection of existing vegetation shall be accomplished to the maximum extent practicable. Generally, protection of existing vegetation applies to native trees, shrubs, and other native plants. All new plantings shall be adequately protected with tree guards and similar protective devices.

18.10.2 A vegetation assessment of the entire construction/demolition site shall be conducted prior to site layout development. The assessment shall identify trees, shrubs, and other plant materials to be retained, transplanted, or cut down.

18.11. Retained Trees

18.11.1 Trees that are to be retained in-situ shall be fenced off by the Contractor using steel T- posts and high visibility barrier fencing prior to commencing land-clearing activities. Fencing shall be installed 10 feet beyond the drip line of each tree or cluster of trees. Where this is not

practicable, trees shall be fenced at the drip line, as a minimum. Tree care procedures for relocated trees shall be specified for the contract period. Barrier fencing shall be maintained in working order for the duration of the contract

18.12. Transplantable Trees

18.12.1 If trees cannot be retained in place, they shall be transplanted or cut down and removed. Transplantable trees are defined as healthy, native, well-formed trees (as determined by TAFB) with trunk diameters between 1" - 8" (measured at 6" above the ground). Transplantable trees shall be replanted on-site or at another Base location as approved by the Contracting Officer.

18.13. Cut-Down Trees

18.13.1 Trees that cannot be retained in place or transplanted shall be removed and processed as determined by the TAFB natural resources function (72 ABW/CEIEC). Depending on marketability, wood may be processed as mulch, firewood, sawtimber, or other salable products. Some removed trees may be hauled intact to a staging area or installed directly in base ponds for fish and wildlife habitat enhancement as directed by 72 ABW/CEIEC. For every live tree removed from the construction site, two replacement trees (1" – 2" caliper) shall be planted on the Base in locations approved by the Government.

18.14. Landscape Maintenance

18.14.1 All trees shall be temporarily irrigated during the growing season for three years following planting to ensure proper establishment. This may be accomplished with temporary subsurface drip irrigation, watering trucks, or devices such as 'Tree Gators'.

18.15. Additional objectives of Project Planting Schemes

18.15.1 All landscape plantings shall be hardy for this region. Plantings shall be specified with the following objectives:

18.15.1.1. low maintenance

18.15.1.2. visual complement to TAFB facilities

18.15.1.3. integration of facility exteriors with natural environment

18.15.1.4. establish human scale among the landscape, facilities, and Planning Districts of TAFB

18.15.1.5. reinforce and accent picturesque views

18.15.1.6. screen views of lesser attraction on Base

18.15.2 All plant selections shall be subject to the review and approval of the TAFB Architectural Compatibility Board.

19. Structural Engineering Requirements

19.1. General Requirements

19.1.1 All structures designed and constructed for Tinker AFB shall meet the requirements of the current edition of UFC 3-301-01 *STRUCTURAL ENGINEERING* except as modified by this document. The technical requirements of UFC 3-301-01 are based on the International Building Code (IBC), as modified by UFC 1-200-01. This information shall be used by the structural engineer of record to develop design calculations, specifications, plans and design-build Requests for Proposals (RFPs). All structures shall be designed by a Professional Engineer licensed to practice structural engineering in the State of Oklahoma.

19.1.2 Minimum Risk Category for Buildings and Other Structures shall be II.

19.1.3 Minimum Wind Exposure Category shall be C.

19.1.4 Minimum roof live loads of 20 pounds per square foot (psf) shall not be reduced for tributary (influence) areas.

19.2. Geo-technical Investigation

19.2.1 Soil borings and investigations shall be used to determine the average depth of bedrock and allowable bearing pressures of each type of geologic formation encountered in the investigation for all structures designed and constructed for Tinker AFB. Geotechnical Investigation Report shall be included in project documents and all soil boring logs shall be placed on the as-built drawings.

19.2.2 Engineer of Record (EOR) may elect to design foundation based on conservative assumptions made in accordance with the International Building Code in lieu of performing a geotechnical investigation. Engineer shall provide all calculations and basis for assumptions to 72 ABW/CE for approval with 35% design submittal.

19.3. Foundation Design

19.3.1 The predominant type of foundation used on TAFB is pier and grade beam type. This foundation shall be utilized in combination with isolated, floating slabs-on-grade unless project geotechnical investigations recommend the use of structural slabs-0n-grade.

19.3.2 Given the advance review and approval of 72 ABW/CE, projects can be designed and constructed which utilize mat-type foundations or spread footings. These types of foundations will only be considered where recommended in the Geotechnical Investigation Report prepared by a geotechnical engineer.

19.4. Structural Economy

The most economical and efficient structural system of steel, concrete, and/or load-bearing masonry shall be utilized for building superstructures for all TAFB projects. The use of wood for building superstructures is prohibited.

19.5. Facility Hardening

19.5.1 For required Antiterrorism building structural hardening refer to: UFC 4-010-01 *DOD MINIMUM ANTITERRORISM STANDARDS FOR BUILDINGS*, UFC 4-020-01 *DoD Security Engineering Facilities Planning Manual* and UFC 4-023-03 *DoD Design of Buildings To Resist Progressive Collapse*.

19.5.2 The Base Anti-Terrorism Office can be reached at 405-734-7120 or 405-734-6381. Anti-Terrorism Officers will assist project designers as to the incorporation of structural hardening requirements for proposed projects.

19.6. Roof Design

19.6.1 Due to potential changes in facility use, all low-slope roof structures, which are designed to support a built-up roof membrane, shall be designed for a minimum Roof Dead Load of 25 pounds per square foot (PSF).

19.6.2 This minimum value shall include the weight of proposed and future loads associated with the

roofing system, including decking, insulation, suspended ceilings, mechanical ducts/diffusers, electrical lighting/conduit, and automatic fire suppression sprinkler systems.

19.6.3 A minimum Roof Dead Collateral Load of 10 PSF shall be used for standing seam metal roof systems.

19.7. Seismic Design

19.7.1 Seismic design shall be in accordance with the latest edition of the International Building Code, UFC 1-200-01, UFC 3-301-01 and UFC 3-310-04.

19.7.2 A soil site classification of "D" shall be assumed, unless proven otherwise by soil exploration testing.

19.8. Shelter Design

19.8.1 TAFB Storm Shelter Policy:

19.8.1.1. Organizations who would like to install or construct storm shelters (internal or external) at their facilities must submit a Base Civil Engineer Work Request (AF Form 332) to 72 ABW/CE in order to begin the assessment and approval process. All new storm shelters shall be above ground facilities.

19.8.1.2. New Facilities – (Mandatory) New occupied buildings must be constructed with internal storm shelters designed according to International Code Council 500 (ICC 500) standards and be sized to accommodate the maximum expected occupancy, as determined by civil engineering's siting criteria assessment.

19.8.1.3. Existing Facilities – (Optional) Dedicated ICC 500 rated storm shelters are authorized. Storm shelters shall be sized according to ICC 500 standards, comply with all applicable codes, and accommodate the maximum expected occupancy, as determined by the siting criteria assessment. Exterior storm shelters may be permitted when the siting criteria assessment deems the exterior solution the most feasible alternative.

19.8.1.4. Existing Facilities – (Mandatory) In occupied facilities that do not have designated areas of adequate refuge, major renovation projects must include the identification of structurally enhanced refuge areas if construction of new walls total 25% or more of the interior walls in the renovated area. Each project will be analyzed to determine the best solution.

19.8.1.5. Approval Process – (Mandatory) All storm shelters, even if incidental to renovation projects and even if interior to a facility, shall be approved by the Facilities Board to ensure compliance with this policy and the criteria herein. All renovation projects will be reviewed by the Civil Engineering Architectural/ Engineering Review Board (AERB) to ensure compliance with the structurally enhanced refuge requirement.

19.8.1.6. Shelter Priority Areas – Tinker AFB has determined that the following facilities should receive priority consideration when submitting shelter projects for funding and execution. They are: 1) Child Development Centers and Youth Centers; 2) Dormitories; 3) Air Traffic Control Tower; 4) Security Forces locations and gates; 5) Command Post; 6) Fire Department; 7) Base Defense Operations Center; and 8) Boiler Plant.

19.8.1.7. Policy Definitions:

a. ICC 500 – This code standard applies to design, construction, installation and inspection of storm shelters constructed as separate detached buildings or constructed as safe rooms within buildings for the purpose of providing safe refuge from storms that produce high winds, such as tornadoes and hurricanes.

b. Occupied Buildings – A building shall be considered occupied at any time it meets any of the following criteria: 1) It is open for general occupancy; 2) It is open to the public; and 3) It is occupied by more than 10 persons.

c. Storm Shelter – A storm shelter is any building, structure or portions thereof, constructed in accordance with the ICC 500 standard, designated for use during a

severe wind storm event, such as a hurricane or tornado. A residential storm shelter serves occupants of a dwelling unit, with an occupant load of less than six people. A community storm shelter is defined as any storm shelter not classified as residential.

d. Tornado Refuge Area – Tornado refuge areas are those in an existing building that have been deemed by a qualified architect or engineer to likely offer the greatest safety for building occupants during a tornado. It is important to note that refuge areas are not ICC 500 compliant, but they do offer the best protection in a given area. People sheltering in the refuge area are more likely to survive than people sheltering in other areas of the building.

e. Siting Criteria Assessment – When determining the best location for a proposed storm shelter, civil engineering, in conjunction with the requestor, will consider: 1) Existing tornado shelter/refuge opportunities in or near the facility; 2) Cost effectiveness; 3) Land availability; 4) Architectural compatibility; 5) Accessibility; 6) Anti-terrorism/Force protection; 7) Environmental concerns; and 8) Facility personnel loading. This list is not all-inclusive, and some shelter siting proposals will have additional aspects to analyze.

19.8.1.8. Any approved shelter, regardless of the funding source, will be open to any personnel (with appropriate clearance/authorization) seeking protection.

19.9. Deferred Submittals

19.9.1 All deferred design submittals shall be incorporated into the Final As-built Drawings. Deferred design submittals shall include, but not be limited to Pre-Engineered Metal Buildings, Cold Formed Metal Framing Steel Connections, Steel Joist and Metal Deck, Metal Stairs, Metal Ladders, Handrail and Guardrail Systems and Precast Structural Concrete.

20. Architectural Systems Requirements

20.1. Excellence in Design

20.1.1 Excellence in design is a primary goal for all construction projects.

20.1.2 Reaching this goal requires a commitment by designers and administrators to quality architecture.

Reference the following web links:

https://www.wbdg.org/ffc/af-afcec/instructions-afi/afi-32-1023f

Design and Construction Standards and Execution of Facility Construction Projects

http://www.wbdg.org/

Whole Building Design Guide

20.2. Quality Architecture

20.2.1 The design of projects in harmony with the architectural character of existing facilities and the environment is a significant aspect in the definition of quality architecture.

20.2.2 Pay particular attention to project siting, economy, life cycle cost, functionality, energy conservation, interior and exterior details and accessibility.

For accessibility reference the following web link.

https://www.access-board.gov/guidelines-and-standards/buildings-and-sites/about-the-aba-standards/aba-standards

20.2.3 Take special care to avoid adversely affecting the historic value of property listed (or eligible for listing) on the National Register of Historic Places, or located within the boundaries of a Historic District.

20.3. Integration of Programming, Design, Engineering and Construction Excellence

20.3.1 There are very few places where an organization serves as its own project programmer, designer, engineer, and municipal authority-having-jurisdiction. At TAFB this is true every day for 72 ABW/CE.

20.3.2 Due in large part to the above responsibilities, a special and unique opportunity exists at TAFB for 72 ABW/CE to provide projects to AF customers which have the highest integration of design and construction value possible.

20.4. Sustainable Design of AF Facilities

- **Tinker AFB Policy:** Every project shall address the most economic and sustainable building practice to the fullest extent possible. Sustainable practices include those elements of planning, design and construction that promote the efficient use of energy and material resources, the conservation of water and the protection of land and water environments.
- Refer to the current TAFB Sustainability Guideline for requirements.

21. Interiors Systems

The interior of TAFB facilities is what helps our missions deliver. Being online and with lights, heat, water and working toilets is what keeps our missions going, and these entire "utilities" help make up our interiors. Although the Standard divides the multiple aspects of Base facilities among many disciplines and specialties, it is with interior environments that "it can all come together" to provide the facilities excellence which TAFB deserves.

21.1. Elements of TAFB Interior Systems

The major variables which combine to create a project interior include the following design considerations. It is important to note that all design aspects have at least one separate specialty organization on Base to address facility quality.

21.2. Safety

Building life safety in facility occupation by personnel is a different concern from worker safety relative to mission accomplishment and operation of process equipment.

Protection of occupants from exposure to hazard and injury during emergencies and the facilitation of occupant evacuations are the twofold missions of building life safety. Every building utility system, even the structure and architectural enclosure, contributes to a facility's level of life safety.

21.3. Access

The TAFB Disability Awareness Committee meets monthly to maintain open communications among the Committee members, the TAFB workforce at large, and ABW / CE. Projects which are undertaken to improve accessibility to facilities and amenities throughout the Base are discussed regularly.

Reasonable access to and from work areas for all personnel is the goal of 72 ABW/CE. Public and employee access is to be provided all Base personnel, resident military families, and visitors in compliance with the ABA.

Clearly, there are limits to the level of convenience which is afforded any given facility.

21.4. Function

Usually thought of as the first requirement for the successful interior project, the occupant's mission has to be facilitated and enhanced in the project.

21.4.1 Projects for TAFB facilities shall utilize Sample User Questionnaire Forms to optimize the common understanding of all projects' program requirements among AF customers, engineers &

contractors.

21.4.2 Questionnaire Forms can follow the prototype given in Appendix 2-1 of the **United States Air Force Project Manager's Guide for Design and Construction**, 2000 Edition.

http://www.wbdg.org/FFC/AF/AFDG/pmguide.pdf

21.5. Lighting

Lighting fixture layouts and illumination levels have to orient personnel and clearly direct them in the safe and efficient use of their functional areas. Refer to UFC 3-530-01 *DESIGN OF INTERIOR AND EXTERIOR LIGHTING SYSTEMS AND CONTROLS*.

21.6. Acoustics

The protection of personnel health & the provision of worker privacy contribute to long term productivity.

21.7. Comfort

For the Standard, interior comfort refers to the provision and maintenance of facility interiors year round at pre-determined "design" temperatures.

Without temperature control, personnel are distracted from their mission at best, and worker health can be compromised when fluctuations in temperature are frequent.

21.8. Indoor Air Quality

Ventilation and maintenance of fresh air levels within all interiors is the collective concern of the Air Base Wing and Environmental.

21.9. Security

21.9.1. Physical security includes construction such as doors and locks which limit and control a person's access within facilities.

21.9.2. Information security includes construction such as sound isolation design which prevents information in the form of speech and electronic signals from spreading beyond their intended audiences.

21.9.3. Electronic security includes electro-mechanical systems which detect and deter personal access to a facility or that facility's interior.

21.10. Interior Signage

Way-finding within many facilities can determine the efficiency at which the Installation operates.

21.10.1. Project signage shall be essential to include for all projects unless accepted through review and approval of 72 ABW/CE.

21.10.2. Signage design and construction shall comply with UFC 3-120-01 *DESIGN: SIGN STANDARDS*.

21.11. Aesthetics

21.11.1. The quality of positive visual composition is never to be sacrificed or ignored at the expense of any project.

21.11.2. The requirement for TAFB projects is to provide a positive visual image fitting to the customer.

22. Categories of Equipment

22.1. Office Equipment

This category shall include systems furniture, personal computers, copiers, vending equipment, coffee makers, telephones, and individual office conveniences.

22.2. Building Equipment

This category shall include facility physical plant components such as furnaces, boilers, direct expansion units, package chillers, water circulation pumps, water heaters, electrical transformers, service panels, switchgear, fire alarm control panels, and ventilation and exhaust fans.

22.3. Process Equipment

This category shall include all devices which are dedicated to the execution of mission-specific job production whether mechanical, electrical, or chemical in principle operation.

22.4. Project Equipment Schedules

Projects which include any or all of the above categories shall separately schedule and locate, as part of the construction documentation, the exact, size, function, energy consumption, and utility requirements of each equipment piece within the proposed design.

23. Fire Protection Engineering

23.1. Base Fire Suppression Systems

Design and construction of mechanical improvements to all real property on Tinker AFB shall comply with the ***Base Mechanical Standard***. (Please refer to Attachment C of this Standard.)

23.2. System Design

All fire protection system designs shall be accomplished by a qualified Fire Protection Engineer. All fire protection systems shall be designed in accordance with UFC 3-600-01 *DESIGN: FIRE PROTECTION ENGINEERING FOR FACILITIES*, UFC 3-601-02 *OPERATIONS AND MAINTENANCE INSPECTION, TESTING, AND MAINTENANCE OF FIRE PROTECTION SYSTEMS*, NFPA 13, and the specific project's *Life Safety Fire Protection System Analysis*.

Hyperlink for UFC 3-600-01: http://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc/ufc-3-600-01

Hyperlink for UFC 3-601-02: http://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc/ufc-1-200-02

23.2.1. Design Submittal

23.2.1.1. The designer shall provide a preliminary fire sprinkler design, including hydraulic calculations no later than 60% design.

23.2.2. Minimum Wall Thickness for Piping

23.2.2.1. Minimum wall thickness for sprinkler piping using screwed joints shall be schedule 40 steel.

23.2.3. All new construction and/ or new equipment shall not block or impede access to utility or maintenance points.

23.3. Firewalls and Fire Area Limitations

All construction, including fire walls, fire area limitations, emergency lighting systems, means of egress and exit stairways, shall meet the more requirements of **UFC 1-200-01**.

23.4. New construction and/ or new equipment shall not block or impede access to utility or maintenance points. ex: (vav boxes, bleed valves, room to pull coil)

24. Plumbing Requirements

24.1. Base Plumbing Systems

Design and construction of mechanical plumbing improvements to all real property on Tinker AFB shall

comply with the ***Base Mechanical Standard***. (Please refer to Attachment C of this Standard.)

25. Mechanical Engineering

25.1. Base Mechanical Systems

Design and construction of mechanical improvements to all real property on Tinker AFB shall comply with the **Base Mechanical Standard**. (Please refer to Attachment C of this Standard.)

26. Electrical Requirements

26.1. Base Electrical Systems

Design and construction of electrical improvements to all real property on Tinker AFB shall comply with the Tinker AFB **Base Electrical Standard**, most current Edition. (Please refer to Attachment B of this Standard.)

26.2. Related Requirements found elsewhere within the Standard

26.2.1. Telecommunication Utility requirements on Base are generally separate from telephone utility requirements. Please refer to Chapter 27 Telecommunication Requirements.

26.2.2. Systems Furniture Policy. Please refer to chapter 15.

27. Telecommunication (COMM) Systems Requirements

27.1. Utility domain of the 72 ABW/SC

Design and construction of COMM improvements on Tinker AFB shall comply with the Tinker AFB **Base Electrical Standard**, most current edition. (Please refer to this Standard's Attachment B.)

27.1.1. All Contractors working on TAFB shall accommodate within their project areas and schedules the work necessarily completed by the Communications Directorate and its Contractor forces in order to provide the Government real property improvements which are complete in respect to telecommunication utility services.

27.1.2. Advance notice for demolition activities - No demolition of existing COMM utility raceways, panels, or control boxes can be undertaken without prior removal of COMM conductors by the personnel of 72 ABW/SC. Advance notice of at least 72 hours shall be provided 72ABW/SC prior to undertaking any demolition activity which potentially impacts either exterior or interior COMM utility construction.

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27.2. Civil Provisions

27.2.1. Communications utilities construction Projects which install utilities between facilities shall include cable as well as duct. 72 ABW/SC shall be consulted for correct sizing of all new communications utility cabling and duct banks proposed to serve all existing and/or new Base Facilities. Approval of 72 ABW/SC shall be required of all project specifications which include replacement and/or new construction of duct banks and conductor systems on Base.

27.3. Telephone and Cable

27.3.1. Utility systems which interconnect TAFB organizations with off Base systems are accomplished by the Communications Directorate. The user shall complete and submit an AF form 3215 to request phone and cable connections.

27.3.2. Communications within this section refers to all telecommunications requirements that are not simply limited to telephone systems. Telecommunications covers any transmission, emission, or reception of signs, signals, writings, images, and sounds, or information of any nature by wire, radio, visual, optical or other electromagnetic systems. Similarly, cabling not only applies to only cable themselves, it includes a combination of all cables, wire, cords and connecting hardware. The soon to be released revised standard American National Standards Institute/Electronic Industry Association/Telecommunications Industries Association (ANSI/EIA/TIA)-568-C

(currently in draft form as PN-2840), has changed its name to reference the term "cabling" as opposed to "wiring".

27.4. Contractor Responsibilities

27.4.1. The Contractor shall coordinate all communications-computer system requirements with Base Civil Engineering, the using agency, and Base Communications. The A/E shall provide drawings specifically for Tinker requirements based upon all necessary provisions per Air Force Communications Command (AFCC) Technical Bulletin (TB) 90-02. The A/E shall include communications pre-wiring for buildings in all construction projects. Provide cable box rough in and conduit for connection by the Communications Squadron.

27.4.2. The Contractor shall insure the construction contract specifies that all installation personnel must have a minimum of three years of experience. Further, the specifications shall require a detailed work plan be provided if a project requires re-routing or changing of the configuration of a base communications cable or related equipment. The work plan shall explain the work required and how the work will be accomplished by the Contractor. All new materials (i.e. telephone and data cable, splicing connectors, splice closures, etc.) shall conform to Government standards.

27.5. General Specifications for New Base Facilities

27.5.1. A building's communications backbone and horizontal distribution systems shall consist of 1) conduits, 2) sleeves, 3) cable trays/raceways, 4) communications rooms, 5) copper voice and data cable, 6) fiber-optic cable, 7) copper information outlets, 8) fiber-optic outlets, 9) fiber and copper data patch panels, 10) voice connecting blocks, and 11) Intermediate Cross-connects (ICs) and Horizontal Cross-connects (HCs).

27.5.2. For new administrative facilities the Contractor shall utilize a raised floor system and under floor horizontal cable distribution system for general design of the building cable plant including the Communications Equipment Room (CER), primary Network Equipment Rooms (NER), and secondary NER as the preferred design method. The under floor horizontal cable distribution system shall include the underfloor conduits and solid cable trays. Conduits shall also extend from the cable trays to the raised floor information outlet boxes. The under floor horizontal cable distribution system shall be coordinated with the raised floor system to run without affecting the alignment of the raised floor system.

27.5.3. However, if utilization of a raised floor and under floor horizontal cable distribution system is not economically feasible or otherwise practical, the Contractor shall utilize an overhead or in-ceiling delivery system for general design of the horizontal distribution cable plant for the building being constructed or renovated.

27.6. Communication Equipment Room

27.6.1. A Communications Equipment Room (CER) shall be included on the basement or the first floor level of the building.

27.6.2. The CER will house the Main Building Cross-Connect (MC) frame for copper and fiber-optic cabling into/out of the building. The CER may also house some common local area network (LAN) equipment for the building. The CER needs to be approximately 12 feet by 24 feet in area and have 24-hour, 7-day air conditioning.

27.7. Primary Network Equipment Rooms

27.7.1. At least one primary Network Equipment Room (NER) shall be included on each respective floor level of the building. Sufficient primary NER shall be included on each floor level to ensure backbone and horizontal distribution cable runs do not exceed maximum allowable lengths in accordance with Electronic Industry Association/Telecommunication Industries Association (EIA/TIA) 568-C and EIA/TIA- 569-B standards. The primary NER shall have 24-hour, 7-day a week environmental control.

27.7.2. The primary NER(s) within the building shall be vertically "stacked" directly over the one on the floor level below. A minimum of six 4-inch sleeves shall be used to interconnect the primary NER to the primary NER on the floor level directly above it. The 4-inch sleeves shall be placed

between the adjoining floor/ceiling of the primary NER to provide vertical access for the copper and fiber backbone cable for the building.

27.7.3. If more than one vertical "stack" of primary NER is required, the primary NER on each respective floor shall be horizontally interconnected with a minimum of two 4-inch conduits for both initial and future tie cable requirements for the building. A minimum of one 4-inch conduit to/from the primary NER shall have four 1-inch inner ducts placed within the conduit for fiber-optic cable.

27.7.4. If an overhead or in-ceiling delivery system for general design of the horizontal distribution cable plant must be used, the Contractor shall use a minimum of four 4-inch sleeves to route cables into the ceiling spaces to the work areas from the CER and all NER. The design shall include overhead ladder cable trays to route voice and data cables from the CER and the NER that are properly sized for the number of cables to be installed and to permit future cable expansion within the building. The design shall require the utilization of plenum cable and shall use power poles and system furniture panels to deliver the cables to the individual workstations.

27.8. Secondary Network Equipment Rooms

27.8.1. A minimum of one secondary NER shall be included in all vault areas designated as secure areas. Each secondary NER shall be directly connected to the CER with a minimum of two 4-inch conduits for both initial and future cable requirements for the building. A minimum of one 4-inch conduit to/from each secondary NER shall have four 1-inch inner ducts placed within the conduit for fiber-optic cable.

27.8.2. In addition, each secondary NER shall be directly connected to the nearest primary NER on the respective floor using a minimum of two 4-inch conduits. One of these conduits shall have four 1-inch inner ducts installed for fiber-optic cabling.

27.8.3. The secondary NER(s) shall have 24-hour, 7-day a week environmental control

Part 5: Project Construction and Installation Procedures

28. Safety Requirements

28.1. General Health and Safety Work Practices on Base

All construction on Tinker AFB is subject to applicable federal, state and Air Force laws, rules and regulations. It is a condition of each contract, and shall be made a condition of each sub-contract, that Contractors and subcontractors shall not require any laborer or mechanic employed in the performance of any contract, nor cause any Air Force military, civilian, or other Contractor personnel to be exposed to any unsanitary, health, or safety hazard or condition. These requirements include at a minimum the following standards:

28.1.1. Title 29 Code of Federal Regulations, Parts 1910, General Industry Standards and Interpretations, and 1926, Construction Safety and Health Standards, United States Secretary of Labor.

28.1.2. Safety and Health Requirements Manual (EM 385-1-1), the US Army Corps of Engineers.

28.1.3. HQ AFMC/CEC EGL 92-2.

28.1.4. US AFI 91-202, "The US Air Force Mishap Prevention Program."

28.1.5. US AFI 91-204, "Safety Investigations and Reports"

28.1.6. US AFM 91-203, "Air Force Occupational Safety, Fire, and Health Standards"

28.2. Site Practices specific to TAFB

The following worker health and safety practices shall be maintained on all projects: Section 00 70 00 / 00 71 00 General Requirements.

29. Special Base Procedures

29.1. Requirements for all demolition and construction contracts on TAFB

For more specific information refer to Tinker AFB Specifications Section 00 70 00/00 71 00 GENERAL REQUIREMENTS. The current version of General Requirements is made a part of construction contract specifications issued at Tinker AFB by the Contracting Officer.

29.2. Demolition, Excavation and Construction Permits:

Contractors shall be required to obtain an approved Base Civil Engineering Work Clearance Request prior to starting any construction work.

29.3. Master keying and locks:

Tinker AFB utilizes the master keying system provided by the BEST Universal Lock Co. The designer shall clearly specify that only those cores which are compatible to BEST locksets with BEST 7-pin L-type keyways (no substitution) with 2-key blanks shall be used. Locks shall be supplied with construction cores. Individual locks shall be provided for in all areas except public toilets. Where existing locksets are to be replaced, ensure that the existing cores are turned in to the Base Lock Shop. Locks shall be shipped directly to the Base Lock Shop.

29.4. Procedures for non-standard work days:

The standard workday for the Base Civil Engineer Directorate at Tinker AFB is from 0715 (7:15 a.m.) to 1600 (4:00 p.m.). The Contractor's workday shall be compatible with that schedule. Written requests for any deviations from the Contractor's work schedule (overtime or night shifts) shall be made to the CO 48 hours in advance of the proposed scheduled deviation. Approval of such requests shall also be in writing and in advance of any proposed schedule deviation.

29.5. Utility outages and closures (street, sidewalk, aisle, etc.):

Refer to Tinker AFB specification section 00 70 00 General Requirements for Construction.

29.6. Contractor Identification credentials while on TAFB

Without exception, each company contracted to TAFB shall require all personnel at all times to display identification credentials appropriate to the area of the Base in which they are employed.

Security clearances: All Contractor personnel are required to obtain a base pass from the Base Security Forces Squadron through the CO.

For work within "Controlled Access" areas, Contractors shall provide names, birth dates, and social security numbers of everyone who shall need access to the site.

29.7. Soil and Foundation Conditions

All project designs shall consider the detail character of the geotechnical conditions prevailing TAFB, and exercise prudent engineering judgment in the evaluation of allowable foundation bearings for the site in question and both dead and live loads applicable to the building type proposed.

29.7.1. Corps of Engineers shall conduct a soil investigation as required to determine the site specific subsoil conditions. Frequently within TAFB the soil varies from sandy silt to sandy clay with areas of stratification of the various types.

29.7.2. Soil resistively varies from a high of 26,100 ohm-cm to a low of 529 ohm-cm. There is no site specific soil resistively data currently available to design and construction Contractors.

29.7.3. Unless specifically waived by the CE, all foundation designs for facilities at Tinker AFB shall be

conventional pier and grade beam systems, separated from a "floating slab" or "slab on grade" by use of isolation and/or expansion joints. Formed voids shall be provided for all grade beam constructions, and all sub-grades immediately below grade beams shall be compacted to the same density specification as that required of under slab sub-grades.

29.8. Construction Facilities and Job Site Standards

The Government retains the right to limit the number and location of various construction and office trailers, temporary structures, and open storage and storage areas used by Contractors. These facilities shall be clean, in good condition, and free of rust or surface deterioration. Rental trailers shall be of a neutral color. Specifications to enforce these requirements shall be included in each project.

29.8.1. Screening fences shall be installed around the site perimeter. The screening shall be approved by 72 ABW/CE Architects, due to differing conditions in Visual Districts around the base.

29.8.2. Project rooftop equipment shall be specified to feature exterior cabinet enclosures of factory finish to match the Standard field color specific to the District in which the Project is sited.

29.9. MILCON Requirements

Projects whose design agencies are provided by the USACE have particularly high standards of design documentation, and include the following procedures.

29.9.1. MILCON Solicitation Proposal Exclusions Statements. All design/build proposals for consideration of MILCON award shall offer under the cover of signed certification that all requirements of the Solicitation have been fulfilled unless taken specific exception within the same letter of certification.

29.9.2. Architecturally Significant Projects Process / ASP. The ASP Process is mandated by HQ AFMC and applies to specific MILCON projects which promise to contribute permanent and conspicuous improvements to the living and working environment within the Installation. The Process includes special design collaboration within the formulation of the Project Request for Proposals / RFP, and is oriented to providing the Base with the highest quality of facility design possible within the available design/construction funds, and to providing the Government optimal comprehension of the finished construction product features before design is complete.

30. Contractor Use of Available Utilities

Base services and utilities available to the Contractor:

30.1. Electrical Service

The Contractor may temporarily hook up to existing electric as required to accomplish the work. The Contractor must turn off lights when an area is not occupied, turn off or reduce heat when an area is not occupied, provide enclosures to prevent unnecessary heat loss from the building envelope and institute similar actions to conserve energy.

30.2. Water

The Contractor may temporarily hook up to existing water as required to accomplish the work. The Contractor must use water only as required for construction purposes and must otherwise practice water conservation.

30.3. Sewage

The Contractor shall provide portable toilets for construction crews.

30.4. Trash Disposal and Construction Debris

The Contractor may not use trash dumpsters on the installation. All waste material generated by construction or demolition activities shall be hauled off-base by the Contractor and disposed of at a legal dump site. The haul route shall be maintained free of debris, mud, rock, and trash by the Contractor at all times.

30.5. Maps

Base utility and contour maps are available at the Base Civil Engineer office, Building 400. The designer shall have access to the Base Civil Engineering record drawings in order to perform any required research and investigation of existing as-built drawings. The designer shall be responsible to field verify all as-built drawings as the Government does not guarantee their accuracy.

31. Property Maintainability

31.1. Mandatory References

The following publications are mandatory references as applicable to this section:

ETL 01-1	Reliability & Maintainability Design Checklist	11 Oct 01

31.2. Re-use of Existing Materials

Contractors shall exercise caution in the planned reuse of any existing material, (or material that is to be Government Furnished Equipment). In the time period between project inception, design, and actual construction, either the condition of the material, or its availability may change. For major items of equipment, specify by manufacturer's name plate data exactly which items are to be used and their location.

31.3. Manufacturer's name plate, parts and maintenance manuals

Ensure that equipment items which require periodic maintenance and repair have sufficient manufacturer's identification data permanently affixed. Specify that the Contractor shall provide copies of parts identification manuals and installation and maintenance instructions customarily furnished with the equipment.

31.4. Construction over Buried Utilities

New construction should not be placed over existing buried water, sewer, heating, compressed air, electric, or telephone utilities except in extraordinary situations and only if special provision is made for maintenance access. In NO case should any construction be placed over existing POL or natural gas lines.

31.5. Refuse Collection

All new building designs or major modifications shall show on the drawings the following:

31.3.1 Proposed refuse container location(s) and all screening, pads, walkways, or other pavements.

31.3.2 All needed features to facilitate possible recycling efforts.

Adequate pavement design to permit safe and easy approach, container handling, and maneuvering by refuse vehicles.

31.6. Termite Control

The application of a residual termiticide during construction shall provide years of termite protection to the building and its contents.

31.3.3 Termiticide pre-treatments are required regardless of type of construction. Termite control measures are also needed when building modifications disturb the in-place termiticide barrier or when construction occurs on untreated soil.

31.3.4 Wood treated with a preservative shall be used where soil termiticides cannot be used or where wood shall be in direct contact with the soil.

Part 6: Links and Documents in Attachment to the Facility Standard

List of ATTACHMENTS

“ATTACHMENT A”	Native Landscaping Plant Material Working List	
“ATTACHMENT B”	BASE ELECTRICAL STANDARD Tinker Air Force Base, Oklahoma	*[Published Separately]*
“ATTACHMENT C”	BASE MECHANICAL STANDARD Tinker Air Force Base, Oklahoma	*[Published Separately]*
“ATTACHMENT D”	BASE SUSTAINABILITY GUIDELINES Tinker Air Force Base, Oklahoma	
“ATTACHMENT E”	Pavement Trench Detail	
“ATTACHMENT F”	Bird Proofing Facilities at Tinker AFB	

“ATTACHMENT A”

Native Landscaping Plant Material Working List

TINKER AIR FORCE BASE

TREES

Scientific Name	Common Name
Acer saccharum ‘Caddo’ * **	Caddo maple
Betula nigra	River birch
Bumelia lanuginose	Chittamwood
Carya cordiformis **	Bitternut Hickory
Carya illinoensis **	Pecan
Carya texana	Black hickory
Celtis laevigata **	Sugarberry
Celtis occidentalis **	Hackberry
Cercis Canadensis **	Eastern redbud
Cercis canadensis ‘Forest Pansy’ **	Eastern redbud.
Cercis canadensis var. texensis cult. Oklahoma **	Oklahoma redbud
Cotinus obovatus	American smoketree
Crataegus crus-galli	Cockspur hawthorn/Red haw
Diospyros virginiana	Common persimmon
Fraxinus americana ‘Autumn Purple’	White ash
Fraxinus pennsylvanica	Green ash
Fraxinus quadranulata	Blue ash
Gleditsia triacanthos **	Honeylocust
Gymnocladus dioica **	Kentucky coffeetree

Juglans nigra **	Black Walnut
Juniperus virginiana **	Eastern red cedar
Juniperus virginiana ‘Canaert’	Eastern red cedar
Juniperus virginiana ‘Taylor’	Eastern red cedar
Liquidambar styraciflua **	Sweetgum
Maclura pomifera ‘White Shield’ or ‘Pawhuska’	Osage orange
Platanus occidentalis **	Sycamore
Populus deltoides (male only) **	Cottonwood
Prunus americana	American plum
Prunus Mexicana	Mexican plum
Prunus serotine **	Black Cherry
Ptelea trifoliate	Wafer ash
Quercus falcate	Southern red oak
Quercus macrocarpa **	Bur oak
Quercus marilandica	Blackjack oak
Quercus muehlenbergi **	Chinquipin oak
Quercus prinoides	Dwarf chinquipin oak
Quercus rubra **	Northern red oak
Quercus shumardii	Shumard’s oak
Quercus stellata	Post oak
Quercus velutina **	Black oak
Salix nigra **	Black Willow
Sapindus drummondii	Western soapberry
Sophora affinis	Eve’s necklace
Ulmus americana ‘New Harmony’ **	American elm

Ulmus americana ‘Valley Forge’ **	American elm
Ulmus crassifolia	Cedar elm
Ulmus rubra **	Slippery elm

SHRUBS

Aesculus glabra var. arguta	Texas buckeye/Horse chestnut
Amorpha canescens	Leadplant
Ceanothus ovatus	Ceanothus
Cephalanthus occidentalis	Buttonbush
Cornus drummondii **	Roughleaf dogwood
Euonymus atropurpureus	Wahoo (Burning bush)
Hypericum spathulatum	Shrubby St. John’s-wort
Ilex decidua ‘Warren’	Deciduous holly
Juniperus virginiana ‘Grey Owl’	Eastern red cedar
Prunus angustifolia	Chickasaw plum
Rhamnus caroliniana	Buckthorn
Rhus aromatica	Fragrant sumac
Rhus aromatica ‘Gro-low’	Fragrant sumac
Rhus copallina	Shining or Winged sumac
Rhus glabra	Smooth sumac
Rhus glabra lanciniata	Cutleaf smooth sumac
Ribes odoratum	Clove current
Symphoricarpos orbiculatus	Coralberry
Vibernum rufidulum	Rusty blackhaw
Xanthocephalum sarothrae	Broom snakeweed

Yucca glauca	Soapweed yucca/Great Plains yucca

VINES

Campsis radicans	Trumpet vine
Celastrus scandens	American bittersweet
Cocculus carolinus	Snailseed/Moonseed
Parthenocissus quinquefolia	Virginia creeper
Passiflora incarnata	Passion flower

PERENNIAL FLOWERS

Achillea millefolium	Western yarrow
Asclepias tuberosa	Butterflyweed
Allium stellatum	Fall glade onion
Artemisia ludoviciana	White sage
Artemesia ludoviciana ‘Silver King’	Silver King white sage
Aster oblongifolius	Aromatic aster
Baptisia australis	Blue wild indigo
Baptisia lactea	White false indigo
Callirhoe involucrata	Purple Poppy Mallow (Winecup)
Petalostemon purpureum	Purple prairie clover (Dalea purpurea ‘Stephanie’)
Echinacea angustifolia	Narrow-leaved purple coneflower
Echinacea pallida	Pale purple coneflower
Echinacea paradoxa	Yellow coneflower
Helianthus maximiliani	Maxmillian sunflower
Helianthus maximiliani ‘Santa Fe’	Maxmillian sunflower
Hymenoxys odorata	Limonillo

Hymenoxys scaposa	Bitterweed/Plains yellow daisy
Liatris mucronata	Gayfeather
Liatris punctata	Dotted gayfeather
Liatris pycnostachya	Prairie blazing star
Linum perene ‘Blue Saphire’	Flax
Oenothera serrulata (Carylophus serrulatus)	Half shrub sundrops
Oenothera speciosa	Showy primrose
Penstemon tubaeflorus	Tube flower penstemon
Physostegia virginiana	Obedient plant
Rudbeckia fulgida	Orange coneflower
Rudbeckia fulgida ‘Goldsturm’	Black-eyed Susan
Rudbeckia fulgida var. deamii	Black-eyed Susan
Solanum eleagnifolium	Silver-leafed nightshade
Solidago canadensis	Canada goldenrod
Solidago canadensis ‘Golden Baby’	Canada goldenrod
Solidago missouriensis	Missouri goldenrod
Solidago rigida	Rigid goldenrod
Salvia pitcheri ‘Grandiflora’	Azure blue sage
Scutellaria resinosa	Resindot skullcap/Wright’s skullcap
Talinum calycinum	Rockpink Flameflower
Tradescantia bracteata	Spiderwort
Verbena canadensis	Rose verbena
Verbena canadensis ‘Homestead Purple’	Homestead Purple
verbena Vernonia fasciculata	Ironweed

Zinnia grandiflora	Plains zinnia

CACTI

Coryphantha vivipara	Pin cushion cactus
Opuntia macrorhiza (compressa)	Prickly pear cactus

GRASSES

Andropogon gerardii	Big bluestem
Andropogon glomeratus	Bushy bluestem
Andropogon virginicus	Broomsedge bluestem
Buchloe dactyloides	Buffalo grass ‘Cody’ or ‘Legacy’, et al.
Bouteloua curtipendula	Sideoats grama
Bouteloua gracilis	Blue grama
Bothriochloa lageroides (saccharoides)	Silver bluestem (beardgrass)
Bothriochloa barbinodis var perforatus	Pinhole bluestem or Cane
bluestem Chasmanthium latifolium	Broadleaf uniola
Chloris cuculata	Hooded windmill grass (sandy
soils) Elymus canadensis var. canadensis	Canada wildrye
Eragrostis spectabilis	Purple lovegrass
Eragrostis trichoides ‘Mason Sandhill’	Sand lovegrass (sandy
soils) Erianthus contortus	Bentawn plumegrass
Panicum virgatum	Switchgrass
Panicum virgatum ‘Heavy Metal’	Switchgrass
Panicum virgatum ‘Prairie Sky’	Switchgrass
Schizachyrium scoparium var. frequens	Little bluestem
Schizachyrium scoparium ‘The Blues’	Little bluestem

Sorghastrum nutans ‘Bluebird’	Indiangrass
Sporobolus heterolepis	Prairie dropseed

Note: Tinker Air Force Base lies in Central Oklahoma/Texas Plains and Central Great Plains ecoregions. This list identifies select plants that are considered native to these ecoregions. The list is not exhaustive, but is working list of native plants that possess actual or potential ornamental merit. (Updated Jul 07)

* Plants in **red** are suitable for use in the 10 M AT/FP setback zone
** Preferred trees for carbon sequestration

“ATTACHMENT B”

TINKER AFB ELECTRICAL STANDARD

TINKER AIR FORCE BASE

Note: *Document is incorporated by reference herein, but is published separately. Please contact your project POC such as the contracting officer or Air Force Project Manager as appropriate.*

“ATTACHMENT C”

BASE MECHANICAL STANDARD

TINKER AIR FORCE BASE

Note: *Document is incorporated by reference herein, but is published separately. Please contact your project POC such as the contracting officer or Air Force Project Manager as appropriate.*

"ATTACHMENT D"

Sustainability Guidelines

TINKER AIR FORCE BASE

PART 1 –GENERAL

Background:

The Energy Policy Act of 2005, Energy and Independence Security Act of 2007 and Executive Order (EO) 13693 mandate Federal agencies to lead by example, promoting sustainable Federal buildings through sound environmental and economic fiscal design, construction and operating decisions. The Federal requirements collectively are referred to as the "Guiding Principles" and are detailed in "Guiding Principles for Sustainable Federal Buildings and Associated Instructions", February 2016. UFC 2-100-02 integrates DOD requirements with High Performance and Sustainable Building (HPSB) Guiding Principles and industry standards for high performance and sustainable buildings.

- **TAFB Requirements:**

1.1 **UFC 1-200-02**, dated 01-Dec-2016, applies to all planning, design and construction, renovation, repair, operations and maintenance, and affixed equipment installation in new and existing buildings, regardless of funding source, that result in DOD real property assets.

1.1.1 New design and construction and assessments of existing buildings larger than 5,000 SF shall comply with the UFC listed above.

1.1.2 For renovation, maintenance and restoration work in existing buildings, the goal is to improve the performance of the building with every investment.

1.1.3 Integrated design is the most important requirement in achieving a high performance building. A design team must have strong, consistent representation from all stakeholders throughout the project phases to improve building performance.

1.1.4 Employ collaborative, integrated planning by a design team composed of user, Government support staff and appropriate professionals to establish performance goals for siting, energy, water, materials and other comprehensive design goals.

- **Tinker AFB Policy:** Every project shall address the most economic and sustainable building practice to the fullest extent possible. Sustainable practices include those elements of planning, design and construction that promote the efficient use of energy and material resources, the conservation of water and the protection of land and water environments.
- **Primary Principles:**

1.2 Design for energy efficiency – Meet the requirements of ASHRAE 90.1 for commercial buildings. Meet the requirements of International Energy Conservation Code for low-rise residential buildings.

1.3 Enhance indoor environmental quality – Meet the requirements of ASHRAE 55 and 62.1 (62.2 for low-rise residential.)

1.3.1 Specify materials and products with low or no pollutant emissions (VOCs).

1.3.2 Protect indoor air quality during construction – For new construction and renovation of unoccupied existing buildings, comply with ASHRAE 189.1 Section 10.3.1.4 with maximum outdoor air while

keeping relative humidity no greater than 60%. For renovation of occupied existing buildings, comply with ANSI/SMACNA 008-2008, 2nd Edition, *SMACNA IAQ Guidelines for Occupied Buildings Under Construction*.

1.3.3 Smoking is not allowed within fifty feet of building entrances, operable windows and building ventilation intakes.

1.4 Protect and conserve water – Meet the requirements of ASHRAE 189.1 Sections 6.3.2 and 6.4.2.

1.5 Employ environmentally preferable products – Use RCRA 6002 compliant products that meet or exceed EPA's recycled content recommendations, per Comprehensive Procurement Guideline at http://www.epa.gov/.

1.5.1 Use biologically-based products whenever possible.

1.5.2 Do not use ozone depleting substances or high Global Warming Potential (GWP) chemicals where other environmentally preferable products are available – Re: www.epa/snap

1.6 In building demolition, work to divert nonhazardous waste materials from landfills through recycling.

1.7 Sustainability resources available online include:

1.7.1 http://www.wbdg.org/resources/sustainability-building-envelope

1.7.2 http://www.wbdg.org/resources/sustainable-historic-preservation

1.7.3 A new (3/2017) Air Force Sustainability Requirements Scoresheet can be downloaded: http://www.wbdg.org/ffc/af-afcec/policies-and-guidance-af-design-and-construction/AF-Sust-Scoresheet-GP-vFeb2017

1.8 **Contracting Officer Primer on Green Procurement**, as issued by SAF-AQC dated 28- Apr-2011, as follows:

1.8.1 **FAR 23.203**, entitled Energy-Efficient Products, states:

1.8.1.1 When acquiring energy-consuming products listed in the ENERGY STAR ® Program or Federal Energy Management Program (FEMP) –

(i) Agencies shall purchase ENERGY STAR ® or FEMP- designated products; and

(ii) For products that consume power in a standby mode and are listed on FEMP's Low Standby Power Devices product listing, agencies shall –

(A) Purchase items which meet FEMP's standby power wattage recommendation or document the reason for not purchasing such items; or

(B) If FEMP has listed a product without a corresponding wattage recommendation, purchase items which use no more than one watt in their standby power consuming mode. When it is impracticable to meet the one watt requirement, agencies shall purchase items with the lowest standby wattage practicable.

1.8.1.2 When contracting for services that will include the provision of energy-consuming products, agencies shall specify products that comply with the applicable requirements in paragraph (1.8.1.1) of this section.

Information is available via the Internet about -

(1) ENERGY STAR ® at http://www.energystar.gov/; and

(2) FEMP at http://www1.eere.energy.gov/femp/procurement/eep_requirements.html

PART 2 - Definitions:

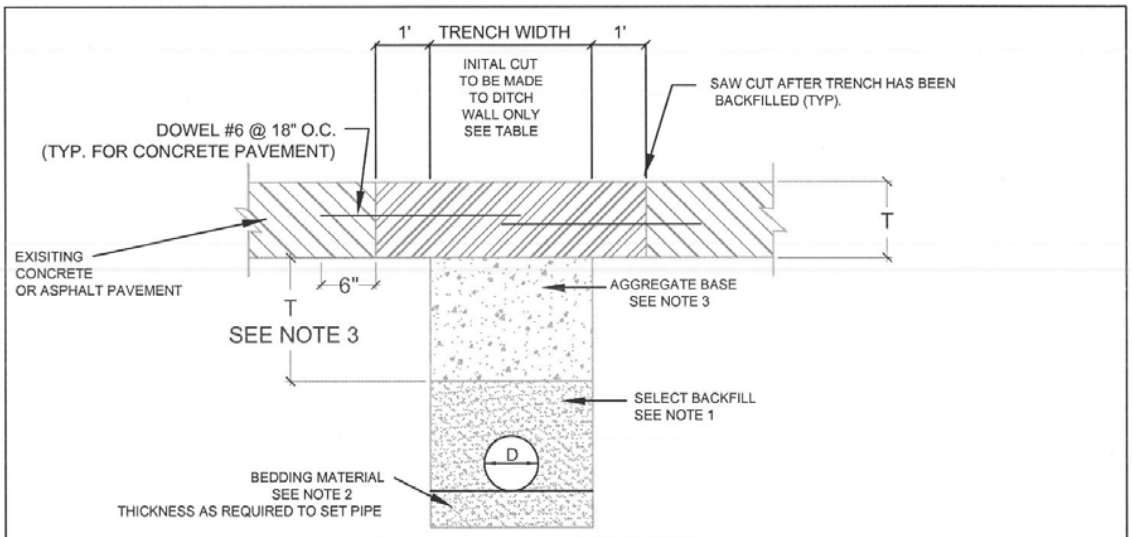
Sustainability:	Sustainable building projects integrate building materials and methods that promote environmental quality, economic vitality, and social benefit through the design, construction and operation of the built environment. Sustainable building merges sound, environmentally responsible practices into one discipline that looks at the environmental, economic and social effects of a building or built project as a whole. Sustainable design encompasses the following broad topics: efficient management of energy and water resources, management of material resources and waste, protection of environmental quality, protection of health and indoor environmental quality, reinforcement of natural systems, and integrating the design approach.
Agrifiber Products:	Composite panel products derived from agricultural fiber.
Bio-based Product:	As defined in the 2002 Farm Bill, a product determined by the Secretary to be a commercial or industrial product (other than food or feed) that is composed, in whole or in significant part, of biological products or renewable domestic agricultural materials (including plant, animal, and marine materials) or forestry materials.
Bio-based Content:	The weight of the bio-based material divided by the total weight of the product and expressed as a percentage by weight.
Composite Wood:	A product consisting of wood fiber or other plant particles bonded together by a resin or binder.
Construction and Demolition Waste:	Includes solid wastes, such as building materials, packaging, rubbish, debris, and rubble resulting from construction, remodeling, and repair and demolition operations.
Major Renovation:	Construction work that is extensive enough such that normal building operations cannot be performed while the work is in progress and/or a new certificate of occupancy is required.
Recycled Content Materials:	Products that contain pre-consumer or post- consumer materials as all or part of their feedstock.
Post-Consumer Recycled Content:	The percentage by weight of constituent materials that have been recovered or otherwise diverted from the solid- waste stream after consumer use.
Pre-Consumer Recycled Content:	Materials that have been recovered or otherwise diverted from the solid-waste stream during the manufacturing process. Pre• consumer content must be material that would not have otherwise entered the waste stream as per Section 5 of the FTC Act, Part 260 "Guidelines for the Use of Environmental Marketing Claims":

www.ftc.gov/bcp/grnrule/guides980427

Sealant:	Any material that fills and seals gaps between other materials.
Volatile Organic Compounds (VOCs):	Any compound of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, which participates in atmospheric photochemical reactions.
Sustainable Practices:	Those elements of planning, design and construction that promote the efficient use of energy and material resources.

“ATTACHMENT E”

Pavement Trench Detail



TYPICAL PAVEMENT TRENCH DETAIL

NOTES:

1.0 SELECT BACKFILL

Select backfill shall consist of satisfactory materials and cohesionless and cohesion materials.

1.1 Satisfactory Materials

Satisfactory materials shall comprise any materials classified by ASTM D 2487 as GW, GP, SW, SP, CL, and ML. Materials shall be compacted to 98% of standard proctor.

1.2 Unsatisfactory Materials

Unsatisfactory materials shall comprise any materials classified by ASTM D 2487 as PT, OH, MH, CH, and OL. Unsatisfactory materials also include man-made fills, trash, refuse, or backfills from previous construction. Unsatisfactory material also includes material classified as satisfactory, which contains root and other organic matter, frozen material, and stones larger than 3 inches. The Contracting Officer shall be notified of any contaminated materials.

1.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as ML and CL. Cohesive fill material shall have a PI of 5-15. Cohesionless fill material shall have a PI of 0-5. Materials shall be compacted to 98% of standard proctor.

2.0 BEDDING MATERIAL

Bedding material shall consist of granular material that shall consist of well-graded sand, composed of the following gradation:

Sieve Size	Percent Passing
3/8 in.	100
No. 4	95-100
No. 16	50-85
No. 50	15-33
No. 100	0-10

3.0 AGGREGATE BASE

Aggregate base shall be clean crushed limestone conforming to Oklahoma State Highway Commission Standard Specification (OSHC CSS) for aggregate base, Section 703.01, Type A. Materials shall be compacted to 98% of standard proctor.

3.1 Aggregate base for concrete pavement shall match existing concrete pavement thickness. Minimum thickness shall be 6".

3.2 Aggregate base for asphalt pavement shall be 8".

4.0 CONCRETE PAVEMENT

New concrete pavement shall have a 28 day compressive strength of 4,000 psi.

DIA IN.	TRENCH WIDTH IN.
6	18
8	24
10	30
12	30
15	36
18	36
21	42
24	42
27	48
30	48
33	54
36	54
42	60
54	72
60	78
66	84

AIR FORCE MATERIEL COMMAND
72 ABW CIVIL ENGINEER DIRECTORATE
TINKER AFB, OK

PROJECT NAME: PAVEMENT TRENCH DETAIL

PROJECT NUMBER:

NOTES:

MANAGEMENT INFORMATION:
ISSUE DATE: 28-Feb-2011
DESIGN GROUP: CECD
DESIGNED BY: R.H. Dein
DRAWN BY: R.H. Dein
CHECKED BY: M. NABYWANEC
DESIGN FILE LOCATION:

SHEET NUMBER: C-1

SHEET 1 OF 1

"ATTACHMENT F"

Bird Proofing Facilities at Tinker AFB

Bird/wildlife-proofing should be accomplished on all new construction including buildings, hangars, outbuildings, lean-tos, utility poles, large drainage culverts, etc.

As a general rule, the following are not effective as longterm bird-proofing for buildings or are not preferred due to high cost and/or maintenance requirements:

- Scare devices (inflatable balloons/eyes/owls, reflective foil)
- Sonic and ultra-sonic devices
- Bird-misting
- Falconer
- Electric track repellers
- Bird gel
- Large scale netting (such as in a hangar)

The following bird/wildlife-proofing techniques should be incorporated into facility designs on TAFB:

1. Bird-proofing should focus on exclusion of birds. Permanently cover all holes, gaps, penetrations, or other openings on the outside of the building. On new construction, filling holes with rigid foam, spray foam or similar products is not considered permanent. These products often deteriorate in time or birds peck out the brittled material and gain access to the building. Covering holes should include screening vents, louvers, exhausts, intakes and similar openings.

   Special attention should be given to covering openings around hangar doors and their tracks. Bird access is particularly problematic at these locations. A couple of hangars on Tinker AFB (Building 2283 and MROTC hangars) were constructed within the past 10 years, and these facilities have not experienced door-related bird access problems. From a bird-proofing standpoint, these door types are preferred. Designers should consider how these were built as they could provide insights to effective bird-proofing. Also, some hanger doors have been equipped with durable broomlike bristles to ensure that holes that must remain are inaccessible to birds when the doors are closed. Alternatively, provide removable panels which can be removed and replaced with normal means of access to and tools used by maintenance and support personnel.

2. Eliminate all ledges and other potential perching surfaces on the exterior of the building to discourage roosting and nesting. This can be done by sloping surfaces or eliminating them altogether. Bird-proofing was included in the design and construction of Building 6612 (Tinker Gate). It has not experienced bird access or roosting problems and therefore could provide bird-proofing insights to designers.

   Also, eliminate or reduce interior ledges (e.g., C channels, purlins, girts on walls and roofs) to the maximum extent practical. Particular attention should be given to the upper 1/3 of the interior of the

facility. For areas where ledges cannot be eliminated, install stainless steel (not plastic or polycarbonate in whole or in part) bird spikes. These should only be used in targeted locations where bird problems have been identified post construction.

3. Netting may be an appropriate means of bird-proofing in certain instances, but this should be used with discretion and only on smaller scale areas. Netting should not be used on a large scale (e.g., to cover the entire ceiling space in a hangar). An example of a successful net installation is in the exterior "U" of Building 1 on Tinker AFB.

4. Install vinyl strip curtains on doorways or similar openings as appropriate. For these to be effective, facility users must not tie the strips to the side or shorten the strips.

Vinyl curtains installed on culvert opening to discourage entrance and nesting by swallows (effective)

Bird excreta on inflatable eyes (ineffective)

Birds nesting on inflatable owl (ineffective)

Tinker Air Force Base Facility Standard - Attachment C

BASE MECHANICAL STANDARD

Tinker Air Force Base, Oklahoma

ISSUED: AUG-2020

NOTICE

In addition to the TAFB Facility Standard, compliance with applicable United Facilities Criteria (UFC), Air Force Instruction (AFI) and other requirement in effect upon Contract Solicitation and/or Award, whichever applies, is required. The contractor shall be responsible to review all publications referenced herein to determine applicability to specific project requirements.

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APPROVING OFFICIAL:

_____

Stephanie Wilson
Base Civil Engineer
Civil Engineer Directorate, 72 ABW

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I. Energy Conservation Requirements

A. Facilities shall include those energy conservation design features which can be economically justified or are otherwise required by UFC in conjunction with this TAFB Facility Standard. Principal considerations are building envelope and mechanical systems design and operation to minimize the use of fossil fuels.

1. Additional guidance may be found in prevailing Executive Orders in effect.

B. Minimum Efficiency Requirements

1. Minimum Energy Efficiency Requirements of buildings are established by the American National Standards Institute (ANSI), the American Society of Heating, Refrigerating & Air-Conditioning Engineers (ASHRAE) and the Illuminating Engineering Society (IES) and published in two separate standards. These standards are incorporated by reference into UFC 3-410-01 *Heating, Ventilating and Air Conditioning Systems.*
2. **ANSI/ASHRAE/IES Standard 90.1 - *Energy Standard for Buildings Except Low-Rise Residential Buildings*** (latest edition) establishes minimum efficiency and performance requirements for the following:
   a) Building Envelope
   b) Heating, Ventilating, Air-Conditioning, Refrigeration (HVAC/R)
   c) Service Water Heating (Boilers, Water Heaters)
   d) Power
   e) Lighting
   f) Other Equipment (Electric Motors, Service Water Pressure Booster Systems, Elevators, Escalators and Moving Walks)

   Note: *ASNI/ASHRAE/IES Standard 90.1 applies to new and existing building facilities at TAFB (except low-rise residential buildings).*
3. **ANSI/ASHRAE Standard 90.2** - ***Energy Efficient Design of Low-Rise Residential Buildings*** (latest edition) establishes design requirements for single-family houses, multi-family structures of three stories or fewer above grade, and manufactured houses (modular and mobile).

C. Energy Metering

1. Energy usage metering shall be provided for all projects in accordance with UFC 3-401-01 *Mechanical Engineering*, **ANSI/ASHRAE/IES Standard 90.1** - ***Energy Standard for Buildings Except Low-Rise Residential Buildings*****,** and the most recent Energy Policy Act.
2. Reference the most current version of the "Air Force Meter Data Management Plan" maintained by AFCEC. This can be found at the following link: https://cs2.eis.af.mil/sites/10159/SitePages/Service%20Page.aspx?Service=Air%20Force%20Facility%20Metering%20Program
3. All meters shall meet the minimum requirement of the AF's Advanced Meter Reading System (AMRS).
4. AMRS and Utility Metering Requirements include but are not limited to:
   a) New Gas and Water meters and replacement of existing analog Gas and Water meters shall, as a minimum, be equipped with pulse output which can be connected to an external pulse accumulator/counter. Pulse accumulators may be supplied by others. Pulse accumulators and digital "smart" Gas and Water meters must, as a minimum, communicate using Modbus TCP protocol with the AMRS system at Tinker AFB. Daily totalized consumption is required for a minimum of 90 days.
   b) Electric Meters; a) 15-minute interval data with 30 days memory, b) local, scrolling LED or LCD display, c) hand-held data reader support (Bluetooth wireless or Optical Port), d)

Minimum data recorded to include; kWh, kW demand, kVARh, kVAR demand, power factor, e) Communicate using Modbus TCP protocol with the AMRS system at Tinker AFB.

D. Energy Management Considerations

1. Other items for consideration for energy conservation are economy cooling cycle, variable volume systems, and night and weekend system shutdown. Controls for night and weekend setup/setback of space temperature shall be provided for all areas.
2. Air-Conditioning of Occupied Spaces. Occupancies where air conditioning is permitted shall be per UFC 3-410-01.

E. Computer Analysis

1. For all major Military Construction (MILCON) projects, computer dynamic analysis techniques shall be utilized to effectively evaluate all design parameters associated with energy conservation design.
2. In addition to the calculations and analysis requirements indicated in UFC 3-401-01, provide calculations listed in UFC 3-410-01 Chapter 5, part 5-1.2, including an Energy Compliance Analysis (ECA), "U" Factor calculations, HVAC Load Calculations, Outside Air Requirements/ Calculations, Building Air Balance Calculations, Duct Pressure Drop Calculations, Hydronic System Pressure Drop Calculations, Pipe Expansion Calculations, and Equipment Sizing Calculations.

F. Life Cycle Cost Analysis

1. Design features shall be evaluated via life-cycle cost analysis. The various alternatives and their costs evaluated during design shall be documented by the designer and included in submittals.
2. The National Institute of Standards and Technology (NIST) has prepared the Life Cycle Costing Manual for the Federal Energy Management Program (NIST Handbook 135), and annually issues real growth energy price indices and discount factors for life cycle cost analysis. As a companion product, NIST has also established the Building Life Cycle Cost (BLCC) computer program to perform LCC analyses. The latest versions of the BLCC program not only structure the analysis but also include current energy price indices and discount factor references. These NIST materials define all required LCC methodologies used in GSA design applications. The A/E may obtain the BLCC software and updates from NIST. The project team must integrate the LCC analysis into the concept design process, and the analysis must be completed by the design development phase. Facilities Standard for the Public Buildings Service P100 - Chapter 1.7 - Life-Cycle Costing by GSA.

G. Design and Construction of Energy Monitoring Control Systems (EMCS)

1. An energy monitoring control system shall be provided for all projects in accordance with UFC 3-401-01 *Mechanical Engineering*, ANSI/ASHRAE/IES Standard 90.1 - *Energy Standard for Buildings Except Low-Rise Residential Buildings*, and the most recent Energy Policy Act.
2. All stages of EMCS designs shall be coordinated with the Energy Management Program monitor in the Utility Engineering section (72 ABW / CECO) and HQ AFMC. All installed control systems shall be connected to the existing base wide Civil Engineering Community Of Interest Network Enclave (CE COINE). The control system contractor shall contact the base Information Technology (IT) contractor for pricing and include this pricing in their estimate and scope to include the installation of the Ethernet drops and corresponding network IP addresses in the quantity and location detailed and required by the controls contractor. The control systems shall be integrated into the base wide Energy Management and Control Systems (EMCS's) that are approved for Authority to Operate (ATO). These system vendors are Automated Building Systems, Inc., Honeywell and Paragon Robotics. Contractor shall contact and coordinate connections with the CE Information System Security Manager (ISSM), the CE Energy Management office and CE Operations.

3. **Control Protocol.** ASHRAE's BACnet® protocol is the required system for Tinker AFB facility monitoring and control systems. Facility HVAC control systems based on the BACnet® protocol must be designed and constructed in accordance with ANSI/ASHRAE Standard 135, UFGS 23 09 00, UFGS 23 09 23.02 and UFGS 23 09 13. For additional information refer to specific UFCs such as UFC 3-401-01 *Mechanical Engineering* and UFC 3-410-01 *Heating, Ventilating, and Air Conditioning Systems.*

4. Civil Engineer-owned, operated, or maintained control systems shall follow policy directives published in **Air Force Guidance Memorandum AFGM 2018-32-01** *Civil Engineer Control Systems Cybersecurity* (or latest edition), and AF CE CS *Cybersecurity Plan v 2.0* submitted 17-Sep-18. In addition, follow guidance published in UFC 4-010-06 Cybersecurity of Facility-Related Control Systems. Additional guidance is found in the Appendix section of this Standard, US DoD publication FACILITY-RELATED CONTROL SYSTEMS CYBERSECURITY GUIDELINE.

5. **System Design Requirements**

   Mechanical and electrical systems in facilities shall be provided with the necessary sensors, controls, and hardware points to implement the EMCS application programs per UFC 3-410-01 *Heating, Ventilating, and Air Conditioning Systems* (latest edition), following the guidance for ASHRAE BACnet® monitoring and control of the systems.

   a. The new and replacement network controllers shall be selected to be fully functional and seamlessly compatible with the equipment controllers such that the base operations control technicians utilize their systems training and system support tools to maintain, configure and program both the network controllers and the equipment controllers at the same time.

   b. Control system designers shall submit the proposed schedule of points to be monitored and/or controlled in the I/O summary table format as outlined UFC 3-410-01 *Heating, Ventilating, and Air Conditioning Systems* (latest edition). For additional requirements, consult other sections within the TAFB Facility Standards (such as the requirement for vibration isolation sensing and monitoring controls listed in Section IV herein).

   c. Site-specific schematics shall be provided showing all sensors, controls, and hardware points.

   d. Pneumatic HVAC controls are no longer allowed at Tinker AFB. All projects modifying, replacing, or installing HVAC controls shall utilize DDC.

   e. The new installation/replacement shall be coordinated in a way that does not interfere with existing performance contract(s) (ESPC/UESC) in place, where the majority of the specified areas are dictated by such contracts. In a building where the existing performance contract covers only a part of the area or systems, any controller may be selected as long as such installation does not interfere with the existing performance contract. Such controller shall be fully compatible with the existing EMCS's that are approved for ATO and serviceable by the base operations control technicians or local service crews.

6. **Installation Requirements**

   a. All abandoned-in-place temperature controls shall be demolished as part of the construction, renovation, repair or other improvement project.

   b. Where DDC controls are installed, the controls shall be fully compatible with the existing control system and the base wide EMCS system. Comply with specific code provisions regarding network controls, such as UFC 3-410-01, Chapter 4, Section 309, para. 309.3.

   c. **ALL** wiring from sensors, controls, and hardware points shall be in conduit. Conduit shall meet requirements outlined in the ***Base Electrical Standard***. Wiring shall be terminated at a Data Termination Cabinet (DTC) located in mechanical rooms. The conduit shall enter the side and bottom of the panel only.

d. Install conduits entering panels from side and bottom of panel to prevent water from entering the panels and destroying the electronics.

e. Provide adequate clear space around EMCS Data Gathering Panel (DGP) location of future FID and MUX and accessibility of maintenance personnel.

H. Solar Heating System Requirements

1. Any facility undergoing major renovation must be evaluated per life cycle costing to determine if 30% or more of required domestic hot water can be supplied by a cost effective solar heating system.

– End of Section –

II. Fire Protection Engineering

A. Safety Deficiencies in Existing Facilities

1. Existing facilities requiring correction of any fire safety deficiency shall comply with Air Force Instruction 32-10141 – *PLANNING AND PROGRAMMING FIRE SAFETY DEFICIENCY CORRECTION PROJECTS.*

B. System Design for Existing and New Facilities

1. All fire protection system designs shall be accomplished by a qualified Fire Protection Engineer. All fire protection systems shall be designed in accordance with the following:
    - UFC 3-600-01 Design: Fire Protection Engineering for Facilities,
    - UFC 3-601-02 Operations and Maintenance: Inspection, Testing, and Maintenance of Fire Protection Systems,
    - UFC 4-010-06 Cybersecurity of Facility-Related Control Systems,
    - NFPA 13,
    - *Life Safety Fire Protection System Analysis* (project specific, to be provided by the Engineer of Record).
2. Fire Protection designs shall reference the new **Air Force Corporate Facilities Standards** at the following web hyperlink:

    http://www.wbdg.org/ffc/af-afcec/corporate-facilities-standards-afcfs

3. Fire Protection designs shall incorporate cybersecurity requirements. Consult the Base Information System Security Manager (ISSM) regarding “Authority to Operate” (ATO) requirements for fire protection control communications systems.

C. Design Submittal

1. The designer shall provide a preliminary fire sprinkler design, including hydraulic calculations IAW UFC 3-600-01 requirements.

D. Piping System Design and Installation

1. Piping material for dedicated fire suppression systems shall be ductile iron or steel only and meet or exceed the material standards and requirements listed in NFPA 24 as amended by UFC 3-600-01. Minimum wall thickness for all sprinkler piping shall be schedule 40 steel.
2. COLOR IDENTIFICATION. In the absence of project-specific contract specifications, all fire suppression/sprinkler piping constructed of ferrous metal (non-galvanized) shall be painted red. New coatings shall be compatible with existing coatings. This requirement applies to all piping, whether concealed or exposed. Use of the following or equivalent paint system is required:
    a. Sherwin Williams Pro-Cryl Universal Acrylic Primer (One Coat)
    b. Sherwin Williams ProMar 200 Zero VOC Interior Latex (Two Coats if exposed)
3. LABELING. Piping shall be labeled IAW UFC 3-600-01 requirements. Painted labels shall be applied after piping has been painted and fully cured.

E. Firewalls and Fire Area Limitations

1. All construction, including fire walls, fire area limitations, emergency lighting systems, means of egress, and exit stairways, shall meet the more stringent requirement of both the NFPA 101 and the International Building Code.
2. All wall penetrations through existing firewalls shall be fire caulked and sealed.
3. All duct penetrations through fire walls on both new and repair projects shall have operational and code compliant dampers and seals as required by current code.

4. Identification (by painting) of Fire Rated Walls, Fire Pumps, Hydrants, Automatic Sprinkler Systems, Fire Alarm conduit, junction boxes and covers shall be provided and performed for all projects IAW UFC 3-600-01, *Fire Protection Engineering for Facilities.*

– End of Section –

III. Mechanical Engineering: *Plumbing Systems*

A. Plumbing Systems – General

1. Plumbing systems at Tinker AFB generally include the following facility systems:
    - Domestic water supply piping, booster pumps and related systems
    - Waste water piping and related components
    - Natural Gas piping and related components
    - Compressed air piping and related components (i.e. air-compressors)
    - Lavatory, toilet and related plumbing fixtures
    - Water heaters and boilers for domestic water heating
    - Storm drainage systems within and to 5 feet outside buildings
    - Water for landscaping
    - Water softening and treatment (small) systems for buildings
    - Corrosion control (cathodic) protection systems
2. Design and construction of plumbing systems shall be in accordance with the International Plumbing Code and the following, as applicable:
    - UFC 3-420-01 Plumbing Systems
    - UFC 3-420-02FA Compressed Air
    - UFC 3-230-01 Water Storage, Distribution and Transmission
    - UFC 3-430-09 Exterior Mechanical Utility Distribution
    - Air Force Instruction AFI 32-1066 *Backflow Prevention Program*
    - NFPA

B. Facility Domestic Water Supply

1. Base domestic water supply systems shall be from potable water lines. All water used for process purposes (heating, air conditioning) shall be isolated from domestic supply systems, or 'drinking water', by means of reduced-pressure backflow prevention devices.
2. Tie-ins to existing water lines shall be analyzed to document as part of the project design analysis that existing demands shall not be adversely affected by new demands.
3. Incorporate handicapped accessible design for all toilet areas, shower areas, and drinking fountains.
4. Provide access to piping, valves, and instrumentation for maintenance personnel. Access to through-wall piping shall be provided by means of wall access panels or, where space is available, from a walk-in plumbing chase. Where carriers are utilized to support fixtures, a walk-in plumbing chase is preferred.
5. Domestic hot and cold potable water piping shall be of Type L seamless copper tubing with dielectric insulators at point of contact with dissimilar metallic piping. Provide insulation for all domestic and comfort cooling supply and return lines.
6. Specify Type K copper pipe for underground domestic hot water supply applications and Type L copper pipe for above ground hot water applications.
7. Do not use dissimilar metals in contact with each other on piping in a common electrolyte such as water or soil.
8. Provide stop-valves at all plumbing fixtures.
9. Provide water hammer arrestors as required by code and for any location where quick-acting valves are installed. Utilize devices that comply with relevant standards such as ASSE 1010.
10. Design piping with the following velocity limitations to minimize erosion:

Pipe Dimension		Maximum Velocity	
inches	*mm*	*m/s*	*ft/s*
1	25	1	3.5
2	50	1.1	3.6
3	75	1.15	3.8
4	100	1.25	4
6	150	1.5	4.7
8	200	1.75	5.5
10	250	2	6.5
12	300	2.65	8.5

11. No asbestos-containing materials of any kind shall be used in construction.
12. Water meters shall be installed on all facilities. See TAFB Facility Standard Section 6: Utilities for full metering requirements.
13. For engineering design and system sizing determinations, it shall be anticipated by project designers that the highest demand for water shall be during normal duty hours.

C. Cross-Connection and Backflow Prevention

1. Cross-connection and backflow prevention policies of AFI 32-1066 *Backflow Prevention Program* shall be followed to protect the potable water system and facility occupants.
2. The proper backflow prevention device shall be specified as required in AFI 32-1066 for the hazard involved.
3. Backflow prevention devices shall be located and installed to ensure they shall function, not freeze, and are readily accessible for testing, service and repair.

D. Wastewater Systems Design

1. Comply with Air Force Instruction AFI 32-1066 *Backflow Prevention Program*, latest edition.
2. Where specific project requirements are determined more stringent by 72 ABW/CE, use the manual of practice Gravity Sanitary Sewer Design and Construction**,** as jointly published by the *Water Environment Federation* and the *American Society of Civil Engineers* as the MOP FD-5**.**

3. All projects on TAFB which include earthwork shall comply with Engineering Technical Letter ETL 03-1: Storm Water Construction Standards.

4. **General Requirements**

   a) Provide sanitary drain systems from lavatories, toilet areas, break areas, and non-industrial waste floor drains to sanitary lines. Piping shall be installed to provide a slope of ¼ inch per foot for a pipe diameter of 2 inches and below and 1/8 inch per foot for piping 2-1/2 inches and larger.

   b) All Restrooms projects involving under-floor plumbing work shall locate new floor drains under the partitions in the new or final floor layout.

   c) All projects involving a janitor closet and under-floor piping shall place a floor drain in the center of the janitor room with grading to ensure removal of all water from floor.

   d) Trap primers are required on all floor drains. Trap primers are preferred to be installed in the wall with access panels and with hammer arresters.

   e) Wall cleanouts shall be incorporated at appropriate points within plumbing system designs to serve all water closets, urinals, and lavatories. Wall cleanouts shall be located 26" A.F.F. Floor cleanouts are not acceptable in restrooms.

   f) Where piping is to be installed in exterior walls, the designer must show that the exterior wall design will prevent water or waste piping from experiencing freezing conditions.

   g) Do not provide water or waste piping in attic spaces where there is danger of freezing.

   h) The installation of an electric waste disposer/food waste grinder is prohibited except as provided in UFC 3-420-01 *Plumbing Systems*.

5. **Additional Requirements**

   a) Pre-Construction & Post-Construction Scoping. Prior to beginning construction, a contractor performing a renovation, repair or replacement project that involves sanitary waste lines shall snake existing sanitary pipes 100 feet to identify and clear any blockages in existing lines. Upon construction completion, following all clean-up activities, the contractor shall scope both new and existing sanitary pipe to clear any obstructions. Snake pipes that are smaller than 6". Provide video footage for sanitary pipes 6" and larger in diameter. Video footage shall be obtained pre-construction and again post-construction. Submit video evidence prior to new pipe being installed. Following construction, submit post-construction video evidence of all new and existing pipes. The Contractor shall perform the above work in the presence of the Construction Inspector. The above is a minimum standard requirement. Project specific requirements may differ and/or increase the line length.

E. Corrosion Prevention and Control

AFI 32-1054 Corrosion Control https://www.wbdg.org/ffc/af-afcec/instructions-afi/afi-32-1054

Cathodic protection for buried metallic structures shall be designed IAW UFC 3-570-02A Cathodic Protection, UFC 3-570-02N Electrical Engineering Cathodic Protection, and UFC 3-570-06 O&M Cathodic Protection System.

1. Protective coatings: Coating specifications for above and below ground high value metallic structures shall be prepared IAW the guide specifications as shown in UFC 3-190-06 *Paints & Protective Coatings.*

2. Underground piping systems shall conform to either FS-L-C-530, Type II except tape and primer

conform to AWWAC203, for epoxy or for continuously extruded polyethylene, FS-L-C-530, Type I.

3. On all metallic structures where the surface is blasted to white or near white finish, no blasted surface shall be left unprimed beyond the normal workday.
4. Coatings specified for underground or submerged use shall be those specifically designed for those types of environmental conditions.
5. Under no circumstances shall thin plastic film tapes, such as electrical tape, be used to coat underground structures or wiring.
6. Reference NACE Standard RP-01-69 for coating information.

F. Cathodic Protection

1. General soil conditions at Tinker AFB are very conducive to corrosion of underground metal structures.
   a) The soil varies from sandy silt to sandy clay with areas of stratification of the various types.
   b) Soil resistivity varies from a high of 26,100 ohm-cm to a low of 529 ohm-cm. There is no soil resistivity data available at the base.
2. Designer shall take readings at the locations of structures and paths of utilities having cathodic protection.
3. Design analysis shall contain a map showing the sites of such readings, type of instrument used and a table containing location designation and soil resistivity.
4. Cathodic protection design shall be a complete design and not a performance specification.
5. The cathodic protection system to be installed shall be designed by an engineer who has been accredited as a "Corrosion Specialist" by the National Association of Corrosion Engineers, which verifies that engineer has had experience in cathodic protection design, installation and testing as per UFC 3-570-02A *Cathodic Protection* and UFC 3-570-06 *O&M Cathodic Protection Systems*.
6. Guidance for the installation and/or use of corrosion mitigation equipment and procedures is provided by UFC 3-570-02A *Cathodic Protection* and UFC 3-570-06 *O&M Cathodic Protection Systems.*
7. All metals installed underground or in contact with the ground at Tinker AFB shall have cathodic protection for control of corrosion.

G. Water Treatment

1. Water treatment shall be provided for all transfer media in all heat transfer equipment.
2. Heat transfer equipment shall be taken to include cooling towers, chilled/hot water systems, and boilers.
3. Treatment shall contain no chromates and no heavy metals.
4. Water treatment design analysis shall contain base water analysis and step-by-step procedures used to arrive at suggested treatment.
5. This analysis shall include which constitute of water is the limiting parameter.
6. All new equipment, water treatment systems and methods installed shall be in compliance with support the descriptions, recommendations, and guidelines of UFC 3-240-13FN *Industrial Water Treatment Operation and Maintenance.*
7. Air Force Non-Chemical/Nontraditional Water Treatment Devices Policy: Most non-chemical water treatment devices or equipment are not currently authorized for use on military installations, as stated in paragraph 1-1.5. The Air Force will allow their use only under an Energy Saving Performance Contract (ESPC) in which the contractor assumes all performance-based risk. The performance standards for system component protection must meet or exceed those that are

achievable with chemical treatment. (See UFC 3-240-13FN Chapter 8 for details).

H. Water Softeners/Water Treatment Equipment:

1. Water softeners are required on all open loop makeup systems including but not limited to steam boilers, humidifiers, and commercial domestic hot water systems (kitchens).
2. Softeners shall be properly sized to allow soft water to be introduced into systems at all times, including emergency shutdown.
3. Provide adequate water/conditioned water for all boiler systems.
4. Side stream pot feeders and annual chemical treatment shall be provided on all "closed loop" systems including but not limited to heating water loops, chilled water loops, and fluid cooler applications.

I. Existing Energy Source

1. Natural gas is available for facility heating if steam is not available.
2. Natural gas pressure varies from 30 to 40 psig, seasonally.
3. Gas is on an uninterruptible contract.
4. Steam is no longer supplied from centralized locations on Tinker AFB (i.e. boiler plants). Most facilities previously served by a central boiler plant have been converted to heating water. A facility having a stand-alone steam boiler (except process boilers), will need to be evaluated for conversion to other mediums. Designers/contractors shall consult with Base Civil Engineering in order to confirm requirements for specific heating equipment.

J. Natural Gas Systems

1. Exterior Distribution Piping (Mains): Refer to TAFB Facility Standard, part 6.9 **Natural Gas Delivery Systems.**
2. Building Service:
   a) Install sufficient isolation valves to repair units without shutting off entire system
   b) Replace natural gas regulators over 15 years old.
   c) Distribution regulators: All distribution regulator sets shall be installed with:
      - Regulators that do not fail in the valve "open" position (e.g., do not use pilot loaded regulators since they fail to "open").
      - Valved, regulated bypasses to permit equipment repair or replacement.
      - Regulators that have valve stem indicators.
      - Sets that use one regulator for control of flow and a second regulator to monitor the flow.

K. Welding

1. All welding shall be performed by a welder certified IAW ANSI B31.1 or API 1104 codes. Welds shall be made and inspected IAW ANSI B31.8 requirements.

L. Plumbing Piping

1. Piping installed on new systems shall be corrosion resistant. Otherwise a cathodic protection system shall be provided. Provide necessary shutoff valves and identification.
2. Pipe Painting**:** All exposed plumbing piping shall be primed with paint suitable for metal surfaces and finish painted with color to match background. This requirement applies to repair and renovation projects as well as new construction or additions to existing building plumbing systems.

3. Pipe Labeling: All supply and return lines shall as a minimum be identified with markings denoting both flow direction and fluid transported.

M. Piping Thermal Insulation

1. Insulation of plumbing piping located outdoors. Where piping that serves domestic hot water, domestic cold water or similar fluid is installed outdoors or otherwise exposed to the elements, insulation shall exceed by 30% the requirements of ASHRAE 90.1, the International Mechanical Code, or the standard UFGS specification whichever is greater. This shall apply to all new construction, renovation, repair or replacement projects.
2. Insulation of plumbing piping located within a conditioned environment. Where piping is installed indoors or otherwise within a conditioned environment, thermal insulation shall meet requirements of ASHRAE 90.1, International Mechanical Code, or the standard UFGS specification, whichever is more stringent. This shall apply to all new construction, renovation, repair or replacement projects.

N. Compressed Air Systems

1. Compressed air, if required, shall be provided by base compressed air distribution system where available.
2. Where Base system is unavailable to the project site, provide stand-alone compressors and locate in facility mechanical room.
3. Provide necessary maintenance access for controls, refrigerated air dryers, and condensate handling equipment.
4. Ventilate mechanical rooms to prevent overheating of components and to maintain acceptable indoor air quality. Ventilation system designs shall comply with **ASHRAE Standard 62.1 – *Ventilation for Acceptable Indoor Air Quality,*** latest edition.
5. Install inlet air filtration with instrumentation.
6. Install vibration isolation pads (neoprene component material is preferred), including flexible connections between the compressor and its associated piping, to prevent vibration damage to compressors.
7. Noise suppression shall be provided to keep compressor noise within Occupational Safety and Health (OSHA) limitations.
8. Oil free compressors shall be required for breathing air applications.

O. Equipment & Fixtures

1. Electric Water Coolers/Drinking Fountains. Design electric water coolers (drinking fountains) to be dual use water coolers and bottle filling stations. Units shall be filter-less type. Provide accessible models where required.
2. Standard Restroom Fixture - Basis of Design.
   a) Faucet, hand washing. Sloan EAF-275 sensor activated, or equal.
   b) Service Faucet. T&S Brass & Bronze Works, Inc. model B-0665-BSTP wall mounted, or equal.
   c) Flush Valve (new/replacement). Sloan or equal, AC powered sensor-activated, single-flush or manual flush valve.
   d) Flush Valve (retrofit conversion). Sloan or equal AC-powered sensor activated, single-flush retrofit conversion kit for exposed closet or urinal applications.

– End of Section –

IV. Mechanical Engineering: *HVAC/R Systems*

A. General

1. Proper design of mechanical systems is required for the health and life safety of building occupants, operations and maintenance personnel and the general public.
2. Mechanical systems shall be designed, constructed, operated and maintained according to UFC requirements, Air Force Instructions, TAFB Instructions and other requirements. In the absence of specific criteria, follow recommendations from ASHRAE and/or the equipment manufacturer.
3. Mechanical systems, including all heating, ventilating, air-conditioning and refrigeration systems shall be designed and constructed, operated and maintained to meet applicable code requirements and Tinker AFB Standards.
4. All HVAC systems shall be tested and balanced following installation or replacement. Testing and balancing shall be performed in accordance with UFC requirements.
5. All mechanical equipment schedules shall incorporate the use of existing unit identification numbering (UID) for all real property equipment.

B. Submittal Requirements for All Mechanical Projects

The information herein applies to all construction and/or repair projects regardless of delivery method. Refer to contract documents for additional information on submittal requirements. In the absence of specific contract requirements, the following minimum requirements shall apply:

1. Design submittals shall be provided at one or more levels; schematic, preliminary, design development and final design phases (i.e. 15%, 35%, 65%, etc.) as per contract documents.
    a) Schematic phase: Preliminary design analysis to include manufacturer cut-sheets, sketches, preliminary load calculations.
    b) Design development phase: Preliminary design analysis, preliminary load calculations, mechanical equipment plan layout and air distribution design, preliminary hydraulic calculations, plumbing design, equipment selections, outline specifications, etc.
    c) Construction document phase: Final design analysis, final mechanical equipment plans, final air distribution design, final plumbing design, equipment selections, schedules, specifications, etc.
2. Shop drawing submittals shall consist of the following:
    a) Installing contractor or sub-contractor provided drawings to illustrate the dimensional requirements (including spatial constraints, maintenance requirements, etc.) for all systems, materials and equipment to be assembled or constructed in-place. Examples include isometric drawings for all plumbing and instrumentation (P&I), air distribution systems, buried piping, utility vaults, etc.
    b) Manufacturer's published data for all pre-manufactured items to be installed and/or otherwise provided on Tinker AFB. Data shall include, but not be limited to all of the following as applicable: certified performance data, capacities, dimensions, ratings, code approvals, the approval seal and/or published rating information for all listing agency standards, manufacturer's special requirements, general installation requirements, access requirements, electrical characteristics (voltage, frequency, phase, amperage, capacitance, resistance, inductance ratings, etc.).
3. Combine all related materials into one submittal, i.e. all plumbing fixtures, all air distribution devices, all related mechanical assemblies, etc. to be submitted using one form AF3000, with each item listed separately.
4. The following required deliverables shall be provided in electronic (PDF) format and hard copy:

a) Installation manuals

b) Operation & maintenance (O&M) manuals, including spare parts list

c) Wiring diagrams, including project specific wiring diagrams, control diagrams, etc.

d) Start-up test and check reports, Test and balance (TAB) reports, etc.

e) Commissioning plans, reports and manuals

5. As-built drawings shall be provided in both hard copy and electronic form. Electronic documents shall be in both AutoCAD and PDF formats.
6. Additional requirements are published in Tinker AFB Standard Specification Section 01 33 00 SUBMITTAL PROCEDURES. Specific drawing documentation details may be found in various code documents such as UFC-3-401-01 Mechanical Engineering, UFC 3-410-01 Heating, Ventilating, And Air Conditioning Systems, etc.

C. Mechanical Equipment

1. All abandoned-in-place mechanical equipment shall be demolished as part of the construction, renovation, repair or other improvement project.
2. All outdoor mechanical equipment shall be rated and installed for all weather conditions. These provisions shall include but not be limited to the following:
   a) Low voltage electrical connections to outdoor mechanical equipment.
   b) Heat tracing and insulation to prevent freezing.
   c) Aluminum protective covering for outdoor insulation.
   d) Protection for pipe insulation in high traffic areas.
   e) Rain tight NEMA rated enclosures and watertight EMT as applicable.
   f) Hail damage guards and high wind protection for refrigerant condenser coils.
   g) Low ambient capability (to at least 0 degrees F) for air-cooled refrigeration condensers, compressor-bearing condensing units and packaged outdoor HVAC units when required to operate in low ambient conditions.
   h) Hot gas reheat for packaged outdoor HVAC units for dehumidification.
3. All installed equipment utilizing refrigerants shall use a refrigerant which is approved for use on Tinker AFB as listed in the Base Refrigerant Management section of this Standard.
4. All HVAC installation, repair or replacement work shall be performed in accordance with ASHRAE and other industry-accepted standards.
5. The minimum thickness for pleated media shall be 4”.
6. Whenever possible, install bypasses or some other means to ensure regular maintenance items such as strainers may be cleaned without plant shutdown.
7. Provide disconnect switches for remote controlled equipment like air handlers and exhaust fans.
8. All equipment which could be damaged by inclement weather or accidental damage shall be installed with protective equipment options or provisions including, but not limited to, hail guards for all air-cooled condensers.
9. Floor mounted equipment shall be mounted on suitable concrete housekeeping pads extending 6 inches beyond the unit footprint.
10. Mechanical equipment having rotating or reciprocating components, such as compressors, fans, motors, etc. shall be mounted on spring isolators.
11. All equipment shall be located with sufficient clearance for maintenance and be provided with access by means of identified panels, catwalks, platforms, stairs or ladders as required.

12. Requirements for Boilers: Prior to construction, contractors shall contact Tinker AFB 72 ABW Civil Engineering Squadron, Environmental Management, Air Quality Division, regarding current environmental requirements for new boiler equipment. Additional requirements may be found in Tinker AFB General Specification Section 00 72 00 - *ENVIRONMENTAL REQUIREMENTS FOR CONSTRUCTION ON TINKER AIR FORCE BASE*. Tinker AFB Environmental shall also be contacted for current environmental metering, recording, and report requirements for new boilers.
13. Infrared Heating Systems, infrared heaters and system components installed on base, specifically in buildings located near the flight line such as aircraft hangers, shall be designed to prevent movement caused by vibration during aircraft take-off operations. Consider designing with seismic protection to accomplish this measure.

D. Mechanical Piping - General

1. All abandoned in place mechanical piping shall be demolished as part of the construction, renovation, repair or other improvement project.
2. Isolation valves shall be provided at each piece of connected equipment.
3. Isolation valves shall be provided at each branch line extending from a main line (tee fitting).
4. Thermometers, pressure gauges and PT plugs shall be provided at all coils.
5. All supply and return lines shall be identified with markings denoting flow direction and fluid transport.
6. Pipe Painting: All exposed mechanical piping shall be primed with paint suitable for metal surfaces then finished with a paint color to match the background. This requirement applies to repair and renovation projects as well as new construction or additions to existing building systems regardless of method of project delivery.
7. Pipes containing water or other fluids subject to freezing, when routed inside of an exterior wall cavity, ceiling cavity or other location exposed to an unconditioned space or to the outdoors, shall be protected from freezing.
8. All condensation shall be drained into sanitary sewer on all projects.
9. Piping installed on new systems shall either be manufactured as corrosion resistant, have protective coatings applied in the field or have a cathodic protection system.

E. Underground Piping

1. Steam utility piping systems shall be designed in accordance with UFC 3-430-01FA *Heating & Cooling Distribution Systems.*
2. All steam and hot water distribution systems shall have a cost analysis performed comparing aboveground, surface utility, and underground conduit systems to determine the most economical system. Comparison should include cost, maintainability, and system performance.
3. Install cathodic protection systems to protect all piping and appurtenances located underground.

F. Piping Thermal Insulation

1. Insulation of mechanical piping located outdoors. Where mechanical piping that serves steam, chilled water, hot water, domestic water or similar fluid is installed outdoors or otherwise exposed to the elements, insulation shall exceed by 30% the requirements of ASHRAE 90.1, the International Mechanical Code, or the standard UFGS specification, whichever is more stringent. This shall apply to all new construction, renovation, repair or replacement projects.
2. Insulation of mechanical piping located within a conditioned environment. Where mechanical piping is installed indoors or otherwise within a conditioned environment, thermal insulation shall

meet requirements of ASHRAE 90.1, International Mechanical Code, or the standard UFGS specification, whichever is greater. This shall apply to all new construction, renovation, repair or replacement projects.

G. Ductwork

1. All abandoned-in-place ductwork systems shall be demolished as part of the construction, renovation, repair or other improvement project.
2. All ductwork shall have a class A seal.
3. All HVAC ductwork shall be constructed and installed in accordance with industry-accepted standards including but not limited to ASHRAE and SMACNA standards.
4. Install sufficient insulation and vapor barrier on air conditioning ductwork and chilled water piping to prevent condensation. Duct liner shall be kept to a minimum for sound control only. The preferred thermal insulation shall be external wrap.
5. Balancing dampers in ductwork shall be installed so as to be inaccessible to the occupants of the space being served, i.e. in the take offs from the duct branches rather than in the diffusers.
6. Exposed Ductwork Painting: All exposed mechanical ducts shall be primed with paint suitable for metal surfaces and finish painted with color to match background. This requirement applies to repair and renovation projects as well as new construction or additions to existing building systems regardless of method of project delivery.

H. Natural Gas Systems

1. Refer to Plumbing Section for requirements.

I. Welding

1. All welding shall be performed by a welder certified IAW ANSI B31.1 or API 1104 codes. Welds shall be made and inspected IAW ANSI B31.8 requirements.

J. Temperature Controls / Energy Management / EMCS Systems

1. All abandoned-in-place temperature controls shall be demolished as part of the construction, renovation, repair or other improvement project.
2. Temperature controls for all renovation and new construction projects shall utilize direct digital control (DDC) systems as required by UFC 3-410-01.
3. Provide vibration sensors for all mechanical equipment having electric motor(s) equal to or exceeding 50 HP. Vibration sensing equipment shall include permanent mount sensors/transducers, collection boxes and cabling sourced via the same manufacturer – all devices shall be compatible. Preferred products are as manufactured by Connection Technology Center, Inc. Victor, NY.
4. Provide baseline measurements for all equipment in commissioning reports. Record results on the EMCS monitoring system.
5. For additional requirements, refer to **Section I – Energy Conservation Requirements** in this document.

K. Water Treatment

1. In order to protect boilers, cooling towers, chillers and other capital-intensive mechanical equipment, water treatment shall be provided as recommended by the specific equipment manufacturer. Site specific water quality testing shall be performed and written lab test results shall be provided by an independent third party test agency. Based on the lab test results, a formal water treatment plan shall be developed and a water treatment program implemented.

2. Annual chemical treatment shall be provided on all "closed loop" systems including but not limited to heating water loops, chilled water loops, and fluid cooler applications. Side stream pot feeders shall be provided for all mechanical systems requiring chemical treatment whether or not specified on plans, drawings or otherwise.
3. Water treatment shall be provided using traditional chemical-based methods. Non-chemical treatment methods are prohibited by USAF policy.
4. Ensure the output capacity (volume and pressure) from the water treatment equipment is adequate for the volume of makeup water required, according to the boiler manufacturer.
5. Water softeners are required on all open loop makeup systems including but not limited to steam boilers, humidifiers, cooling towers and commercial domestic hot water systems (kitchens).
    a) Softeners shall be properly sized to allow soft water to be introduced into systems at all times, including emergency shutdown.
    b) Provide soft water/conditioned water for all boiler systems.

L. Mechanical Room Design

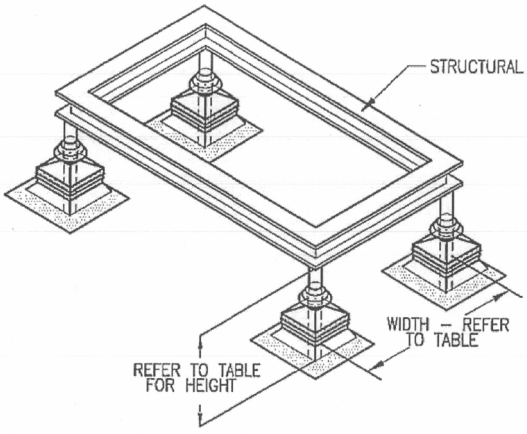
1. In order to protect boilers, cooling towers, chillers and other capital-intensive mechanical systems, dedicated mechanical room(s) shall be provided for all mechanical equipment and systems in accordance with the International Mechanical Code.
2. Mechanical rooms shall be provided with doorways suitable for passage of the mechanical equipment to be installed inside the space.
3. Mechanical rooms containing refrigeration equipment such as water chillers, refrigerant cooled equipment, coils, etc. shall comply with **ASHRAE Standard 15** ***Safety Standard for Refrigeration Systems***, latest edition. *This is a mandatory, Life Safety, Health and Welfare requirement.*
4. Ventilate mechanical rooms to prevent overheating of components and to maintain acceptable indoor air quality. Ventilation system designs shall comply with **ASHRAE Standard 62.1** ***Ventilation for Acceptable Indoor Air Quality****,* latest edition.
5. Concrete housekeeping pads shall be provided for all floor mounted mechanical equipment. Housekeeping pads shall be constructed of approved materials and shall be secured to the building foundation by means of mechanical, structural and/or chemical-bonding material. Construct pads to extend beyond supported mechanical equipment by six inches (6”) on each side. Pads shall be placed level, to a height of four inches (4”) above the floor, and all exposed edges shall have a one inch (1”) chamfer. Pads shall not be placed adjacent to a wall, column, or other building element unless suitable maintenance access is provided to the equipment to be mounted onto the pad.
6. For mechanical rooms housing chillers, boilers or heat exchangers, allow sufficient clearance to access the tube bundles for tube cleaning, eddy current testing or tube replacement. Typically, to meet the “sufficient space” requirement, allow clearances equal to the overall equipment length plus 20%, measured from the accessible end(s) of the equipment (i.e. end bell covers). Where possible, this type of equipment should be located at ground floor level and near an exterior, overhead door. In cases where space is at minimum, equipment could be positioned to allow for servicing through the open doorway.
7. Chillers, boilers, heat exchangers, fans, pumps motors or other large equipment exceeding 100 HP, 100 tons in refrigerating capacity, or having serviceable components exceeding 150 lbs. should be provided with permanently installed, overhead hoist or crane rails secured to and integrated with the building structure.

M. Mechanical Equipment Location

1. Locate equipment to allow access for maintenance IAW the International Building Code (IBC) and International Mechanical Code (IMC). Avoid locating equipment on roofs due to maintenance

problems. Provisions shall be made for removal of equipment for maintenance. Assure that proper distance between system components and walls is maintained to ensure ability to clean, repair, or replace system components.

2. Equipment such as Air Handling Units, large supply, return or exhaust fans, fan coil units and similar equipment shall not be located above spaces having ceilings constructed with acoustical tile (drop ceiling systems), gypsum board, or other material unless provided with dedicated code-compliant access stairways, ladders, maintenance walkways and other means of mechanical access IAW the International Building Code (IBC). This includes variable air volume (VAV) or other air terminals where the bottom of such units would be located more than 12'-0" above the finished floor space.
3. Curbed Applications. Where HVAC systems are to be installed on a roof using a roof curb assembly, the requirements of the roof assembly, including roof insulation material thickness, will need to be considered when selecting the height of the roof curb.
4. Non-Curbed Applications. Where HVAC systems must be installed above a roof in a non-curb application (no roof curb), provide an Elevated Mechanical Platform which will allow sufficient access for roof maintenance and repair without removal of the HVAC equipment. Elevated Mechanical Platform shall comply with the following requirements:
    a) Elevated Mechanical Platform shall be designed to support the HVAC equipment weight as well as the required maintenance walkway around the equipment including any stairs or ladders required for access, in addition to ductwork, piping and appurtenances.
    b) Minimum clear height from the roof surface to the elevated structure shall be as shown in Figure 1, below.
    c) Roof supports shall be secured to structure. Refer to Figure 2 (below) for typical requirements.
    d) Access to the roof below the Elevated Mechanical Platform supporting the HVAC system shall be provided on at least three sides, and the open sides shall not be obstructed with flashing, fencing, covering or other material.
    e) All penetrations, duct routing, conduit routing and equipment placement not on curbs shall be in general conformance to the representative set of details found in the Appendix section, ***Attachment of Rooftop Equipment in High-Wind Regions,*** **FEMA.**
    f) All pipe supports shall be structurally anchored to the deck.



WIDTH OF EQUIPMENT	HEIGHT OF LEGS
UP TO 24"	20"
25" – 36"	24"
37" – 48"	30"
49" – 60"	36"
61" AND WIDER	54"

FIGURE 1 – ELEVATED MECHANICAL PLATFORM SUPPORT STRUCTURE FOR INSTALLATIONS ABOVE ROOF

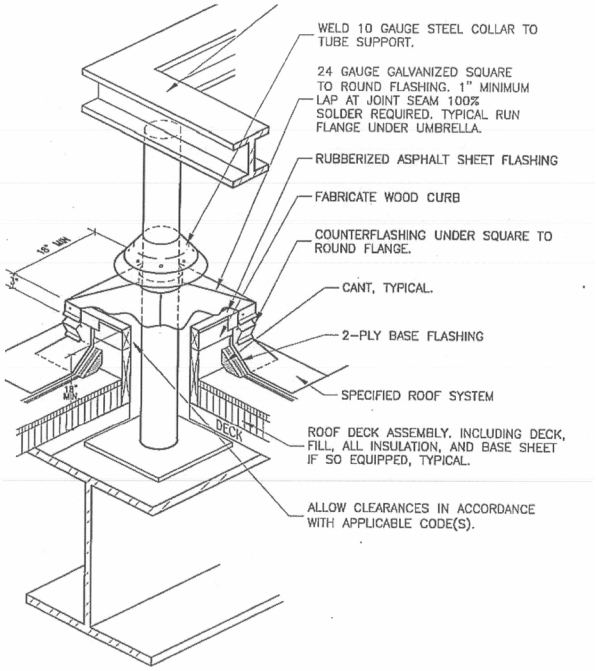


FIGURE 2 – TYPICAL ROOF SUPPORT DETAIL FOR ELEVATED PLATFORM

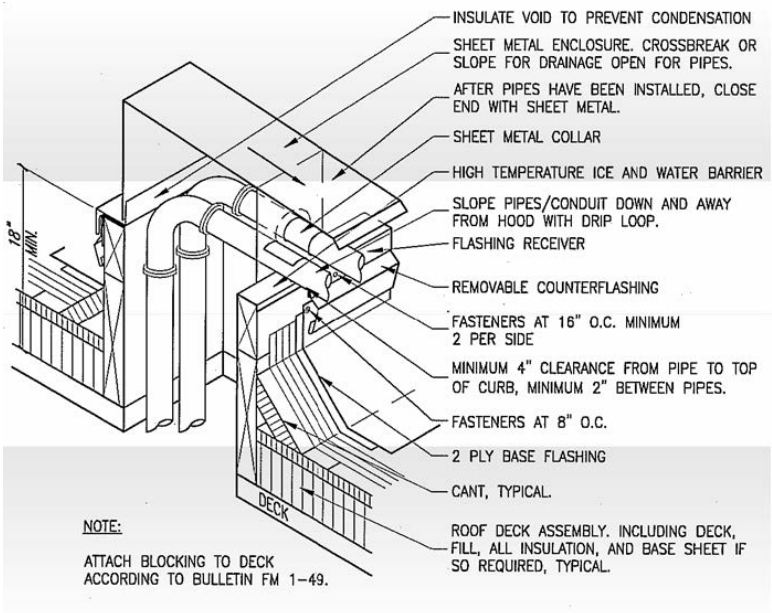


FIGURE 3 – TYPICAL PIPE AND CONDUIT ROUTING DETAIL FOR ROOF INSTALLATIONS

N. Base Refrigerant Management

1. The 72 ABW/CE is tasked to maintain a Refrigerant Management Program in accordance with the **Air Force Manual 32-7089 Refrigerant Management Program issued 4-Nov-2016.**
2. **ANSI/ASHRAE Standard 34, *Designation and Safety Classification of Refrigerants***, establishes a simple means of referring to common refrigerants and assigns safety classifications and refrigerant concentration limits based on toxicity and flammability data.
3. HQ AFMC Guidance (10 Jul 95 letter from HQ AFMC/CECS) strictly prohibits contractors from purchasing, providing or removing any refrigerants that contain either *chlorofluoromethane, chlorodifluoromethane or other "CFC" gases* (such as R-11, R-12, R-500, R-502 or R-503), to or from the government's inventory to perform contracts.
4. Contractors are prohibited from purchasing, providing, or removing any prohibited refrigerants to or from the government inventory. Refer to list of Prohibited Refrigerants below.
5. It is the obligation of 72 ABW/CE to account for use of all contractor-provided refrigerants on Tinker AFB which is to be installed to contracted equipment, and this obligation consists of the following:
   a) Track Environmental Protection Agency (EPA) certifications for refrigerant technicians and refrigerant recovery equipment.
   b) Track refrigerant inventory levels for each type of refrigerant.
   c) Report on refrigerant emissions.
6. REMOVAL OF REFRIGERANT (*Refrigerant Recovery*). Recovery of refrigerant (*as defined by 40 CFR 82*), from existing, government-owned "appliances" (*as defined by 40 CFR 82.152, i.e. HVAC, commercial refrigeration, industrial refrigeration or other refrigerant systems, except for small appliances*), will be performed by the Government upon written notice from the contractor. However, contractors may remove government refrigerants from contracted equipment into government-furnished containers, only when so directed in writing by the Contracting Officer.
7. NEW REFRIGERANT. All refrigerant provided or furnished for use on Tinker AFB shall be produced and sold as new, virgin refrigerant. Use of recovered, recycled, reclaimed or other category of refrigerants (i.e. used refrigerant) is strictly prohibited. Contractors shall only use refrigerant that is approved for use at Tinker AFB unless otherwise approved in writing by 72 ABW/CE.
8. REFRIGERANTS APPROVED FOR USE AT TINKER A.F.B.*
   Refrigerant 134a
   Refrigerant 410A
   * There are multiple refrigerants which are acceptable per current EPA regulations but current TAFB Refrigerant management policy is to simplify and standardize our refrigerant inventory to R134a and R410a refrigerant inventories for new equipment wherever possible. Therefore the refrigerants automatically approved for new equipment are only R134a and R410a unless approved in writing by TAFB Base Civil Engineering.
9. REFRIGERANTS PROHIBITED FROM USE AT TINKER A.F.B. Prohibited refrigerants include all refrigerants other than approved refrigerants.
10. EXCEPTIONS.

    Excluded from the list of prohibited refrigerants are "process" systems utilized in production and/or manufacturing, unless otherwise prohibited by USAF or TAFB policy.

    Any other exceptions to the Base Refrigerant Management policy requirements must be approved in writing by the Base Civil Engineer for the specific equipment, system or project for which the refrigerant is required. Exceptions will be made as needed on a case by case basis only.

O. Contractor Certifications and Recordkeeping for Refrigerant Management

1. When required to install, remove or recover refrigerants pursuant to provisions of part N above, Contractors shall furnish the following in conjunction with the performance of contracted work at TAFB:
   a) Prior to bringing technicians on base for installation or recovery of refrigerants to or from contracted equipment, the Contractor should submit to the Contracting Officer's Technical Representative (COTR): (1) A copy of the refrigerant technician's certification as required by 40 CFR (Code of Federal Regulations) part 82, subpart F; and (2) A copy of the certification to the EPA that the Contractor acquired refrigerant recovery equipment per 40 CFR 82.162.
   b) Prior to final acceptance of contract work, the Contractor should provide a record of the amount of refrigerant installed with the contracted equipment or recovered from equipment contracted for demolition into government furnished containers. In the case of commissioning new or retrofitted equipment, the Contractor shall provide the refrigerant amount determined to be the "Full Charge" as defined in 40 CFR 82.152.
   c) The Contractor shall provide information concerning refrigerant emissions.
   d) Prior to final acceptance of contract work, the Contractor shall provide to the COTR a record of any refrigerant losses to the atmosphere.
   e) Included with all warranty work, the Contractor shall provide to the Contracting Officer a record of all refrigerant losses to the atmosphere. The Contractor shall assume that the amount of refrigerant added to the equipment to bring it back to "Full Charge" is the amount of refrigerant that was emitted to the atmosphere.

P. Electrical and VFD Requirements:

1. Comply with the Tinker AFB Base Electrical Standards (Appendix B) for the following:
   a) All Variable Frequency Driven (VFD) electric drives and motors.
   b) All low-voltage control wiring.
   c) All wiring and conduit for mechanical systems.
2. Variable Frequency Driven (VFD) motor applications shall comply with all NEC rules for motor disconnect. In addition:
   a) VFD selection should include provisions for radio frequency (RF) shielding on incoming feeder side by either internal protection or cables.
   b) VFD selection should include provisions for radio frequency (RF) shielding on outgoing motor side by either internal protection or cables.
   c) VFD selection shall include an integral means of disconnect by manufacturer design.
   d) When necessary to utilize a brake function, it shall be provided with a separate power supply.
   e) VFD's shall be set to limit motor speed from exceeding 60 Hz.
3. Exhaust fan applications shall comply with all NEC rules for motor disconnect.
4. Exhaust fan applications serving restrooms.
   a) Ventilation exhaust fans for restroom shall not control fans by the light switch. Restroom exhaust fan(s) shall either operate continuously or interlocked with the HVAC system to operate when the HVAC supply fan operates.

Q. Anti-Terrorism Force Protection (ATFP) Requirements

1. UFC 4-010-01 *DoD Minimum Antiterrorism Standards for Buildings* applies to all facilities on Tinker AFB (*latest edition*).

2. ATFP provisions regarding Standard 18 – Emergency Air Distribution Shutoff: This provision is not applicable to small exhaust fans such as toilet exhaust fans, smoke purge (negative pressure) fans, or other fans where "*interior pressure and airflow control would more efficiently prevent the spread of airborne contaminants and/or ensure the safety of egress pathways.*"

– End of Section –

V. Appendix

This section includes the following: No. of Pages

- References 2
- Abbreviations and Acronyms 1
- Attachments
  - Table 1. Attachment of Rooftop Equipment in High-Wind Regions (FEMA) 4
  - FACILITY-RELATED CONTROL SYSTEMS CYBERSECURITY GUIDELINE 28

References

(Partial list - Not all inclusive)

UNITED FACILITIES CRITERIA

GENERAL

UFC 1-200-01 DoD Building Code (General Building Requirements)
UFC 1-200-02 High Performance and Sustainable Building Requirements

MECHANICAL

UFC 3-400-02 Design: Engineering Weather Data
UFC 3-401-01 Mechanical Engineering
UFC 3-410-01 Heating, Ventilating, and Air Conditioning Systems
UFC 3-410-02 Lonworks® Direct Digital Control for HVAC and Other Local Building Systems
UFC 3-410-04N Industrial Ventilation
UFC 3-420-01 Plumbing Systems
UFC 3-420-02FA Compressed Air
UFC 3-430-01FA Heating and Cooling Distribution Systems
UFC 3-430-02FA Central Steam Boiler Plants
UFC 3-430-07 Inspection and Certification of Boilers and Unfired Pressure Vessels
UFC 3-430-08N Central Heating Plants
UFC 3-430-09 Exterior Mechanical Utility Distribution
UFC 3-430-11 Boiler Control Systems
UFC 3-440-01 Facility-Scale Renewable Energy Systems
UFC 3-450-01 Noise and Vibration Control
UFC 3-460-01 Design: Petroleum Fuel Facilities
UFC 3-460-03 O&M: Maintenance of Petroleum Systems
UFC 3-470-01 Lonworks® Utility Monitoring and Control System (UMCS)

MULTI-DISCIPLINARY AND FACILITY SPECIFIC

UFC 3-190-06 Protective Coatings and Paints
UFC 3-230-01 Water Storage, Distribution and Transmission
UFC 3-240-13FN Industrial Water Treatment Operation and Maintenance
UFC 3-310-04 Seismic Design for Buildings
UFC 3-430-09 Exterior Mechanical Utility Distribution
UFC 3-520-05 Stationary Battery Areas
UFC 3-570-02A Cathodic Protection
UFC 3-570-06 O&M Cathodic Protection Systems
UFC 4-010-01 DoD Minimum Antiterrorism Standards for Buildings
UFC 4-010-05 Sensitive Compartmentalized Information Facilities Planning, Design, and Construction
UFC 4-010-06 Cybersecurity of Facility-Related Control Systems
UFC 4-024-01 Security Engineering: Procedures for Designing Airborne Chemical, Biological, and Radiological Protection for Buildings
UFC 4-211-01N Aircraft Maintenance Hangars: Type I, Type II and Type III, with Change 3; also see the Supplement ITG FY10-01
UFC 4-211-02 Aircraft Corrosion Control and Paint Facilities
UFC 4-390-01 O&M: Unmanned Pressure Test Facilities Safety Certification Manual
UFC 4-440-01 WAREHOUSE AND STORAGE FACILITIES
UFC 4-510-01 Design: Medical Military Facilities
UFC 4-610-01 Administrative Facilities
UFC 4-826-10 Design: Refrigeration Systems for Cold Storage
UFC 4-832-01N Design: Industrial and Oily Wastewater Control

FIRE PROTECTION

UFC 3-600-01 Fire Protection Engineering for Facilities

UFC 3-601-02 Operations and Maintenance: Inspection, Testing, and Maintenance of Fire Protection Systems

AIR FORCE PUBLICATIONS

AFI 32-1054, *Corrosion Control*

AFI 32-1066, *Backflow Prevention Program*

AFI 32-1068, *HEATING SYSTEMS AND UNFIRED PRESSURE VESSELS (14 MAY 2013)*

AFI 32-10141, (3 March 2011) – *PLANNING AND PROGRAMMING FIRE SAFETY DEFICIENCY CORRECTION PROJECTS*

AFI 23-204, *Organizational Fuel Tanks*

AFI 32-7044, *Storage Tank Environmental Compliance*

AFPD 90-17, Energy Management, and AFI 90-1701, Energy Management

AIR FORCE MANUAL 32-1084, Facility Requirements

ETL 03-1: *Storm Water Construction Standards*

ETL 11-25, *Implementation of Major and Area Source Rules as Applied to Boiler Tune-ups and Energy Assessments for the Boiler MACT Rule*

INDUSTRY STANDARDS AND CODES

ANSI/ASHRAE Standard 15 *Safety Standard for Refrigeration Systems*, latest edition

ANSI/ASHRAE Standard 34 *Designation and Safety Classification of Refrigerants*

ANSI/ASHRAE Standard 62.1 *Ventilation for Acceptable Indoor Air Quality,* latest edition

ANSI/ASHRAE/IES Standard 90.1 *Energy Standard for Buildings Except Low-Rise Residential Buildings* (latest edition)

ANSI/ASHRAE Standard 90.2 *Energy Efficient Design of Low-Rise Residential Buildings* (latest edition)

ASME *Boiler and Pressure Vessel Code*

ASME *Boiler and Pressure Vessel Code*, Section IX, “Welding and Brazing Qualifications,”

Gravity Sanitary Sewer Design and Construction**,** as jointly published by the *Water Environment Federation* and the *American Society of Civil Engineers* as the MOP FD-5

National Fire Protection Association

FEDERAL

40 CFR (Code of Federal Regulations) part 82

Executive Order 13423 - Strengthening Federal Environmental, Energy, and Transportation Management

Executive Order 13693 - Planning for Federal Sustainability in the Next Decade

Executive Order - FEDERAL LEADERSHIP IN ENVIRONMENTAL, ENERGY, AND ECONOMIC PERFORMANCE

Energy Policy Act of 2005 (EPAct 2005)

EPA 40 CFR Part 63, Subpart JJJJJJ, *National Emission Standards for Hazardous Air Pollutants for Industrial, Commercial, and Institutional Boilers Area Sources*

Building Life-Cycle Cost Program (BLCC) available at the Federal Energy Management Program website: http://www1.eere.energy.gov/femp/information/download_blcc.html**.**

Attachment of Rooftop Equipment in High-Wind Regions, FEMA, July 2006

Abbreviations and Acronyms

72 ABW – 72^{d} Air Base Wing, Tinker Air Force Base, Oklahoma

AFCEE – Air Force Center for Engineering and the Environment
AFCESA – Air Force Civil Engineer Support Agency
AF – Air Force
AFB – Air Force Base
AFI – Air Force Instruction
AFGM – Air Force Guidance Memorandum
AFMAN – Air Force Manual
AFMC – Air Force Materiel Command
ANG – Air National Guard
AFPD – Air Force Policy Directive
AFRC – Air Force Reserve Command
ANSI – *American National Standards Institute*
ASHRAE – Official name of the international professional technical society formerly known as the *American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.*
ATO – Authority to Operate

BCE – Base Civil Engineer
BCP – Base Comprehensive Plan

CATCODE – Category Code
CE – Base Civil Engineering
CECE – Base Civil Engineering Design & Construction
CECO – Base Civil Engineering Operations and Maintenance
CFR – Code of Federal Regulations
CS – Control Systems

DoD – Department of Defense

E.T.L. – Engineering Technical Letter

FOMA – Facilities Operation and Maintenance

IAW – in accordance with

MAJCOM – Major Command
MILCON – Military Construction
NFPA – National Fire Protection Association

NTE – Not to Exceed

O&M – Operation & Maintenance
OH&P – Overhead and Profit
OSD – Office of the Secretary of Defense

RPIE – Real Property Installed Equipment

SIOH – Supervision, Inspection and Overhead
SRM – Sustainment, Restoration and Modernization

TAFB – Tinker Air Force Base

ATTACHMENTS FOLLOW

DOCUMENT CONTROL RECORD

ISSUE	REV	DATE	BY
ORIGINAL DRAFT FOR QC REVIEW	-0-	10-FEB-2017	KDW
ISSUED FOR BASE WIDE REVIEW	1.1	14-FEB-2017	KDW
ISSUED FOR APPROVAL	-0-	01-MAR-2017	KDW
ISSUED FOR APPROVAL	2.0	20-MAR-2018	KDW
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Attachment of Rooftop Equipment in High-Wind Regions

FEMA

HURRICANE KATRINA RECOVERY ADVISORY

Purpose: To recommend practices for designing and installing rooftop equipment that will enhance wind resistance in high-wind regions.

> **Note:** For attachment of lightning protection systems, see Hurricane Katrina Recovery Advisory on Rooftop Attachment of Lightning Protection Systems in High-Wind Regions.

Key Issues

Rooftop equipment frequently becomes detached from rooftops during hurricanes. Water can enter the building at displaced equipment (see Figure 1); displaced equipment can puncture and tear roof coverings (thus allowing water to leak into the building). Equipment blown from a roof can damage buildings and injure people. Damaged equipment may no longer provide service to the building.

Figure 1. This gooseneck was attached with only two small screws. A substantial amount of water was able to enter the building during the hurricane.

Construction Guidance

Mechanical Penthouse: By placing equipment in mechanical penthouses rather than being exposed on the roof, equipment within penthouses is shielded from high-wind loads and windborne debris (see Figure 2). Therefore, use of mechanical penthouses designed and constructed in accordance with a current building code are recommended, particularly for critical and essential facilities.

Design Loads and Safety Factors: Loads on rooftop equipment should be determined in accordance with the 2005 edition of ASCE 7.

Note: For guidance on load calculations, see "Calculating Wind Loads and Anchorage Requirements for Rooftop Equipment," ASHRAE Journal, volume 48, number 3, March 2006.

A minimum safety factor of 3 is recommended for critical and essential facilities, and a minimum safety factor of 2 is recommended for other buildings. Loads and resistance should also be calculated for heavy pieces of equipment (see Figure 2).

Figure 2. This 30' x 10' x 8' 18,000-pound HVAC unit was attached to its curb with 16 straps (one screw per strap). Although the wind speeds were estimated to be only 85 to 95 miles per hour (3-second peak gust), it blew off the building.

Simplified Attachment Table: To anchor fans, small HVAC units, and relief air hoods, the following minimum attachment schedule is recommended (see Table 1) (note: the attachment of the curb to the roof deck also needs to be designed to resist the design loads):

Table 1. Number of #12 Screws for Base Case Attachment of Rooftop Equipment

Case No.	Curb Size and Equipment Type	Equipment Attachment	Fastener Factor for Each Side of Curb or Flange
1	12"x 12" Curb with Gooseneck Relief Air Hood	Hood Screwed to Curb	1.6
2	12"x 12" Gooseneck Relief Air Hood with Flange	Flange Screwed to 22 Gauge Steel Roof Deck	2.8
3	12"x 12" Gooseneck Relief Air Hood with Flange	Flange Screwed to 15/32" OSB Roof Deck	2.9
4	24"x 24" Curb with Gooseneck Relief Air Hood	Hood Screwed to Curb	4.6
5	24"x 24" Gooseneck Relief Air Hood with Flange	Flange Screwed to 22 Gauge Steel Roof Deck	8.1
6	24"x 24" Gooseneck Relief Air Hood with Flange	Flange Screwed to 15/32" OSB Roof Deck	8.2
7	24"x 24" Curb with Exhaust Fan	Fan Screwed to Curb	2.5
8	36"x 36" Curb with Exhaust Fan	Fan Screwed to Curb	3.3
9	5'-9"x 3'- 8" Curb with 2'- 8" high HVAC Unit	HVAC Unit Screwed to Curb	4.5*
10	5'-9"x 3'- 8" Curb with 2'- 8" high Relief Air Hood	Hood Screwed to Curb	35.6*

Notes to Table:

1. The loads are based on the 2005 edition of ASCE 7. The resistance includes equipment weight.

2. The Base Case of the tabulated numbers of #12 screws (or ¼ pan-head screws for flange-attachment) is a 90-mph basic wind speed, 1.15 importance factor, 30' building height, Exposure C, using a safety factor of 3.

3. For other basic wind speeds, or for an importance factor of 1, multiply the tabulated number of #12 screws by $\left(\frac{V_D^2 \times I}{90^2 \times 1.15}\right)$ to determine the required number of #12 screws or (¼ pan-head screws) required for the desired basic wind speed, V_D (mph) and importance factor, I.

4. For other roof heights up to 200', multiply the tabulated number of #12 screws by (1.00 + 0.003 [h - 30]) to determine the required number of #12 screws or ¼ pan-head screws for buildings between 30' and 200'.

Example A: 24" x 24" exhaust fan screwed to curb (table row 7), Base Case conditions (see Note 1): 2.5 screws per side; therefore, round up and specify 3 screws per side.

Example B: 24" x 24" exhaust fan screwed to curb (table row 7), Base Case conditions, except 120 mph and importance factor of 1: 120^2 x 1 ÷ 90^2 x 1.15 = 1.55 x 2.5 screws per side = 3.86 screws per side; therefore, round up and specify 4 screws per side.

Example C: 24" x 24" exhaust fan screwed to curb (table row 7), Base Case conditions, except 150' roof height: 1.00 + 0.003 (150' - 30') = 1.00 + 0.36 = 1.36 x 2.5 screws per side = 3.4 screws per side; therefore, round down and specify 3 screws per side.

* This factor only applies to the long sides. At the short sides, use the fastener spacing used at the long sides.

Fan Cowling Attachment: Fans are frequently blown off their curbs because they are poorly attached. When fans are well attached, the cowlings frequently blow off (see Figure 3). Unless the fan manufacturer specifically engineered the cowling attachment to resist the design wind load, cable tie-downs (see Figure 4) are recommended to avoid cowling blow-off. For fan cowlings less than 4 feet in diameter, 1/8-inch diameter stainless steel cables are recommended.

Figure 3. Cowlings blew off two of the three fans shown in this photo. Cowlings can tear roof membranes and break glazing.

Figure 4. To overcome blow-off of the fan cowling, this cowling was attached to the curb with cables.

For larger cowlings, use 3/16-inch diameter cables. When the basic wind speed is 120 mph or less, specify two cables. Where the basic wind speed is greater than 120 mph, specify four cables. To minimize leakage potential at the anchor point, it is recommended that the cables be adequately anchored to the equipment curb (rather than anchored to the roof deck). The attachment of the curb itself also needs to be designed and specified.

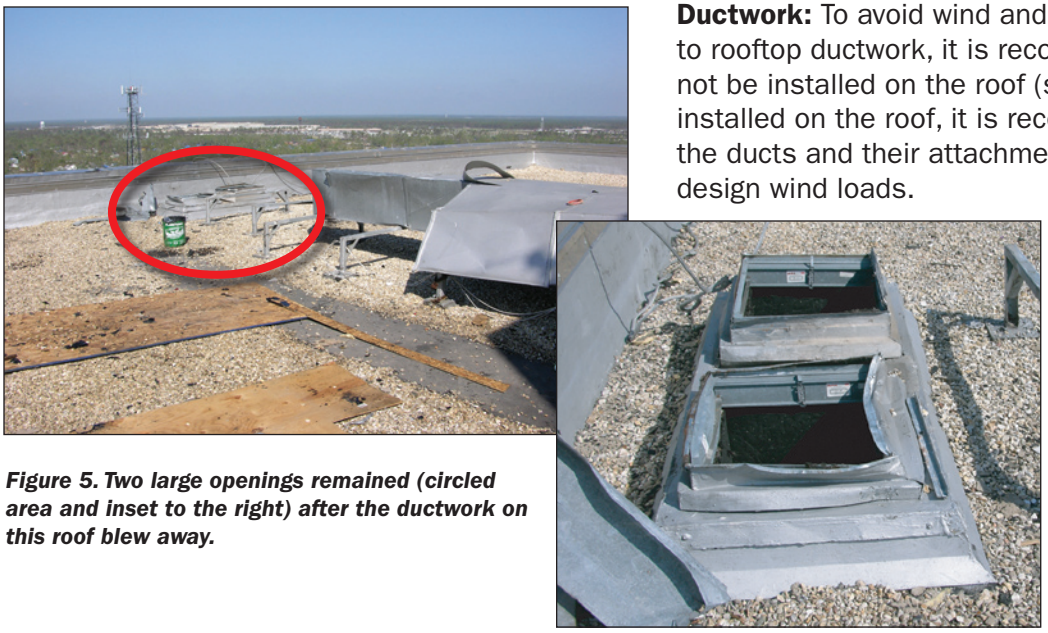

Figure 5. Two large openings remained (circled area and inset to the right) after the ductwork on this roof blew away.

Ductwork: To avoid wind and windborne debris damage to rooftop ductwork, it is recommended that ductwork not be installed on the roof (see Figure 5). If ductwork is installed on the roof, it is recommended that the gauge of the ducts and their attachment be sufficient to resist the design wind loads.

Condensers: In lieu of placing rooftop-mounted condensers on wood sleepers resting on the roof (see Figure 6), it is recommended that condensers be anchored to equipment stands. (Note: the attachment of the stand to the roof deck also needs to be designed to resist the design loads.) In addition to anchoring the base of the condenser to the stand, two metal straps with two side-by-side #14 screws or bolts at each strap end are recommended (see Figure 7).

Figure 6. Sleeper-mounted condensers displaced by high winds.

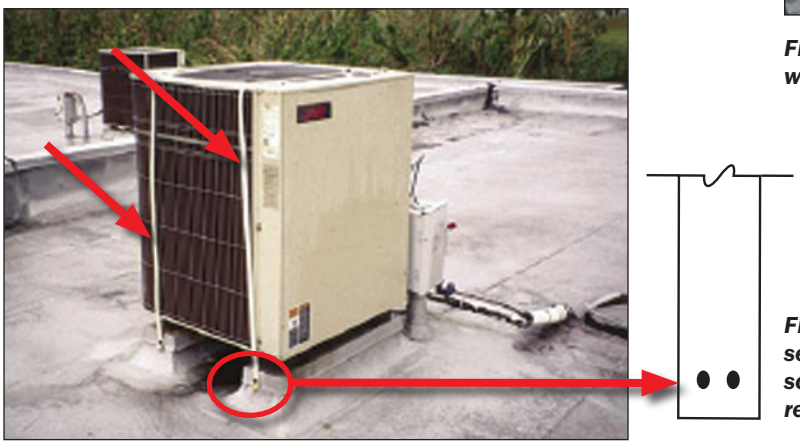

Figure 7. This condenser had supplemental securement straps (see arrows). Two side-by-side screws with the proper edge and end distances are recommended at the end of the strap.

Vibration Isolators: When equipment is mounted on vibration isolators, an isolator that has sufficient resistance to meet the design uplift loads should be specified and installed, or an alternative means to accommodate uplift resistance should be provided (see Figure 8).

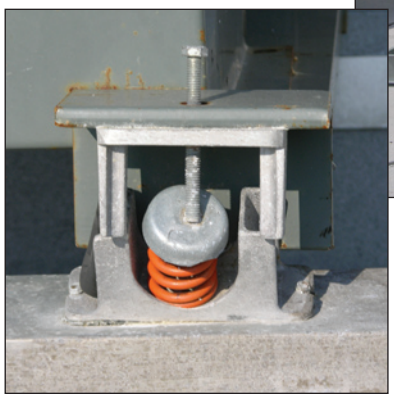

Figure 8. The equipment on this stand was resting on vibration isolators that provided lateral resistance but no uplift resistance (above). A damaged vibration isolator is shown in the inset (left).

Access Panel Attachment: Access panels frequently blow off. To minimize blow-off of access panels, job-site modification will typically be necessary (for example, the attachment of hasps and locking devices such as a carabiner). The modification details will need to be tailored for the equipment, which may necessitate detail design after the equipment has been delivered to the job site. Modification details should be approved by the equipment manufacturer.

Figure 9. Several of the equipment screen panels were blown away. Loose panels can break glazing and puncture roof membranes.

Equipment Screens: Equipment screens around rooftop equipment are frequently blown away (see Figure 9). Equipment screens should be designed to resist the wind loads derived from ASCE 7.

Note: The extent that screens may reduce or increase wind loads on equipment is unknown. Therefore, the equipment behind screens should be designed to resist the loads previously noted.

Other resources: Three publications pertaining to seismic restraint of equipment provide general information on fasteners and edge distances:

- Installing Seismic Restraints for Mechanical Equipment (FEMA 412)
- Installing Seismic Restraints for Electrical Equipment (FEMA 413)
- Installing Seismic Restraints for Duct and Pipe (FEMA 414)

FACILITY-RELATED CONTROL SYSTEMS

CYBERSECURITY GUIDELINE

DOCUMENT CONTROL	
VERSION	**DESCRIPTION**
Version 1.0 – 10/31/2016	Draft
Version 2.0 – 01/24/2017	Updated to use Facility-Related Control Systems (FRCS), incorporated External and Internal Networks definitions, updated Chapter 4
Version 3.0 – 05/16/2017	Updated to use Cybersecurity in lieu of Information Assurance, updated Design and Construction Sequence Table STIGs development time line

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CHAPTER 1. INTRODUCTION

1.1 PURPOSE AND SCOPE This document defines the Cybersecurity Procedures for ESTCP Facility-Related Control Systems projects. The intention of this document is to provide a general outline and more granular guide for the planning, design, construction, operations and commissioning of the FRCS following the Risk Management Framework (RMF) process outlined in UFC 04-010-06 Cybersecurity of Facility-Related Control Systems.

1.2 BACKGROUND Department of Defense Instruction (DoDI) 8500.01, Cybersecurity, and DoDI 8510.01, Risk Management Framework (RMF) for DoD Information Technology (IT), incorporate Platform IT (PIT) into the RMF process. PIT is a category of both IT hardware and software that is physically part of, dedicated to, or essential in real time to the mission performance of special purpose systems. PIT is further categorized as PIT products, PIT subsystems, or PIT systems. PIT differs from "traditional" IT in that it is integral to – and dedicated to the operation of – a specific platform. Although the term PIT is used only by DoD, the concept of categorizing components and systems dedicated to the operation of a specific platform is not. For example, the term "Operational Technology" (OT) is also used to refer to these systems and components.

The most common forms of Facilities-Related PIT are Control Systems (CS), which are a combination of control components (e.g., electrical, mechanical, hydraulic, or pneumatic, etc.), special purpose controlling devices, and standard IT that act together upon underlying mechanical and/or electrical equipment to achieve an objective (e.g., transport of matter or energy, maintain a secure and comfortable work environment, etc.). All automated control systems are considered PIT. Industrial Control Systems (ICS) are automated control systems that act upon industrial systems and processes. ICS is used as a general term that encompasses several – but not all -- types of control systems. These include supervisory control and data acquisition (SCADA) systems, distributed control systems (DCS) and other control systems, such as the Programmable Logic Controllers (PLCs) often found in the industrial sector and critical infrastructure.

To protect its facilities and infrastructure, DoD needs to know the type, quantity and purpose of PIT it owns and uses. For all PIT identified, including CS, the PIT owner, in coordination with an Authorizing Official (AO), must determine whether a collection of PIT products and/or subsystems "rises to the level of" a PIT System. In accordance with DODI 8510.01, PIT products and/or subsystems which do not rise to the level of a PIT System must undergo security assessment, but do not necessarily need to be authorized under the RMF. However, PIT Systems undergo both security assessment and authorization by an AO.

The enterprise system used to track DoD IT, including PIT, is the Enterprise Mission Assurance Support Service (eMASS). Both "Assess and Authorize" and "Assess-Only" CS will be entered into eMASS. In order to standardize how EI&E-owned and -operated CS information is entered into eMASS, the DoD CS Working Group (WG) is working to incorporate new data fields and PIT capabilities into eMASS. DoD has developed a list of common CS and a corresponding control overlay selection tool for selecting an appropriate combination of security controls in the EI&E PIT Control System Master List. The EI&E PIT Control System Master List is maintained along with this step-by-step guide on the DoD Chief Information Officer (CIO) RMF Knowledge Service portal, where it will remain a living document.

1.3 APPLICABLE POLICIES, STANDARDS AND PROCEDURES

- CNSSI 1253, Security Categorization And Control Selection For National Security Systems 2014
- Department of Defense Instruction 8500.01, Cybersecurity, March 2014 (available online at www.dtic.mil)
- Department of Defense Instruction 8510.01, Risk Management Framework (RMF) for DoD Information Technology (IT), March 2014 (available online at www.dtic.mil)
- Department of Defense Instruction 8140 Cyberspace Workforce Management (available online at http://www.wbdg.org/pdfs/dod_cyberworkforce.pdf)
- Department of Defense Instruction 8530 Cybersecurity Activities Support to DoD Information Network Operations March 2016 (available online at http://www.wbdg.org/pdfs/DODI_853001_2016.pdf)
- Department of Defense Industrial Control Systems Advanced Tactics, Techniques and Procedures Jan 2016 (available online at http://www.wbdg.org/pdfs/jbasics_aci_ttp_2016.pdf)
- Department of Defense Handbook for Self-Assessing Security Vulnerabilities & Risks of Industrial Control Systems on DoD Installations (available online at http://www.wbdg.org/pdfs/ics_handbook.pdf)
- Federal Information Processing Standard 200 Minimum Security Requirements for Federal Information and Information Systems
- Federal Information Processing Standard 201-2 Personal Identity Verification (PIV) of Federal Employees and Contractors
- National Institute of Standards and Technology Special Publication 800-37, Guide for Applying the Risk Management Framework to Federal Information Systems, February 2010
- National Institute of Standards and Technology Special Publication 800-53 R4 Security and Privacy Controls for Federal Information Systems and Organizations 2013
- National Institute of Standards and Technology Special Publication 800-82 R2 Guide to Industrial Control Systems (ICS) Security 2015
- National Institute of Standards and Technology Special Publication SP 800-115 Technical Guide to Information Security Testing and Assessment 2008
- Department of Veterans Affairs Mental Health Facilities Design Guide 2010
- Department of Veterans Affairs Office of Information & Technology Design Guide 2011
- Department of Veterans Affairs Telecommunications and Special Telecommunication Design Manual (TDM) 01-2016
- Unified Facility Criteria Design 4-510-01 Military Medical Facilities 2014
- UFC 3-410-01 Utility Monitoring And Control System (CS) Front End And Integration 2016 (DRAFT)
- UFC 3-410-02 Direct Digital Control For HVAC And Other Building Control Systems 2016 (DRAFT)
- UFGS 23 09 00 Instrumentation and Control for HVAC (available online at www.wbdg.org)
- UFGS 23 09 23.01 LonWorks® Direct Digital Control for HVAC and Other Building Systems (available online at www.wbdg.org)
- UFGS 23 09 23.02 BACnet Direct Digital Control for HVAC and Other Building Systems (available online at www.wbdg.org)
- UFGS 25 10 10 Utility Monitoring And Control System (CS) Front End And Integration (available online at www.wbdg.org)

- Government Accounting Office Report 15-6 Federal Facility Cybersecurity 2014
- Building Industry Consulting Service International (BICSI) Telecommunications Distribution Methods Manual (TDMM)
- National Fire Protection Association (NFPA) 101 Life Safety Code 2015
- UL 639 Intrusion Detection Standard 2007
- UL 60950-1 Information Technology Equipment - Safety - Part 1: General Requirements 2013

1.4 ROLES AND RESPONSIBILITIES

Role: Government Stakeholders
Members: Service Design Manager, Facilities Engineering Acquisition Department (FEAD), Services Civil Engineering Representative (NAVFAC, AFCEC, USACE, DPW, etc.), Integrated Product Team (IPT).
Responsibilities: Review ESTCP CS Installation Contractor submittals, test reports, and Commissioning reports.

Role: ESTCP CS Installation Contractor
Members: Contractor responsible for the installation or modification of a CS network component. Includes the contractor's Control Systems Cybersecurity Specialist and Integration Specialist.
Responsibilities: Responsible for production and submittal of all project Configuration Items (CI's), project CI inventories, and design/construction/commissioning documentation associated with the installation or modification of CS systems.

Role: ESTCP CS Engineer of Record
Members: Project mechanical engineer of record, electrical engineer of record, and control system engineer of record (if applicable)
Responsibilities: Responsible for modifying the provided UFGS and ESTCP CS Engineering Manual design templates to meet the requirements of the specific project

Role: ESTCP CS Service Agreement Contractor
Members: Contractor(s) responsible for the operation and maintenance of the installation's CS network.
Responsibilities: Following configuration management procedures during required system modifications, security patches, and firmware upgrades.

Role: ESTCP Information Owner/Steward
Members: Installation Chief Information Officer (CIO)
Responsibilities: Responsible for maintaining the current baseline of Configuration Items, management of the CI repository, and managing and tracking the security state of information systems.

Role: Security Control Assessor (SCA)
Members: Installation Chief Information Officer (CIO)

1.5 REQUIRED SUBMITTALS

The Contractor(s) shall develop and upload into the DoD CIO eMASS tool, if required, for an Assess Only, Interim Authority To Operate (IATO), or Authority To Operate (ATO) package, all required artifacts and supporting documentation. The required artifacts are determined by the system security classification, system categorization, and cybersecurity controls.

For ETSCP projects, the intent is to only provide the **MINIMUM** documentation necessary to

demonstrate the R&D objective and capability to achieve an RMF approval. In general, for a Closed Restricted Network (CRN) or Stand-Alone, it will be an Assess Only project and **ONLY** the System Security Plan, the IT Contingency Plan and CONOPS Plans are required. For projects that will connect to the DoDIN, the full RMF Asses and Authorization will typically be required for the IATO or ATO packages. The RMF package information may include but is not limited to the list below:

a. System Security Plan (SSP)
b. Configuration Management Plan (CMP)
c. Disaster Recovery Plan (DRP)
d. Continuity of Operations (COP)
e. Information Technology Contingency Plan (ITCP)
f. Incidence Response Plan (IRP)
g. Security Assessment Report (SAR)
h. Plan of Action and Milestones (POAM)
i. System Architecture/Topology/Data Flow
j. Configuration Validation Checklist
k. Security Classification Guide
l. System Configuration Guide
m. Hardware Inventory List
n. Software Inventory List
o. Physical Security Plan
p. Personnel Security Plan
q. Cybersecurity Vulnerability Management (IAVM) Process
r. Patch Management Process, Connection Approval / System Approval documentation
s. Ports, Protocols, and Services (PPS) List
t. Active Directory (AD) Documentation, (if applicable)
u. TBD on project specific basis: Jump-Kit Rescue CD

For projects requiring an IATO or ATO, the data representing this information may either be uploaded directly, or cut and pasted from the CSET tool or the CIO Core Authorization excel file, into the eMASS tool for each applicable control. In addition, eMASS will provide a rollup of inherited controls for each system once it has been properly identified and classified. It is recommended that the current version of the Department of Homeland Security (DHS) Cyber Security Evaluation Tool (CSET) be used as a development tool for eMASS tool artifacts.

Completion of Scan/Fix/Scan Testing and Analysis: This work is performed before the Security Control Assessor (SCA) assesses the system(s) and provides a certification recommendation to the Authorizing Official (AO). The Contractor shall assess (scan and perform manual checks) its own system using

approved cybersecurity scanning tools. When issues are found (High, Medium, Low Impact Levels) the Contractor shall fix those issues and rescan the system to ensure all issues have been fixed and/or properly and acceptably mitigated. High impact level findings that cannot be fixed are to be reported to the Government immediately along with a valid reason the vulnerability cannot be fixed and a mitigation plan to fix the vulnerability in the future. The goal is for the system to have a proper cybersecurity posture before the SCA comes in to assess the system. The scan/fix/scan process should find and fix all issues before the SCA's assessment.

Completion of Documentation to Connect to the DoDIN: This shall be based on the services connection approval process (CAP). The ESTCP Project Team shall provide required assistance and documentation to the Government to satisfy the CAP. Normally this entails having an approved IATO or ATO, but it may vary depending on the site. When Penetration Vulnerability Testing (PVT) will be required to be performed on the sites network then completion of the CAP should be scheduled to occur before PVT. When PVT is not performed then the timeline for the CAP should be at least forty-five (45) days before connecting to the sites network.

1.6 APPLICABLE ESTCP FRCS TEMPLATES

- Factory Acceptance Testing Checklist
- Site Acceptance Testing Checklist
- DoD RMF Core Security Authorization Package
- ESTCP FRCS RMF ATO WBS Cost Template

1.7 GLOSSARY (PER UFC 4-010-06)

1.7.1 ACRONYMS

Acronym	Term
ACL	Access Control List
AO	Authorizing Official
BAS	Building Automation System
BCS	Building Control System
CCTV	Closed Circuit Television
CNSSI	Committee on National Security Systems Instruction
CCI	Control Correlation Identifier
COTS	Commercial Off The Shelf
CS	Control System
DoD	Department of Defense
ESS	Electronic Security System
EMCS	Energy Monitoring and Control System

FCN	Field Control Network
FISMA	Federal Information Security Management Act
FPOC	Field Point of Connection
GFE	Government Furnished Equipment
ICS	Industrial Control System
IDS	Intrusion Detection System
ISSM	Information System Security Manager
ISSO	Information System Security Officer
IP	Internet Protocol
IT	Information Technology
MOA	Memorandum Of Agreement
MOU	Memorandum Of Understanding
NIST	National Institute of Standards and Technology
OS	Operating System
PIT	Platform Information Technology
PKI	Public Key Infrastructure
SCADA	Supervisory Control and Data Acquisition
SO	System Owner
UCS	Utility Control System
UFC	Unified Facilities Criteria
UFGS	Unified Facilities Guide Specification
CS	Utility Monitoring and Control System
USACE	U.S. Army Corps of Engineers

1.7.2 DEFINITION OF TERMS

Term Definition

Authorizing Official (CNSS Glossary) A senior (federal) official or executive with the authority to formally assume responsibility for operating an information system at an acceptable level of risk to organizational operations (including mission, functions, image, or reputation), organizational assets, individuals, other organizations, and the Nation.

Building Automation System (BAS) The system consisting of a CS Front End, connected Building Control Systems which control building electrical and mechanical systems, and user interfaces for building control supervision. The BAS is a subsystem of the Utility Monitoring and Control System. This term is being phased out in favor of CS.

Building Control System (BCS) A system that controls building electrical and mechanical systems such as HVAC (including central plants), lighting, vertical transport systems, and irrigation systems. Building Control Systems generally do not have a full-featured user interface; they may have "local display panels" but typically rely on the CS front end for full user interface functionality. BCS is a subsystem of the Utility Monitoring and Control System, and is a class of Field Control System.

Closed Circuit Television System (CCTV) An ESS that allows video assessment of alarm conditions via remote monitoring and recording of video events. Video monitoring may also be incorporated into other systems which are not CCTV.

Control Correlation Identifier (CCI) The Control Correlation Identifier (CCI) provides a standard identifier and description for each of the singular, actionable statements that comprise a security control.

Control System (CS) A system of digital controllers, communication architecture, and user interfaces that monitor, or monitor and control, infrastructure and equipment.

Controller An electronic device – usually having internal programming logic and digital and analog input/output capability – which performs control functions. Two primary types of controller are equipment controller and supervisory controller.

Distributed Control System This term is being phased out in preference of BCS, UCS, and/or CS.

Electronic Security System (ESS) The integrated electronic system that encompasses interior and exterior (physical) intrusion detection systems (IDS), CCTV systems for assessment of alarm conditions, access control systems, data transmission media, and alarm reporting systems for monitoring, control, and display.

Energy Monitoring Control System (EMCS) Another name for a Utility Monitoring and Control System. See CS.

Equipment Controller (EC) A controller implementing control logic to control a piece of equipment. Note: a controller is defined by use, and many ECs also have the capability to act as supervisory controllers (SC). Some examples of equipment controllers are air handler controllers, protective relays, and pump controllers. Note that some devices, such as power meters or smart sensors, which only perform monitoring functions are still considered equipment controllers (despite not actually controlling anything).

Facility-Related Control System A control system which controls equipment and infrastructure that is part of a DoD building, structure, or linear structure.

Field Control System (FCS) A Building Control System, Utility Control System, Access Control System, etc. within the Facility and "downstream" of the FPOC.

Field Control Network (FCN) The network used by the Building Control System, Utility Control System, etc., within a facility "downstream" of the FPOC. This includes IP, Ethernet, RS-485, TP/FT-10 and other network infrastructure that support control system(s) in a given facility.

Field Point of Connection (FPOC) The FPOC is the point of connection between the ICS IP network and the field control network (an IP network, a non-IP network, or both). The hardware which provides the connection at this location is an IT device such as a switch, IP router, or firewall.

[CS, PCS, ESS, etc.] Front End The portion of the control system consisting primarily of IT equipment, such as computers and related equipment, intended to perform operational functions and run monitoring and control/engineering tool application software. The front end does not directly control physical systems; it interacts with them only through field control systems (FCS). The front end is a component of the [CS, ESS, etc.] infrastructure (see definition).

Impact The effect on organizational operations, organizational assets, or individuals due to a loss of Confidentiality, Integrity, or Availability in the control system. Impact is categorized as one of three levels:

- LOW: limited adverse effect
- MODERATE: serious adverse effect
- HIGH: severe or catastrophic adverse effect

The impact level of a system is generally written in ALL CAPS for clarity.

Incident (FIPS 200) An occurrence that actually or potentially jeopardizes the confidentiality, integrity, or availability of an information system or the information the system processes, stores, or transmits or that constitutes a violation or imminent threat of violation of security policies, security procedures, or acceptable use policies

Industrial Control System (ICS) One type of control system. Most specifically a control system which controls an industrial (manufacturing) process. Sometimes also used to refer to other types of control systems, particularly utility control systems such as electrical, gas, or water distribution systems.

Information Technology (IT) Any equipment or interconnected system or subsystem of equipment that is used in the automatic acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information by the executive agency.

[CS, ESS, ...] Infrastructure The portion of a control system (such as a CS or ESS) which includes all components that are not part of a field control system. These components include the FPOC, the Platform Enclave, and the front end (i.e. it's architecture Levels 3, 4 and 5)

Intrusion Detection System (IDS) [Physical/ESS] A system consisting of interior and exterior sensors, surveillance devices, and associated communication subsystems that collectively detect an intrusion of a specified site, facility, or perimeter and annunciate an alarm.

Intrusion Detection System (IDS) [Cyber] A device or software application that monitors network or system activities for malicious activities or policy violations, and produces reports to management.

Mobile Code (NIST SP 800-53r4) Software programs or parts of programs obtained from remote information systems, transmitted across a network, and executed on a local information system without explicit installation or execution by the recipient.

Mobile Code Technology (NIST SP 800-53r4) Software technologies that provide the mechanisms for the production and use of mobile code (e.g. Java, JavaScript, ActiveX, VBScript)

Non-Local Maintenance (NIST SP 800-53r4) Maintenance activities conducted by individuals communicating through a network; either an external network (e.g., the Internet) or an internal network.

[CS, ESS, ...] Platform Enclave Those components of the control system that are standard IT components and can be secured in a standard manner independent of the type of control system. These components serve only the control system and include the IP network, network management and security devices (e.g., switches, routers), software, computers and/or other devices which provide management and security of the network.

Platform IT (PIT) IT, both hardware and software, which is physically part of, dedicated to, or essential in real time to the mission performance of special purpose systems.

Remote Access (NIST SP 800-53r4) Remote access is access to organizational information systems by users (or processes acting on behalf of users) communicating through external networks (e.g., the Internet).

Risk (NIST SP 800-53r4) A measure of the extent to which an entity is threatened by a potential circumstance or event, and typically a function of: (i) the adverse impacts that would arise if the circumstance or event occurs; and (ii) the likelihood of occurrence. Information system-related security risks are those risks that arise from the loss of confidentiality, integrity, or availability of information or information systems and reflect the potential adverse impacts to organizational operations (including mission, functions, image, or reputation), organizational assets, individuals, other organizations, and the Nation.

Risk Management (NIST SP 800-53r4) The process of managing risks to organizational operations (including mission, functions, image, reputation), organizational assets, individuals, other organizations, and the Nation, resulting from the operation of an information system, and includes: (i) the conduct of a risk assessment; (ii) the implementation of a risk mitigation strategy; and (iii) employment of techniques and procedures for the continuous monitoring of the security state of the information system.

Security Content Automation Protocol (SCAP) A method for using specific standards to enable automated vulnerability management, measurement, and policy compliance evaluation (e.g., FISMA compliance). The National Vulnerability Database (NVD) is the U.S. government content repository for SCAP.

Supervisory Control and Data Acquisition (SCADA) This term is being phased out in preference of BCS, UCS, and/or CS.

Supervisory Controller A controller that implements a combination of supervisory logic (global control or optimization strategies), scheduling, alarming, event management, trending, web services or network management. A supervisory controller may be located between the Platform Enclave and the FCS

serving as the data aggregation conduit between the FCS and the front end. Note that this arrangement is defined by use; many supervisory controllers have the capability to also directly control equipment, and serve the role of both supervisory controller and equipment controller.

Utility Control System (UCS) A type of field control system used for control of utility systems such as electrical distribution and generation, sanitary sewer collection and treatment, water generation and pumping, etc. Building controls are excluded from a UCS, however it is possible to have a Utility Control System and a Building Control System in the same facility, and for those systems to share components such as the FPOC. A UCS is a subsystem of a Utility Monitoring and Control System (CS) and is a class of Field Control System (FCS).

Utility Monitoring and Control System (CS) The system consisting of one or more building control systems and/or utility control systems and the associated CS Infrastructure. In other words, it is the complete utility monitoring system – from the front end to equipment controllers. At the highest level the CS is composed of a CS Platform Enclave and CS Front End (jointly referred to as CS Infrastructure), and connected Field Control System(s).

CS IP Network The Level 4 IP network used by the CS.

Vulnerability (NIST SP 800-53r4) Weakness in an information system, system security procedures, internal controls, or implementation that could be exploited or triggered by a threat source.

1.8 REQUIREMENTS FOR SUBJECT MATTER EXPERTS

The CS shall be designed and engineered by qualified Control System Cybersecurity, Information and Communication Technology, and System Integration specialists complying with the requirements listed below.

1.8.1 Control Systems Cybersecurity Specialist:

The Control Systems Cybersecurity specialist shall have a minimum of five years' experience in control system network and security design and shall maintain current certification as a Global Industrial Cyber Security Professional (GISCP) or Certified Information Systems Security Professional (CISSP). The Control Systems Cybersecurity specialist must have demonstrated knowledge and experience applying IT and OT security strategies such as the application of the NIST security controls, exploitation techniques and methods, continuous monitoring, and utility/building control systems design. The résumé of the specialist must be submitted to the ESTCP Project Manager (PM) for review and approval prior to the concept phase of the project. The qualifications of the firm for whom the specialist works must also be submitted with the résumé.

1.8.2 Information and Communication Technology Specialist:

The Information and Communication Technology specialist shall have a minimum of five years' experience in control system network and security design and shall maintain current certification as a Registered Communications Distribution Designer (RCDD®). The Information and Communication Technology specialist must have demonstrated knowledge and experience applying IT and OT security strategies such as the application of the NIST security controls, cable network design and installation, project management, and data center design. The résumé of the specialist must be submitted to the ESTCP Project Manager (PM) for review and approval prior to the concept phase of the project. The qualifications of the firm for whom the specialist works must also be submitted with the résumé.

1.8.3 System Integration Specialist:

The System Integration specialist shall have a minimum of five years' experience in control system network and shall maintain current certification as a Certified System Integrator (CSI) for the products they are integrating (Tridium, Johnson Controls, Wonderware,

Schneider, Schweitzer Engineering Laboratories, Rockwell, etc.) and/or be Control System Integrators Association (CISA) Certified. The System Integrator specialist must have demonstrated knowledge and experience applying IT and OT security strategies such as the application of the NIST security controls, BAS design and installation, project management, quality assurance and commissioning. The résumé of the specialist must be submitted to the ESTCP Project Manager (PM) for review and approval prior to the concept phase of the project. The qualifications of the firm for whom the specialist works must also be submitted with the résumé.

1.9 **FRCS REFERENCE ARCHITECTURE** The DoD FRCS Reference Architecture as defined in UFC 04-010-06 Cybersecurity of Facility-Related Control Systems is provided in Figure 1.

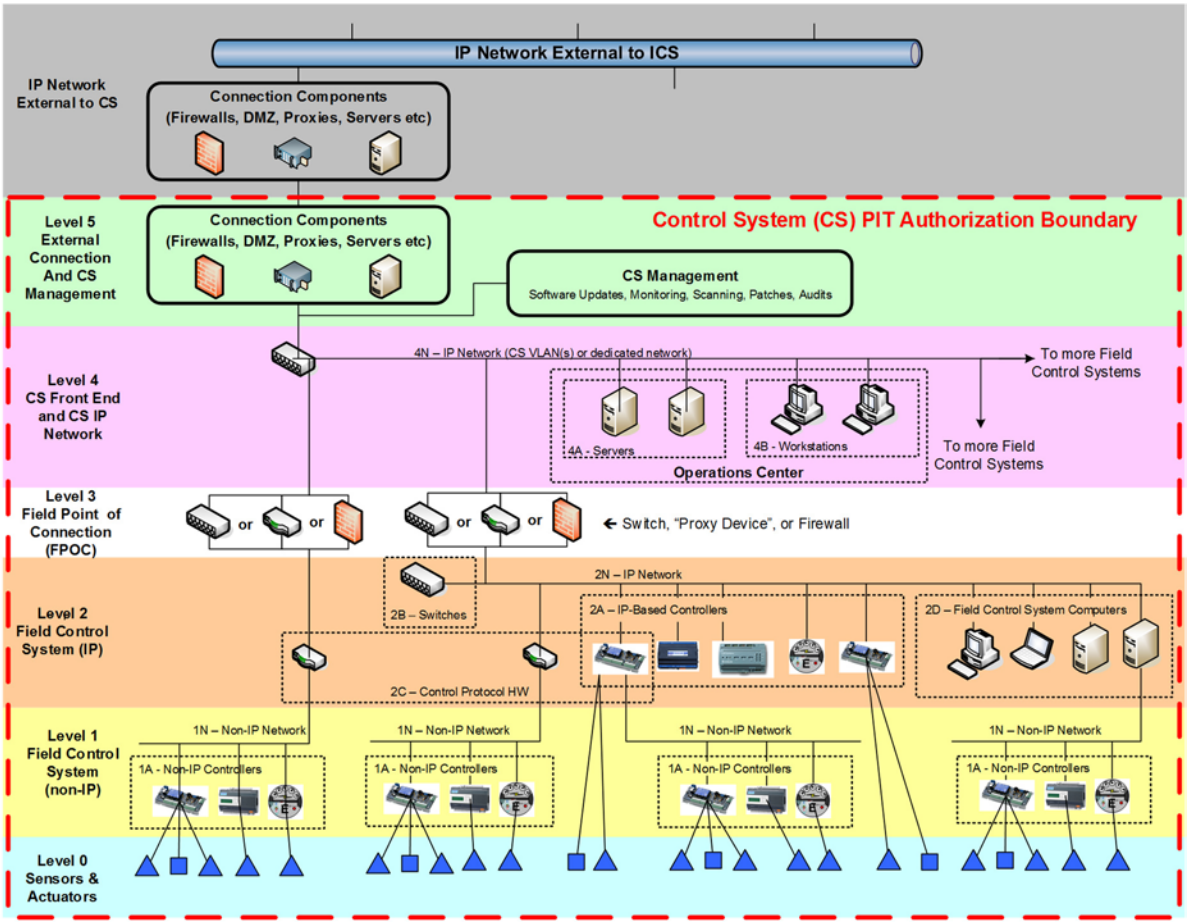

Figure 1 DoD FRCS Reference Architecture

UFC 04-010-06 Appendix E 5-Level Control System Architecture describes the 5-Level architecture for FRCS and presents cybersecurity considerations for each level. The FRCS level architecture is used to define the authorization boundary for FRCS systems and is a logical representation of the FRCS network. While many baseline security controls can be applied to a FRCS, how and where they are implemented varies, primarily because of technical and operational constraints. Interconnections between FRCS and organizational networks and business systems expose FRCS to exploits and vulnerabilities. Any attempts to address these exploits and vulnerabilities must consider the constraints and requirements of the FRCS.

Networked FRCS are those systems which have multiple controllers and can have both traditional IP traffic at the Level 3 and up, and Ethernet IP and serial traffic at the lower levels as defined by the UFC 04-010-06 Cybersecurity of Facility-Related Control Systems Reference Architecture Figure 5.1. Depending on the age and type of FRCS, these FRCS **MAY** have the capability for remote monitoring; almost all 2005 and newer CS are IP and web based and typically as part of the vendor service level agreement, most require remote access to the system for maintenance.

Non-networked FRCS are generally those that consist of a single controller, and do not have the capability for remote monitoring.

There are two types of networked FRCS; Internally Networked (IN), also designated as Closed Restricted Networks (CRN), which have multiple components networked together, but does not have a network connection to anything that is not part of the control system, and FRCS that are Externally Networked (EN), where the control system has multiple component networked together, and does connect to a network that is not part of the control system, most commonly the NIPR, Commercial Carrier/Internet, or separate government backbone network such as DHA Med COI, Navy PSNet or the Air Force CE VLAN.

If the FRCS is a EN (requires a connection to the DoDIN as defined by DoDI 8530.0), it will go through the full 6-step RMF process. If the FRCS is an IN and is a CRN, it can use the shorter Evaluate and Endorse process. Both IN and EN FRCS will follow the DoD Control Systems Reference Architecture levels as defined by UFC 04-010-06 Cybersecurity of Facility-Related Control Systems. Organizations will use a tailored set of security controls to evaluate automated control systems consistent with the RMF Assess & Authorize process through the implementation of the applicable controls in NIST SP 800-82R2.

The IA Guideline applies to all of the networks, components and devices within the Authorization Boundary.

1.10 TEST AND DEVELOPMENT ENVIRONMENT

For new or major modernization projects, the Systems Integrator will establish a Test and Development Environment (TDE) that replicates the Production Environment to the highest degree possible starting with the Level 4 Workstations, Servers, software and with at least one of each of the Level 3-0 major components, devices, and actuators. At approximately the 50-75% construction complete, the TDE will be used to perform Factory Acceptance Testing (FAT) of the project to ensure the project has end-to-end functionality, has been properly configured using the Security Content Automation Protocol (SCAP) tool and the Security Technical Implementation Guides (STIGS), all patches (OS and CS) are installed and properly configured, and begin creating the artifacts for the draft System Security Plan.

At approximately 95-100% construction complete, the TDE will be used to conduct Site Acceptance Testing of the complete CS, and if required, Penetration testing. The SAT artifacts will be included in the final System Security Plan, FMC and Jump-Kit (if required).

The ESTCP Project Team/System Integrator will transfer the TDE to the ESTCP PM for inclusion into the Platform Enclave FRCS Operations Center.

CHAPTER 2. FRCS CYBERSECURITY REQUIREMENTS

2.1 FRCS CYBERSECURITY REQUIREMENTS

As long as DOD uses outside contractors to design, construct, and operate building control systems, it is vitally important that contractors and vendors become part of the cybersecurity solution, starting with the supply chain and ending with proper disposal of obsolete equipment. Cybersecurity of the FRCS begins in the planning and design phases, it is imperative that the FRCS design and construction teams understand the NIST RMF process and the various documents and artifacts associated with an Authorization package.

The Continuous Monitoring (CM) Strategy has been developed by the DOD using the DISA ESS tool suite for the Level 4 Operations Center servers and workstations. The ESTCP PI and support/system integrator contractors will be given guidance on the tools and applications to use for Level 3 and below components and devices. The PIT Control System Cybersecurity Lifecycle is shown in Figure 2.

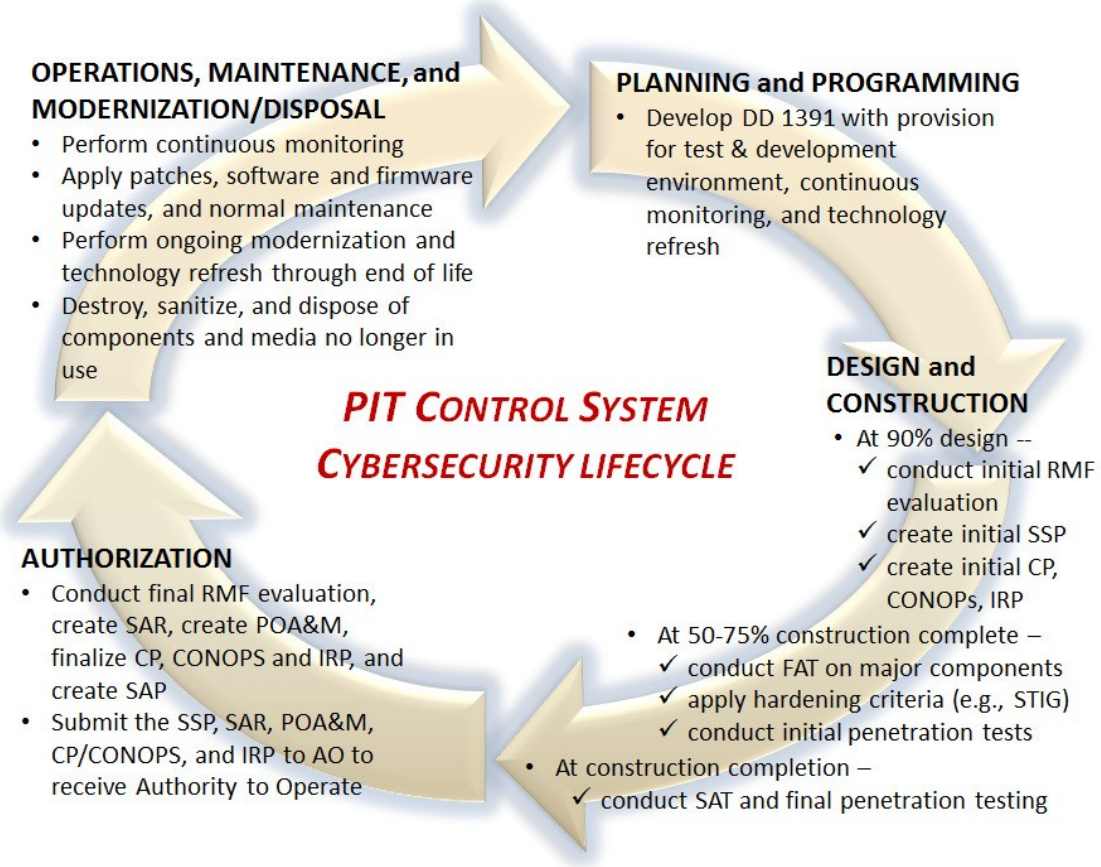

Figure 2 CS Cybersecurity Lifecycle

DoD has developed the facilities RMF Enclave Boundary approach that provides Defense In Depth and which is composed of two distinct authorizations:

- Platform Enclave (provided by hosting service/agency)
- Operational Architectures (the authorization that ESTCP projects will document)

The ESTCP office will assist Project Teams to obtain PE integration and documentation to coordinate their OA RMF authorization.

2.2 FRCS CATEGORIZATION

A key first Step 1 of the RMF is to categorize the FRCS for Confidentially, Integrity and Availability (C-I-A). The RMF KS portal EI&E webpage and the ESTCP website have the FRCS Master List and preliminary C-I-A values. The ESTCP office in conjunction with the PE owner and the Project Team will determine the final C-I-A values. In general, the majority of the ESTCP projects are expected to be L-L-M or M-M-H systems.

2.3 FRCS CONFIGURATION MANAGEMENT A FRCS configuration standard shall be established to support effective and efficient monitoring of the FRCS. Managing the configuration requires the following:

- Maintain baseline configurations in accordance with technical specifications for systems and security technology set forth by the PE.
- Establish and enforce security configurations for individual applications such as HVAC, Lighting, and IDS systems and products employed in FRCS.
- Monitor and control changes to the baseline configurations and to the constituent components of security systems (including hardware, software, firmware, and documentation) throughout the respective system lifecycle. Configuration management can be largely accomplished through updating FRCS documentation received during initial project installation.
- The PE and the CIO, is responsible for tracking and maintaining the baseline configuration of the FRCS.

2.2 FRCS COMMISSIONING FRCS systems, subsystems, and software programming shall undergo comprehensive Factory and Site Acceptance Testing. The acceptance test process shall be documented using a standard testing process that is implemented and assessed by a qualified independent third party. At a minimum, the process shall meet the following requirements:

- Demonstrate the functionality of each FRCS device or component.
- Demonstrate performance characteristics consistent with the manufacture's specifications.
- Demonstrate all functionality including software programming, integration of subsystems, and automation of system functions as specified for the particular project.
- Verify that network connections, IT integration, and IT security requirements meet FIPS, NIST, and all other applicable standards.
- Verify that all life-safety integration requirements and functions meet local and national codes and ordinances.
- Demonstrate startup, recovery from failure, and operator training requirements.

2.2 FRCS CONTINUOUS MONITORING For ESTCP projects that require connection to the DoDIN, the Project Team will be required to demonstrate the solution is compatible with the FRCS continuous monitoring Host-Based Scanning System (HBSS) and ACASS for Level 4, using active scanning and a FRCS passive network monitoring capability to provide end-to-end monitoring of both legacy systems and new systems that can support end-to-end active scanning. The monitoring capability will be based on a robust, multi-tier architecture that provides local, regional, and NSOC alarm monitoring, as well as

remote alarm assessment, dispatch, and response. The multi-tier structure provides multiple levels of FRCS event visibility that corresponds to the DoD Mission Assurance program and includes redundant primary and secondary monitoring capability within regions or in clusters.

For CRN projects, FRCS monitoring capability shall be analyzed on a case-by-case basis to determine suitability and cost effectiveness. The FRCS SSP and ITCP shall identify overall system framework and operational procedures.

CHAPTER 3. DESIGN AND CONSTRUCTION RESOURCES, DELIVERABLES AND CHECKLISTS

3.1 DESIGN AND CONSTRUCTION RESOURCES

The FRCS consultants shall comply with the FRCS UFC's, UFGS, and services/agencies latest construction specifications for FRCS, found on the Whole Building Design Guide, and augmented by other service/agency Policies and Directives. Additional sections shall be prepared by the designer as necessary to suit the project requirements.

The Whole Building Design Guide Cybersecurity Resource Page provides current best cybersecurity practices and references for all types of building control systems and links to several tools to support the development of the RMF IA package and documentation.

A FRCS **MAY** be a hybrid, or converged, system of traditional IT products and Operational Technologies (OT) products that must now be considered an exploit vector that can be used to penetrate into the larger DoDIN network. These hybrid systems contain or transmit Personally Identifiable Information (PII), Protected Critical Infrastructure Information (PCII), Health Insurance Portability and Accountability Act (HIPAA), or Payment Card Industry (PCI) information/data. Examples of systems that may be hybrid, or converged, systems include:

- Access control/alarm systems that use badges/PIV Cards and Active Directory for keyless entry (contain PII).
- Keyless entry/keypad systems that use Active Directory (contain PII).
- Meter data management systems that interconnect with a local utility with real time demand and response (if the meter data is determined to contain PCII).
- Patient Monitoring and Wandering Systems (contain PII, HIPAA).
- Patient Comfort Systems (contain PII, HIPPA)
- Vehicle fueling/charging stations/pumps with credit card swipe (contain PCI).
- Computerized maintenance management systems/work order systems that interconnect with control system back-end controllers and devices (if the system is determined to contain PCII or PII).

IF the FRCS is determined to be a Hybrid/Converged system, then the RMF package will consist of both the NIST SP 800-53R4 and NIST SP 800-82R2 Security Controls. Reference the CIO RMF KS EI&E web portal for more detailed guidance.

The following tools are available for the ESTCP Project Team, designer, construction and systems integrators to use in the creation of the Test and Development Environment (TDE) and Production FRCS.

3.1.1. Cyber Security Evaluation Tool (CSET) The DHS CSET is a useful tool that supports the FRCS design, construction and authorization phases of the CS lifecycle. CSET incorporates NIST, ISO, SANS, and other industry standard references. CSET includes the NIST SP 800-53 R4, NIST SP 800-82 R2, the NIST Cybersecurity Framework, and the Committee for National Security Systems Instruction (CNSSI) 1253 RMF standards and guidelines.

CSET has a plug-in (on initial install of CSET use the custom option) that connects to the National Security Agency-developed GrassMarlin (GM) passive network analysis tool. GM can be used to create

an initial network architecture diagram of existing FRCS. The CSET tool can be used during design and construction to develop baseline risk assessments and initial System Security Plans (SSPs). SSPs are published as Word documents that can be copied into the CIO eMASS Information Repository tool. CSET and the CIO eMASS Information Repository tool relationship is shown in Figure 3.

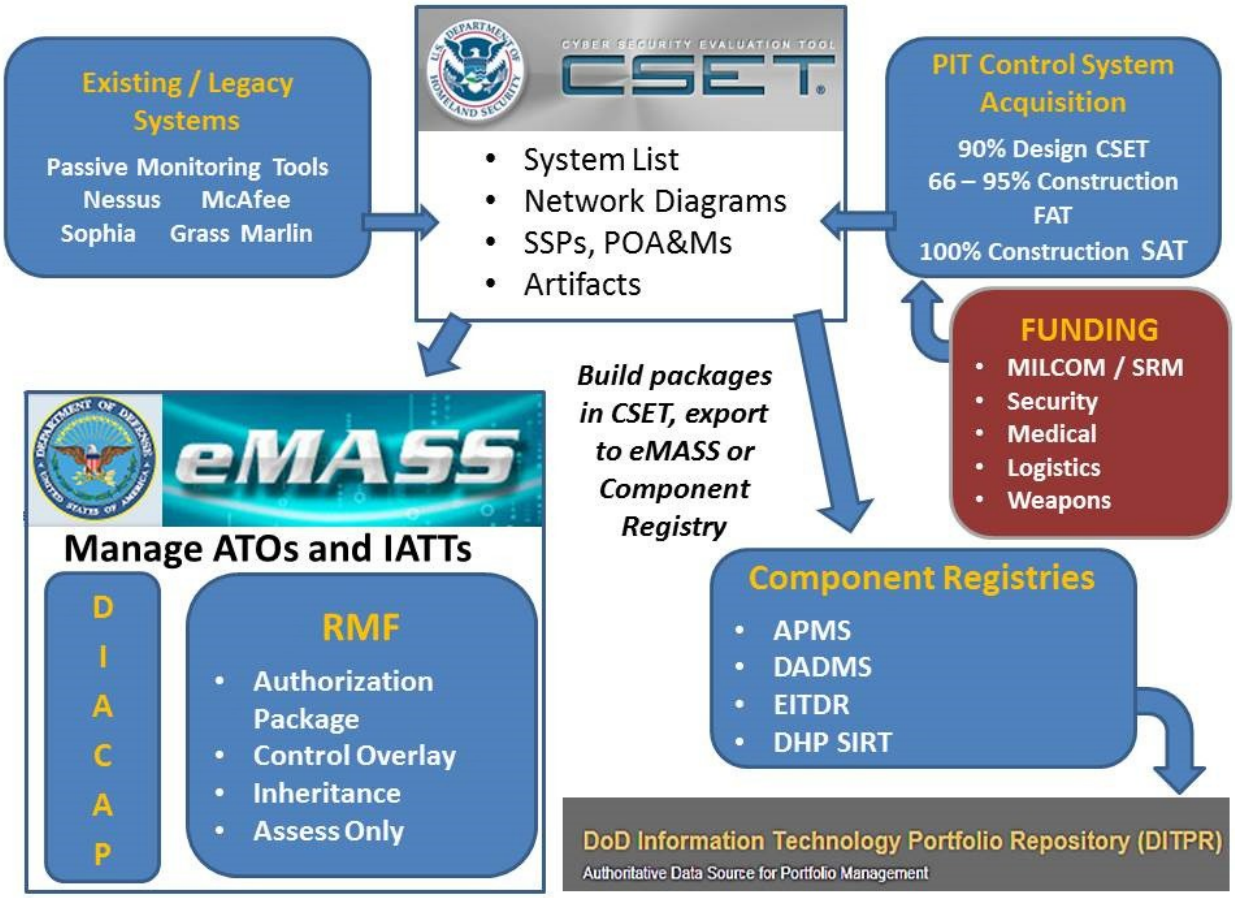

Figure 3 - Relationship of CSET, Component Registry, eMASS, and DITPR

3.1.2 GrassMarlin Passive Network Discovery Tool

In support of a passive means to generate an Industrial Control System network and discover IP devices, NSA developed the GrassMarlin (GM) tool. GrassMarlin discovers and catalogs Control System on IP-based networks. GM uses a variety of sources to generate this data, including PCAP files, router and switch configuration files, CAM tables, and live network packet captures. The tool can automatically determine the available networks and generate the network topology as well as visualize the communication between hosts. The GrassMarlin file can be imported into the CSET tool to generate the network architecture and topology diagram and the preliminary inventory of devices and components and should be included on the Jump-Kit Rescue CD.

3.1.3 Security Content Automation Protocol (SCAP) Tool

The SCAP tool is used to configure the FRCS BAS hardware and software to the proper DoD and Navy configurations using the Security Technical Implementation Guides (STIGS). The FRCS designer, construction and systems integrators will use the SCAP tool in the Test and Development Environment to create the artifacts required for the RMF

package documentation. The TDE SCAP configuration should be as close as possible to the HBSS ACAS configuration and should be included on the Jump-Kit Rescue CD (if required).

3.1.4 Samurai Software Testing For Utilities Tool

The tool was developed by EPRI along with the Smart Grid and Advanced Meter Infrastructure Penetration Guides. The guides and the tool have electrical and utility analysis, penetration, exploit and RF communications procedures and processes and should be included on the Jump-Kit Rescue CD (if required).

3.1.5 Kali Linux Tool

The tool is the state of the practice penetration and exploitation tool. The tool is used primarily for penetration testing of IT systems, but is beginning to get some OT capabilities to include Modbus and DNP3 protocols and should be included on the Jump-Kit Rescue CD (if required).

3.1.6 Glasswire Tool

The tool is a combination network, firewall, usage and alert capability for IT systems. The tool can be used in the Test and Development Environment to establish the preliminary Functional-Mission Capability Baseline and should be included on the Jump-Kit Rescue CD (if required).

3.1.7 Belarc Advisor Tool

The tool is a data gathering and analysis tool for IT systems. The tool can be used in the Test and Development Environment to establish the preliminary Functional-Mission Capability Baseline and should be included on the Jump-Kit Rescue CD (if required).

3.1.8 MalwareBytes Tool

The tool is a malware and anti-virus scanner and cleaner for IT systems. The tool can be used in the Test and Development Environment to establish the preliminary Functional-Mission Capability Baseline and should be included on the Jump-Kit Rescue CD (if required).

3.1.9 OSForensics Tool

The tool is a forensics data gathering and analysis tool for IT systems. The tool can be used in the Test and Development Environment to establish the preliminary Functional-Mission Capability Baseline and should be included on the Jump-Kit Rescue CD (if required).

3.1.10 Mandiant Redline Tool

The tool is a data gathering and analysis tool for IT systems. The tool can be used in the Test and Development Environment to establish the preliminary Functional-Mission Capability Baseline and should be included on the Jump-Kit Rescue CD (if required).

3.1.11 Microsoft SysInternals Suite Tool

This suite of tools includes data gathering and analysis tools for IT systems, applications and processes, CPU and memory usage, and Registry tools. The suite can be used in the Test and Development Environment to establish the preliminary Functional-Mission Capability Baseline and should be included on the Jump-Kit Rescue CD (if required).

3.1.12 Host-Based Scanning System (HBSS) and Assured Compliance Assessment Solution (ACAS) Tools

HBSS and ACAS are components of the DISA Endpoint Security Solutions (ESS) suite which is an integrated set of capabilities that work together to detect, deter, protect, and report on cyber threats across all DOD networks. The FRCS designer, construction and systems integrators will not typically have access to HBSS ACAS; ESTCP CIO and DISA typically deploy the tools to the new systems being added to the DoD network.

3.2 TYPICAL SEQUENCE OF FRCS DESIGN AND CONSTRUCTION ACTIVITIES

An example sequence and duration of FRCS activities during design and construction is outlined in Table 1.

Table 1 Typical Sequence of FRCS Design and Construction Activities

Activity / Lead	New Project	Renovation Project	Typical Duration
Presolicitation RFP Considerations	Obtain the Regional and ESTCP Platform Enclaves catogorization and categorize the FRCS Use the EI&E FRCS Master Control List for C-I-A Values and Information/Data Types	Obtain the Regional and ESTCP Platform Enclaves catogorization and categorize the FRCS Use the EI&E FRCS Master Control List for C-I-A Values and Information/Data Types	NA
Design • Basis of Design • Concept Design (10-15%) • Design Development (35-50%) • Pre-Final (90%) • Final (100%) Lead: A/E Documents/Models/Tools: • Construction Design Documents / Building Information Model (BIM) / CAD • CSET • GrassMarlin • Draft Baseline System Security Plan (SSP) • IT Contingency Plan and CONOPS (ITCP)	FRCS front end or new susbsystem back end to connect to front end Confirm/revise system categorization, define network architecture, system components, concept of operations, drawings, and specifications. At 90% design create initial SSP and baseline security risk assessment.	FRCS front end upgrade or subsystem modernization Confirm/revise system categorization, define network architecture, system components, concept of operations, drawings, and specifications. At 90% design create initial SSP and baseline security risk assessment.	3-6 Months
Construction Test and Development (T&D) and Patch Management Environments (Virtual or Physical) Lead: Construction/System Integrator Documents/Models/Tools: • VM • Kali Linux • SamuraiSTFU	Conduct FRCS build and patch activities without impacting the organization's production systems (test and development environment typically provided by vendor).	Validate and verify the upgrade/modernization/ patch is ready to support the additional systems without impacting the organization's production systems (test and development environment typically provided by vendor).	4 – 6 weeks

Activity / Lead	**New Project**	**Renovation Project**	**Typical Duration**
Construction Build/Configure Servers	Build and/or configure servers to properly operate the FRCS solution.	Build and/or configure servers to properly operate the FRCS solution.	1 – 2 weeks
Construction Install Supporting Software Lead: Construction/System Integrator	Install supporting software on FRCS servers.	Install supporting software on FRCS servers.	1 – 2 weeks
Construction Configure Supporting Software Lead: Construction/System Integrator Documents/Models/Tools: • STIGS • SCAP • Continuous Monitoring • Kali Linux • SamuraiSTFU • FAT/SAT Checklist • Penetration Testing Scope and ROE (if required) • Jump-Kit Rescue CD	Configure FRCS software to meet unique needs. After the operating system is loaded, apply hardening criteria (STIGs), run Security Content Automated Protocol (SCAP)-validated tool, perform factory acceptance testing (FAT) on major system components and devices, perform initial penetration testing.	Configure FRCS software to meet unique needs. After the operating system is loaded, apply hardening criteria (STIGS), run Security Content Automated Protocol (SCAP)-validated tool, perform FAT on major system components and devices, perform initial penetration testing.	1 – 2 weeks NOTE: If a vendor will be creating a STIG for the UMCS Front-End or lower Level devices, this process can take several months to a year. Apply STIGS to the PE and isolate lower Levels until vendor STIGS are approved.
Construction Implement and assess security controls Lead: construction/system integrator Documents/Models/Tools: • CSET • SSP • Security Assessment Report (SAR) • Plan of Action & Milestones (POAM) • ITCP • Event/Incident Communications Procedures (EICP)	Conduct RMF Steps 3 and 4 by applying controls identified during the requirements and design phase, by assessing the adequacy and effectiveness of security controls, and by documenting findings in the security assessment report. Create draft approval package.	Conduct RMF Steps 3 and 4 by applying controls identified during the requirements and design phase, by assessing the adequacy and effectiveness of security controls, and by documenting findings in the security assessment report. Create draft approval package.	12 – 20 weeks

Activity / Lead	**New Project**	**Renovation Project**	**Typical Duration**
• Security Incident Response Procedures (SIRP) • Penetration Testing Scope, ROE, Checklist (if required) • Jump-Kit Rescue CD			
Conduct testing on initial build Lead: construction/system integrator Documents/Models/Tools: • Kali Linux • SamuraiSTFU	Test FRCS solution in a test and development environment to ensure system errors are found, corrected before solution is deployed on network.	Test FRCS solution in a test and development environment to ensure system errors are found, corrected before solution is deployed on network.	2 – 4 weeks
Construction - conduct pilot implementation deployment Lead: construction/system integrator Documents/Models/Tools: • Kali Linux • SamuraiSTFU • OIT IT Repository • Penetration Testing Scope, ROE, Checklist (if required) • Jump-Kit Rescue CD	Pilot implementation of FRCS solution on a small subset of user base to evaluate solution against real-world requirements. Conduct site acceptance testing, and if required final penetration testing, and create final approval package.	Conduct site acceptance testing, and if required final penetration testing, and create final approval package.	Varies with size of deployment (number of facilities and interconnections)
Receive Authorization (ATO) and move to production Lead: construction/system integrator Documents/Models/Tools: • OIT IT Repository • Continuous Monitoring tools • Jump-Kit Rescue CD	Deploy the FRCS to full production and implement continuous monitoring.	Deploy the FRCS to full production and extend continuous monitoring to new systems.	NA

CHAPTER 4. TYPICAL FACILITY-RELATED CONTROL SYSTEMS CONTRACT SUBMITTALS

This chapter provides guidance and the engineering requirements to the designers, construction and systems integrators to cover the lifecycle of the FRCS Cybersecurity process.

At contract award, all FRCS contractors must complete or have current DOD Cybersecurity Awareness training and have a security background clearance or similar e.g. Facility Access Determination – FAD (SECNAV M-5510.30).

FRCS contractors cannot use non-approved laptops/ computer and external portable media storage devices on the DoD network; only FRCS/ UCS/ BCS/ DDC government-approved field laptop and portable media will be used for both the Test and Development Environment and the Production system.

All FRCS construction and building modifications must meet the requirements of the local Building Standards Code, National Fire Protection Association (NFPA) 101, and Life Safety Code such as DDC raceway penetrations of fire wall boundaries.

While no FRCS can be guaranteed to continue to function and operate when a determined advisory has targeted the FRCS, the ability to withstand cyberwar attacks, even if in a degraded state, is a key consideration, particularly for Mission Critical and Mission Essential facilities. Contractors should design, construct, and operate the FRCS in accordance with the USCYBERCOM Industrial Control Systems Advanced Techniques, Tactics, and Procedures 2016. Understanding how to Detect, Mitigate, and Recover from a cyberattack on the CS is vital; the Jump-Kit Rescue CD is a key deliverable that defines the Fully-Mission Capable (FMC) Baseline and is the living document that maintains the current FRCS configurations and operating parameters. USCYBERCOM, the Network Security Operations Center (NOSC), and the services Facilities-Related Control Systems Operations Center (FRCSOC) use the FMC to develop and manage the Continuous Monitoring strategy.

4.1 FRCS IA SUBMITALL REQUIREMENTS

Configure all installed hardware and software to comply with DOD cyber security requirements that will be needed for Risk Management Framework (RMF) certification in accordance with DoDI 8510.1 with all applicable DISA STIGs applied.

Provide all necessary documentation for system RMF certification and accreditation to include all relevant artifacts for installed equipment (hardware and software). Documentation should include the following.

- Hardware and Software (both OS and Applications) STIG
- Provide ACAS (Nessus) and/or Security Content Automation Protocol (SCAP) scans of installed and configured systems to demonstrate DOD cyber security compliance.
- Identify and close/mitigate category 1 & 2 findings
- System/Mission Description/CONOPS/COOP
- Actual or intended installation platform/location(s)
- Hardware and Software lists if selected, including list of IA managed or IA enabled devices, if any
- Topology/architecture/boundary diagram that identifies major component(s) and all interconnections.

- Current life cycle status (acquisition milestone or fielded).
- Identification of the Platform IT Infrastructure (PITI) on the boundary diagram with sufficient detail for Office of Designated Approving Authority (ODAA) to determine accreditation status of PITI.
- Include Ports/Protocols/Services in accordance with DoD PPS CAL.
- Identify interfaces that cross differing security domains.

Provide all technical documentation including as built drawings, software and hardware inventory, standard operating procedures as well as cabling diagrams.

Project reports including system status, problem resolution, unresolved system problems, patch and updates Cybersecurity Vulnerability Management (IAVM) compliance.

4.1.1 Security Controls Documents

The Security Controls Documents document the engineering requirements for the FRCS/ UCS/BCS/ DDC Hardware, Software/Firmware; the Platform Enclave and network topology; Operating System Software and multicast filtering, port configuration, status, statistics, mirroring, and security for reliability and redundancy; Field Control Systems software/firmware; and the various plans required as artifacts for the eMASS RMF ATO Package.

As part of the Design Development (35-50%) and Final (100%) design submittal, provide the following document deliverables:

System Authorization Documents

- Draft hardware list (Hardware list must include the following for each device):
  - Manufacturer,
  - Model,
  - Location,
  - Server and Workstation technical ratings (e.g. memory),
  - Serial number,
  - MAC addresses,
  - IP addresses.
- Software and Firmware List (list must include the following for each device):
  - Manufacturer
  - Version/subversion,
  - Location/device,
  - Used network ports/protocols/services.

(Both hardware and software/firmware lists should also include Common Criteria EAL status, eMASS entry number, and OS/IOS/Firmware version(s) as applicable).

- Network diagram
  - Network diagram must show equipment locations, names, models, and IP addresses on network communications schematic.
- Jump-Kit Rescue CD (if required)

- The Rescue CD is a bootable CD with tools, rootkit detection, master boot record check, and other capabilities. A Recovery Jump-Kit contains the tools the CS team and IT team will need to restore a system to its last FMC state during Mitigation and Recovery. The Jump-Kits must be maintained and be a part of configuration management. When configuration files or new versions ofoperating systems or applications are updated, the Jump-Kits need to be updated as well.

Access Controls Summary

- Information on software access controls, port control, and protection.
- System user roles implemented by application and access privileges assigned by default to each role. If privileges can be added to, or removed from, a role, so specify.
- Details on system logon, including denial after three (3) invalid attempts, how to delay subsequent logons.
- Details on privileged accounts - who should have them and when are they used.
- Details on kinds of accounts, their associated privileges, which roles should have access, and so on - servers, wireless, equipment, meters.
- User ID/Password requirements and/or PKI requirements including details on shadowing, enforcement of password strength, encryption of passwords.
- Details of system library structure and what roles should be allowed what access privileges to library components.
- Details on remote (wireless) access by laptops or servers to meter and/or radio data. Auditing Controls Summary
- Details on auditing controls and auditing (creation of system audit trail for user accountability).

COOP or Disaster Preparedness Plan

- Contractor will work with government personnel to develop COOP and Disaster Preparedness Plan for the updated system (applications and hardware)

Configuration Management Plan

- The Fully-Mission Capable (FMC) Baseline Configuration, to be included on the Jump-Kit Rescue CD.

Vendor Configuration Management Plan

- Information required to test all patches and upgrades prior to deployment, including coordination as required with any test procedures run at vendor labs.

Contingency Plan

- Restoration Procedures – Guidance on restoring vendor software & hardware including guidance to help determine priority for restoration.
- Startup & Shutdown Procedures – Details of system initialization, shutdown/aborts designed to ensure secure system state.

Security Features Guide List and discussion of all security features of Vendor hardware and software.

- Document use of mobile code (e.g. scripts, such as Java) and protections in place to prevent malicious content from using associated runtime systems.
- Documented FIPS 140-2 validated cryptography (or equivalent) compliance.

Vulnerability Management Plan

- Information required to test all patches and upgrades prior to deployment, including coordination as required with any test procedures run at vendor labs.
- Security issues associated with implementation and maintenance of the application.
- Cybersecurity POC for resolution of Cybersecurity issues post accreditation.

Maintenance Plan

- Names and other required information of personnel who will be authorized to perform maintenance in accordance with maintenance agreement

Documented Statements

- Declaration that public domain software (e.g., freeware, shareware) is not used in the system.
- Information on Common Criteria or National Cybersecurity Partnership (NIAP) or Federal Information Processing Standards (FIPS) evaluation status of hardware and software.

Include the following documents:

- As-built System Accreditation Documents (Security Controls documents, along with as-built drawings submittals). Follow requirements for as-built drawings submittal format, and additionally provide hardware and software lists in Microsoft Excel 2010 or .cvs format and the network diagram in editable AutoCAD 2010 format.
- Download the FAT and SAT Checklist from the ESTCP website, and annotate with information required by the checklist, as well as the date and name of the government representative who witnessed validation of each item. (Demonstrate to the satisfaction of the government that system components are in compliance with the FAT and SAT Checklist and Security Controls documentation prior to commissioning. Facilitate government testing of the system via network scans and Security Template Implementation Guide (STIG) testing, and provide support for interpreting scan and STIG test results as needed).

4.1 FRCS FRONT END INTEGRATION is the portion of the control system consisting primarily of IT equipment, such as computers and related equipment, intended to perform operational functions and run monitoring and control/engineering tool application software. The front end does not directly control physical systems; it interacts with them only through field control systems (FCS). The following UFC's and UFGS's provide detailed design guidance for the FRCS:

- UFC 3-410-01 Utility Monitoring And Control System (CS) Front End And Integration 2016 (DRAFT)
- UFC 3-410-02 Direct Digital Control For HVAC And Other Building Control Systems 2016 (DRAFT)
- UFGS 23 09 00 Instrumentation and Control for HVAC (available online at www.wbdg.org)
- UFGS 23 09 23.01 LonWorks® Direct Digital Control for HVAC and Other Building Systems (available online at www.wbdg.org)

- UFGS 23 09 23.02 BACnet Direct Digital Control for HVAC andOther Building Systems (available online at www.wbdg.org)
- UFGS 25 10 10 Utility Monitoring And Control System (CS) Front End And Integration (available online at www.wbdg.org)

NOTE: A major objective of the IA process is to obtain a Type Authorization for the FRCS and use Reciprocity to extend the ATO to other similar FRCS that will be added to the service/agency PE.

4.1.1 FRCS Front End System Elements and Features

- CS Compatibility: All components of the FRCS shall be fully compatible and shall not require the addition of interface equipment or software upgrades to ensure a fully operational system.
- CS System Integration: The FRCS shall be fully integrated with other FRCS subsystems and the Level 4 DMZ firewalls.

4.2 **FRCS CABLING** is the physical transport layer of the FRCS to include the IP, Ethernet and serial communication. Cabling can be legacy CAT-5, RS232, RS465 or can be next generation fiber Passive Optical Networks (PONs), or can be a combination of both. Refer to the Telecommunications and Network Engineering Requirements for more detailed guidance.

4.3 **FRCS WIRELESS** is currently a challenging area where ESTCP projects may provide insight into many aspects of best practices for wireless deployment and operation. Commercial wireless products are expanding rapidly to include 802.XX, HART, Bluetooth, and ZigBee and DoD will need to plan for and eventually incorporate these devices and protocols into the DoDIN or CS networks. If the ESTCP Project Team intends to use wireless products and devices, coordinate with the ESTCP PM ASAP to ensure the CIO, Spectrum Manager, and host PE will be prepared to support.

TINKER AIR FORCE BASE
FIRE PROTECTION
STANDARD

2023 Edition

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1. Fire Protection & Life Safety

1.1. Introduction

1.1.1. This section shall be utilized in conjunction with the latest version of Unified Facilities Criteria (UFC) 1-200-01, the criteria, standards, and codes referenced therefrom, and the requirements from subsequent references therefrom.

1.1.2. This section shall be utilized as the minimum standard(s) for the planning and development of projects and the design, construction, and commissioning for procurement of facilities for projects located at Tinker AFB, OK. Examples include, but are not limited to, the development of scopes of work, DD1391 documentation, drawings, specifications, and request for proposals. These standards will serve as the primary fire protection criteria reference document.

1.1.3. This document shall be used in conjunction with detailed design documents (e.g., shop drawings) in the procurement of Facility construction. No part of this document should be considered inclusive to all government requirements.

1.1.4. Prior to the first fire protection related contractual submittal, the designer shall meet with the 72d ABW/CE Contracted Alarm Shop, 72d CE Fire & Emergency Services Fire Prevention Branch, and 72d CE Engineering Flight Project Management Branch personnel to review and discuss the portions of the project that relate to fire protection and/or life safety. This meeting shall be coordinated through the Contracting Officer.

1.2. Reserved

1.3. Reserved

1.4. Reserved

1.5. Reserved

1.6. Reserved

1.7. Fire and Smoke Protection Features

1.7.1. Fire Rated Walls' Identification

1.7.1.1. Fire rated walls shall be labeled using terminology found in the International Building Code, except as modified by this document.

1.7.1.2. Labeling shall consist of the type of construction, prefaced by the hours for which it is rated. Examples: "2 HR FIRE BARRIER", "1 HR FIRE PARTITION", "3 HR FIRE WALL".

1.7.1.3. Smoke rated walls shall be labeled using terminology found in the International Building Code.

1.7.1.4. Labeling shall consist of the type of construction, prefaced by the hours for which it is rated (if applicable). Examples: "1 HR SMOKE BARRIER", "SMOKE PARTITION".

1.7.1.5. All required wall labeling shall be located within 15 feet of the end of each wall and at intervals not to exceed 20 feet measured horizontally along the wall.

1.7.2. Firestopping

1.7.2.1. Firestopping Contractor Qualifications

Contractors installing firestopping systems shall be FM Research approved in accordance with FM 4991 or a UL Certified Firestop Contractor. The Installer shall have been trained by a direct representative of the manufacturer (not distributor or agent) in the proper selection and installation procedures. The installer shall obtain from the manufacturer and submit written certification of training and retain proof of certification for duration of firestop installation. A manufacturer's willingness to sell its firestopping products to the Contractor or to an installer engaged by the

Contractor does not in itself confer installer qualifications on the buyer.

1.7.2.2. Firestopping Inspector Qualifications

The firestopping inspector shall be certified/qualified through the Intertek's Qualified Personnel (IQP) program as a Firestop Inspector, International Firestop Council (IFC) Special Inspector program, or approved equal. The inspector shall have a minimum of two years experience in construction field inspections of firestopping systems, products, and assemblies. The inspector shall be completely independent of, and divested from, the installer, the manufacturer, and the supplier of any material or item being inspected. The inspector shall not be a competitor of the installer, the contractor, the manufacturer, or supplier of any material or item being inspected. Include in the qualifications submittal a signed and sealed or notarized statement assuring compliance with the requirements stated herein.

1.7.2.3. Submittals

1.7.2.3.1. Submit typical details conforming to UL Fire Resistance or other details certified by another nationally recognized testing laboratory, installation instructions or UL listing details for a firestopping assembly in lieu of fire-test data or report.

1.7.2.3.2. For those firestop applications for which no UL tested system is available through a manufacturer, a manufacturer's engineering judgment, derived from similar UL system designs or other tests, shall be submitted for review and approval prior to installation.

1.7.2.3.3. Installer and inspector qualifications shall be submitted for review.

1.7.2.3.4. Submittals must indicate the firestopping material to be provided for each type of application.

1.7.2.3.5. When more than a total of 5 penetrations and/or construction joints are to receive firestopping, provide drawings that indicate location, "F" "T" and "L" ratings, and type of application..

1.7.2.3.6. Submit a written report indicating locations of penetrations, types of penetrations, and types of firestopping used at each location; record type by UL list printed numbers or engineering judgement number.

1.7.2.3.7. Submit inspection report stating that firestopping work has been inspected and found to be applied according to the manufacturer's recommendations and the specified requirements.

1.7.2.3.8. Submit certificates attesting that firestopping material complies with the specified requirements. For all intumescent firestop materials used in through penetration systems, manufacturer shall provide certification of compliance with UL 1479.

1.7.2.4. Firestopping Materials

Provide firestopping materials, supplied from a single domestic manufacturer, consisting of commercially manufactured, asbestos-free, nontoxic products FM APP GUIDE approved, or UL listed, for use with applicable construction and penetrating items, complying with the following minimum requirements.

1.7.2.5. Installation

1.7.2.5.1. Firestopping shall be installed by a Firestopping Contractor who meets the requirements of the "Firestopping Contractor Qualifications" section above. All firestopping systems shall be installed by a single Fire Stopping Contractor for each separate project. Multiple firestopping contractors shall not be used for a project unless otherwise approved.

1.7.2.5.2. Install firestopping in accordance with manufacturer's written instructions.

1.7.2.5.3. Provide tested and listed firestop systems or system with an approved engineering judgement.

1.7.2.5.4. Where necessary to prevent soiling of adjacent surfaces by firestopping materials during installation, provide masking and/or temporary covering..

1.7.2.5.5. All firestopping systems shall be labeled with a permanent label containing, at minimum, the following information:

1.7.2.5.5.1. Firestopping material manufacturer

1.7.2.5.5.2. Firestopping system UL number or engineering judgement number/title

1.7.2.5.5.3. Date of firestopping system installation

1.7.2.6. Inspection

1.7.2.6.1. Firestopping shall be inspected by an inspector who meets the requirements of the "Firestopping Inspector Qualifications" section above.

1.7.2.6.2. Firestopping shall not be covered or enclosed until inspection is complete and approved by the Contracting Officer. The inspector must inspect the applications initially to ensure adequate preparations (clean surfaces suitable for application, etc.) and periodically during the work to assure that the completed work has been accomplished according to the manufacturer's written instructions and the specified requirements.

1.7.2.6.3. Submit written reports indicating locations of and types of penetrations and types of firestopping used at each location; type shall be recorded by UL listed printed numbers.

1.7.2.6.4. Inspect all firestopping in accordance with ASTM E2393 and ASTM E2174 and document inspection results to be submitted.

1.8. Reserved

1.9. Fire Protection Systems

1.9.1. Fire Department Access

For all new construction projects, a KNOXBOX Model 3200 – Non-Monitored, recessed is required. For renovations that add a KNOXBOX, recessed is preferred. On renovations where a recessed box cannot be achieved, coordinate with 72d Fire & Emergency Service Fire Prevention Branch for guidance. Knox Boxes are not required for gates.

1.9.2. Interior Fire Lanes – B3001 & B9001

1.9.2.1. Fire Lanes as described below, are lanes to be used by emergency services personnel for emergency vehicle access, and emergency vehicle staging. Building 3001 and building 9001 are two facilities large enough to require interior dedicated fire lanes.

1.9.2.2. Fire lanes for these two facilities shall be established and maintained in accordance with this instruction.

1.9.2.3. Fire lanes shall not be obstructed or used for storage or staging.

1.9.2.4. Fire lane dimensions shall be as follows:

1.9.2.4.1. Continuous Width – 20 feet wide

1.9.2.4.2. Structures at corners shall have 45-degree angle cut and three-foot setback for emergency vehicle maneuverability.

1.9.2.5. Fire lane identification shall be:

1.9.2.5.1. 8-inch wide solid and continuous line that is "Safety Red" in color.

1.9.2.5.2. 6-inch tall "Arial Font" or similar lettering that is high contrast/high visibility white color.

1.9.2.6. Building 9001 main north-south aisle (44-45), east-west (SRQ), and east-west (AB) shall maintain their current widest width. No future decreasing deviation shall be allowed, only an

increase to meet this standard.

1.9.3. **Fire Hydrants**

1.9.3.1. Newly installed fire hydrants barrels shall have one 4” Storz quick connect outlet and two 2.5” NHT outlets.

1.9.3.2. Fire hydrants supplied by domestic water mains shall have barrels factory painted “OSHA Safety Yellow”. A flow test shall be performed to determine the available supply. Hydrant caps and bonnets shall be painted with reflective paint in accordance with NFPA 291 to identify the flow capacity. The colors designated in NFPA 291 shall be modified as follows:

1.9.3.2.1. Light Blue – Change to Light Blue – Krylon A01540007 Light Blue or equivalent

1.9.3.2.2. Green – Change to OSHA Safety Green

1.9.3.2.3. Orange – Change to OSHA Safety Orange

1.9.3.2.4. Red – Change to OSHA Safety Red

1.9.3.3. Fire hydrants supplied by dedicated fire protection water mains shall be factory painted “OSHA Safety Red”.

1.9.4. **Special Hazards Systems Contractor Qualifications**

1.9.4.1. Contractors performing installation or modification of special hazards systems which utilize a chemical agent shall have Special Hazards Systems NICET certification.

1.9.4.2. These systems shall be installed by or under the supervision of a contractor who is NICET Level III.

1.9.4.3. Control and releasing equipment shall be installed by a contractor who is NICET Level III.

1.9.4.4. System circuit terminations shall be performed by, or under the direct supervision of, a contractor who is NICET Level III.

1.9.4.5. Proof of qualifications must be submitted to and approved by Contracting Officer prior to beginning work.

1.9.5. **Automatic Sprinkler Systems**

1.9.5.1. Contractor Qualifications

1.9.5.1.1. Contractor’s performing installation or modification of fire sprinkler systems shall have Water-Based Systems Layout NICET certification.

1.9.5.1.2. All fire sprinkler systems shall be installed by or under the direct supervision of a contractor who is NICET Level III (minimum).

1.9.5.1.3. Proof of qualifications must be submitted to and approved by Contracting Officer prior to beginning work.

1.9.5.2. Piping

1.9.5.2.1. All aboveground sprinkler piping shall be black steel Sch. 40.

1.9.5.2.2. All aboveground sprinkler piping shall be painted using two coats of Red No. 1110.

1.9.5.3. Fire Department Connection (FDC)

1.9.5.3.1. FDCs shall be provided with 4" Storz x 4" Female NPT with 30^{o} bend.

1.9.5.3.2. FDC location and finish shall be approved by the 72d CE Fire & Emergency Services Fire Prevention Branch

1.9.5.4. Exterior Waterflow Alarm

1.9.5.4.1. Exterior sprinkler waterflow alarm appliance shall be an electrically operated alarm bell.

1.9.5.4.2. The exterior waterflow alarm shall function independently from the building’s fire alarm control unit.

1.9.5.4.3. Exterior waterflow alarm shall be located within five feet of the exterior door providing access to the building sprinkler riser(s).

1.9.6. **Fire Alarm**

1.9.6.1. Contractor Qualifications

1.9.6.1.1. Contractor's performing installation or modification of fire alarm systems or combination fire alarm / mass notification systems shall have Fire Alarms Systems NICET certification

1.9.6.1.2. All fire alarm and mass notification systems shall be installed by, or under the supervision of, a contractor who is NICET Level III.

1.9.6.1.3. Control equipment shall be installed by a contractor who is NICET Level III.

1.9.6.1.4. System circuit terminations shall be performed by, or under the direct supervision of, a contractor who is NICET Level III.

1.9.6.1.5. Proof of qualifications must be submitted to and approved by Contracting Officer prior to beginning work.

1.9.6.2. Plans and Calculations

Intelligibility measurement results shall be documented on the record drawings, in addition to the information required by NFPA 72.

1.9.6.3. B3001/B9001 Requirements

Circumstances within the existing buildings 3001 and 9001 may require deviation from the fire alarm guidance provided in this standard. Requirements provided in this standard shall be followed unless otherwise approved by 72d CE Fire & Emergency Services Fire Prevention Branch and 72d CE Engineering Flight Project Management Branch.

1.9.6.4. Fire Alarm System Reporting

1.9.6.4.1. New fire alarm reporting equipment shall be manufactured by Monaco Enterprises and have point-to-point reporting capabilities. These systems shall report to the base supervising station receiving equipment (Monaco D-21).

1.9.6.4.2. System antenna installation shall be in accordance with all manufacturer requirements and recommendations unless otherwise approved by the 72d CE Fire & Emergency Services Fire Prevention Branch or 72d CE Engineering Flight Project Management Branch.

1.9.6.5. Fire Alarm Control Equipment

1.9.6.5.1. Scope of Work (SOW) for projects which will include new control equipment shall be approved by the 72d CE Fire & Emergency Services Fire Prevention Branch or 72d CE Engineering Project Management Branch. Approval must be obtained prior to contract solicitation.

1.9.6.5.2. New fire alarm systems shall be addressable.

1.9.6.5.3. Fire alarm control units (FACU) shall be manufactured by Monaco Enterprises and shall provide point-to-point reporting.

1.9.6.5.4. Local Operating Consoles shall have a label "MASS NOTIFICATION SYSTEM LOC" affixed permanently to the front of the cabinet.

1.9.6.5.5. Local Operating Consoles shall not be provided with push buttons to initiate the "Carbon Monoxide Emergency" or "Fire Emergency" messages.

1.9.6.6. Initiating Devices

1.9.6.6.1. All initiating devices shall have a label affixed permanently to the exterior of the device identifying its assigned address and circuit. These shall match the information provided in the record drawings

1.9.6.6.2. Where concealed, duct smoke detectors shall be provided with an access panel for

maintenance and access to the detector. Access panel shall be a minimum 18”x18”.

1.9.6.7. Notification Devices

1.9.6.7.1. All notification devices shall have a label affixed permanently to exterior of the device identifying its device number and circuit. These shall match the information provided in the record drawings.

1.9.6.7.2. Textual display signs shall be two line programmable. Top line shall display stationary alert message “Evacuate” (red text) or “Announcement” (green text). Second line shall scroll message from right to left (white text).

1.9.6.7.3. Textual display signs shall be centered above the door(s) for which they serve. Where exit signs are also provided, textual display signs shall be installed above the exit signs. Where space does not allow for installation above the exit sign, the textual display sign shall be installed on the right side of the exit sign.

1.9.6.8. Wiring, Circuits, and Conduit

All circuits shall be installed in no smaller than ¾” conduit (EMT minimum).

1.9.6.9. Power

The circuit breaker for the primary power supply circuits serving fire alarm systems shall be provided with a red circuit breaker lock intended for use on the panel in which it is installed.

1.9.6.10. MNS Messages

1.9.6.10.1. The messages provided below represent the messages that shall be utilized for all in-building mass notification systems. Message files shall be from Monaco Enterprises, Inc. When there is a direct conflict with requirements found in a governing FC, the FC criteria shall take precedence.

1.9.6.10.2. Message #1: Fire Emergency / Fire Alarm

Alert Sound: NFPA Temporal 3 (T-3) pattern tone - 0.50 seconds on / 0.50 seconds off – 1000 Hz, followed by a 1 second delay (Alert Sound played twice by Announcement)

Announcement: Female voice. Message shall play followed by a 2-second delay, then repeat Message once.

Visual Notification: Must flash/operate until system is reset.

Message 1A (For facilities with NO elevators): “May I have your attention. May I have your attention. A fire emergency has been reported in the building. Please walk to the nearest exit or exit stairway.”

Message 1B (For facilities with elevators): “May I have your attention. May I have your attention. A fire emergency has been reported in the building. Please walk to the nearest exit or exit stairway. Do not use elevators.”

The playing of the Alert Sound and the Announcement, as described above, shall constitute as a Cycle. After the first Cycle, there shall be a 2-second delay and then the Cycle shall repeat.

1.9.6.10.3. Message #2: Carbon Monoxide Detection

Alert Sound: NFPA Temporal 4 (T-4) pattern tone - 0.10 seconds on / 0.10 seconds off – 520 Hz, followed by a 4 second delay (Alert Sound played twice, followed by Announcement)

Announcement: Male voice. Message shall play followed by a 2-second delay, then repeat Message once.

Visual Notification: Must flash/operate until system is reset.

Message: “May I have your attention. May I have your attention. Carbon Monoxide has been detected in the building; please leave the building by the nearest exit.”

The playing of the Alert Sound and the Announcement, as described above, shall constitute as a Cycle. After the first Cycle, there shall be a 2-second delay and then the Cycle shall repeat.

1.9.6.10.4. Message #3: Hazardous Condition

Alert Sound: Hi-Lo - 780 to 600 Hz alternately - 0.57 seconds repeated 4 times, followed by a 1 second delay (Alert Sound played twice by Announcement)

Announcement: Male voice. Message shall play followed by a 2-second delay, then repeat Message once.

Visual Notification: Must flash/operate until message is deactivated.

Message: “May I have your attention. May I have your attention. A hazardous condition outside the facility has been reported. Please shelter in place and respond appropriately.”

The playing of the Alert Sound and the Announcement, as described above, shall constitute as a Cycle. After the first Cycle, there shall be a 2-second delay and then the Cycle shall repeat.

1.9.6.10.5. Message #4: Security Breach

Alert Sound: Rapid Siren - 600-1250 Hz up and down sweep in 0.25 seconds, played for 3 seconds, followed by 1 second delay (Alert Sound played once, followed by Announcement)

Announcement: Male voice. Message shall play followed by a 2-second delay, then repeat Message once.

Visual Notification: Must flash/operate until message is deactivated.

Message: “May I have your attention. May I have your attention. A possible security breach has been reported. Take appropriate security measures; report suspicious personnel, vehicles, or activities to Security Forces.”

The playing of the Alert Sound and the Announcement, as described above, shall constitute as a Cycle. After the first Cycle, there shall be a 2-second delay and then the Cycle shall repeat.

1.9.6.10.6. Message #5: Severe Weather

Alert Sound: Slow Whoop – 600 to 1250 Hz upward sweep for 4 seconds, followed by 1 second delay (Alert Sound played once, followed by Announcement)

Announcement: Female voice. Message shall play followed by a 2-second delay, then repeat Message once.

Visual Notification: Must flash/operate until message is deactivated.

Message: “May I have your attention. May I have your attention. The National Weather Service has issued a severe weather warning for this area. Please tune to local weather stations for further information.”

The playing of the Alert Sound and the Announcement, as described above, shall constitute as a Cycle. After the first Cycle, there shall be a 2-second delay and then the Cycle shall repeat.

1.9.6.10.7. Message #6: All Clear - Return to Normal Operations

Alert Sound: Ding-Dong – Percussive pairs of 700 and 570 Hz tones each damped to zero for 0.5 seconds, followed by 1 second delay (Alert Sound played three times, followed by Announcement)

Announcement: Female voice. Message shall play followed by a 2-second delay, then repeat Message once.

Visual Notification: Must flash/operate until the Cycle stops repeating.

Message: “May I have your attention. May I have your attention. The building

emergency has ended and an all clear has been given. Please resume normal activities."

The playing of the Alert Sound and the Announcement, as described above, shall constitute as a Cycle. After the first Cycle, there shall be a 2-second delay and then the Cycle shall repeat. The Cycle shall stop repeating once three consecutive Cycles have played.

1.9.6.10.8. Message #7: MNS Test

Alert Sound: 1 Chime Tone – 575 Hz percussive for 1 second, followed by 1 second delay (Alert Sound played three times, followed by Announcement)

Announcement: Female voice. Message shall play followed by a 2-second delay, then repeat Message once.

Visual Notification: Must flash/operate until message is deactivated.

Message: "May I have you attention, May I have your attention. This is a test of the Mass Notification system, repeat this is only a test."

The playing of the Alert Sound and the Announcement, as described above, shall constitute as a Cycle. After the first Cycle, there shall be a 2-second delay and then the Cycle shall repeat.

1.9.6.10.9. Message #8: MNS Test Complete

Alert Sound: 1 Chime Tone – 575 Hz percussive for 1 second, followed by 1 second delay (Alert Sound played three times, followed by Announcement)

Announcement: Female voice. Message shall play followed by a 2-second delay, then repeat Message once.

Visual Notification: Must flash/operate until the Cycle stops repeating.

Message: "May I have you attention, May I have your attention. The test of the Mass Notification System is complete."

The playing of the Alert Sound and the Announcement, as described above, shall constitute as a Cycle. After the first Cycle, there shall be a 2-second delay and then the Cycle shall repeat. The Cycle shall stop repeating once two consecutive Cycles have played.

TAFB ELECTRICAL STANDARDS

Tinker Air Force Base, Oklahoma

2024

Highlighted text indicates revisions since the 2023 Edition.

1. General

1.1 References

As a minimum, all electrical work performed on Tinker AFB shall conform to the latest edition of the following codes/standards, and all applicable UFCs, AFMANs, and AFIs:

(1) NFPA 70, *National Electrical Code (NEC)*
(2) NFPA 70E, *Standard for Electrical Safety in the Workplace*
(3) NFPA 72, *National Fire Alarm and Signaling Code*
(4) NFPA 101, *Life Safety Code*
(5) NFPA 170, *Standard for Fire Safety and Emergency Symbols*
(6) NFPA 780, *Standards for Installation of Lightning Protection Systems*
(7) IEEE C2, *National Electric Safety Code (NESC)*
(8) UFC 3-260-01, *Airfield and Heliport Planning and Design*
(9) UFC 3-460-01, *Design: Petroleum Fuel Facilities*
(10) UFC 3-501-01, *Electrical Engineering*
(11) UFC 3-520-01, *Interior Electrical Systems*
(12) UFC 3-530-01, *Interior and Exterior Lighting and Controls*
(13) UFC 3-535-01, *Visual Air Navigation Facilities*
(14) UFC 3-540-01, *Engine-Driven Generator Systems for Backup Power Applications*
(15) UFC 3-550-01, *Exterior Electrical Power Distribution*
(16) UFC 3-560-01, *Electrical Safety*
(17) UFC 3-575-01, *Lightning and Static Electricity Protection Systems*
(18) UFC 3-580-01, *Telecommunications Building Cabling Systems Planning and Design*
(19) UFC 3-600-01, *Fire Protection Engineering for Facilities*
(20) UFC 3-601-02, *Operation and Maintenance: Inspection, Testing and Maintenance of Fire Protection Systems*
(21) UFC 4-010-01, *DOD Antiterrorism Standards for Buildings*
(22) UFC 4-011-06, *Cyber Security for Facility-Related Control Systems*
(23) UFC 4-021-01, *Design and O&M: Mass Notification Systems with Change 1*
(24) UFC 4-211-01, *Aircraft Maintenance Hangars*
(25) ANSI/NETA ATS, *Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems*
(26) ANSI/NETA MTS, *Standard for Maintenance Testing Specifications for Electrical Power Equipment and Systems*
(27) ANSIA/TIA/EIA 568-C, *Series of Telecommunication Standards*
(28) ANSIA/TIA/EIA 569-B, *Commercial Building Telecommunications Cabling Standard*

(29) ANSIA/TIA/EIA 607, *Generic Telecommunications Grounding and Bonding(Earthing) for Customer Premises*

(30) NEIS, *National Electrical Installation Standards*

- NECA 1, Good Workmanship in Electrical Contracting
- NEC A 90, Commissioning Building Electrical Systems
- NECA 100, Symbols for Electrical Construction Drawings (ANSI)
- NECA 101, Installing Steel Conduits (Rigid, IMC, EMT)
- NECA/NEMA 105, Standard for Installing Metal Cable Tray Systems (ANSI)
- NECA 111, Installing Nonmetallic Raceways (RNC, ENT, LFNC)
- NECA/NACMA 120, Installing Armored Cable (AC) and Metal-Clad Cable (MC)
- NECA 169, Standard for Installing and Maintaining Arc-Fault Circuit Interrupters
- NECA 200, Temporary Electric Power
- NECA 202, Installing Industrial Heat Tracing Systems
- NECA 230, Electric Motors and Motor Controllers
- NECA/FOA 301, Installing and Testing Fiber Optic Cables
- NECA 305, Standard for Fire Alarm System Job Practices
- NECA 331, Standard for Building and Service Entrance Grounding and Bonding
- NECA 400, Installing and Maintaining Switchboards
- NECA 402, Installing and Maintaining Motor Control Centers
- NECA/EGSA 404, Installing Generator Sets
- NECA 407, Installing Panelboards
- NECA 408, Installing and Maintaining Busways
- NECA 409, Installing and Maintaining Dry-Type Transformers
- NECA 410, Installing and Maintaining Liquid-Filled Transformers
- NECA 411, Standard for Installing and Maintaining Uninterruptible Power Supplies (UPS) (ANSI)
- NECA 420, Standard for Fuse Applications (ANSI)
- NECA 430, Standard for Installing Medium-Voltage Metal-Clad Switchgear
- NECA/IESNA 500, Installing Indoor Commercial Lighting Systems
- NECA/IESNA 501, Installing Exterior Lighting Systems
- NECA/IESNA 502, Installing Industrial Lighting Systems
- NECA 505, Standard for Installing and Maintaining High Mast, Roadway and Area Lighting
- NECA/BICSI 568, Installing Commercial Building Telecommunications Cabling
- NECA/MACSCB 600, Installing and Maintaining Medium-Voltage Cable
- NECA/NEMA 605, Installing Underground Nonmetallic Utility Duct
- NECA 607, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
- NECA 700, Standard for Installing Overcurrent Protection to Achieve Selective Coordination

1.2 Design

(a) As a minimum, all electrical design shall conform to the latest edition of the above codes/standards.

(b) To the extent possible, Unified Facility Guide Specifications (UFGS) and standard detail shall be utilized in the design. All specifications and general notes shall have the non-applicable parts edited.

(c) Existing as-built drawings (if available) may be used as guidelines, but "information must be verified by field investigation." The Designer shall be responsible for the verification of all dimensions, measurements, and location of existing facilities, utilities, equipment and other existing conditions that may affect the design.

(d) The following items shall be taken into consideration and included as part of the design analysis:

(1) Exterior – Primary circuit availability and location.

(2) Exterior – Primary circuit loading (generally, existing primary loops at TAFB are designed for loads of 400A or less. Future loops may be designed for higher capacities as long as analysis shows that existing switchgear/substations can support the higher requirement).

(3) Existing equipment age and condition

(4) Transformer/panelboard/switchgear loading (existing and future).

(5) Non-linear loads (Lighting, computers, variable frequency drives, etc.)

(6) Energy Analysis

(7) When designing/installing new electrical distribution systems the designer should take into account future load growth for components of the system supporting space conditioning, water heating, cooking, and laundry systems due to the all-electric directive; i.e. plan for any gas fired equipment/components to be replaced with resistive heat.

(e) All new building wiring systems shall consider using 480/277V unless uneconomical to accomplish. Designer shall make recommendations of building voltages at the design analysis phase of each project.

(f) All new electrical transformers and distribution equipment shall have a Fault Current Calculations and Arc Flash analysis performed IAW NFPA 70E Annex "D". Calculations shall be performed using "Easy Power" software and submitted to 72ABW/CENMP for review and approval prior to equipment installation.

(1) Contractor shall confirm the Easy Power Software Version requirement with Contracting Officer at the beginning of the project.

(2) All Data fields in the software shall be filled out.

(3) Available Fault Current data shall be provided to the designer by 72ABW/CENMP upon request, if available.

(4) Complex projects shall be provided with separate drawing sets for One-Line Information and Fault Current / Arc Flash Data.

(5) Design/Build Projects
   i. Coordination Study, Fault Current Calculations and Arc Flash Analysis shall be included no later than the 95% design submission to the Gov't for review and approval of Design/Build Projects.

(6) A&E Design only projects
   i. Fault Current calculations One-Line must be submitted using Easy Power software with the assumption clearly stated that all upstream overcurrent protection devices are in proper working condition and have been maintained and certified. For systems which no certification of the maintenance can be produced, the requirement to perform the maintenance and certification must be included in the design package for the contractor to perform this work as part of the project.
   ii. The .dez file shall be included in the construction contractor's package to complete the Fault Current calculations and Arc Flash Analysis based in the electrical distribution equipment being provided.
   iii. For construction only projects, the Easy Power Model One-Line drawing shall be provided by the A&E designer and completed using Easy Power software by the construction contractor based on the approved electrical equipment being provided.

(7) Use the 0.5sec maximum arc time as a conservative, but more realistic, value when doing arc flash calculations for 208V systems which are fed from step down transformers less than 125KVA

(8) A copy of the Easy Power Model (.dez) and One-Line Drawings shall be submitted with other material submittals prior to Construction Start.

(g) Arc Flash labeling shall be installed on all new installed electrical transformers, disconnects and distribution equipment.

(1) All Arc Flash Labeling shall be "Easy Power" containing the following information.
   i. Company Name
   ii. Date of Arc Flash Analysis
   iii. Equipment Identification
   iv. Required PPE
   v. Arc Flash Hazard Risk Category
   vi. Incident Energy (Cal/cm2)
   vii. Shock Protection
   viii. Limited Approach Boundary
   ix. Restricted Approach Boundary

1.3 Installation

(a) As a minimum, all electrical installations shall conform to the latest edition of the above codes/standards.

(b) NEIS shall be used for quality and reliability standards for construction. These criteria will be used to define acceptable industry practices for installations.

(c) Only state licensed journeymen electricians or registered apprentices under the direct supervision of journeymen will be permitted to install, alter, or repair electrical systems.

(d) Material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. All materials in the same category shall be by a single manufacturer. Equipment from discontinued product lines shall not be accepted in new installation.

(e) All conductors shall be color-coded at panelboards, switchboard, terminations, junction boxes, manholes, hand holes, etc. Factory-applied color-impregnated insulation is required for all sizes unless waived by 72ABW/CENMP or 76 MXSG/MXDEJ. Equipment grounding conductors (EGC) shall have factory-applied color-impregnated insulation for all sizes. A green equipment-grounding conductor shall be installed with all branch circuits. Circuit conductors shall be color coded as follows:

(1) *All Configurations:* Equipment Grounding Conductor, Green. (Exception: Where an isolated ground is required the isolated ground shall be identified as green with a yellow stripe.)

(2) *120V, 2-wire circuit:* Grounded conductor (neutral), White; Ungrounded leg, Black.

(3) *240/120V, 1-phase, 3-wire circuit:* Grounded conductor (neutral), White; Phase A, Black; Phase B, Red.

(4) *208Y/120V, 3-phase, 4-wire circuit:* Grounded conductor (neutral), White; Phase A, Black; Phase B, Red; Phase C, Blue.

(5) *208V, 3-Phase, 3-wire circuit:* Phase A, Black; Phase B, Red; Phase C, Blue.

(6) *480Y/277V, 3-phase, 4-wire circuit:* Grounded conductor (neutral), Gray; Phase A, Brown; Phase B, Orange; Phase C, Yellow.

(7) *480V, 3-phase, 3-wire circuit:* Phase A, Brown; Phase B, Orange; Phase C, Yellow.

(f) All new floor mounted electrical equipment installed in damp or wet locations shall be installed on a housekeeping pad a minimum of 3 1/2" A.F.F. Any exposed edges shall be ¾" chamfered. Electrical Equipment installed in dry areas, such as Electrical Vaults and Comm. rooms, does not require a housekeeping pad.

1.4 Metering

1.4.1 Digital Metering

(a) Advanced Digital Metering (ADM) shall be installed in each switchboard or switchboard section (for double ended applications) for billing and energy monitoring & reduction purposes. Advanced meters are electronic meters that have the capability to measure and record interval data and communicate that data to an Advanced Metering System (AMS).

(b) The ADM may also be remotely mounted at 72" Above Finished Floor (AFF) to the center of the display. ADM shall conform to Unified Facilities Guide Specification (UFGS) 26 27 13.10 30, except numbered terminal wiring sequence and case size may be the manufacturer's standard.

(c) All setup parameters required by the electronic monitor shall be stored in non-volatile memory and retained in the event of a control power interruption. Any battery or other device used to provide non-volatile memory shall be user serviceable from the front of the

monitor and servicing shall not require removing the monitor from the gear in which it is mounted.

(d) The ADM monitor shall maintain in non-volatile memory maximum and minimum values for each of the instantaneous values reported as well as the time and date that the minimum or maximum was set.

(e) The ADM monitor shall have the ability to communicate information to a remote data collection system.

(1) An exterior CAT 6 connect point must be provided for each new meter so accessing the interior of the ADM enclosure is not required.

(f) All new ADM shall be a Schneider ION 8650 series or next generation equivalent.

(g) All necessary instrument transformers (CTs/PTs) shall be provided in the switchgear.

(h) At the time of installation, the Meter shall be calibrated to the specific Transformer/CTs and installed providing a 'Calibration Certification' document for Government acceptance. Meter shall be calibrated to measure usage in KW, not Watts.

(i) The monitor shall be listed according to UL 508, and have an over-current withstand rating of 500 amps for 1 second.

(j) The monitor shall provide true RMS metered values accurate for distorted, non-sinusoidal wave-shapes beyond the 30^{th} harmonic (fundamental of 60 hertz).

(k) The monitor shall be accurate to ± 0.25% of reading ± 0.05% of full scale for voltage and current metering, and ±1.0% for all power and energy functions. The accuracy shall be maintained for both light and full loads. No annual re-calibration by users shall be required to maintain these accuracies.

(l) Voltage and current for all phases shall be sampled simultaneously to assure high accuracy in conditions of low power factor or large waveform distortions (harmonics).

(m) The monitor shall be equipped with an integral, continuous duty, long-life display to provide local access to the following metered quantities as well as the minimum and maximum value since last reset of each quantity:

(1) Current (RMS), per phase and neutral
(2) Voltage, phase-to-phase and phase-to-neutral
(3) Real power, per phase and 3-phase total
(4) Reactive power, per phase and 3-phase total
(5) Apparent power, per phase and 3-phase total
(6) Power factor, per phase and 3-phase total
(7) Frequency
(8) Demand current, per phase and three phase average
(9) Demand real power, three phase
(10) Demand apparent power, three phase
(11) Accumulated Energy, (MWH and MVARH)
(12) THD, current and voltage, per phase
(13) K-factor, current, per phase

(n) The following demand readings shall be included as local display access and also reported by the monitoring system:
  (1) Average KW demand current, per phase
  (2) Peak KW demand current, per phase
  (3) Average demand for real power, reactive power, and apparent power
  (4) Predicted demand for real power, reactive power, and apparent power
  (5) Peak demand for real power, reactive power, and apparent power
  (6) The default demand calculations method shall be 15-minute sliding window.

(o) Where ADM is to be connected to the VLAN, contractor shall install conduit with pull string to the nearest Comm Rack as specified in the project SOW.
  (1) 72 ABW/CE must submit a CIPS request to 72 ABW/SC for installation of Cat 6 Cabling and connections to the Comm Equipment.
  (2) When LAN drop is completed, a notification shall be sent to the COINE support team to configure Network Connection and Meter Security.

(p) All ADM installed indoors and outdoors must be hardware connected to the nearest CE-COINE connection point such as the nearest facility Communication Rack. There are no approved wireless options for Tinker AFB at this time. In addition, meter boxes shall be installed in accordance with the 'Meter Can Configuration for Network Connection' diagram.

(q) IP addresses, Ethernet gateways, and subnet masks for the ADM will be configured by 72 ABW/SC ICS support.

(r) A standard local digital meter (Volt, Amp, and Demand Amp) shall be installed on circuit breakers 600 amp and larger to include all main service switchgear and secondary switchgear branch circuits.
  (1) The digital meter shall maintain in non-volatile memory maximum and minimum values for each of the values as well as the time and date that the minimum or maximum was set.

(s) Commissioning
  (1) Installation contractor shall be required to provide documentation verifying proper meter commissioning and verifying proper operation/readings for all digital metering during commissioning of the equipment IAW MXSG meter commissioning checklist. Commissioning checklist must be approved and accepted by MXSG prior to project.
  (2) Verification of acceptable communications will be established by 72 ABW/SC ICS support.

2. Exterior Electrical

Note: Any project performed by OG&E or their sub-contractors shall install all Medium Voltage (MV) systems and equipment IAW OG&E specifications.
All other MV systems installed on TAFB shall comply with the following requirements.

2.1 General

(a) All exterior pad mounted equipment shall be installed in accordance with (IAW) the Base Facility Standard for Architectural Compatibility.

(b) Medium Voltage Transformer Pads shall be installed by the contractor per OG&E supplied specifications.
    (1) Forms and Reinforcement shall be inspected and approved by OG&E prior to pouring concrete.

(c) All exterior pad mounted equipment shall have permanently affixed identification labels. Labels shall be weather resistant, engraved, Laminated Plastic. Labels shall indicate equipment identification, rating, and circuit designation. Information for new equipment identification and circuit designation will be provided by 72ABW/CENMP.
(d) All exterior underground cables shall have permanent identification tag installed at each manhole, hand hole, pull box, or termination. Labels shall be weather resistant, engraved, metal or Laminated Plastic. Labels shall indicate at a minimum the circuit designation and To/From information. Information for circuit designation shall be provided by72ABW/CENMP.
(e) Disconnects for mechanical and other equipment on the outside of buildings shall be served from the rear (through the wall feeder) or bottom (below grade feeder).
(f) All bussing in electrical equipment shall be copper.
(g) Utility Lines and Structures
    (1) Place utilities underground and screen above-ground equipment to minimize their visual impact.
    (2) Exposed conduits, cables, and wires are prohibited.
    (3) Construct underground utility system components as elements of any new or renovated facilities. When this is unfeasible, locate screened equipment on the least visible side of the building.

2.2 Underground Electrical Distribution

2.2.1 Concrete Encased Duct Bank
(a) Concrete encased conduits shall have minimum spacing between conduits as specified by NFPA 70 and UFC 3-550-01 with a minimum of 3 inches of concrete protecting them on top, bottom, and sides.
(b) The top of the concrete encasement shall be a minimum of 30” below finished grade.
(c) All concrete encased duct banks shall have a 1/0 bare copper counterpoise system installed immediately above the duct bank (6” or less) and continuous the length of the duct bank. Counterpoise shall be connected to a ¾” x 10’ grounding electrode in each manhole and at each transformer and switching-station installation (including primary substations). Where duct bank terminates at a pole riser, counterpoise shall be connected to a ¾” x 10’ grounding electrode and bonded to the pole grounding system.

2.2.2 Direct Buried Conduit
(a) For 600V and below, where direct buried service or feeder conduit is specified in the project documents, direct buried conduit shall be Schedule-80 PVC conduit a minimum of 30” below grade. Direct buried conduit supplying individual branch circuits, such as

exterior lighting or power receptacles, may be Schedule 40 PVC conduit installed at a minimum depth of 24" below grade. All conduits shall be encased with sand and compacted prior to backfilling with other materials.

(b) When PVC is used underground, all conduit which extends from excavations to above finished grade shall be galvanized rigid conduit starting from minimum depth as specified and include the 90 degree elbow. All metallic conduit which contacts the earth shall have a Factory Applied PVC Coating. PVC tape may only be used to protect threaded areas and where adapting to PVC.

Exception: Fiberglass conduit may be used in lieu of PVC Coated GRC with 72ABW/CENMP approval for real property electrical systems or 76 MXSG/MXDEJ approval for non-real property electrical systems.

(c) HDPE conduit may be utilized for approved Boring applications with prior written approval by 72ABW/CENMP for real property electrical systems or 76 MXSG/MXDEJ for non-real property electrical systems.

2.2.3 All utility road and driveway crossings shall be bored and sleeved with single schedule 80 PVC or ¼"-wall steel sleeve. Roadways and driveways shall not be crossed by open cut unless approved. Wherever boring is impractical, street crossings shall be limited to three (3) days maximum (including trenching, compaction, and replacement of existing pavements). Contractor shall provide steel matting sufficient to carry the traffic load of the excavated area.

2.2.4 All underground electrical and communication installations (conduit, duct bank, etc.) shall be identified using marking tape. Tape shall have the following characteristics:

(a) 5-mil plastic
(b) Brightly colored (electric – red; communication – orange)
(c) Minimum of 3 inches in width
(d) Suitably inscribed at not more than 10 feet on centers
(e) Continuous metallic backing and a corrosion resistant 1-mil metallic foil core to permit easy location of duct line.
(f) Tape shall be placed 12-inches below finished grade.

2.2.5 The open ends of all Underground Electrical Conduit being installed must be temporarily sealed at the end of each workday to prevent ground water or condensation from entering the conduit and associated electrical equipment.

2.3 Medium Voltage Distribution

2.3.1 General

(a) Install distribution conductors in underground ducts in lieu of direct burial and/or overhead.
(b) Air vacuum type switches are required in lieu of oil insulated. SF6 switches may be used in areas where equipment size is a concern with 72ABW/CENMP approval.
(c) All primary loop switches shall be equipped with Directional Fault Indication.

2.3.2 Primary Loop Feeders

(a) Medium voltage cable shall be (minimum) 15kV-500 kcmil copper, XLP/XLPE or EPR, with 100/133% insulation, wire shield or separator tape, and an ozone/sunlight resistant PVC jacket. Concentric neutral cable shall not be used.
(b) Grounding conductor shall be (minimum) 600V- #4/0 AWG copper.
(c) Conductors shall be protected by a (minimum) 5-inch diameter concrete-encased Schedule-40.
(d) Cables shall be routed and racked inside manhole to allow the longest possible length of spare cable in each manhole possible (minimum of 1 full loop around the interior of the manhole).

2.3.3 Primary Radial Feeders

(a) Medium voltage cable shall be (minimum) 15kV- #2 AWG copper, XLP/XLPE or EPR, with 100/133% insulation, wire shield, separator tape, and an ozone/sunlight resistant PVC jacket. Concentric neutral cable shall not be used.
(b) Grounding conductor shall be (minimum) 600V- #2 AWG.
(c) Conductors shall be protected by a minimum 5" diameter concrete-encased Schedule-40.
(d) Cables shall be routed and racked inside manhole to allow the longest possible length of spare cable in each manhole possible.

2.3.4 Medium Voltage Branch Circuits Installed Inside Buildings shall meet the following requirements.

(a) All Conductors shall be Class B compressed strand copper.
(b) Conductor shield shall be 16 mils minimum extruded semi-conducting, thermosetting compound.
(c) Insulation shall be 220 mils average Extruded Ethylene Propylene Rubber
(d) Insulation shield shall be 32mil minimum and 60 mils maximum extruded semi-conducting, thermosetting compound.
(e) Metallic Shield shall be 5 mil bare copper tape, helically applied with minimum 25% overlap.
(f) Galvanized Steel Interlocked Armor with overall 85 mil minimum average thick PVC Jacket.
    (1) Aluminum Armor Jacket may be approved by 72ABW/CENMP on a case-by-case basis.

2.3.5 Medium Voltage Cable Terminations and Splices

(a) Terminations and splices shall be of the preformed type only, tape type are not acceptable.
(b) All cable splices and terminations shall be installed in accordance with the manufacturer's specifications.

2.3.6 Medium Voltage Cable Testing

(a) Testing requirements shall be coordinated during design of each project.

(b) Approved testing methods are Hi-Pot and Very Low Frequency (VLF) High-Voltage testing.
(c) All new cable being hi-pot tested shall be in accordance with manufacturer's recommendations, but not to exceed 3-times the cable voltage rating. Testing shall be performed in accordance with the methodology described in the applicable IEEE, ICEA, or AEIC standards.
(d) Existing cable being reused, or spliced into, shall be hi-pot tested at its rated insulation voltage. Testing shall be performed in accordance with the methodology described in the applicable IEEE, ICEA, or AEIC standards.
(e) Cable testing performed using VLF procedures shall be in accordance with IEEE Std. 400.2.
(f) All cable testing must be coordinated with the 72ABW/CE electric shop in advance.
(g) Cable test data and results shall be documented and signed by both the testing technician and the job supervisor. Copies of the test data/certification/results shall be submitted to the 72ABW/CE for review and approval.
(h) For new construction, the recorded test data must be submitted to and approved by the Contracting Officer.

2.4 Low Voltage Distribution

(a) Conductors shall be 600V-rated copper, with thermoplastic insulation (unless specified otherwise on the design plans).
(b) Conductors to be installed in wet locations must be UL listed for the application.
(c) Conductors shall be sized as appropriate for the application.
(d) New Feeder conductors shall be installed without splices.
(e) Existing Feeder Conductors must be replaced in full when electrical distribution equipment and panels are required to be replaced or relocated.
Exception: Splicing of feeder conductors may be performed on a case-by-case basis with prior written approval at the design phase of the project by 72ABW/CENMP for real property electrical systems or 76 MXSG/MXDEJ for non-real property electrical systems.

2.5 Transformers

(a) New building transformers shall be either unit substation or fully enclosed pad mounted (in lieu of pole mounted).
(b) **Unit Substation:** Based on existing site conditions and availability of medium-voltage feeders, transformers shall be either:
(1) Radial type fed with integral single, metal-enclosed, fused, load-interrupter switch.
(2) Loop-fed type with integral dual, metal-enclosed, fused, load-interrupter switches.
(3) Incoming section shall include surge arrestors.
(4) Outgoing sections shall be as specified in the project definition.
(5) Gear shall have copper bussing and windings.

(6) All Unit Substations shall be equipped with forced fan cooling, temperature monitoring with local alarm, and remote alarm capability. Power for cooling fans shall be integrally derived from the Unit Substation secondary power.

(c) **Pad-Mounted:** Pad mounted transformers shall meet the following criteria.
(1) Transformers shall be loop-feed type.
(2) Transformers shall be dead front type with separable load break connectors, surge arrestors, and parking bushings.
(3) Transformers shall have load break switches and primary fuses mounted inside the enclosure. Transformer fusing shall be oil-immersed, bayonet type, overload fuses in series with partial range current-limiting fuses. Fuses shall be interlocked with primary load break switches.
(4) Transformers shall have copper windings.
(5) Transformers shall have, as a minimum, four (4) 2.5% taps (2+, 2- nominal voltage).

(d) Each transformer shall be fed from a dedicated disconnect switch with overcurrent protection. The switch shall be located in the same general area as the equipment being served.

(e) Transformer primary feeders shall not be t-spliced into existing feeders in manholes or hand holes.

(f) The main primary feeder (12.47KV and larger) shall be concrete encased in underground duct bank.

(g) Transformer output voltage shall be verified at commissioning of system and load taps adjusted to provide voltage +/- 2.5% of nominal.

(h) Oil filled transformers shall utilize Mineral Insulating Oil per ASTM D3487-00 and shall be equipped with relief valves and, if pad mounted, a means of sampling the oil.

(i) Oil filled transformer installations shall comply with IEEE 979 regarding fire protection. Oil filled transformers may be physically separated from building surfaces or other oil filled transformers or may be separated by appropriate fire rated barriers. Space limitations may dictate the method of fire protection employed.

(j) Field-testing, pre-energizing, or manufacturer's field service report shall be required unless specifically stated in project definition.

2.6 Auxiliary Power/Generators

(a) Emergency generators shall only be installed for facilities authorized for emergency power by AFCEC as required by UFC 3-540-01, and AFMAN 32-1062, Chapter 3. No Emergency generator shall be installed on TAFB without prior written approval from AFCEC.

(b) The following information shall be submitted to 72ABW/CENMP for approval of the following criteria prior to ordering or installing any generator on TAFB.
(1) A justification letter, signed by the Commanding Officer of the submitting group, stating the applicable criteria which qualify the system to be supported by auxiliary power as listed in AFMAN 32-1062, Chapter 3. This justification letter will be needed to facilitate the required formal request for approval to AFCEC.

(2) All generators shall comply with the requirements contained in AFMAN 32-1062 and UFC 3-540-01.
   i. All Generators installed on TAFB must be manufactured by Cummins IAW AFCEC/CO Memorandum of Record dated 27 Jun 22.
(3) In addition, all generators shall be equipped with the following.
   i. Weather protective and sound attenuated enclosure.
   ii. Engine Block Heater with Thermostatic control.
   iii. In-Line Fuel Heater with Thermostatic control.
(4) A design analysis shall be performed prior to the installation of any generator demonstrating sizing compliance with AFMAN 32-1062, whether new or replacement.
(5) Generator Engines must be in compliance with all applicable regulations and permits (40 CFR 63, Subpart ZZZZ, 40 CFR 60, Subpart IIII, Title V Permit, etc.).
(6) Generator Engines shall be equipped with a Non-Resettable Runtime Hour Meter.
(7) Environmental approval of the engine emission must be received prior to ordering.
   i. Submittal approval by 72ABW/CEIE shall contain the following.
      a. Engine Manufacturer/Make/Model/Year
      b. Engine Full Load Rating (not generator output)
      c. Engine Specific EPA Emissions Certification Data
(8) Fuel storage tanks shall be double wall construction.
(9) Integral Fuel Storage Tank shall provide 24 hours of service, based on engine maximum load consumption.
(10) The contractor is responsible to provide adequate fuel to perform the manufacturer's commissioning, Gov't acceptance requirements, and shall turn over the generator to the Gov't with a full tank of fuel.

(c) Static Grounding of fuel tank shall comply with NFPA 30 and UFC 3-460-01, *Design: Petroleum Fuel Facilities,* paragraph 2-11.3.

(d) The emergency generator one-line diagram shall be posted at the generator location.
(1) The One Line Diagram shall contain the following information.
   i. Generator Model#, Serial#, Voltage, and Size (KVA & KW),
   ii. Transfer Switch Size (KVA & KW), Voltage Rating, Number of Poles, Open or Closed Transition, Location of Transfer Switch (Bldg. & Room #), if not mounted locally at the generator.
   iii. Normal Power Source (Bldg. #, Room #, Panel Name), Circuit Number and Breaker Size
   iv. Emergency Panel Identification, Location (Bldg. & Room #), if not mounted locally at the generator.
   v. Conductor Sizes (between Normal Power, Generator, Transfer Switch and Panels)

(e) Provide combination automatic transfer switches with integral manual bypass. All transfer switches shall be 4-pole with switched neutral for each permanent generator installation.

(f) Emergency generator installations shall be placed in existing equipment yards or provided with suitable enclosure (fenced yard) to hide from public view. Where suitable enclosure

cannot be provided, generators shall be factory painted a base standard color as determined by 72ABW/CENMP Architects which may not be a manufacturer's standard color.

(g) Provide a non-fused disconnect and 4-pole three-way Manual Transfer Switch (MTS) on the outside of the facility for portable generator connection when authorized by AFMAN 32-1062 and with prior written 72ABW/CENMP approval.

(1) All MTSs shall be equipped with Cam-Lock style connectors for connection of Portable Generator (EAID).

i. All Cam-Lok style connectors shall be rated at 200A.

ii. All Cam-Lok style Connectors shall be properly color coded for the generator application.

iii. For MTS rated 200A and below: Provide one (1) set of four (4) connectors for three phase and one (1) set of three (3) connectors for single phase with one (1) dedicated Cam-Lok style connection with properly sized EGC connector for individual cables IAW UFC 3-540-01.

iv. For MTS rated 200A to 600A: Provide parallel sets of Cam-Lok style connectors for individual cables IAW UFC 3-540-01 as required up to three (3) sets of 4 connectors for three phase and three (3) sets of 3 connectors for single phase with one (1) dedicated Cam-Lok style connector with properly sized EGC per set.

(h) Permanently installed Generators of all sizes shall be provided with the capability of connecting a load bank for generator full load testing compliance.

(1) All Automatic Transfer Switches (ATS) shall be equipped with Cam-Lock style connectors between the Permanently Installed Generator and the ATS.

i. All Cam-Lok style connectors shall be rated at 200A.

ii. All Cam-Lok style Connectors shall be properly color coded for the generator application.

iii. For ATS rated 1200A and below: The total load bank connection shall be rated at least 50% of rated ATS. Provide Cam-Lok style connection box for individual cables IAW UFC 3-540-01. Maximum shall be 3 sets of (12 connectors) for three phase and (9 connectors) for single phase with one (1) dedicated Cam-Lok style connector with properly sized EGC per set.

iv. For ATS rated more than 1200A: Provide one (1) Cam-Lok style connection box with three (3) sets of (12 connectors) for three phase and (9 connectors) for single phase and one (1) dedicated Cam-Lok style connection per set for EGC rated for 200A for individual cables IAW UFC 3-540-01.

2.7 Exterior Lighting – Parking Lot, Roadway, Fitness Trails, and Walking Paths

(a) Exterior lighting is a system that has direct and indirect impacts on the visual qualities of the base. During the day the fixtures and poles are visible. At night the light becomes dominant to signify safety and security and to enhance the visual character of the base. The use of consistent lighting components and the reduction of overhead utilities will help unify the base appearance.

(b) Keep mounting heights low to Control spillover light near residential areas. Any lighting fixtures mounted over 30 feet high require special review by 72ABW/CENMP.

(c) Use only aluminum or steel poles, taking into consideration the economics and aesthetics.

(d) All power and light poles, steel support structures and their foundations, shall be designed for NESC Heavy Loading District conditions and 100 mph wind loads on bare structure face.

(e) All New and Replacement High Mast Lighting Poles (60 feet and Taller) installed on TAFB shall be ABACUS Hydraulic Style.

(f) All parking/roadway lighting fixtures shall be supplied with Light Emitting Diode (LED) fixtures unless a written waiver from 72ABW/CENMP is obtained.
   (1) LED Fixtures shall comply with current UFC 3-530-01 requirements.
   (2) Color temperature of LED Exterior Lighting Fixtures shall be 4000K.

(g) Photoelectric controls with over-ride astronomical timers shall be used on all exterior lighting for energy conservation, unless specifically deleted in project requirements (such as for security lighting).
   (1) All exterior building fixtures providing security illumination and at personnel entrances shall be equipped with integral motion sensor for 30% / 100% illumination control for energy conservation.

(h) Where a grounding electrode is specified to be installed at light poles, the connection of the bonding conductor at the grounding electrode, and at the concrete encased reinforcement of the base, shall be either exothermic weld process, or irreversible compression connector listed for the purpose. Mechanical lugs or connections shall not be allowed.

(i) A minimum of 100 hours of "Burn-in time" shall be performed before acceptance and final inspection.

3. Interior Electrical:

3.1 General

(a) Riser and one-line diagrams shall show vertical and electrical relationships. Riser shall include voltage, amperage, and short circuit interrupting capacity at each transformer, switchboard, panelboard, and motor control center. Devices shall also indicate the room location they are installed.

(b) A framed One-Line Drawing shall be posted by the contractor in the Main Building Service room and/or any distribution switchgear room where new electrical equipment is installed, or modifications are made.

(c) All new electrical equipment shall be flush mounted except where noted otherwise on the design plans.

3.2 Grounding Requirements

(a) Provide ¼" thick x 2" tall grounding bus bar in all electrical rooms/vaults for interconnection of panels, transformers, etc. to the main building grounding electrode system.

(b) All grounding electrodes shall be copper clad with a minimum size of ¾" diameter x 10' long.
    (1) The connection of the bonding conductor at the grounding electrode shall be either exothermic weld process, or irreversible compression connector listed for the purpose. Mechanical lugs or connections shall not be allowed.
(c) The Main Building Grounding Electrode Conductor (GEC) for new construction, and GEC for all switchgear associated with electrical vaults renovations, shall be identified with a military grade heat shrinkable Tyco TMS-SCE type wire identification sleeve for testing IAW AFI 32-1065.
    (1) Where the GEC is concealed inside of a switchgear compartment and not readily accessible from the exterior, a permanent label shall be affixed to the compartment door where the GEC is terminated.

3.3 Interior Wiring System

3.3.1 General

(a) Each branch circuit shall be installed with a dedicated neutral conductor, if a neutral conductor is required.
(b) Junction box covers shall be clearly identified with the following information.
    (1) Panelboard from which the power originates.
    (2) Panelboard Circuit numbers
    (3) Voltage present within the junction box

(c) All wiring devices (receptacles, switches, etc.) shall have a minimum rating of 20 amps.
(d) All wiring device cover plates shall be clearly identified with a Brady Label Maker, or equal, printer ¼" tall, black characters on white or clear tape label, containing the following information.
    (1) Panelboard from which the power originates.
    (2) Panelboard Circuit number(s).
(e) PlugTail type receptacles are not allowed on TAFB.
(f) Combination receptacles with USB charger are not allowed on TAFB.

3.3.2 Conduit

(a) All wiring for power, fire alarm, and controls shall be installed in metallic raceway. Wiremold is a suitable metallic raceway for interior installations where surface mounting in finished spaces is required.
(b) Indoor medium-voltage (primary) wiring shall be in appropriately marked galvanized rigid metal conduit or cable tray.
(c) Secondary voltage wiring may be in galvanized rigid metal conduit, rigid aluminum conduit, or Electrical Metallic Tubing (EMT). Electrical Non-metallic Tubing (ENT) shall not be used.
(d) All metallic conduit fittings shall be Compression Type. No Set Screw fittings are allowed to be installed on TAFB.

(e) Flexible metal conduit (FMC) shall only be used for equipment connections (appliances, luminaries), and to fish into existing walls. FMC shall not be used for general wiring applications.

(f) Equipment that requires flexibility at connections, to include but not limited to motors and transformers, shall utilize liquid-tight flexible metal conduit (LFMC). LFMC used outdoors shall be listed and identified on the outer shield as "sun light resistant" or similar verbiage.

(g) When PVC is used underground, all conduit which extends from excavations above finished grade shall be galvanized rigid conduit, starting from minimum depth as specified and include the 90-degree elbow. All metallic conduit which contacts the earth shall have a Factory Applied PVC Coating.

(1) PVC tape may only be used to protect threaded areas and where adapting to PVC.

(2) Exception: Fiberglass conduit and 90-degree elbows may be used in lieu of PVC Coated GRC with prior written approval from 72ABW/CENMP for real property electrical systems or 76 MXSG/MXDEJ for non-real property electrical systems.

(h) No metal-clad cable, (Type MC), shall be permitted.

(1) Exception: Metal Clad (MC) cable shall be allowed for Flexible Light Fixture Whips whether field installed or provided by the manufacturer with new luminaires.

(2) Exceptions must be approved by 72ABW/CENMP for real property electrical systems or 76 MXSG/MXDEJ for non-real property electrical systems.

(i) Raceways shall not be supported by suspended ceiling or suspended ceiling support wires. Only wires installed and approved per the NEC shall be permitted for supporting raceway.

(j) All raceways shall be concealed above ceiling, under floor, or in walls, except where noted on the design plans. No exposed raceways shall be permitted on exterior building surfaces without a Written Waiver of these requirements by 72ABW/CENMP.

(k) Where possible, raceways to roof mounted equipment shall be routed beneath the roof structure to a penetration immediately adjacent to the equipment.

(l) Exposed conduit on exterior of buildings and on roofs, where approved, shall be galvanized rigid conduit or rigid aluminum conduit. Exposed conduit on exterior walls shall be painted to match the building colors.

(1) All Exterior Conduit Fittings shall be Weatherproof Rated.

(m) All raceway penetrations through established fire barriers shall be sealed with an approved fire stopping material.

(n) All unused conduit in renovated areas shall be removed to the source. Exception: Conduit installed in concrete or masonry walls and underground may be abandoned in place with 72ABW/CENMP approval.

(o) Factory expansion fittings are required for conduit, cable tray, and bus duct when crossing building expansion joints or changes in temperature of greater than 25 degrees F from one area to the other. LTFMC may be used between Bus Duct tap boxes with prior design submittal review and written approval by 72ABW/CENMP for real property electrical systems or 76 MXSG/MXDEJ for non-real property electrical systems.

(p) Reinforced Thermosetting Resin Conduit may be used with 72ABW/CENMP or 76 MXSG/MXDEJ Approval.

3.3.3 Conductors

(a) Insulated conductors shall be copper, type THHN, unless otherwise specified on the design plans or as code requires.

(b) Insulated conductors to be installed in wet locations (i.e. below grade) shall be type THWN, THWN-2, XHHW, or an approved equal.

(c) Insulated conductors used for a new service mast or a new utility pole riser shall be identified on the outer insulation layer as "sunlight resistant".

(d) Conductors shall be stranded for all sizes.

(1) Exception: Branch circuit feeders for general purpose wiring #12 may be solid for ease of wiring device termination, however #12 stranded may be used for ease of installation, only if an approved crimp termination is used at the wiring device.

(e) All unused conductors in renovated areas shall be removed to the source.

(f) All conductor testing shall be performed IAW ANSI/NETA ATS or ANSI/NETA MTS as applicable.

(1) Licensed Electricians shall perform all conductor testing IAW NETA Testing Standards.

3.3.4 Busway

(a) Grounding shall be integral type, utilizing the case of the busway as the equipment grounding conductor with approved splicing and joint construction.

(b) Neutral bus, where required, shall be rated at 100% of the current carrying bus bar rating.

3.4 Transformers

3.4.1 Transformers shall meet the following criteria:

(a) All transformers shall have copper bussing and windings. Transformers 75KVA and below may have aluminum windings if approved by 72ABW/CENMP or 76 MXSG/MXDEJ.

(b) Transformers shall have, as a minimum, four (4) 2.5% taps (2+, 2- nominal voltage).

(c) Transformers serving non-linear loads shall have appropriate K-factor rating.

3.4.2 Transformer installation:

(a) Conductor sizing (primary and secondary) for new transformer installations shall be rated not less than 125% of the transformer rated current.

(b) All transformers shall have primary and secondary overcurrent protection sized per article 450 of the National Electrical Code.

(c) Where K-rated transformers are utilized. Neutral conductors shall be up-sized as required.

(d) Ventilation (distance from walls) shall be as specified by the manufacturer. Normally the recommended clearances are listed on the transformer data plate.

(e) Transformers shall be secured to floors using the four mounting holes provided by the manufacturer.

(f) All new raceway installations to new/existing transformers shall have insulated grounding bushings installed.

(g) There shall be no modification (i.e. drilling holes bigger) of connectors being used for conductor terminations to the transformer bushings.

(h) Connections to the MV primary bushings shall comprise of bronze bolts, bronze flat washers, bronze lock washers and bronze nuts. Bronze or cadmium bolts, flat washers, lock washers and nuts may be used on the secondary bushings.

(i) The bolts used to secure the MV cable terminations to the transformer bushing shall be of the same diameter as the manufactures hole in the transformer bushing.

(j) Conductor terminations for low voltage transformers (600 volts and less) shall be made utilizing compression style terminations.

(k) Conduit entries into transformer housings shall be made at the lower portion of the housing as indicated by the manufacturer to avoid excess heating of the primary and secondary conductors.

(l) All bolts used to secure the cable terminations to the transformer bushings shall be tightened to the torque specified for that particular diameter of bolt. Tightening shall be performed using a calibrated torque wrench. After tightening, each connection shall be marked per industry standards using a grease pen or permanent marker.

(m) All ground terminations secured to the transformer case shall have the factory paint removed prior to the installation of the ground lug. The diameter of the removed paint area shall exceed the mounting surface area of the termination to allow for inspection.

(n) All ground terminations secured to the transformer case shall comprise of a drilled hole (same diameter hole as in the ground lug), bronze bolt, bronze flat washer, bronze lock washer and bronze nut. Ventilation openings on the bottom of transformers shall not be used as bolt holes for the securing of any ground termination/bus.

(o) Bolts used to secure ground lugs to the transformer case shall be tightened to the torque specified for that particular diameter of bolt. Tightening shall be performed using a calibrated torque wrench. After tightening, each connection shall be marked per industry standards using a grease pen or permanent marker.

3.4.3 Transformer Bonding:

(a) Transformer bonding shall be completed in strict compliance with Article 250 of the NEC.

(b) Resistance readings shall be obtained, officially documented, and become a matter of record on all new grounding electrode system installations. This same requirement shall apply to any existing transformer installation to be altered/tapped due to new electrical design requirements.

(c) New transformer installations and existing transformers that have been altered or tapped shall not be energized until the grounding system has been inspected and approved by a government representative.

(d) All grounding electrode conductor (GEC) connections to grounding electrodes, building steel and metal bar joists shall comprise of the exothermic welding process or an approved irreversible compression connector listed for the purpose. Mechanical lugs shall only be allowed with waiver by 72ABW/CENMP or 76 MXSG/MXDEJ.

(e) All GEC connections to fire sprinkler piping, steam piping and water piping shall comprise of a pipe clamp listed for the purpose. Mechanical piping systems utilizing Victaulic connections shall not be used as a grounding electrode.

(f) All Bonding Conductors shall be stranded copper.

(g) Grounding conductor bonding terminations shall be made utilizing compression style terminations.

(h) The penetration for the GEC into the new/existing transformer shall comprise of listed bushings or metal fitted locknut. Drilling a hole or using the ventilation openings on the bottom of the transformer to install the new GEC shall not be allowed.

(i) As required for physical protection, the GEC shall be installed within a raceway. The raceway shall be either electrical metallic tubing (EMT) or rigid metal conduit (RMC). Grounding bushings shall be installed (on both ends) of the new raceway. PVC raceways shall not be used for the physical protection of a GEC.

(j) All transformers directly feeding distribution panels shall bond the neutral at the transformer X0 terminal and to building ground reference. Neutral buss bonding is also required at the first point of service in the building.

3.4.4 Transformer output voltage shall be verified at commissioning of system and load taps adjusted to provide voltage ± 2% of nominal.

3.4.5 All Transformers shall be installed with a primary disconnecting means at the transformer. Exception: If the transformer is located in the same room as, or within sight of the feeder breaker, a local disconnecting means is not required.

3.5 Panelboards, Switchboards, Safety Switches, Motor Control Centers

(a) Panelboards, switchboards, safety switches and motor control centers (MCCs) shall be provided with a dedicated space equal to the width and depth of the equipment and extending from the floor to a height of 6 feet above the equipment (per NEC) or to the structural ceiling, whichever is lower. No piping, ducts, or equipment foreign to the electrical installation shall be located in this space. Sprinkler protection shall be permitted if the electrical equipment is protected from water leakage.

(b) All Electrical Distribution Equipment serving outdoor electrical and mechanical equipment shall be provided with a properly sized Surge Protective Device (SPD).

(c) All Panelboards shall be Door-in-Door Construction.

(1) Both doors shall be equipped with lockable lever/handle.

(2) Each lockable device shall be provided with two keys, both keyed the same.

(d) All electrical distribution equipment rated 1200amps and larger shall incorporate Arc Mitigating construction and/or other Arc Energy Mitigation techniques, such as Maintenance Switching with local status indicator, which meet the intent of NFPA 70 Art. 240.87.

(e) Every circuit and circuit modification shall be legibly identified as to its clear, evident, and specific purpose or use. The identification shall include sufficient detail to allow each circuit to be distinguished from all others.

(1) Circuits for panelboards shall be identified using a directory located inside the panel door (mounted behind a clear protective cover/holder). In addition, panelboard directories shall also indicate panel identifier (provided by 72ABW/CENMP), "Fed from" information, and the date of installation.

(2) A new typewritten panel schedule shall be supplied for any additions or modifications to the circuitry. Handwritten changes to the panel schedule are not acceptable.

(3) Circuits for switchboards and MCCs shall be identified using an engraved Laminated Plastic label at each switch position. In addition, switchboards and motor control centers shall also include an engraved Laminated Plastic label indicating switchboard/MCC identifier (provided by 72ABW/CENMP), "Fed from" information, and the date of installation.

(f) All replacement panelboards shall be identified using an engraved Laminated Plastic Nameplate.

Note: Only Replacement Panelboards required the UID name to be listed on the Laminated Plastic Nameplate. New Panelboards shall not include the UID # on the engraved nameplate.

Example:

PANEL "PP1"

UID Identification Name
480Y/277 VOLT, 30, 4W, 400A/3P MCB
18kAIC RATING
FED FROM MDP-12 IN ROOM E101
INSTALLED DD/MM/YYYY

(1) Equipment Nameplates shall be 0.125" thick x 2" tall x 5" wide custom engraved tile, Laminated Plastic, black nameplate with white letters, to include the following information.

i. Equipment Name in 3/8" Minimum Height Lettering
ii. UID Identification Name in 1/8" Minimum Height Lettering
iii. Voltage, Ampacity Rating and Type in 1/8" Minimum Height Lettering
iv. Equipment AIC Rating in 1/8" Minimum Height Lettering
v. Feeder Source of Supply description and location in 1/8" Minimum Height Lettering
vi. Installation Date MM/DD/YYYY in 1/8" Minimum Height Lettering

(2) Mounting shall be made utilizing Stainless-Steel Screws or Stainless-Steel Pop-Rivets.

(3) Mounting holes shall be sealed with silicone rubber for exterior and damp applications.

(g) All new panelboards shall be equipped with a properly sized Molded Case Switch (MCS) if feeder conductors have proper over-current protection. A Main Circuit Breaker (MCB) is required when providing over-current protection for the secondary of a transformer or when the panel is fed from an overhead bus switch.
Exception: If the panelboard is located in the same room as, or within sight of, the feeder breaker, an MCB or MCS is not required.

(h) All new panelboards shall have copper buses.

(i) All new panelboards fed from K-rated transformers shall be rated for non-linear loads (200% neutral).

(j) All new panelboards and switchboards shall be supplied with 20% spare circuit breakers, based on the panel maximum number of breaker spaces.

(k) Half-Size and Tandem Breakers are not allowed to be installed on TAFB.

(l) A separate, listed equipment ground bar kit (not bonded to the neutral bus) shall be provided in all new panelboards.

(m) All new panelboards shall contain provisions for bolt-on type branch circuit breakers or Sq D I-Line style.

(n) All new circuit breakers shall be bolt-on type. Exception shall be made for Square-D I-Line panels.

(o) The circuit breaker servicing any Mechanical Equipment being replaced which is older than ten (10) years must also be replaced or rebuilt and recertified, whichever costs less. A minimum of two spare ¾" conduits shall be stubbed and capped off from each new flush mounted branch circuit panel to above ceiling and below accessible floor.

(p) All new safety switches shall be listed for heavy duty (HD) applications.

(q) Grounding conductor bonding terminations shall be made utilizing compression style terminations.

(r) All new conductor termination points in new panelboards, switchboards, safety switches and motor control centers shall have the bolts tightened to the torque specified on the label attached by the manufacturer within the equipment.

(s) All conduit fittings utilizing "Concentric Knock-outs" shall have grounding bushings installed for systems 250 volts or higher.

3.6 Motors and Motor Controls

(a) Premium efficiency motors shall be utilized for all applications 25 HP or larger.

(b) All motors controlled by a Variable Frequency Drive (VFD) shall be Inverter Duty Rated.

(c) Provide phase loss relay for each motor 25 HP or larger in size. The phase loss relay shall be integral part of starter and shall NOT require a separate enclosure.

(d) Conductors for motors shall be sized in accordance with the NEC amperage x 125%, not the data plate full load amps. Exception: HVAC equipment.

(e) Motor Conductor Terminations for all voltages of #6 conductors and smaller shall be made utilizing crimp-on style ring terminals with bolt, nut washers and lock washers. Proper insulating tape per NEIS motor terminations shall be used. Twist-On style terminations are not allowed. Motors with #4 or larger conductors may be made utilizing "Insul-Lug" style mechanical multi barrel lug.

(f) Motor overloads (heaters) shall be sized utilizing the motor data plate full load amps and motor data plate service factor.

(g) All VFDs shall be supplied with manual integral bypass for emergency operation in the event of a VFD failure. The Bypass shall be constructed so that the VFD may be safely serviced and/or repaired while the VFD bypass is energized.

(h) No Disconnecting Means shall be installed between a VFD and the Motor it controls.

3.7 Systems Furniture

3.7.1 The requirements listed below are the minimum for standard office furniture units. The term "system furniture" used below is applicable to cubical office furniture, demountable wall, furniture wall, and/or similar system/items.

(a) **User organizations will be responsible to provide designer with the proposed new system furniture layout (scaled drawing) and specifications on the system furniture to be purchased.** Design information shall include but not limited to, wiring (type and size), raceways (type and size), j-boxes (size, wall or ceiling mounted), volt amps and voltage of each unit for connection of the system furniture. Reference NEC Handbook, Section 605.6 Fixed-Type Partitions and 605.7 Freestanding-Type Partitions for multi-wire circuit breaker requirements.

(1) Modular Furniture units must be provided with 5-wire harness consisting of 2 circuit conductors, 2 neutral conductors and 1 equipment grounding conductor or 10-wire harness consisting of 4 circuit conductors, 4 neutral conductors and 2 separate equipment grounding conductors.

(2) New system furniture which has multi-wires or sharing neutral are prohibited to connect to facility/building power.

(b) Each "cubicle" (or renovated walled office) shall be provided with one designated computer duplex receptacle (Orange) on a separate circuit. Circuit may be shared among multiple cubicles or offices; however, never more than four (4) designated computer duplex receptacles will share a single circuit. For electrical calculation purposes, for update of an existing panelboard directory, or to construct a new panelboard directory, a load of 480 volt-amps (VA) shall be used for each computer duplex receptacle.

(c) Each cubicle (or renovated walled office) shall be provided with a minimum of two (2) additional general use duplex receptacles. Duplex receptacles may share a single circuit or be provided with separate circuits. Circuits may be shared among multiple cubicles; however, never more than Eight (8) duplex receptacles will share a single circuit. For electrical calculation purposes, for update of an existing panelboard directory, or to construct a new panelboard directory, a load of 180 VA shall be used for each of the eight duplex receptacles for circuit load calculations.

(d) All modular furniture receptacles shall have a minimum rating of 20 amps IAW 3.3.1 (c) above.

(e) Each circuit shall have a separate neutral conductor. Where more than one neutral conductor terminates in a junction box, each neutral conductor shall be identified with its corresponding circuit number.

(f) Due to harmonics generated by computer power supplies, the neutral conductor shall be considered current carrying for all wire sizing (de-rating) calculations.

(g) If Systems Furniture power is provided by Tele-Power Pole, a label must be installed on the Tele-Power Pole IAW 3.3.1 (d) above

(h) Each Systems Furniture receptacle must have a label installed IAW 3.3.1 (d) above.

(i) Electrical receptacle shall not be installed in modular office furniture to support appliances of any kind, which is also applicable to cubical office furniture, demountable wall, furniture wall, and/or similar system/items furniture or partition wall panels.

(j) All new break areas housing appliances, i.e. coffee makers, microwaves, refrigerators, etc., are considered to be Real Property and must be permanently constructed.

3.8 Interior Lighting

3.8.1 General

(a) Illumination Levels - General illumination levels shall not exceed the intensities shown in the latest edition of UFC-3-530-01 Interior and Exterior Lighting and Controls. Where lighting intensities are not indicated in UFC-3-530-01, the IES Lighting Handbook shall be used.

(b) Lighting shall be installed using 277V where available.

(c) Overhead lighting fixtures for buildings (interior lighting) shall comply with design requirements of UFC 4-010-01, paragraphs 3-16 and 3-20, antiterrorism provisions.

(d) Provide luminaire supports that are independent of the ceiling system and ceiling supports for suspended or grid ceilings. Attach safety and seismic supports for luminaires to main structure, concrete or steel floor deck, beams, columns, etc. Safety supports for luminaire components, such as reflectors, may be attached to the luminaire itself.

(e) Flexible Light Fixture Whips, whether provided by the fixture manufacturer or by the contractor, are required to be 3/8" flexible metallic conduit or MC cable with approved fittings.

(f) Fixture whips must be supported independently of the ceiling grid. Coiling of the fixture whip and placing on top of the fixture is not permitted.

(g) Test instruments used to measure both normal and emergency illumination levels shall contain a current calibration sticker that indicates the current calibration date and the date due for the next calibration.

(h) Emergency Lighting:

(1) Emergency lighting must be provided in accordance with latest edition of NFPA 101.

(2) Emergency lighting is required along paths of egress.

(3) Emergency battery backup shall be provided in all lighting fixtures in mechanical and electrical equipment rooms.

(4) Emergency lighting shall be provided in interior windowless conference rooms, classrooms, and large office areas.

(5) All Emergency lighting fixtures installed in High Bay Areas (higher than 10' A.F.F.) must be provided with a remote test switch installed @ 6' A.A.F.

i. A Single Remote Test Switch shall be installed for all Emergency lighting fixtures serving a specified area.

(6) Twin head "lunchbox" style light fixtures shall not be used.

Exception: Use of lunchbox style fixtures in warehouses and manufacturing areas may be approved on a case-by-case basis by 72ABW/CENMP or 76 MXSG/MXDEJ.

(7) All new emergency light installations shall be witness tested as outlined in NFPA 101. The test shall comprise of turning off the branch circuit and allowing the emergency lights to burn for at least 90 minutes. Illumination level readings shall be taken during and at the end of the test. The illumination level readings shall comply with NFPA 101. The test results shall be documented and become a matter of official record.

(i) Emergency/exit lighting ballasts/batteries shall include self-testing/self-diagnostic features, which meet the requirements of NFPA 101 for testing. Ballasts shall include an indicator light and audible alarm to indicate battery/charger status and test results.

(j) All exit light fixtures shall be of the diffused LED type with red lettering and have emergency battery backup, and self-diagnostic feature.

(k) Where a single bank battery UPS style "emergency lighting system" is used, the requirement for a self-contained diagnostics and individual battery packs in (g) and/or (h) of this section will be waived. The emergency lighting system shall be required to have a diagnostic feature.

3.8.2 Interior Lighting Fixture Requirements

(a) All new high bay lighting shall be provided by Light Emitting Diode (LED) fixtures or as specified in the Statement of Work for each project. LED Fixtures shall comply with current UFC 3-530-01 requirements.

(b) All High Bay Lighting Fixtures shall be equipped and installed utilizing flexible cord w/ twist locking style plug and receptacle.

(c) All new lighting for general office areas, classrooms, corridors, conference rooms, and lobbies shall be provided by Light Emitting Diode (LED) fixtures or as specified in the Statement of Work for each project. LED Fixtures shall comply with current UFC 3-530-01 requirements.

(d) All LED lighting color temperature shall be 4000K, or as specified in the Statement of Work for each project.

(e) Manufacturer's Published Photometric Data shall be used for lighting calculations.

(f) Fluorescent fixtures may be installed for renovation projects to match surrounding area fixtures with a written waiver from 72ABW/CENMP or 76 MXSG/MXDEJ.

(1) If approved, fluorescent fixtures shall use T-5 or T-8 lamps, electronic ballast with high power factor (greater than .9) and low harmonic distortion (less than 10%).

(g) Acrylic lens shall be a minimum .156 inches thick.

(h) For energy efficient interior lighting schemes, lighting systems should be designed to allow reduction of lighting levels by appropriately banking lighting circuits. Dual Technology Motion Detection sensors shall be used for lighting controls in restrooms, storage rooms, office areas, hallways and warehouses.

(i) Any proposed Wireless Lighting Control Systems must be submitted to the 72ABW/SC Spectrum group for review and approval prior to including in the project design.

(j) Consideration should also be given for any task lighting that might be provided by systems furniture, and overhead lighting should be reduced accordingly.

(k) An un-switched lighting circuit phase conductor shall be provided and installed to serve self-contained emergency battery packs in new fixtures installed or where these units are shown to be installed in existing fixtures. This un-switched phase conductor shall be on the same lighting branch circuit serving switched lamps and installed in existing lighting branch circuit conduit system.

3.9 Communications/LAN

All Communication/LAN Room construction and Cable installations shall comply with the latest version of the 72 ABW/SC COMM.RM-STANDARD.

4. Fire Protection

All Fire Alarm and Mass Notification must comply with the latest version of the Tinker Air Force Base Fire Protection Standard.

5. Intrusion Detection Systems (IDS)

5.1 General

(a) Intrusion Detection will be designed and installed in accordance with the most current version of ICD/ICS 705-1, UFC 4-021-02, DOD 5200.1-R, AFI 31-101, NFPA 731, NFPA 70, and UFC 4-010-05.

(1) All materials must be listed in the current approved CMD Equipment List.

(b) Only Honeywell Vindicator model VPC shall be installed on TAFB. PL4 level Vindicator systems shall be provided with Fiber Media converter for communication with the Base Security Monitoring System. PL1 – PL3 level, SAPF, and SCIF systems shall be provided with a base approved switch at site and SFP Module at head end for communication with the Base Security Monitoring System.

(c) Intrusion Security Systems maps shall show device locations, point numbers and shall be configured for use in the VAC, VSC, and the VCC. Each map will be sized appropriately for each device.

(1) All VCC sites will then be updated on the Global Tinker System.

(d) And Intrusion Security Systems Riser diagram shall show all devices with room number (and address if addressable) for each device included.

(e) The system will have tamper switches on all devices that would disable the detection device which will transmit all tamper alarms to the Base Security Forces.

(f) Circuit conductors for Intrusion Detection Systems shall be stranded #22 AWG and 18/2 AWG for power provided to all accessory devices.

(g) Circuit conductors for new Intrusion Detection Systems installation shall be installed without splices and joints. It shall be allowed to install pull boxes as necessary and as required by code, however, the pull boxes shall only be used for conductor pulling purposes and not for the splicing or joining of conductor.

(1) All splices or joining of conductors shall be done in a manner of Crimp style connections.

(h) All IDS field system devices are required to have resistors packs installed at IDS device. Stage devices can utilize a single resistor.

(i) All IDS projects must have a kickoff meeting with Security Forces, Alarm Shop, and User prior to construction to review all prints and approved codes for current job.

(j) Device info for programming and Alarm Point Range will be given on site after kickoff meeting has taken place.

(k) All testing requires 48-hour prior notice.

(1) Contractor must complete all pre-testing before scheduling alarm test with SFS, Alarm Shop, and User. – Test plan shall be submitted at this time.

(2) All alarm points will be tested.

(3) 24-hour Battery Test.

(4) 72 HOUR Burn In.

(5) Completion Paperwork and As-Builts must be turned over upon acceptance.

6. Lightning Protection Systems (LPS)

6.1 General

(a) LPS shall be installed IAW UFC 3-575-01, AFMAN 32-1065, and NFPA 780 whichever is more restrictive.

(b) Provide dedicated grounding electrode for each down conductor.

(1) Each down conductor grounding electrode must be bonded to the building grounding system.

(2) Provide Test Well at each down conductor termination, but no farther apart than 200 feet.

i. Test wells for hangar door spans may be located on each side of the hangar door.

(c) All LPS grounding electrodes shall be bonded to facility grounding electrodes (i.e. service entrance grounding electrode or facility ground ring/loop).

(d) Bonding of conductors and grounding electrodes to facility grounding electrodes shall be below grade.

(e) All connectors shall be high compression or exothermic-weld type connectors except the connections to air terminals.

(f) Provide 2/0 AWG bare copper down conductors for any structure exceeding 75 feet (23m)

6.2 Design and shop drawing submittal

A dedicate sheet(s) shall be provided for LPS. Provide overall LPS layout which shall be including all LPS components, i.e., air terminal(s), test well(s), SPD(s) location, grounding system, etc.

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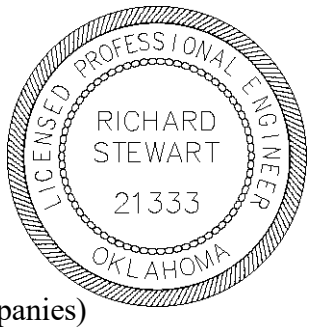

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