

UFC 3-600-01  
8 August 2016  
Change 2, 25 March 2018

# UNIFIED FACILITIES CRITERIA (UFC)

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## FIRE PROTECTION ENGINEERING FOR FACILITIES



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**UNIFIED FACILITIES CRITERIA (UFC)**  
**FIRE PROTECTION ENGINEERING FOR FACILITIES**

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U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING COMMAND (Preparing Activity)

AIR FORCE CIVIL ENGINEER CENTER

Record of Changes (changes are indicated by \1\ ... /1/)

<b>Change No.</b>	<b>Date</b>	<b>Location</b>
1	28 Nov 2016	<u>Change to definition of 'AHJ' (paragraph 2-1.3) required modifications to paragraphs 1-7.2.2, 1-9, 9-16.1, and 9-18.5.1. Change to paragraph 9-13.1.3 was a technical change.</u>
2	25 Mar 2018	<u>Clarification to definitions <i>Fire Water Demand</i> (2-1.11) and <i>Multi-Family Housing</i> (2-1.26), in addition to many clarifications of requirements. Paragraphs added for <i>Hydroelectric Generating Plants</i>(4-20) and <i>Navigation Locks</i>" (4-31). Change in requirements for <i>Liquid Oxygen</i> (4.3-33). Army eliminated the requirement for two water storage tanks. DLA requires redundant fire pump for large risk facilities. Dry pipe systems require <u>nitrogen.</u></u>

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**This UFC supersedes UFC 3-600-01, dated 26 September 2006, Change 3 and all preceding changes.**

CANCELLED

## FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with [USD \(AT&L\) Memorandum](#) dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA.) Therefore, the acquisition team must ensure compliance with the most stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and Air Force \2\ Civil Engineer Center (AFCEC) /2/ are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content of UFC is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale should be sent to the respective service proponent office by the following electronic form: [Criteria Change Request](#). The form is also accessible from the Internet sites listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site <http://dod.wbdg.org/>.

Hard copies of UFC printed from electronic media should be checked against the current electronic version prior to use to ensure that they are current.

### AUTHORIZED BY:



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JAMES C. DALTON, P.E.  
Chief, Engineering and Construction  
U.S. Army Corps of Engineers



---

JOSEPH E. GOTT, P.E.  
Chief Engineer  
Naval Facilities Engineering Command



---

EDWIN H. OSHIBA, SES, DAF  
Deputy Director of Civil Engineers  
DCS/Logistics, Engineering &  
Force Protection



---

MICHAEL McANDREW  
DASD (Facilities Investment and Management)  
Office of the Assistant Secretary of Defense  
(Energy, Installations, and Environment)

## UNIFIED FACILITIES CRITERIA (UFC)

### REVISION SUMMARY SHEET

**Document:** UFC 3-600-01, *Fire Protection Engineering for Facilities*

**Superseding:** This UFC supersedes UFC 3-600-01, dated 26 September 2006, Change 3 and all preceding changes.

**Description of Changes:** This update to UFC 3-600-01 clarifies many of the requirements in the 26 September 2006, Change 3, 1 March 2013 version, as well as updates references, and further coordinates the Services' requirements. This update also coordinated requirements with consensus standards and reorganized the document to match the organization of the IBC to make it easier to use for the Architectural-Engineering Firms. New criteria for the following were added:

- Planning Section
- Definitions
- Facilities Housing Unmanned Aerial Vehicles (UAV) or Remotely Piloted Aircraft (RPA)
- Military Operations on Urban Terrain (MOUT) Trainers
- Sensitive Compartmented Information Facility (SCIF)

#### Reasons for Changes:

- Planning Section is to help scope projects properly and assist in ensuring the proper funding is requested
- Definitions are to help clarify requirements
- Requirements were added for UAVs to ensure the UAVs and the facility are properly protected
- Information was added for MOUTs to ensure they have the proper protection and are not provided with unnecessary requirements.
- Requirements were added for SCIFs to ensure coordination with the security requirements.

#### Unification Issues:

Some criteria are Service specific as it will reference a Service UFC, FC, Instruction, or Manual.

**Navy Unification Issues:**

- Paragraph 7-2 – The spacing allowed by the IBC for the identification of the rated wall is too large and will not be easily seen by trade personnel performing work.

**Air Force Unification Issues:**

- Paragraph 9-5.4.3 – This paragraph is an option allowed by code. This choice only adds a single engine driven generator and associated maintenance burden, rather than add multiple engine driven drivers and the associated maintenance burden.
- Paragraph 34-10.1.1 – There are many existing Air Force Lodging and Billeting Facilities without sprinkler protection. Requirements are different and exceed those found in minimum criteria, including NFPA 101. The requirements are unique to the Air Force and this section is needed to prevent change to Air Force facilities simply because it is different.

**Army Unification Issues:**

- Paragraph 4-3.4.8 – Provides additional requirements for facilities that support UAV or UAS.
- Paragraphs 4-16.2.2.1, 4-41.2.1, and 9-9.1.2 – AFFF fire suppression is not permitted due to environmental concerns on Army projects.
- Paragraphs 9-6.3.2 and 9-18.2 – Requires fire protection shop drawings prepared under the immediate supervision of and sealed by a professional engineer, who must certify in writing that the system was installed as designed.

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## CHAPTER 1 INTRODUCTION

### 1-1 SCOPE AND ADMINISTRATION.

This UFC establishes fire protection engineering policy and criteria for Department of Defense Components (*DoD Components*). This criteria is based on commercial requirements set forth by national insurance underwriters and may exceed minimum national code requirements. The requirements in this UFC reflect the need for the protection of life, mission continuity, and property (building or contents) while taking into account the costs of implementing the criterion and risks associated with the *Facility*. These criteria have been established in the best interest of DoD.

### 1-2 APPLICABILITY.

#### 1-2.1 General.

**1-2.1.1** The provisions of this UFC are applicable to all new and existing DoD *Facilities* located on or outside of DoD *Installations*, within the United States and its territories and possessions or outside the United States and its territories and possessions, whether owned or leased, by appropriated or non-appropriated funds, or third party financed and constructed.

**1-2.1.2** The provisions of this UFC are applicable to all types of *Facilities* and their contents, structures, whether considered permanent, semi-permanent or temporary construction, mobile and stationary equipment, civil works or military facilities, hydroelectric plants, waterfront facilities, outside storage, and shore protection for ships and aircraft.

**1-2.1.3** Projects outside the United States and its territories and possessions must comply with provisions of this UFC and the host nation fire protection requirements. For conflicts between this UFC and the host nation fire protection requirements, the *2\AHJ/2* must be consulted.

#### 1-2.2 Acronyms, Abbreviations, Defined Terms, and Referenced Criteria.

Acronyms and abbreviations used within this UFC are defined in Appendix F. The full name of referenced criteria, codes or standards can be found in Appendix A. Terms defined in Chapter 2 are italicized in this UFC.

#### 1-2.3 Fire Department Operations.

Matters relating to fire department operations, staffing and firefighting equipment are outside the scope of this UFC.

**1-3 PURPOSE.**

This UFC must be used as the minimum standard for the planning and development of projects and, design, construction and commissioning documentation used for the procurement of Facilities. Examples include, but are not limited to, the development of scopes of work, DD1391 documentation, drawings, specification and request for proposals. It is the primary fire protection criteria reference document for services provided by architectural and engineering (A&E) firms and consultants in the development of both design-bid-build and design-build contracts. It is not intended to be used in lieu of detailed design documents in the procurement of *Facility* construction.

**1-4 CRITERIA.**

**1-4.1 Federal Laws.**

This UFC complies with all applicable Federal laws, including but not limited to:

- a. UNITED STATES CODE <http://uscode.house.gov/>.
- b. USC Title 10, Chapter 8, Subchapter II, Military Child Care.
- c. USC Title 15, Section 272 Utilization of Consensus Technical Standards by Federal Agencies.
- d. USC Title 15, Section 2225 Hotel-Motel Fire Safety.
- e. USC Title 15, Section 2227 Fire Administration Authorization Act (also referred to as the Fire Safety Act).
- f. USC Title 42, Section 4151 Architectural Barriers Act of 1968.

**1-4.2 DoD Criteria.**

**1-4.2.1** UFC 3-600-01 supplements the requirements listed in UFC 1-200-01. UFC 3-600-01 supersedes NFPA and other industry standards, except where not specifically addressed by this UFC.

**1-4.2.2** Features in excess of the requirements in this UFC must be approved by the *Authority Having Jurisdiction (AHJ)*.

**1-4.2.3** Where the IBC references the International Fire Code (IFC), the IFC must be replaced with NFPA 1, except where superseded by this UFC.

**1-4.2.4** For leased *Facilities*, the criteria in this UFC must apply, unless it is determined by the *DFPE* it is not in the best interest of DoD. For conflicts between this UFC and the local municipal jurisdiction, the *DFPE* must be consulted.

**1-4.2.5** Individual *DoD Components* issue specific technical guidance that expands the requirements of this UFC. For example, the Air Force issues engineering technical letters (ETLs); and the Army and Navy/Marines issue engineering construction bulletins (ECB).

- a. For Army, Air Force, Navy/Marines, see <http://dod.wbdg.org/>.
- b. For Washington Headquarters Service (WHS), see WHS Building Code, <http://www.wbdg.org/ccb>

**1-4.2.6** Where criteria are not included in this UFC, fire protection criteria must conform to the requirements of the latest editions of the National Fire Codes. Where criteria are not available from the National Fire Codes, a fire protection design analysis must be submitted to the *DFPE* for approval.

### **1-4.3 Standards, Codes and Guides.**

Fire protection criteria must conform to the requirements of standards, codes and guides as modified or referenced in this UFC. The primary references include, but are not limited to, the most recent editions of the following:

- a. National Fire Codes, published by the National Fire Protection Association (NFPA).
- b. FM Global (<http://www.fmglobal.com/>) Property Loss Prevention Data Sheets, as referenced by this UFC.

Note: NFPA 5000, state or local building or fire codes must not be used.

### **1-4.4 Antiterrorism and Security Standards.**

Antiterrorism and security requirements noted in UFC 4-010-01, UFC 4-020-01 and other 4 series UFCs must not preclude any fire protection requirements. This UFC will be in coordination with the ATFP sections as noted in the other 4 series UFCs.

## **1-5 GENERAL BUILDING REQUIREMENTS.**

Comply with UFC 1-200-01, general building requirements. UFC 1-200-01 provides applicability of model building codes and government unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, high performance and sustainability requirements, and safety. Use this UFC in addition to UFC 1-200-01 and the UFCs and government criteria referenced therein.

## **1-6 REFERENCES AND DATES OF PUBLICATION.**

### **1-6.1 General.**

Appendix A contains a list of references used in this document. The publication date of codes or standards are not included in this document. Unless modified by UFC 1-200-01, this document or the applicable contract, the latest available issuance of a reference must be used.

### **1-6.2 Project Delays.**

For projects that have a delay, as defined in UFC 1-200-01, the *DFPE* has the responsibility to determine if design revisions are required based on an analysis performed by the *Qualified Fire Protection Engineer (QFPE)*.

## **1-7 FIRE PROTECTION ENGINEERING SERVICES.**

### **1-7.1 General.**

**1-7.1.1** *Major Projects* require the design, review and oversight services of a *QFPE*. A *QFPE* must be involved in every aspect of the design, construction and testing/commissioning as it relates to fire protection and life safety. This includes, but is not limited to, building code analysis, life safety code analysis, design of automatic fire alarm, detection and suppression systems, water supply analysis, a multi-discipline review of the entire project, construction inspections and witnessing of fire protection acceptance testing/commissioning.

Note: Utilization of multiple *QFPEs* on the same project is permitted, but not preferred.

**1-7.1.2** This requirement is applicable to engineering services for design-bid-build projects as well as all phases of design-build projects including RFP development, design development, and construction.

**1-7.1.3** For the purpose of this UFC, the *QFPE* must submit, upon request, a written copy of their resume indicating education, professional registration and work experience, along with a letter attesting to their compliance with the requirements of this Section. The letter must include an imprint of their professional engineering stamp with signature.

### **1-7.2 Fire Protection Design Analysis and Life Safety Plans.**

**1-7.2.1** A fire protection design analysis and life safety plans must be provided for all *Major Projects* and must address the fire protection requirements of the project as required by this UFC. The fire protection design analysis and life safety plans must be submitted with the initial design submission, separate from other disciplines. The final design analysis and life safety plans must be signed and sealed by the *QFPE*.

Note: When directed by the *DFPE*, projects with little or no fire protection considerations may not require a fire protection design analysis or life safety plans.

### **1-7.2.2** Fire Protection Design Analysis.

Where applicable, discuss the following minimum fire protection provisions (include required vs. provided):

- a. Identification of all fire protection and life safety related codes and standards applicable to the project, including the edition. This includes Host Nation requirements.
- b. Building code analysis (e.g., type of construction, height and area limitations, building separation, exposure protection, etc.).
- c. Classification of occupancy (both IBC and NFPA 101).
- d. Requirements for fire walls, fire barriers, fire partitions, smoke barriers and smoke partitions, compartmentation and special hazard protection (both horizontal and vertical). Include the associated fire resistance rating.
- e. Requirements for protection of horizontal and vertical penetrations and openings as well as the associated fire resistance rating.
- f. Separation from hazards per NFPA 101.
- g. Interior finish ratings.
- h. Means of egress provisions and components (occupant load, exit capacity, exit width, travel distance, common path of travel, dead-end corridors, use of suites, etc.).
- i. Water supplies, water distribution, location of fire hydrants, *Fire Flow* calculations.
- j. Location of fire department connections (FDCs).
- k. Location of post indicator valves (PIVs) and other control or isolation valves.
- l. Analysis of automatic sprinkler and suppression systems and protected areas. Include supporting calculations used to establish system performance requirements such as hydraulic analysis of water demand or agent concentration and quantity.
- m. Standpipe systems.
- n. Portable fire extinguishers.
- o. Fire detection (the type of detection and type/location of detectors).

- p. Fire alarm system (the type of alarm system, location of the fire alarm equipment and mass notification).
- q. Smoke management or control methods.
- r. Connection to and description of base *Fire Alarm Reporting System*.
- s. Coordination with security and antiterrorism requirements, including connection to *Installation-wide Mass Notification System*.
- t. Fire department access.
- u. *AHJ* approved equivalencies \1V1/ (see the paragraph entitled "Equivalencies" below).
- v. For projects not within the United States or its territories, identify code/criteria conflicts and *AHJ* approved design solutions\1\ or/1/ equivalencies \1V1/to DoD or Host Nation criteria necessary to resolve. The analysis must also identify the associated impact on project cost.
- w. Initial, or draft, integrated performance verification and testing plan(s) where multiple systems across multiple trades rely on an integrated operation to perform the desired result.

### **1-7.2.3 Life Safety.**

Where applicable, the following minimum fire protection provisions must be included on the life safety plans:

- a. All minimum fire protection provisions listed above, on a separate code summary sheet.
- b. Capacity and number of occupants using each major means of egress component (e.g., stairs, stair doors, exterior doors, assembly exit doors).
- c. Maximum travel distance, dead-end corridor, common path of travel, accessible means of egress and exit components for each floor and occupancy classification. When suites are used, indicate type, location, area and arrangement.
- d. IBC and NFPA occupancy classification of each room, area or compartment (on the drawings or in tabular form). Include occupant load of each room, area or compartment. Similar occupancies can be grouped together for occupant load calculations.
- e. Location and rating of all fire walls, fire barriers, fire partitions, smoke barriers and smoke partitions (both horizontal and vertical). Barriers requiring fire resistance rated supporting construction must be specifically identified for coordination with the structural design.

- f. Location of hazardous materials storage, handling and use that exceed the maximum allowable quantities.
- g. Structural fireproofing locations and associated ratings.

**1-7.2.4** Code Compliance Plans.

**1-7.2.4.1** Code Compliance Summary Sheet.

Provide the building code and life safety code analyses included in the basis of design. Specifically call out any approved criteria exemptions. For projects outside the United States and its territories and possessions, identify code/criteria conflicts and proposed design solutions to resolve.

**1-7.2.4.2** Code Compliance Site Plan.

Where applicable, the following minimum fire protection provisions must be included on the Code Compliance Site Plan:

- a. Line of encroachment identifying assumed property lines and minimum separation distances from adjacent buildings.
- b. Building perimeter used for frontage increases.
- c. Fire department access.
- d. Fire lane width, marking and locations, approach roads and turn radius and location.
- e. Type and quantity of antiterrorism secure access.
- f. Intended fire department main entrance to facility.
- g. Location of fire department connections.
- h. Fire hydrants, post indicator valve or valves and their connected water distribution mains serving facility.
- i. Fire pump room.
- j. Water storage tanks.
- k. Hazardous material spill containment tanks.
- l. Backflow prevention assembly or assemblies serving water-based fire protection systems (if located outside of building).

**1-7.2.5** Preliminary Hydraulic Analysis.

**1-7.2.5.1** Prepare a preliminary hydraulic analysis to demonstrate that the anticipated water demand(s), including those for fire, domestic, and industrial needs, will be satisfied by the available water supply. This analysis must include an estimate for the minimum required capacity of water, along with minimum volumetric waterflow rate and water pressure, with all assumptions clearly defined and referenced and must demonstrate that the available water supply is capable of meeting the required water demands in any project. Include a graphical analysis of the relationship between the *Fire Water Demand* and the available water supply.

**1-7.2.5.2** For design-build projects, prepare the preliminary hydraulic analysis prior to advertisement of the request for proposal.

**1-7.3** Final Design Submission.

The *QFPE* must review the complete 100 percent design drawings and specification submission (all disciplines) and document in writing that the design is in compliance with this UFC and all applicable fire protection and life safety design criteria. The review must provide verification that all items listed in the design analysis are correctly shown on the drawings and in the specification and list any approved equivalencies or deviations from this UFC. This design compliance document must be submitted with the final design submission as part of the design analysis and must bear the signature and professional seal of the *QFPE*.

**1-7.4** Host Nation.

For projects outside the United States and its territories and possessions, a Host Nation Code Compliance certification must be performed by a Host Nation fire protection consultant. For each item of conflict or nonconformance with the Host Nation codes, the certification must include the following:

- a. Item of conflict.
- b. Translation of Host Nation requirement to the English language.
- c. Recommended resolution.
- d. Additional costs, both engineering effort to prepare the design modification and estimated construction costs.

**1-8** **EQUIVALENCIES.**

Alternative design approaches proposed as equivalencies to established criteria must be approved by the *AHJ*. Requests for approval must include written justification for the deviation from established criteria and demonstrate how the proposed alternative solution provides an equivalent level of fire protection and life safety. Requests must also include hazard analysis, compensatory features, comparative cost analyses (first cost and life cycle cost), criteria used, and other pertinent data. Lack of funds is not considered sufficient justification for an equivalency to established criteria. Approved



equivalencies and alternatives apply only to the specific *Facility* or project involved, and do not constitute blanket approval for similar cases.

## **1-9 EXEMPTIONS.**

*Exemptions* to established criteria must be submitted to the \1\Service Signature Authority/1/ for determination. The *exemption* must demonstrate that the criteria cannot be technically executed, or execution of the criteria will increase a hazard or create a new hazard and no technical alternatives exist. Written request for exemptions must include justification, hazard analysis, cost comparison, alternatives considered, and other pertinent data. Lack of funds or cost savings are not considered sufficient justification for deviation from established criteria. *Exemptions* will only apply to the specific *Facility* or project involved and do not constitute blanket approval for similar cases. *Exemptions* must follow the process outlined in MIL-STD-3007.

## **1-10 PERFORMANCE-BASED FIRE SAFETY DESIGN.**

### **1-10.1 General.**

**1-10.1.1** The use of performance-based fire safety design methods may only be permitted upon authorization by the *AHJ*.

**1-10.1.2** Performance-based fire safety design must comply with the procedures, provisions and applicable requirements of Appendix C.

Note: Appendix C is in accordance with the performance-based option of NFPA 101 and the performance-based fire safety design approach of the Society of Fire Protection Engineers (SFPE), Introduction to Performance-Base Fire Safety.

**1-10.1.3** A *QFPE* must perform the performance-based fire safety design.

### **1-10.2 Application.**

**1-10.2.1** Performance-based fire safety design methods may not be used to eliminate required exiting requirements of NFPA 101, nor may it be used to eliminate automatic sprinkler systems required by DoD criteria.

**1-10.2.2** The use of performance-based fire safety design will only be considered for the following:

**1-10.2.2.1** Existing facilities where it is not feasible to meet prescriptive requirements of this UFC.

**1-10.2.2.2** New facilities for which established prescriptive criteria does not exist.

## 1-11 FIRE PROTECTION DURING CONSTRUCTION.

Contract specifications must reference the USACE Engineering Manual (EM), EM-385-1-1 and NFPA 241 and must contain the requirement that the *Installation's* fire regulations be followed.

## 1-12 PLANNING\2\ (CONTRACT DOCUMENT DEVELOPMENT)/2/.

### 1-12.1 General.

**1-12.1.1** The criteria in this UFC must be used in project planning or the development of projects \2\and contract documents/2/. The information in this section must be reviewed during the planning phase to verify that adequate *Installation* infrastructure exists.

**1-12.1.1.1** It is DoD's responsibility to determine whether or not the *Installation* infrastructure is adequate to support the project.

Note: Examples of infrastructure include water supply and fire department access.

**1-12.1.2** The requirement for a *QFPE* must be included in the statement of work for design services as well as design/build services.

### 1-12.2 *Installation* Water Supply.

**1-12.2.1** The quantity of water required is equal to the greater of the largest *Fire Water Demand* or *Fire Flow* for the required duration. This quantity represents fire water supply requirements only, that must be available at all times. Water supply for domestic, industrial, and other demands must be added to these requirements to determine the total amount of water required at an *Installation*.

**1-12.2.2** The water supply analysis must include an analysis of the domestic water quantity using diurnal curves if time of day water curves are not available. The analysis must include historical data to address seasonal water supply fluctuations, peak water demand and average daily demand and its effect on fire suppression water availability.

### 1-12.3 *Installation* Water Distribution.

Note: The requirements of this section apply to the *Installation*, as defined in Chapter 2, not the individual *Facility*.

**1-12.3.1** Except as modified below, water distribution mains, service mains and service laterals must be designed in accordance with AWWA M31, NFPA 24 and UFC 3-230-01.

**1-12.3.2** \2\For *service laterals* that do not utilize PVC pipe, the velocity must not exceed 10 feet per second (3 m/s).

**1-12.3.3**     /2/One or more of the following reliable means must provide fire protection water to an *Installation*:

**1-12.3.3.1**    Multiple connections to looped or gridded public *Service Main(s)* arranged so that during any single-point failure, at least 50 percent of the maximum required *Fire Flow* plus 100 percent of domestic demand can still be supplied to the *Installation*.

**1-12.3.3.2**    A single connection to a public *Service Main(s)*, plus on-site storage sized in accordance with UFC 3-230-01, in the event the connection to the public system is lost.

**1-12.3.3.3**    One or more on-site sources, such as wells or open bodies of water, with treated water storage capacity sized in accordance with UFC 3-230-01.

**1-12.3.4**     For a small *Installation*, such as a Reserve Training Center, a single connection to a looped or gridded public water *Service Main*, capable of providing concurrent domestic demand and *Fire Flow* to the *Installation*, is acceptable.

**1-12.3.5**     For service mains served by fire pumps or service laterals serving fire pumps, velocities must be calculated using 150 percent of the rated capacity of the fire pump.

**1-12.4**        *Installation* On-Site \2\Water/2/ Storage.

\2\2/

**1-12.4.1**     Water level must be remotely monitored in accordance with NFPA 22 and NFPA 72 at a constantly attended location, preferably at the *Installation's* remote supervising station.

**1-12.4.2**     In geographic locations having a 99.6% dry bulb temperature less than 32°F (0°C) per UFC 3-400-02 Engineering Weather Data, water temperature of aboveground storage tanks must likewise be monitored at a constantly attended location.

**1-12.4.3**     Provide an external visual water-level gauge on each non-elevated or below ground tank.

**1-12.5**        Waterflow Testing.

**1-12.5.1**     Conduct waterflow tests, in accordance with the procedures contained in NFPA 291, to determine available water supply for the water-based fire extinguishing systems. The flow test must be performed under the direction of the *DFPE*. Advertisement of the project must not occur without obtaining water supply information.

**1-12.6** *Fire Flow.*

**1-12.6.1** *Fire Flow* for any proposed *Facility* must be calculated to determine if upgrades to the *Installation* water supply is required. *Fire Flow* must be calculated in accordance with Chapter 9.

**1-12.6.1.1** Where the *Fire Flow* cannot be met, the *DFPE* is permitted to approve a reduction in *Fire Flow*.

**1-12.6.2** When the required *Fire Flow* cannot be provided by the existing infrastructure, a cost and benefit analysis must be conducted by the *DFPE*, or their representative, to determine if additional fire protection systems, features, or design changes that provide more favorable factors, such as type of construction or sprinkler protection, are more cost effective than providing the required *Fire Flow*.

**1-12.7** *Fire Pumps.*

**1-12.7.1** The *DFPE* must determine the need for a fire pump in the planning stages of a project in order to ensure adequate space is available at the *Facility*.

**1-12.7.2** The *DFPE* must determine if a *Reliable Power Source* is available to the *Installation* or *Facility* in the planning stages of the project in order to ensure that the cost and space associated with secondary power is considered and included in the project.

**1-12.7.3** Where a fire pump is needed, a single pump is satisfactory for ordinary value and ordinary use structures. For structures with critical missions or very high values, the AHJ may require redundancy in fire pump capacity such, as two pumps at 100% capacity or three pumps at 50% capacity. /2/

**1-12.8** *Automatic Sprinkler Systems.*

**1-12.8.1** For facilities that do not require sprinkler protection as required in the “Special Detailed Requirements Based On Use” or “Fire Protection Systems” chapters of this UFC, /2/ the *DFPE* must determine if an automatic sprinkler or other fire suppression system is required for the *Facility* based on mission, hazard of contents, value of contents or other criteria. This determination must be included in the contract documents for design services or design-build services.

**1-12.8.2** Prior to the installation of backflow preventers in an existing fire suppression system, a thorough hydraulic analysis, including hydraulic calculations and flow test, must be performed to ensure that the water supply is still adequate for the system with the backflow preventer. If the backflow preventer causes the demand to exceed the water supply, the backflow preventer must not be installed until the water supply is corrected to support the new demand.

**1-12.9** *Clean Agent Fire Extinguishing Systems.*

The *DFPE* must determine if a connected reserve supply should be provided.

Note: A reserve supply should only be considered if replacement cannot be delivered to the site within 24 hours. This would typically apply to locations outside the United States and its territories and possessions.

**1-12.10** Rural, Remote, Range, and Wildland Locations.

Fire protection water supplies supporting rural, remote, range, or wildland *Facility* locations without water distribution systems must be in accordance with NFPA 1141 and NFPA 1142.

**1-12.11** Military Operations on Urban Terrain (MOUT) Trainers.

**1-12.11.1** See the paragraph entitled "MOUT" in the "Special Detailed Requirements Based on Use" Chapter in this UFC.

**1-12.12** Warehouses and Storage *Facilities*.

**1-12.12.1** The DFPE must determine if sprinkler protection must be provided for *facilities* less than 5,000 square feet containing materials, equipment and supplies that are critical to operations, pose a severe fire hazard, are of high monetary value, pose a safety or environmental health risk, or expose an important structure.

**1-12.12.2** The DFPE must determine the commodity classification and maximum storage height and include this information in the contract documents when this information differs from the minimum noted in the section on "Warehouse and Storage *Facilities*" in this UFC.

**1-12.12.3** Information such as the storage configuration (racks, shelves, palletized, bin box, and solid-piled), aisle width, clearance to ceiling, and ceiling sprinkler temperature rating must be evaluated prior to developing contract documents in order to provide the proper sprinkler protection.

**1-12.12.4** See the section on "Warehouse and Storage *Facilities*" in this UFC for additional requirements.

**1-12.13** Existing *Facilities*.

**1-12.13.1** When planning any *Additions, Alterations, Modifications, Renovations, Reconstruction, or Repairs* to existing facilities, determine if the facility has any existing or outstanding fire protection or life safety deficiencies and include them into the work being planned.

**1-12.13.2** If work is being phased, the total floor area of all the phased work must be used to determine if the facility needs to be brought into compliance with new criteria in lieu of just the work being performed. See the section for "Phased Projects" in this UFC.

**1-12.13.3** See the "Existing Facilities" Chapter in this UFC for additional requirements.

**1-13 CYBERSECURITY.**

All control systems (including systems separate from an energy management control system) must be planned, designed, acquired, executed, and maintained in accordance with DoD Instruction 8500.01, DoD Instruction 8510.01, and as required by individual Service Implementation Policy.

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## CHAPTER 2 DEFINITIONS

### 2-1 GENERAL.

The definitions contained in this chapter apply to the terms used in this UFC. Where terms are not defined in this chapter or within another chapter, they are defined in the referenced UFC, code or standard applicable to the context in which they are used. Plural terms must have the same definition as singular terms.

#### 2-1.1 Addition.

An increase in the building area, aggregate floor area, building height, or number of stories of a structure. [NFPA 101]

#### 2-1.2 Alteration.

The reconfiguration of any space; the addition, relocation, or elimination of any door or window; the addition or elimination of load-bearing elements; the reconfiguration or extension of any system; or the installation of any additional equipment.

#### 2-1.3 Authority Having Jurisdiction (AHJ).

The term "*AHJ*" as used in this UFC and the codes and standards referenced in this UFC means the Fire Protection Engineer assigned to the Military Service or Defense Component office of responsibility listed below. The exercise of *AHJ* is contingent upon maintaining the qualifications required of the Fire Protection Engineer. For the Defense Components not listed, and where a listed Defense Component is unable to maintain the qualifications of the Fire Protection Engineer, *AHJ* falls to the Military Service with jurisdiction of the *Installation* on which the facility is located.

*AHJ* offices are as follows/1/:

- a. U.S. Army - HQ USACE/CECW-CE.
- b. U.S. Navy - NAVFACENGCHE HQ Code CHE.
- c. U.S. Marine Corps - HQMC Code LF.
- d. U.S. Air Force - AFCEC/CO.
- e. Defense Logistics Agency (DLA), DS-IE./1/
- f. National Geospatial-Intelligence Agency (NGA) - Security and Installations.
- g. National Reconnaissance Office (NRO) - MS&O/ESO.



- h. Washington Headquarters Services (WHS) - Office of the Pentagon Fire Marshal.
- i. National Security Agency/Central Security Service - Office of Occupational Health, Environmental and Safety Services (NSA/CSS OHESS).\1\

**2-1.4** /1/Bin Storage.

Bin storage consists of five-sided, open from top or side storage containers, stacked in rack structures. They are commonly used in automatic storage and retrieval systems.

Note: Bin storage requires unique considerations for fire protection. Bin storage configurations do not limit oxygen supply. Horizontal flame spread can be rapid. The narrower the aisles and the higher the storage, the less ceiling sprinkler water penetration is delivered to control the fire.

**2-1.5** Distribution Main.

Any pipe in a water distribution system other than a *Service Main* or *Service Lateral*. A distribution main carries water from the original source (i.e. tank or underground water source) to the *Service Main*. A distribution main can be connected to the source, *Service Main* or another distribution main. A distribution main cannot connect to a *Service Lateral*.

**2-1.6** DoD Component.

The specific DoD branch or subunit of a branch or service. For the purpose of this UFC, this includes, but is not limited to, Army, Navy, Marines, Air Force, NRO, WHS, NGA and NSA.

**2-1.7** Dwelling Unit.

One or more rooms arranged for complete, independent housekeeping purposes, with space for eating, living, and sleeping; facilities for cooking; and provisions for sanitation. [NFPA 101]

**2-1.8** Electronic Equipment Area.

Areas of a *Facility* that include, but are not limited to data centers, communication centers, and command and control systems. Electronic equipment areas are also areas containing telecommunication equipment that serves more than one *Facility*, a portion of an *Installation* or the entire *Installation*. This section does not apply to the room in a *Facility* that contains the incoming telecommunications service for that specific *Facility* or *Incidental Electronic Equipment* rooms.

**2-1.9** Exemption.

The authority to deviate from a UFC requirement indefinitely. See MIL-STD-3007.

**2-1.10** Facility.

This includes all types of buildings and their contents, structures, mobile and stationary equipment, civil works or military buildings, hydroelectric plants, waterfront structures, outside storage, and shore protection for ships and aircraft. A facility can be either of temporary or permanent construction.

**2-1.11** Fire Alarm Reporting System.

Fire alarm reporting systems are the *Installation*-wide reporting systems that connect the *Facility* fire alarm control panel(s) to a constantly attended location staffed with qualified operators for the receipt and processing of emergency communications. Consider compatibility of extensions of fire reporting systems with existing equipment.

**2-1.12** Fire Area.

The aggregate floor area enclosed and bounded by fire walls, fire barriers, exterior walls or horizontal assemblies of a *Facility*. Areas of the *Facility* not provided with surrounding walls must be included in the *Fire Area* if such areas are included within the horizontal projection of the roof or floor above. [IBC]

**2-1.13** Fire Flow.

The flow rate of a water supply, measured at 20 psi (138 kPa) residual pressure that is available for firefighting. [NFPA 1]

**2-1.14** Fire Water Demand.

The fire water demand is the water flow required for the fire suppression system plus  $\sqrt{2}$  interior/exterior hose stream demands./2/

**2-1.15** Fire Protection Engineer.

**2-1.15.1** Designated (or Service) Fire Protection Engineer (DFPE).

The DoD fire protection engineer that oversees that Area of Responsibility for that project. This is sometimes referred to as the “cognizant” fire protection engineer.

Note 1: For USACE, this is usually the District or Center FPE.

Note 2: For NAVFAC, this is usually the Facilities Engineering Command (FEC) FPE.

**2-1.15.2** Qualified Fire Protection Engineer (QFPE).

$\sqrt{2}$ An individual who is a registered professional engineer (P.E.) who has passed the fire protection engineering written examination administered by the National Council of Examiners for Engineering and Surveying (NCEES) and has relevant fire protection engineering experience./2/

**2-1.16** Incidental Electronic Equipment.

Word processing stations, printers, and systems; desk top computers; office automation systems; individual data output stations (i.e. printers, etc.); individual computer work stations; telephones; communication equipment; video conference centers; administrative telephone rooms; reproduction equipment; and similar equipment. Incidental Electronic Equipment includes building only or building-wide communication/telephone/LAN equipment typically found in communication, data or telephone rooms that do not serve an essential mission or purpose for National Defense. This includes the room in a *Facility* that contains the incoming telecommunications service for that specific *Facility*.

**2-1.17** Inhabited.

See UFC 4-010-01.

**2-1.18** Installation.

As used in this document, the Installation is the DoD base, post, camp, fort, station, airfield or other similar complex that shelters military equipment or personnel or facilitates training and operation. An Installation includes one or more DoD *Facilities*.

**2-1.19** Life Safety System.

Those systems that enhance or facilitate evacuation, smoke control, compartmentalization or isolation. [NFPA Glossary of Terms]

**2-1.20** Major Project.

A project that includes any one of the following:

- a. Addition to an existing *Facility*.
- b. *Renovation, Reconstruction* or *Alteration* of 50 percent or more of the total floor area of an existing *Facility*.
- c. Design or construction of a new *Facility*.
- d. New installation or *Modification* of an area of construction greater than 5,000 ft<sup>2</sup> of floor area that involves existing or new fire barriers or fire-rated construction; *Life Safety Systems*; fire alarm or detection systems; fire suppression systems.

Note: Modification of 20 or more existing sprinklers is considered a Major Project.

- e. New installation or *Modification* of existing HVAC systems that remove or install the duct work passing through fire-rated or smoke partitions/barriers

or interconnected plenum areas serving an area greater than 5,000 ft<sup>2</sup> of floor area.

**2-1.21** Mass Notification System.

Refer to UFC 4-021-01.

**2-1.22** \2\2/Medical Facilities.

Also referenced as Medical Treatment Facilities (MTFs), includes medical and dental treatment facilities, medical training facilities, medical research facilities, and veterinary facilities in the Military Health System (MHS)

**2-1.23** Missile Alert Facilities (MAF).

The aboveground *Facilities* that support underground ballistic missile launch control centers.

**2-1.24** Missile Assemblies.

Missile assemblies are considered to be large rocket type, cruise missiles without their ordnance, intercontinental ballistic missiles, or Poseidon missiles.

**2-1.25** Modification.

The reconfiguration of any space; the addition, relocation, or elimination of any door or window; the addition or elimination of load-bearing elements; the reconfiguration or extension of any system; or the installation of any additional equipment. [NFPA 101]

**2-1.26** Multi-Family Housing.

More than two *Dwelling Units* under one roof intended for occupancy by spouses or dependents of DoD personnel. \2\Multi-Family Housing does not include multiple single-family dwellings, i.e., townhouses./2/

**2-1.27** Noncombustible Material.

A material that, in the form in which it is used and under the conditions anticipated will not ignite, burn, support combustion, or release flammable vapors, when subjected to fire or heat. Materials that are reported as passing ASTM E136 must be considered noncombustible materials. [NFPA 102]

**2-1.28** Ordnance Facility.

A *Facility* or area used for the manufacturing, storage, maintenance or demilitarization of ordnance including, but not limited to, munitions, weapons, missile assemblies.

**2-1.29** Primary Gathering Building.

See UFC 4-010-01.

**2-1.30** Reconstruction.

The reconfiguration of a space that affects an exit or a corridor shared by more than one lockable space; or the reconfiguration of a space such that the rehabilitation work area is not permitted to be occupied because existing means of egress and fire protection systems, or their equivalent, are not in place or continuously maintained. [NFPA 101]

**2-1.31** Reliable Power Source.

**2-1.31.1** For a *Facility* located on an *Installation*, reliability is determined at the power source serving the *Installation*. For a *Facility* not located on an *Installation*, reliability is determined at the power source to the *Facility*.

Note: For example, if the building in question is located on a Navy Base, Army Post or similar, reliability is determined by when power is lost to the entire Base, Post or similar, not the actual building. If the building is located away from a Base, Post or similar, reliability is determined by when power is lost to the building itself.

**2-1.31.2** Unless otherwise noted, a reliable power source is a power source having forced down time, excluding scheduled repairs, that does not exceed 8 consecutive hours for any one incident within the last 3 years, or more than 24 hours cumulatively over the last 3 years.

**2-1.32** Renovation.

The replacement in kind, strengthening, or upgrading of building elements, materials, equipment, or fixtures, that does not result in a reconfiguration of the building spaces within. [NFPA 101]

**2-1.33** Repair.

The patching, restoration, or painting of materials, elements, equipment, or fixtures for the purpose of maintaining such materials, elements, equipment, or fixtures in good or sound condition. [NFPA 101]

**2-1.34** Review Stamp.

A stamp certifying that the *QFPE* has reviewed the document and finds that it meets all contractual requirements. A Review Stamp is not a professional engineer stamp or seal.

**2-1.35** Sensitive Compartmented Information Facility (SCIF).

Accredited areas, room(s), or building(s) where Sensitive Compartmented Information (SCI), is stored, used, processed or discussed. SCIF are only required for SCI and not necessarily required for Secret or Top Secret information. [UFC 4-010-05]

**2-1.36** Service Lateral.

A pipe that connects to the *Service Main* and terminates at a fire hydrant or a *Facility*. A service lateral to a *Facility* is permitted to have no more than two fire hydrants. A service lateral does not connect from one *Service Main* to a second *Service Main*. A service lateral is a private service fire main as used in NFPA 24.

**2-1.37** Service Main.

A pipe that transports water from the *Distribution Main* to the *Service Lateral*. A service main can be connected to a *Distribution Main*, *Service Lateral* or another service main. A main with three or more fire hydrants connected to it is a service main. A main from a fire pump to more than one building is a service main.

**2-1.38** Stakeholders.

A group of identified individuals or representatives, typically having authoritative control or input, having a share or interest in the successful completion of a project. A project's identified stakeholders must include the building's design and construction team members, security, the *AHJ*, accreditation agencies, tenants, supported commands and emergency responders.

**2-1.39** Telecommunications Equipment Areas.

See "Electronic Equipment Areas".

**2-1.40** Tension Membrane Structure.

A membrane structure incorporating a membrane and a structural support system such as arches, columns, and cables, or beams wherein the stresses developed in the tension membrane interact with those in the structural support so that the entire assembly acts together to resist the applied loads. [NFPA 102]

**2-1.41** Very Early Warning Smoke Detection.

Detection that is listed as being capable of providing the level of protection as defined in NFPA 76 for Very Early Warning Fire Detection. Aspirating smoke detection installed in Europe must comply with Class A requirements as specified in EN54 (Fire Detection and Fire Alarm Systems), Part 20 (Aspirating Smoke Detection) (EN54-20).

The maximum area of coverage per detector, or sampling point, is 200 ft<sup>2</sup> (18 m<sup>2</sup>) for one level of detectors. A minimum of one alert and one alarm level are provided.

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## **CHAPTER 3 USE AND OCCUPANCY CLASSIFICATION**

### **3-1 GENERAL**

This UFC utilizes criteria from both IBC and NFPA 101. Care must be exercised when using this UFC to ensure proper use of IBC and NFPA 101.

### **3-2 INTERNATIONAL BUILDING CODE (IBC).**

#### **3-2.1 General.**

**3-2.1.1** The IBC must be used where dictated by UFC 1-200-01 except where noted in this UFC.

**3-2.1.2** The IBC must be utilized to determine the occupancy classification as it relates to allowable construction type, building height, building area, building separation distance, occupancy separation and associated requirements.

**3-2.1.3** Medical funded projects, including but not limited to, healthcare, ambulatory healthcare and all facilities required to comply with The Joint Commission standards must comply with NFPA 101 in its entirety.

### **3-3 NFPA 101.**

#### **3-3.1 General.**

**3-3.1.1** NFPA 101 must be utilized to determine the occupancy classification as it relates to fire/smoke resistance rating of interior non-load bearing partitions (other than occupancy separation), means of egress, interior finish, features of fire protection (including vertical openings) and associated requirements.

**3-3.1.2** Where specific criteria is provided in NFPA 101 related to occupancy location within a building (i.e. story), conform to the requirements of NFPA 101 based on the equivalent construction type.

Note: Where IBC permits a particular occupancy classification on the third floor of a building of Type IIB construction and NFPA 101 only permits that occupancy classification on the second floor for Type II (000), the occupancy is only permitted on the second floor.

**3-3.1.3** Appendix D provides a cross reference between the construction types referenced in NFPA 220 and the IBC.

### **3-4 HAZARDOUS MATERIALS.**

For the purpose of occupancy classification, the maximum allowable quantities (exempt amounts) noted in NFPA 400 must be used. Where the maximum allowable quantities are exceeded in NFPA 400, the H occupancy classification (H-1, H-2, etc.) must be



defined in accordance with IBC for High-Hazard Group H occupancies, except as modified by this UFC. IBC Chapter 4 must be utilized to determine the IBC occupancy type. IBC Chapter 4 is not to be utilized for hazardous materials requirements.

**Table 3-1 Hazardous Materials Classification**

HAZARDS	NFPA 400 & NFPA 1 CLASSIFICATION	NFPA 400 & NFPA1 PROTECTION LEVEL	IBC GROUP H CLASSIFICATION
Detonation Hazard	High Hazard Level 1	Protection Level 1	H-1
Deflagration Hazard	High Hazard Level 2	Protection Level 2	H-2
Physical Hazard	High Hazard Level 3	Protection Level 3	H-2 or H-3
Health Hazard	High Hazard Level 4	Protection Level 4	H-4
HPM Facility	Not Applicable	Not Applicable	H-5

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## CHAPTER 4 SPECIAL DETAILED REQUIREMENTS BASED ON USE

### 4-1 GENERAL.

This Chapter provides specific criteria for special or unique occupancies and hazards and supersedes IBC Chapter 4 in its entirety. For special or unique occupancies and hazards not addressed in this Chapter, comply with the requirements of NFPA 101. This Chapter either supersedes or is in addition to requirements in other Chapters of this UFC.

### 4-2 AIRCRAFT ACOUSTICAL ENCLOSURES.

#### 4-2.1 Complete Enclosures (Hush House).

For Air Force, Aircraft Acoustical Enclosures are not classified facilities (real property); they are classified equipment and as such are managed by the Air Force Sustainment Center, Air Force Logistic Complex, Propulsion Support Equipment, Hush Houses/ Noise Suppressors (AFLCMC/WNZEC) Robins AFB, GA. The criterion of the UFCs does not apply to this equipment. These systems are centrally managed and are not constructed nor maintained as facilities under this UFC. The fire protection system controls in such enclosures are provided with connection to the installation fire alarm communication network by the installation.

**4-2.1.1** Conform to the requirements listed in the paragraph entitled "Aircraft Facilities". Provide separate manual controls for actuation of each foam system.

#### 4-2.2 Out of Airframe Acoustical Enclosures (Test Cells).

Fire protection system for Test Cells must consist of the following:

- a. Overhead water deluge system having a density of  $0.35 \text{ gpm/ft.}^2$  ( $14.3 \text{ L/min/m}^2$ ) over the entire floor area.
- b. Water spray system for the engine having a density of  $0.50 \text{ gpm/ft.}^2$  ( $20.4 \text{ L/min/m}^2$ ) of engine surface area.
- c. Water spray system for the floor area beneath the engine having a density of  $0.50 \text{ gpm/ft.}^2$  ( $20.4 \text{ L/min/m}^2$ ) over the entire shadow area.

Note: The overhead deluge system need not extend into the area where the water spray systems for the engine and floor are present.

### 4-3 AIRCRAFT FACILITIES.

#### 4-3.1 Aircraft Hangars.

For fixed wing and rotary wing aircraft fuel cell maintenance facilities, alert, storage, depot-level and general-purpose maintenance hangars comply with UFC 4-211-01. For corrosion control hangars, comply with UFC 4-211-02.

#### 4-3.2 Tensioned-Membrane Hangars.

**4-3.2.1** Construction type must conform to NFPA 409. Tension fabric hangars must utilize rigid-steel-frame structures.

**4-3.2.2** The minimum separation between tensioned-membrane hangars and all other structures must be 100 feet (30.5 m), with a clear zone of 50 feet (15.3 m) immediately adjacent to the tension fabric structure. The clear zone cannot be used for storage and must be clear of vegetation (maintained lawn is permitted). The clear zone may be used as a street or driveway, but not for vehicle parking. The clear zone must be clearly striped to indicate no storage or parking.

Note: For Navy, see OPNAVINST 11010.33 for regulations and restrictions on the use of relocatable facilities.

#### 4-3.3 Aircraft Weather Covering.

Weather coverings used for aircraft on the flight line (see Figure 4-1), regardless of material, do not require a fire detection or suppression system. Any permanent electrical devices or equipment (receptacles, lighting, or other similar devices) installed on the aircraft weather covering (sunshade) must comply with the requirements for aircraft hangars in NFPA 70 as well as the criteria for fuel servicing safety zone found in the individual *DoD Component* criteria (i.e. AFTO 00-72-125, NAVAIR 00-80R-14, NAVAIR 00-80T-109 or AR 420-90).

**Figure 4-1 Examples of Weather Covering**



#### 4-3.4 Facilities Housing Unmanned Aerial Vehicles (UAV) or Remotely Piloted Aircraft (RPA).

**4-3.4.1** For this UFC, an Unmanned Aerial Vehicle (UAV) or Remotely Piloted Aircraft (RPA) consists of just the vehicle; and, an Unmanned Aerial System (UAS) consists of the vehicle, launcher, and any other associated equipment for that system./2/

**4-3.4.2** *Facilities* designed to support \2\UAS,/2/ UAV, or RPA that have both of the following must be protected in accordance with the section for Aircraft Hangars in this UFC:

- a. Combined fuel capacity of all \2\UAS,/2/ UAV, or RPA equal to or greater than 240 gallons (908.4 L) and
- b. Access to a runway that supports manned aircraft.

**4-3.4.3** *Facilities* designed to support \2\UAS,/2/ UAV, or RPA that have both of the following must be protected in accordance with the section for Aircraft Hangars in this UFC:

- a. Has a door opening greater than \2\or equal to/2/ 20 feet (6.1m) in height and
- b. Access to a runway that supports manned aircraft.

**4-3.4.4** *Facilities* designed to support \2\UAS,/2/ UAV, or RPA that have both of the following must be \2\provided with sprinklers designed/2/ in accordance with NFPA 30, \2\Storage of Liquids in Containers – Storage Occupancies/2/:

- a. Combined fuel capacity of all \2\UAS,/2/ UAV, or RPA is equal to or greater than 240 gallons (908.4 L) and
- b. No access to a runway that supports manned aircraft.

**4-3.4.5** *Facilities* designed to support \2\UAS,/2/ UAV, or RPA that have both of the following must be \2\provided with sprinklers designed/2/ in accordance with NFPA 30, \2\Storage of Liquids in Containers – Storage Occupancies/2/:

- a. Has a door opening less than 20 feet (6.1m) in height and
- b. Access to a runway that supports manned aircraft.

**4-3.4.6** *Facilities* designed to support \2\UAS,/2/ UAV, or RPA that have both of the following must be protected with automatic sprinklers:

- a. Combined fuel capacity of all \2\UAS,/2/ UAV, or RPA is \2\more/2/ than \2\120 gallons (454.2 L) and less than/2/ or equal to 240 gallons (908.4 L) and
- b. No access to a runway that supports manned aircraft.

**4-3.4.7** *Facilities* designed to support \2\UAS,/2/ UAV, or RPA that have all of the following do not require automatic sprinklers:

- a. Combined fuel capacity of all \2\UAS,/2/ UAV, or RPA is less than 120 gallons (454.2 L) per control area (as defined by NFPA 30),
- b. No access to a runway that supports manned aircraft,
- c. Sprinkler protection is not required by the "Application Requirements" paragraph in the section for Automatic Sprinkler Systems in this UFC,

- d. Supports small, human packable, portable UAV or RPA, and
- e. The facility is separated from other structures by a minimum of 100 feet (30.5 m).

**4-3.4.8** \2\For Army, in addition to the aforementioned paragraphs, *Facilities* designed to support UAS or UAV must be protected as follows. If there is a conflict between the aforementioned paragraph and this paragraph, follow the more stringent paragraph.

- a. *Facilities* housing Group 4 UAS or UAV must be protected in accordance with the section for Aircraft Hangars in this UFC. Group 4 UAV weigh more than 1,320 LBS.
- b. *Facilities* housing Group 3 UAS or UAV, where the fire area of the aircraft servicing or storage area exceeds 7,500 SQFT, must be protected in accordance with the section for Aircraft Hangars in this UFC. Group 3 UAV weigh more than 56 LBS but less than 1,320 LBS.
- c. *Facilities* housing Group 3 UAS and UAV, where the fire area of the aircraft servicing or storage area does not exceed 7,500 SQFT, but is required by another section of the UFC to have sprinklers, must have the aircraft servicing or storage area protected in accordance with NFPA 30, Storage of Liquids in Containers – Storage Occupancies. All operations outside the UAV or UAS housing area must be isolated from the UAV or UAS housing area by 1-hour fire barrier walls. Floor elevations must be arranged to prevent a spill within the UAV or UAS housing area from flowing into adjacent areas. Adjacent areas are not permitted to have their required egress through the UAV or UAS housing area, except for normally unoccupied rooms less than 100 sq. ft.
- d. *Facilities* housing Group 3 UAS and UAV, where the fire area of the aircraft servicing or storage area does not exceed 7,500 SQFT, and is not required by another section of the UFC to have sprinklers, is not required to have a suppression system. All operations outside the UAV or UAS housing area must be isolated from the UAV or UAS housing area by 1-hour fire barrier walls. Floor elevations must be arranged to prevent a spill within the UAV or UAS housing area from flowing into adjacent areas. Adjacent areas are not permitted to have their required egress through the UAV or UAS housing area, except for normally unoccupied rooms less than 100 sq. ft./2/

Note: The reference to NFPA 30 in this section pertains to sprinkler requirements only and is not intended to follow all of the requirements in NFPA 30.

#### **4-4 ANECHOIC CHAMBERS.**

Fire protection goals must comply with the section titled "Protection of Chamber and its Contents" as specified in FM Global Data Sheet 1-53. The primary method of fire suppression must be a clean-agent gaseous fire suppression system actuated by an air-

aspirated very early warning smoke detection system. Secondary means of fire protection must consist of an equally sized, manually activated, connected reserve supply of gaseous suppression agent as specified in the FM data sheet.

**4-5 CHILD DEVELOPMENT PROGRAMS.**

**4-5.1** Child Development Centers (CDC).

Comply with UFC 4-740-14. For Navy/Marines, comply with FC 4-740-14N.

**4-5.2** Continuous Child Care Facilities (24/7).

Comply with UFC 4-740-15.

**4-5.3** Other Child Development Programs.

Other child development programs include part-day, preschool, kindergarten, before and after school programs, school-age *Facilities*, etc. Comply with the provisions of educational occupancies in NFPA 101.

**4-5.4** Youth Centers.

Youth centers must comply with UFC 4-740-06.

**4-6 COAL.**

**4-6.1** General.

Coal storage and handling must comply with NFPA 850 and FM Loss Prevention Data Sheet 8-10.

**4-6.2** Pulverizing Equipment.

Use components designed and constructed in accordance with requirements of NFPA 850.

**4-7 COMMISSARIES AND EXCHANGES.**

**4-7.1** Mixed Occupancy.

Commissaries and Exchanges that are part of another facility (i.e., mixed occupancy) and the Commissary or Exchange area is greater than 8,000 ft<sup>2</sup> (743.2 m<sup>2</sup>) gross floor area, the entire facility must meet the requirements of the sprinkler "Application Requirements" section of this UFC.

**4-7.2** Standalone.

Commissaries and Exchanges that are a separate facility (i.e. standalone) and greater

than 8,000 ft<sup>2</sup> (743.2 m<sup>2</sup>) gross floor area must be provided with automatic sprinkler protection regardless of construction type.

**4-8 COMPACT MOBILE SHELVING.**

**4-8.1** Reserved.

**4-9 DEPARTMENT OF DEFENSE EDUCATION ACTIVITY (DODEA).**

DoDEA *Facilities* must comply with the requirements in this UFC.

**4-10 DETENTION AND CORRECTIONAL FACILITIES.**

**4-10.1** Requirements.

Comply with NFPA 101 and the following:

**4-10.1.1** Individual *Fire Areas* must not exceed 50,000 ft<sup>2</sup> (4,647 m<sup>2</sup>).

**4-10.1.2** Construction type must be Type I-A, as defined in the IBC.

**4-10.1.3** Provide a minimum separation from other structures and public ways of 20 feet (6.1 m).

**4-10.1.4** Provide complete automatic sprinkler protection. Design must utilize institutional (breakaway) type sprinklers in areas accessible to detainees or inmates. Sprinkler piping in detainee or inmate areas must be concealed.

**4-10.1.5** Provide an automatic smoke control system in cell areas. In addition, provide manual system activation controls at a continuously manned position outside of the cell area. Design the smoke control system in accordance with NFPA 92.

**4-10.1.6** Provide for constant visual supervision of cell areas. Central supervisory control area must be separated from cell areas by not less than one-hour fire-rated construction.

**4-10.1.7** Fire alarm notification in cell areas must be at a constantly attended location, with detainees or inmates notified by the staff of fire events. Positive alarm sequence is permitted to be provided in accordance with NFPA 72.

**4-10.1.8** Locking Devices.

Provide mechanical or electrical gang release, and individual release devices whenever 10 or more locks must be operated to release prisoners confined in cells. Require gang release devices to open doors necessary to evacuate prisoners to an area of refuge. Require heavy, identically keyed, prison-type locks for exit and corridor doors not requiring gang release devices that must be opened for evacuation in the event of fire.

Dormitory-style confinement facilities are not required to meet the above criteria.

**4-10.1.9** Interior Finish.

Interior finish including padded cells must be Class A flame spread (i.e., 25 or less) and must have a smoke development rating not exceeding 50 when tested in accordance with ASTM E84.

**4-10.1.10** Navy *Facilities* must also comply with the ACA's Planning and Design Guide for Secure Adult and Juvenile Facilities.

**4-11 ELECTRONIC EQUIPMENT AREAS.**

This section applies to *Electronic Equipment Areas* and telecommunications areas as defined in this UFC.

**4-11.1** General.

**4-11.1.1** Construct and protect *Electronic Equipment Areas* in accordance with NFPA 75, except as modified by this UFC.

**4-11.1.2** For Air Force *Facilities*, comply with ETL 01-18 for fire protection criteria, in lieu of this section.

**4-11.2** Telecommunication Equipment Areas.

This section applies to areas containing telecommunication equipment that serves more than one *Facility*, a portion of an *Installation* or the entire *Installation*. This section does not apply to the room in a *Facility* that contains the incoming telecommunications service for that specific *Facility*.

**4-11.2.1** Telecommunication areas must comply with NFPA 76, in lieu of NFPA 75.

Buildings housing telecommunication areas must be of noncombustible construction.

**4-11.2.2** Co-located *Facility*.

For *Facilities* that house telecommunication areas that have occupancies and uses other than telecommunication, the entire *Facility* must be provided with sprinkler protection, including the telecommunication area.

**4-11.2.3** Stand-alone *Facilities*.

**4-11.2.3.1** For stand-alone *Facilities* greater than 2,500 ft<sup>2</sup> (232 m<sup>2</sup>), provide a fire extinguishing system in accordance with either the paragraph entitled "Clean Agent Fire Extinguishing Systems" or "Sprinkler Systems" below.



**4-11.2.3.2** For stand-alone *Facilities* greater than 7,500 ft<sup>2</sup> (696 m<sup>2</sup>), provide a sprinkler system in accordance with the paragraph entitled "Sprinkler Systems" below. A clean agent fire extinguishing system can be provided in addition to, but not in lieu of, the sprinkler system.

**4-11.2.3.3** Single-story *Facilities* may be of Type II-B construction.

**4-11.3** Smoke Detection.

**4-11.3.1** *Electronic Equipment Areas* must be protected by Very Early Warning Smoke Detection systems.

**4-11.3.2** Smoke detection must provide not less than two distinct alarm conditions (levels) indicating increasing smoke/combustion levels.

**4-11.3.3** Smoke detection must notify equipment operators of all distinct threshold conditions/levels. Where operators are not in constant attendance, alarm signals must notify the constantly attended alarm receiving location.

**4-11.4** Sprinkler Systems.

**4-11.4.1** *Electronic Equipment Areas* must be located in *Facilities* protected by wet pipe automatic sprinklers, except those telecommunication areas identified above.

**4-11.4.2** Provide complete wet pipe sprinkler protection throughout the *Electronic Equipment Area*.

**4-11.4.3** The *Electronic Equipment Area* must be able to be isolated from other areas by a zone control valve assembly. The control valve assembly must include a control valve, waterflow switch and inspector's test connection.

Note: Consult with the DFPE to determine the extent, or boundary, of the *Electronic Equipment Area*.

**4-11.4.4** For areas with finished ceilings, use concealed pendent or concealed sidewall sprinklers. For areas without finished ceilings, use upright sprinklers with listed sprinkler guards or concealed sidewall sprinklers.

**4-11.4.5** Fire sprinklers must not be provided below raised floors.

**4-11.5** Clean Agent Fire Extinguishing System.

Note: Consideration may be given to the use of a supplementary,  $\sqrt{2}$ /clean agent fire extinguishing system inside the electronic equipment units or a total flooding system for the room and raised floor.

**4-11.5.1** Clean agent fire extinguishing systems must not be utilized as a substitute for automatic sprinklers.

**4-11.5.2** Where the requirements of the paragraph entitled “Power and Communication Cabling” are not met, the room and the effected space above the ceiling and below the floor in the room must be protected by a \2\2/clean agent fire extinguishing system. Where only the below floor area is affected, it is acceptable to provide a \2\2/clean agent fire extinguishing system below the floor only.

**4-11.5.3** *Very Early Warning Smoke Detection* must be used to activate a clean agent fire extinguishing system.

**4-11.6** Electronic Equipment Power Disconnect.

**4-11.6.1** A means to disconnect power to critical electronic equipment must be provided as required by NFPA 70.

**4-11.6.2** The power disconnect method may be by manual means for *Electronic Equipment Areas* with one of the following:

- a. Areas that are constantly occupied (24 hours per day, 7 days a week) by personnel familiar with the electronic equipment, or
- b. Areas located within a *Facility* that are constantly staffed by a trained response force having ready access to the *Installation* and trained in emergency shutdown procedures.

**4-11.6.3** Where multiple rooms are located in one area that utilize power disconnect simultaneous to water discharge, coordinate with the customer on the shutdown requirements. If all adjacent areas may be considered as one, with power to all discontinued simultaneously, the entire area may be protected by one sprinkler system. However, if the customer requires each physically separated area to operate independently of the other, provide separate shutdown capabilities for the separated areas.

**4-11.6.4** Electrical equipment must be protected by disconnecting the power upon activation of the fire sprinkler system in the electronic spaces, unless power disconnect is permitted by manual means indicated above.

**4-11.6.4.1** The disconnect must be installed downstream of any UPS or similar equipment such that when the disconnect switch is activated, the UPS cannot supply power to the equipment.

**4-11.6.4.2** Electrical power disconnect is not required when approved by the *DFPE*.

**4-11.7** Power and Communication Cabling.

Power and communication (data) cabling installed in spaces above ceilings or below raised floors must be plenum rated or installed in non-combustible conduit in accordance with NFPA 70.

## 4-12 ELEVATORS.

### 4-12.1 General.

This section provides criteria for electric traction, machine room-less equipment and hydraulic elevators. Elevators must comply with the requirements of ASME A17.1 except as modified by this section.

### 4-12.2 $\sqrt{2}$ /Fire-Resistant Construction.

**4-12.2.1** The machine room must have the same fire resistance rating of the elevator shaft it serves.

**4-12.2.1.1** This requirement applies to the room containing the elevator controller for machine room-less elevator systems.

### 4-12.3 Detection.

**4-12.3.1** Provide smoke detectors at all elevator lobbies not open or exposed to the exterior (i.e. open parking structures and similar elevator lobbies) and all elevator machine rooms, including where machine room-less controllers are located.

**4-12.3.2** Provide smoke detectors at the top of elevator hoistway only when automatic sprinklers are provided in the hoistway.

**4-12.3.3** Provide listed control relays within 3 feet (915 mm) of the elevator controller to provide a supervised interface between the fire alarm system and the elevator controller as required by NFPA 72. The wiring between the control relays and the fire alarm control unit must be monitored for integrity as required by NFPA 72.

**4-12.3.4** Activation of any elevator machine room, hoistway, or lobby smoke detector must activate the *Facility* fire alarm system and send the affected elevators to the designated floor.

### 4-12.4 Sprinkler Protection.

**4-12.4.1** Where sprinklers are provided in the *Facility*, provide sprinklers for the elevator as noted below.

#### 4-12.4.2 Elevator Machine Room.

**4-12.4.2.1** Provide sprinkler(s) with listed sprinkler guard(s) in the machine room(s).

**4-12.4.2.2** Provide a supervised shut-off valve, check valve, waterflow switch, and test valve in the sprinkler line supplying the machine room(s). These items must be located outside of and adjacent to the machine room(s).

**4-12.4.2.3** Actuation of the waterflow switch must remove power to the elevator(s) served by that machine room, by direct connection from the waterflow switch (i.e. DPDT switch) to the shunt trip breaker.

**4-12.4.2.4** The waterflow switch must have no time delay capability.

**4-12.4.2.5** Provide an inspector's test connection for each waterflow switch associated with the elevator machine room. Locate the test connection outside the machine room. Route test connection piping to a floor drain location that can accept full flow or where water may be discharged without property damage. Discharge to a floor drain may be permitted only if the drain is sized to accommodate full flow (minimum of 40 gpm). Discharge to service sinks or similar plumbing fixtures is not permitted.

**4-12.4.3** Top of Hoistway.

**4-12.4.3.1** Provide sprinklers at the top of the hoistway when elevator machinery is located within the shaft.

**4-12.4.3.2** When sprinklers are provided at the top of the hoistway, a supervised shut-off valve, check valve, waterflow switch, and test valve must be provided in the sprinkler line supplying the top of hoistway.

**4-12.4.3.3** Actuation of the waterflow switch must remove power to the elevator(s) served by that hoistway, by direct connection from the waterflow switch (i.e. DPDT switch) to the shunt trip breaker.

**4-12.4.3.4** The waterflow switch must have no time delay capability.

**4-12.4.3.5** Provide an inspector's test connection for each waterflow switch. Locate the test connection outside the hoistway. Route test connection piping to a floor drain location that can accept full flow or where water may be discharged without property damage. Discharge to a floor drain may be permitted only if the drain is sized to accommodate full flow (minimum of 40 gpm). Discharge to service sinks or similar plumbing fixtures is not permitted.

**4-12.4.3.6** The top of the hoistway and machine room sprinklers may be served by the same control valve assembly and flow switch.

**4-12.4.4** Hoistway Pit.

**4-12.4.4.1** Provide sprinklers in elevator pits as required by NFPA 13.

**4-12.4.4.2** Provide a supervised shut-off valve in the sprinkler line supplying the pit. Locate the valve outside of and adjacent to the pit. Actuation of the pit sprinkler must not disconnect power to the elevator.

**4-12.5** Host Nation.

Comply with the requirements of the Host Nation.

**Table 4-1 Electric Traction Elevator**

ROOM / AREA	PROVIDE SPRINKLER (Not Applicable for Buildings Without Sprinkler Protection)	PROVIDE SMOKE DETECTOR to INITIATE ELEVATOR FIREFIGHTERS SERVICE and BUILDING FIRE ALARM SYSTEM
PENTHOUSE MACHINE ROOM	YES	YES
ELEVATOR LOBBIES	YES	YES
PIT AREA	NO	NO
TOP of HOISTWAY	NO	NO

**Table 4-2 Direct Plunger Hydraulic Elevator**

ROOM / AREA	PROVIDE SPRINKLER (Not Applicable for Buildings Without Sprinkler Protection)	PROVIDE SMOKE DETECTOR to INITIATE ELEVATOR FIREFIGHTERS SERVICE and BUILDING FIRE ALARM SYSTEM
MACHINE ROOM	YES	YES
ELEVATOR LOBBIES	YES	YES
PIT AREA	YES	NO
TOP of HOISTWAY	NO	NO

**Table 4-3 Holeless Hydraulic and Roped Hydraulic Elevator**

ROOM / AREA	PROVIDE SPRINKLER (Not Applicable for Buildings Without Sprinkler Protection)	PROVIDE SMOKE DETECTOR to INITIATE ELEVATOR FIREFIGHTERS SERVICE and BUILDING FIRE ALARM SYSTEM
MACHINE ROOM	YES	YES
ELEVATOR LOBBIES	YES	YES
PIT AREA	YES	NO
TOP of HOISTWAY	NO	NO

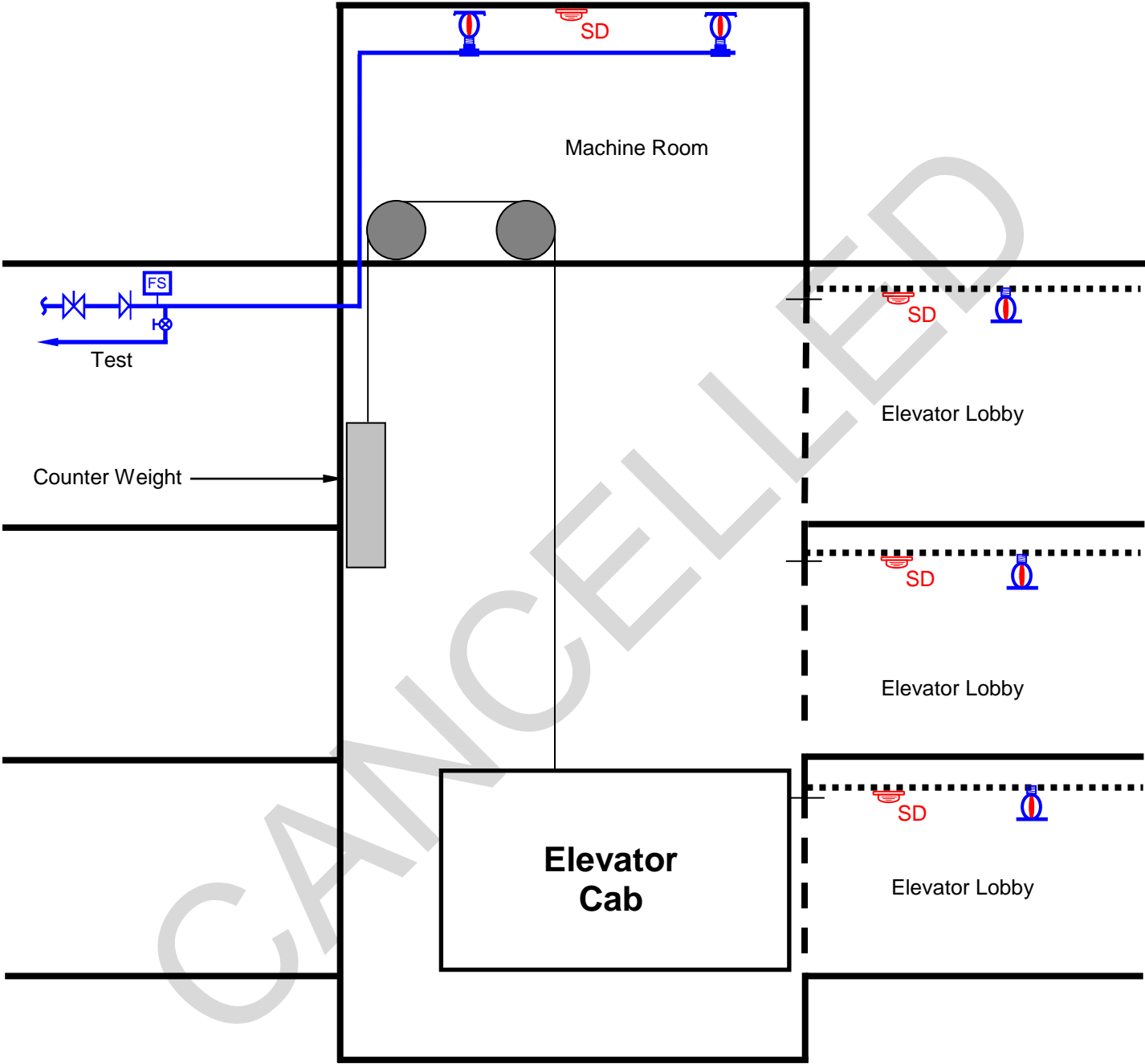


Figure 4-2 Electric Traction Elevator

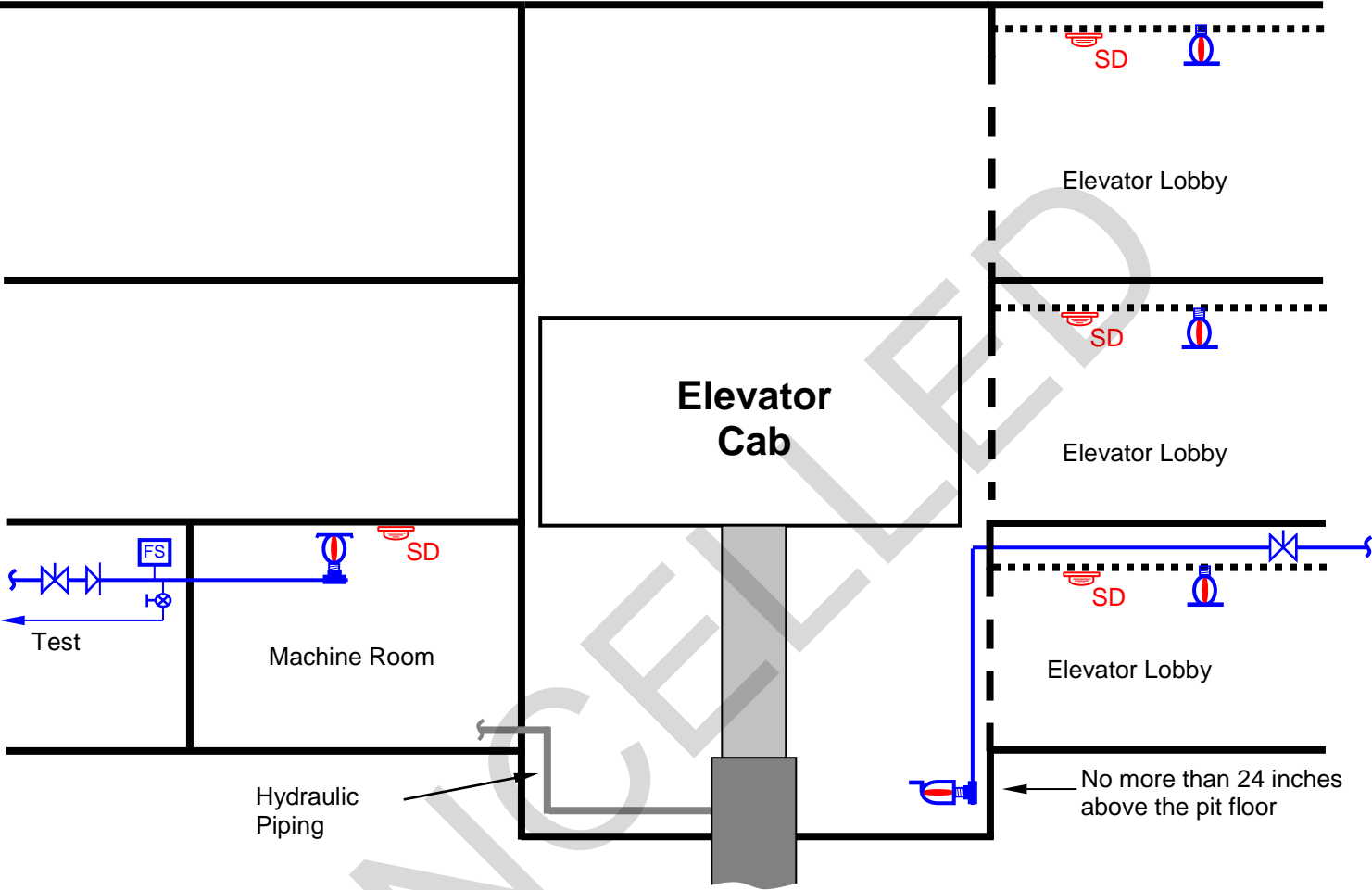


Figure 4-3 Direct Plunger Hydraulic Elevator

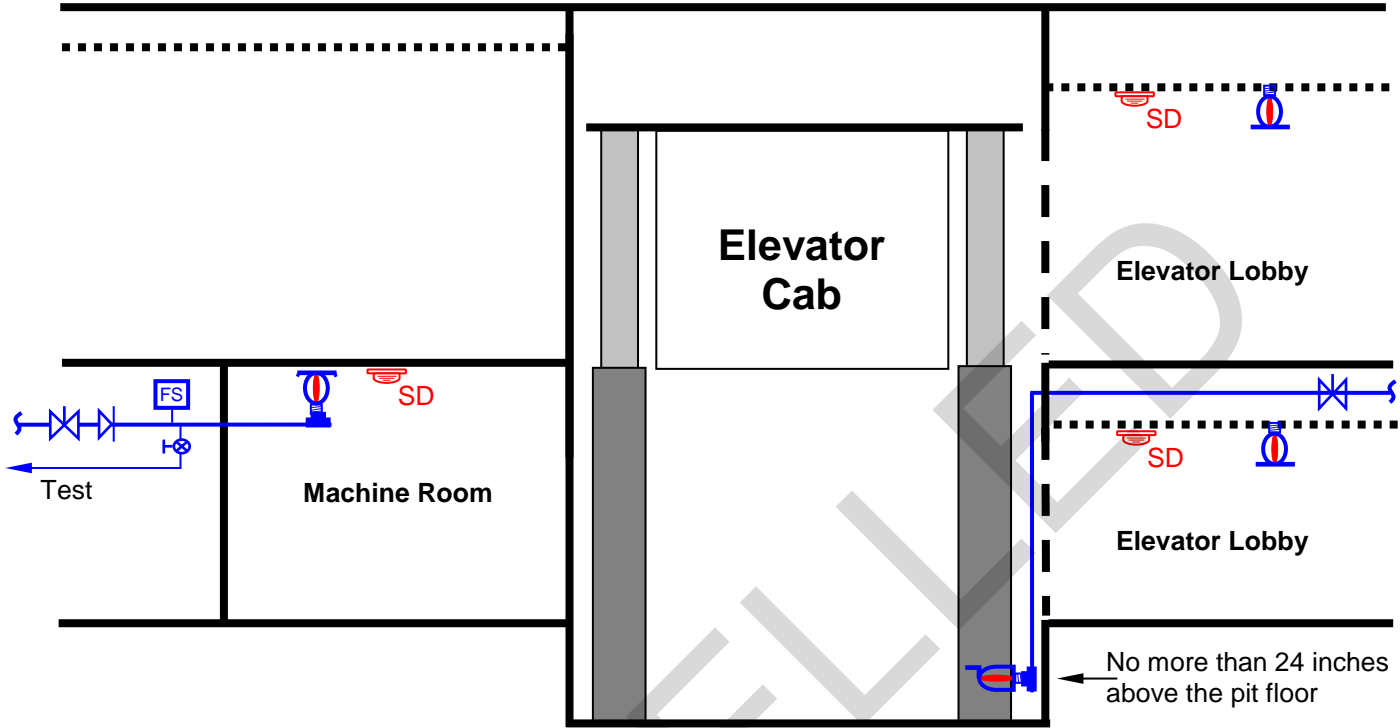


Figure 4-4 Holeless and Roped Hydraulic Elevator

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#### **4-13 EMERGENCY SERVICES COMMUNICATIONS CENTERS.**

Facilities and equipment that are used for the receipt of alarm signals and telephone calls for assistance, and dispatching of fire, police, or emergency medical services personnel and equipment must comply with this UFC and NFPA 1221.

#### **4-14 FAMILY HOUSING.**

##### **4-14.1 General.**

This section includes one-family, two-family, and multi-family dwellings.

##### **4-14.2 Off-*Installation* Family Housing within the United States and its Territories.**

Family housing located outside military *Installations* or bases must comply with provisions of this section and must comply with applicable local fire and building codes when the local fire department has the primary responding responsibility or a local building permit is required.

##### **4-14.3 Family Housing Outside the United States and its Territories and Possessions.**

Family housing outside the United States and its territories and possessions, constructed or leased-constructed, must comply with provisions of this section and the Host Nation fire protection requirements.

##### **4-14.4 Leased Family Housing.**

**4-14.4.1** DoD personnel occupying leased housing deserve the same level of protection as those in DoD-owned housing. Implementation of these standards is therefore mandatory for all housing leased for DoD use. This requirement applies to public-private ventures (PPV) as well as housing leased by DoD for families. This requirement does not apply to housing leased by individuals.

##### **4-14.4.2 New Buildings.**

Buildings that are built to lease to DoD must comply with the standards for new construction.

##### **4-14.4.3 Existing Buildings.**

For new leases or renewals of leases of existing *Facilities*, the *Facilities* must comply with the requirements for new construction.

##### **4-14.5 *Multi-Family Housing.***

*Multi-Family Housing* must comply with the IBC and NFPA 101 as required by other sections of this UFC.

**4-14.6** One- and Two-Family Housing.

One- and two-family housing must comply with the IRC.\2\

**4-14.7** /2/Cooking Areas.

A range top extinguishing system is not required within family housing for cooking areas provided with residential appliances.

**4-15** **FOOD PREPARATION IN FACILITIES.**

**4-15.1** Commercial Cooking Equipment.

**4-15.1.1** Hood and duct systems for commercial cooking equipment that produces smoke or grease-laden vapors must comply with NFPA 96.

**4-15.1.2** Range hood fire extinguishing systems must be wet chemical or water assisted wet chemical designed and installed in accordance with NFPA 96.

**4-15.2** Residential Cooking Equipment.

**4-15.2.1** Non-sprinklered Areas, Other than Housing.

**4-15.2.1.1** Residential type range top cooking surfaces must be equipped with a UL 300A listed residential range top extinguishing system or the cooking surface must be equipped with burners and controls that have their temperature limited to a maximum temperature of 662 degrees F (350 degrees C).

**4-15.2.1.2** The extinguishing system must be connected to the *Facility* fire alarm system, if provided, to sound a general *Facility* fire alarm and must automatically shut off all sources of fuel and electric power that produce heat to the equipment being protected by that unit.

**4-15.2.2** Sprinklered Areas, Other than Housing.

**4-15.2.2.1** Residential range top extinguishing systems are not required in sprinklered areas.

**4-15.2.2.2** If a residential range top extinguishing system is provided, it must be connected to the *Facility* fire alarm system to sound a general *Facility* fire alarm and must automatically shut off all sources of fuel and electric power that produce heat to the equipment being protected by that unit.

**4-15.2.3** Housing.

See "Personnel and Family Housing" section of this UFC for requirements related to cooking facilities in housing.

**4-16 HAZARDOUS MATERIALS AND HAZARDOUS WASTE.**

**4-16.1 General.**

Hazardous materials and hazardous waste (hazardous materials) include flammable and combustible liquids, flammable and combustible gases, flammable solids as well as other materials that are classified as hazardous materials.

**4-16.1.1** Comply with the requirements of NFPA 400, except as noted in this section.

**4-16.1.1.1** The requirements of this section apply to the storage or use of hazardous materials in excess of the maximum allowable quantities permitted by NFPA 400.

Note: As defined in NFPA 30, hazardous materials storage lockers and premanufactured storage buildings may be used to increase the maximum allowable quantities in accordance with NFPA 400.

**4-16.1.1.2** Provide protection for facilities storing flammable and combustible liquids and other petroleum oil lubricant (POL) products in accordance with NFPA 30.

**4-16.1.1.3** Class IIIB combustible liquids must be protected as required by NFPA 30 for Class IIIA combustible liquids in accordance with UFC 3-460-01 and NFPA 30.

**4-16.1.2** A single building is often used for storage of both flammable and combustible liquids and hazardous materials. Requirements for the storage of hazardous waste are separate and distinct from the storage of hazardous materials.

**4-16.1.3** Comply with the requirements of UFC 4-440-01.

**4-16.1.4** All other hazardous materials storage and use must comply with NFPA 400.

**4-16.2 Hazardous Materials Storage Areas.**

**4-16.2.1 Maximum Storage Height and Arrangement.**

The maximum allowable height and arrangement for storage of hazardous materials must be in accordance with NFPA 400.

**4-16.2.2 Fire Protection.**

**4-16.2.2.1** Complete automatic sprinkler protection must be provided throughout all hazardous material areas regardless of area or construction type.

Note: Aqueous film-forming foam (AFFF) or high-expansion (hi-ex) foam systems may be used where permitted by the applicable NFPA code or standard. For Army projects, AFFF is not permitted.

**4-16.2.2.2** Where the rack storage arrangement for hand picking operations provides multiple levels of storage less than 6 feet (1.8 m) above the walking surface and in-rack sprinklers are required for the storage arrangement, provide one extra row of in-rack sprinklers in the longitudinal flue space at the 3 feet (915 mm) level.

**4-16.2.3** Hazardous material storage areas or rooms must be identified in accordance with NFPA 704.

**4-16.2.4** In rooms storing water reactive materials, provide automatic sprinklers that can be isolated with an indicating valve. Locate the indicating valve outside the water reactive storage area.

**4-16.3** Hazardous Waste Storage *Facilities*.

For hazardous waste storage *Facility* requirements, comply with NFPA 400 except as noted below.

For Air Force, Navy and Marines, comply with UFC 4-451-10N.

**4-16.3.1** Fire Protection.

The following minimum criteria must be provided:

- a. Exterior walls must consist of 4-hour fire-resistive construction when the *Facility* is attached to a structure or it is located within 10 feet (3 m) of another building or property line.
- b. Exterior walls must consist of 2-hour fire-resistive construction when the *Facility* is located more than 10 feet (3 m) but less than or equal to 50 feet (15.3 m) from a building or property line.
- c. Exterior walls must be of noncombustible construction when the *Facility* is more than 50 feet (15.3 m) from another building or property line.
- d. Interior walls/ceilings must be 4-hour fire barriers if the *Facility* shares at least one wall with a *Facility* that houses other occupancies.
- e. Interior walls/ceilings must be a minimum 2-hour fire barrier when the area of the room is greater than 300 ft<sup>2</sup> (28 m<sup>2</sup>) and the *Facility* is not located within a structure that houses other occupancies.
- f. Interior walls/ceilings must be a minimum 1-hour fire barrier when the area of the room is 300 ft<sup>2</sup> (28 m<sup>2</sup>) or less and the *Facility* is not located within a structure that houses other occupancies.

**4-16.3.2** Sprinkler Protection.

Install sprinkler systems suitable for a corrosive environment.

**4-16.4** Spill Control and Containment.

Provide spill control and containment complying with NFPA 400 for hazardous materials and hazardous waste storage areas.

**4-16.5** Electric Wiring and Equipment.

Where flammable liquids are dispensed or transferred between containers, electric wiring and equipment must be suitable for classified locations in accordance with NFPA 70. Where flammable liquids are not dispensed or transferred between containers, unclassified locations for electrical equipment may be provided./2/

**4-16.6** Ventilation.

**4-16.6.1** Ventilation must be provided for all hazardous materials storage areas. Ventilation must meet the requirements of NFPA 400.

**4-16.6.2** Fan motors located outside of the hazardous materials storage area are permitted to be classified for ordinary locations in accordance with NFPA 70.

**4-16.7** Prefabricated Structures.

Prefabricated structures (portable or permanent) are permitted to store hazardous materials and hazardous waste provided they meet the requirements of NFPA 400.

**4-16.8** Outdoor Storage Limitations and Separation.

**4-16.8.1** Outdoor storage must comply with all of the following:

**4-16.8.1.1** The building or structure must be constructed of noncombustible materials, and,

**4-16.8.1.2** Walls must not obstruct more than two sides of the structure, or, walls may obstruct portions of multiple sides of the structure, provided that the sum of the walls does not exceed 50 percent of the structure's perimeter./2/

**4-16.8.2** The outdoor storage area must not be more than 400 feet (122 m) long or wide and each area must be separated by 100 feet (30.5 m).

**4-16.8.3** No containers or portable tanks in a pile are permitted to be more than 200 feet (61 m) from a 40 feet (12.2 m) wide minimum fire lane.

**4-16.8.4** Fire hydrants must be installed in accordance with NFPA 24, but spaced not more than 300 feet (91 m) apart. Provide a minimum of two hydrants located so that protected exposures can be reached through hose runs not exceeding 300 feet (91 m).

**4-17** **HIGH-RISE BUILDINGS.**

**4-17.1** General.

High-rise buildings must be provided with smokeproof enclosures. Design and install in accordance with NFPA 101. Design and install stair pressurization in accordance with NFPA 92.

**4-17.2** Emergency Command Center.

**4-17.2.1** Emergency command centers must comply with the following:

- a. Provided with exterior and interior access.
- b. Enclosed by a 1-hour fire-rated barrier.
- c. Provide a minimum area of 200 ft<sup>2</sup> (61 m<sup>2</sup>) with a minimum dimension of 10 feet (3 m).

**4-17.2.2** In addition to the requirements of NFPA 101, the emergency command center must also include the following:

- a. Air-handling system status indicators and controls.
- b. Fire department control panel for smoke control systems (includes visible status indicators and controls).
- c. Schematic building plans indicating the typical floor plan and detailing the building core, means of egress, fire protection systems, fire-fighting equipment and fire department access.

**4-17.3** Fire Service Access Elevators.

When the occupied floor level exceeds 120 feet (36.5 m) above lowest fire department vehicle access, provide at least two fire service access elevators that comply with Fire Service Access Elevator requirements in the IBC.

Mechanical penthouses and mechanical stories are not considered occupied floor levels.

**4-17.4** Buildings Greater than 420 feet (128 m).

The provisions of this UFC are not intended to apply to buildings greater than 420 feet (128 m) in height. For buildings exceeding 420 feet (128 m) in height, the *DFPE* must be consulted for any additional requirements.

**4-18** **HISTORIC FACILITIES.**

**4-18.1** General.

Projects in historic facilities are expected to meet the requirements of the chapter entitled "Existing Facilities" in this UFC.

## **4-19 HYDRAULIC SYSTEMS.**

### **4-19.1 General.**

Any combustible liquids under pressure must be treated as a flammable liquid.

### **4-19.2 Petroleum-Based Hydraulic Fluids.**

**4-19.2.1** Provide automatic sprinklers directly over and at least 20 feet (6.1 m) beyond the hydraulic equipment. Complete sprinkler protection is required if the structure is of combustible construction, regardless of floor area. Sprinklers may be omitted near a single small system or multiple adjacent small systems not exceeding 100 gal (380 L) aggregate capacity, and if the construction is noncombustible and ignition sources are not normally present, and provisions exist for automatic or manual shutdown of the system(s).

**4-19.2.2** An automatic switch, activated by sprinkler waterflow alarm, fusible link, or other fire detector, must be provided to shut down the hydraulic system if there is 100 gal (380 L) or more aggregate capacity of hydraulic fluid.

### **4-19.3 Hydraulic Test Systems.**

**4-19.3.1** For hydraulic systems that use pressures exceeding 200 psi (1380 kPa), SAE 1010 dead-soft, cold-drawn, seamless-steel tubing (or equivalent) must be used. A safety factor of eight over normal working pressure must be used. For systems with working pressures in excess of 2,500 psi (17,240 kPa), a factor of safety of four times the burst pressure is acceptable. Tubing is preferable to pipe. Tubing can be bent to fit in restricted spaces with a minimum number of fittings, reducing the number of possible leakage points. Solderless, steel fittings of the flareless "locking-sleeve" type or flare type must be used.

**4-19.3.2** Use of threaded pipe must be avoided. Where threaded connections are used, requirements of ANSI B1.20.1 must be met. A safety factor of eight over normal pressure must be used.

**4-19.3.3** Tubing runs must have as few bends as possible, but must have at least one bend to provide for thermal expansion and contraction. The minimum radius of tube bend must be three tube diameters.

**4-19.3.4** Where hose must be used for flexible connections, it must be steel reinforced, designed for the hydraulic fluid being used, and capable of withstanding five times the actual operating pressure. Hose couplings and fittings and minimum bending radius must be in accordance with the hose manufacturer's instructions. Hose must be installed so as not to rub against objects as a result of machine movement, vibration, or pressure surges.

**4-19.3.5** Piping and tubing must be anchored or secured to minimize failure due to vibration. Pipe supports must not prevent normal thermal expansion.

**4-19.3.6** There must be an accessible, well-marked, emergency shutoff switch for each pump.

**4-19.3.7** Provide an automatic shutoff switch to deactivate hydraulic pump upon loss of pressure.

## **4-20 HYDROELECTRIC GENERATING PLANTS.**

### **4-20.1** Hydroelectric Generating Plants.

Hydroelectric plants must comply with the section in this UFC for “Power Generating And Utilization Equipment” except as modified in this section. Also, hydroelectric plants must comply NFPA 850, especially the chapter for Identification and Protection of Hazards for Hydroelectric Generating Plants, except as modified by this section.

### **4-20.2** Indoor Transformers

Indoor transformer equipment spaces such as transformer vaults must contain the appropriate fire barrier rating for all partitions and those items installed in the partitions.

**4-20.2.1** Automatic fire suppression systems are not required for the following indoor transformers.

- a.** Dry type indoor transformers.
- b.** FMDS 5-4 “less flammable” fluid filled transformers contained within 3-hour fire rating barriers.
- c.** Transformers rated less than 35 kV containing less than 100 gallon capacity and contained within 3-hour fire rating barriers.

**4-20.2.2** Automatic fire suppression systems must be provided for all other indoor transformers rated 35 kV or greater and all must be enclosed by 1-hour fire-rated barriers. Fire suppression system type must be one of the following.

- a.** Water mist system with operating pressure greater than 175 psi in accordance with NFPA 750.
- b.** Clean agent in accordance with NFPA 2001.

### **4-20.3** Outdoor Transformers.

Structures and equipment in the vicinity of outdoor oil-filled transformers must be protected by separation, fire barriers, or water spray systems.



**4-20.3.1** Where outdoor transformers are located on the hydroelectric plant structure and not protected by water spray systems, provide a structural analysis of the exposed supporting and adjacent structure(s) proving that these structure(s) can withstand the design fire without collapse or severe damage. The design fire must be based upon the "Heat Flux Calculations" of ANSI/IEEE 979. Severe damage is defined as that preventing occupancy or facility use following a fire or based upon an estimated repair cost as compared to estimated project cost.

**4-20.3.2** Fire barriers may be constructed of materials other than concrete block or reinforced concrete construction where the materials provide 2-hour fire resistance rating. Fire barriers must be designed to resist wind loads.

**4-20.3.3** Where outdoor transformers are located on the hydroelectric plant structure containment must be provided for the transformer oil volume plus the 24 hour, 25 year stormwater volume.

**4-20.3.4** Automatic fire suppression water spray systems must comply with the following:

- a. The water supply must be adequate for 2 hours of operation of the water spray system at maximum demand. A hose stream demand of 500 gpm (1900 L/min) must only be included for existing facilities with existing hydrants for reuse or replacement.
- b. Containment must be provided for the water volume produced by the water supply for 2 hours of operation.

**4-20.4** Hydroelectric Generators.

All hydroelectric generators and ancillary equipment contained in generators must be protected by one of the following automatic fire suppression systems regardless of winding insulation material construction.

- a. High or Low Pressure CO<sub>2</sub> system in accordance with NFPA 12.
- b. Clean Agent in accordance with NFPA 2001.

**4-20.5** Oil Storage and Oil Purification Rooms.

Oil storage and oil purification rooms must be protected by one of the following automatic fire suppression systems.

- a. Water mist system with operating pressure greater than 175 psi in accordance with NFPA 750.
- b. Clean Agent in accordance with NFPA 2001.

**4-20.6** Paint and Flammable Liquid Storage Rooms.

Paint and flammable liquid storage rooms must be protected with automatic fire suppression as specified for oil storage and oil purification rooms./2/

**4-21 HYDROGEN FACILITIES.**

**4-21.1** Liquid Hydrogen (LH<sub>2</sub>).

Install LH<sub>2</sub> storage and fueling in accordance with NFPA 52 and FM Global Data Sheet 7-91.

**4-21.2** Gaseous Hydrogen (GH<sub>2</sub>).

Install GH<sub>2</sub> compression, gas processing, and storage in accordance with NFPA 52 and FM Global Data Sheet 7-91.

**4-21.3** Indoor Fueling or Dispensing.

Indoor fueling or dispensing of LH<sub>2</sub> or GH<sub>2</sub> is prohibited.

**4-22 HYPERBARIC AND HYPOBARIC CHAMBERS.**

**4-22.1** Hyperbaric Chambers.

Hyperbaric chambers must comply with the applicable sections of NFPA 99. Incorporate criteria contained in UFC 4-159-01N and SS 521-AA-MAN-010 into the design of hyperbaric chambers.

**4-22.2** Hypobaric Chambers.

Hypobaric chambers must comply with NFPA 99B.

**4-23 LABORATORIES.**

**4-23.1** General.

Laboratories using chemicals must comply with NFPA 45.

Note: NFPA 45 quantities for flammable and combustible liquids may be proposed to the *AHJ* in lieu of NFPA 1 MAQ/CA.

**4-24 HISTORIC RESOURCE LIBRARIES, ARCHIVES, AND FACILITIES.**

**4-24.1** General.

**4-24.1.1** Comply with NFPA 909 or NFPA 232.

For Navy and Marines projects, comply with FC 4-760-10N.

**4-24.1.2** Libraries storing materials that are not culturally significant (e.g., primary or secondary school library) are not required to comply with this section.

**4-24.1.3** Facilities for the restoration of culturally significant materials must comply with this section.

**4-24.1.4** Use noncombustible wall and ceiling finish materials.

**4-24.1.5** Provide complete automatic wet pipe sprinkler protection throughout *Facilities* containing libraries.

**4-24.1.6** Water mist fire protection systems complying with paragraph entitled "Water Mist Fire Protection Systems" in this UFC may be used in those areas of the *Facility* containing rare or unique materials that are particularly susceptible to water damage.

#### **4-25 LIMITED ACCESS AND UNDERGROUND STRUCTURES.**

**4-25.1** General.

Comply with the requirements of NFPA 101, except as noted below.

**4-25.2** Limited Access Structures.

**4-25.2.1** A manually activated smoke exhaust system must be provided for structures three stories or more in height. The smoke exhaust system must be designed for a minimum of six air changes/hour throughout the entire building.

**4-25.2.2** Provide complete automatic sprinkler protection for all limited access structures regardless of floor area or construction type.

**4-25.3** Underground Structures.

**4-25.3.1** A manually activated smoke exhaust system must be provided when there are two or more occupied levels or when an occupied level is greater than 30 feet (9.1 m) below grade plane. The smoke exhaust system must be designed for a minimum of six air changes/hour throughout underground occupied levels.

**4-25.3.2** Provide complete automatic sprinkler protection for all occupiable underground structures regardless of floor area or construction type.

#### **4-26 MEDICAL FACILITIES.**

These facilities must conform to UFC 4-510-01 and NFPA 101.

**4-27 MILITARY OPERATIONS ON URBAN TERRAIN (MOUT) TRAINERS.**

The DFPE must be consulted during the planning phase to determine what specific fire protection and life safety requirements are necessary.

Note: These structures are unique as they can be designed and constructed to mimic conditions in other locations. Guidance can be found in NFPA 101 for Special Amusement buildings.

**4-28 MISSILE ALERT FACILITIES (MAF).**

**4-28.1** Sprinkler Protection.

Protect all missile alert facilities with a sprinkler system designed and installed in accordance with NFPA 13R. Systems must be supplied from the existing domestic water storage tank; a separate water storage tank is not required. Use dry pendent or dry sidewall heads for rooms/spaces exposed to freezing temperatures.

**4-28.2** Heat Detectors.

Thermal detection devices must be provided in rooms, areas and spaces that are not protected by automatic sprinkler protection in accordance with NFPA 13R.

**4-28.3** Fire Hydrants.

Provide a dry fire hydrant installed on the domestic water tank to allow local fire departments the ability to draft firefighting water during emergencies.

**4-29 MORALE WELFARE AND RECREATION FACILITIES (MWR).**

Clubs, bowling centers, craft shops (including hobby shops, woodworking, auto centers) and similar recreational facilities with an occupant load of 50 or more must be protected with automatic sprinkler systems regardless of floor area or construction type.

**4-30 NATURAL GAS SERVICE.**

**4-30.1** General.

**4-30.1.1** Gas service mains must be installed in accordance with NFPA 54 and NFPA 58.

**4-30.1.2** Gas service mains are not permitted within the perimeter of foundation lines.

**4-30.1.3** Provide natural draft cross ventilation for *Facility* crawl spaces containing gas service piping.

**4-30.1.4** Raise supply connections from the gas service mains above grade outside the foundation wall.

**4-30.1.5** Locate pressure regulators outside of the *Facility* or vent to the outside away from air intakes.

#### **4-31 NAVIGATION LOCKS.**

##### **4-31.1 Pump Requirements.**

Two fire water pumps of the equal size are required, one of which must be redundant. Pump sizing must be based on either the gate spray sprinkler systems or hose stations, whichever is greater. Minimum pump design flow must be 250 gpm, to serve the five hose stations with each flowing 50 gpm. The minimum pump pressure must be 100 psi, and increased as required to provide at least 60 psi at each hose station.

##### **4-31.2 Hose Station Requirements.**

Hose stations in accordance with NFPA 14 must be located 25 feet upstream and downstream of each gate. These hose stations must be equally spaced at no more than 300 feet intervals along the walls on both sides of the lock chamber. Hose stations will consist of 150 feet of hose in a permanent cabinet. Hose must be 1-1/2 inch synthetic lined and conform to NFPA 1961.

##### **4-31.3 Miter Gate Spray System Requirements.**

Miter gates (upstream and downstream in lock chamber) must be fitted with a fixed gate spray sprinkler system for coverage of 0.25 gpm/sf of gate. Spray nozzles in accordance with NFPA 15 must be open type with a flat spray pattern operating at 45 psi and a minimum angle of 50 degrees. Nozzle must be brass or stainless steel and sized and spaced to provide complete coverage. Sprinkler piping and bracing must be stainless steel in accordance with NFPA 13 and protected against damage. Connect gate piping with a stainless steel swivel joint with stainless steel ball bearings and grease fittings for lubrication and installed to completely drain. Gate spray system must be separated from hose stations, using a motorized valve.

##### **4-31.4 Aboveground Piping Requirements.**

Aboveground piping and embedded pipe must be corrosion resistant and in accordance with ASTM A312, Schedule 40. All fittings must have a minimum rated working pressure of 175 psi.

##### **4-31.5 Underground Piping Requirements.**

Underground piping must be cement-mortar lined ductile-iron with a 150 psi working pressure and in accordance with AWWA C151 and C104. Pipe will be polyethylene encasement in accordance with AWWA C105.

**4-31.6** Fire Alarm System Requirements.

Provide a fire alarm system in accordance with NFPA 72. The system must consist of an outside electric horn with alarm switches located strategically throughout the project. Electric power for the alarm must be taken from the house-current supply line on the line side of the main switch through an independent switch and circuit breaker. Provide automatic dialers, to facilitate a quick emergency response.

**4-31.7** Supply Water Intake Requirements.

Water supply to fire pumps may be from the river. If the area is contaminated by zebra mussels, then the fire pump intake must have suitable control strategies implemented. Provide intakes with double type strainers and exterior stainless steel screens./2/

**4-32** **ORDNANCE.**

**4-32.1** *Installation Ordnance Facilities.*

**4-32.1.1** Sprinkler protection must be provided for *Installation Ordnance Facilities.*

**4-32.1.2** Munitions storage igloos that are in accordance with DoD explosive safety standards and accessory magazines at security and police stations are not required to comply with this section.

**4-32.1.3** Water demand for other *Ordnance Facilities* must meet or exceed the design requirements for extra hazard as described in this UFC.

**4-32.1.3.1** For Navy and Marine projects, refer to NAVSEA OP-5 for water demand.

**4-32.1.4** For Air Force projects, refer to AFMAN 91-201.

**4-32.2** Ammunition/Explosives (A/E) Storage Facilities.

**4-32.2.1** A/E storage *Facilities* are permitted to be either Earth Covered Magazines (ECM) or Above Ground Magazines (AGM) as defined by DoD 6055.09-M. An A/E storage *Facility* is used for A/E storage only. The storage *Facility* must not be used for handling, processing, testing, servicing, and inspection of ammunition, explosives, propellants, and oxidizers or joint use of storage and the handling, processing, testing, servicing, and inspection of ammunition, explosives, propellants, and oxidizers.

**4-32.2.2** A/E storage *Facilities* must be constructed and located ("sited") in accordance with DoD 6055.09-M.

**4-32.2.3** Automatic sprinklers and hydrant protection are not required for A/E storage *Facilities.*

**4-32.2.4** Compliance with IBC or NFPA 101 is not required for A/E storage *Facilities.*

**4-32.3** Stored Missile Assemblies.

Missile assemblies are considered to be large rocket type, Cruise missiles without their ordnance, Intercontinental Ballistic Missiles, or Poseidon missiles.

**4-32.3.1** Provide sprinkler protection for all stored missile assemblies.

**4-32.3.1.1** Munitions storage igloos that are in accordance with DoD explosive safety standards are not required to be provided with sprinkler protection.

**4-32.3.2** Water demand for stored missile assemblies and all other ordnance facilities requiring sprinkler protection must meet or exceed the design requirements for Ordinary Hazard in Chapter 9.

**4-32.3.2.1** For Air Force projects, refer to AFMAN 91-201, Explosives Safety Standards.

**4-32.4** Other *Ordnance Facilities*.

**4-32.4.1** All other *Ordnance Facilities* including munitions, weapons, and missile maintenance facilities require sprinkler protection.

**4-32.4.2** Water demand for other *Ordnance Facilities* must meet or exceed the design requirements for Ordinary Hazard in Fire and Smoke Protection Features chapter.

**4-32.4.3** For Air Force projects, refer to AFMAN 91-201, Explosives Safety Standards.

**4-32.5** Ordnance Production *Facilities*.

**4-32.5.1** *Ordnance Facilities* used for manufacturing, maintaining, demilitarizing, handling, processing, testing, servicing, and inspection of ammunition, explosives, propellants and oxidizers or related devices containing these materials must have complete automatic sprinkler protection and comply with DoD 6055.9-STD.

Note: These facilities are often known as "ammunition plants / depots".

**4-32.5.2** The applicable requirements of the IBC for Group H occupancies must be followed in the absence of specific guidance in DoD 6055.9-STD and the individual service regulations based directly on DoD 6055.9-STD. The service regulations include:

- For Navy projects, NAVSEA OP-5.
- For Army projects, Army AR 385-64; U.S. Army National Guard NGR 385-64; and the Army Material Command Regulation 385-100.
- For Air Force projects, Air Force AFMAN 91-201.

**4-32.5.3** Risk Assessment.

All munitions production, maintenance, renovation, quality assurance and demilitarization operations will receive a risk assessment to identify potential fire and thermal threats and to assess the level of risk. The hazard must be accurately defined. A potential fire or thermal hazard whose level of risk is high or extremely high is unacceptable. The risk assessment will consider factors such as:

- a. Initiation sensitivity.
- b. Quantity of material.
- c. Heat output.
- d. Burning rate.
- e. Potential ignition and initiation sources.
- f. Protection capabilities.
- g. Personnel exposure.
- h. Munitions configuration.
- i. Process equipment.
- j. Process layout.
- k. The building layout.

#### **4-32.5.4** Sprinkler Protection.

**4-32.5.4.1** Complete automatic sprinkler protection is required for *Ordnance Facilities* used for manufacturing, maintaining, demilitarizing, handling, processing, testing, servicing, and inspecting of ammunition, explosives, pyrotechnics, propellants, and oxidizers or related devices containing these materials, unless such a system will aggravate the hazard.

Note: Automatic sprinkler protection is appropriate for the protection of munitions marked "Apply No Water". "Apply No Water" is intended to prevent the manual application by fire extinguisher or fire service hose stream.

**4-32.5.4.2** Automatic sprinkler systems in *Ordnance Facilities* must be protected from movement in accordance with NFPA 13 for protection of piping where subject to earthquakes, regardless of seismic design category.

**4-32.5.4.3** Where exposed thermally energetic materials are handled that have a high probability of ignition, a large thermal output and a high probability of causing personnel injury, operations must be protected using ultra-high-speed deluge systems. Ultra-high-speed deluge systems have a response time of 100 milliseconds (ms) or less. Response



time is measured from the time that an energy source is presented to the detector to the time of initial water flow from the critical nozzle, which is normally the nozzle closest to the hazard. Ultra-high-speed detectors usually consist of a preprimed water delivery system, optical flame detectors, and electronic controller. The paragraph entitled "Ultra-High-Speed Deluge Systems" provides guidance on ultra-high-speed deluge systems.

Note: NFPA 15 and the NFPA Handbook provide additional information on ultra-high-speed deluge systems.

**4-32.5.4.4** Provide high-speed (operation of 500 ms or less), preprimed deluge systems wherever exposed explosives, pyrotechnics, or propellants are processed or stored in ordnance production facilities. Complete protection of such locations is essential.

**4-32.5.4.5** Provide ordinary deluge systems or wet pipe systems in other areas or auxiliary sections of *Facilities* where processing of explosives, pyrotechnics, or propellants takes place.

**4-32.5.4.6** Provide ordinary deluge systems or wet pipe systems in other areas or auxiliary sections of *Facilities* where storage of explosives or propellants takes place.

**4-32.5.4.7** Provide wet pipe sprinkler systems in other areas or auxiliary sections of *Facilities* if separated by fire barriers.

**4-32.5.4.8** Provide wet pipe sprinkler systems where missile assembly inspection or storage is carried on and where the propellant is confined within the missile, or warheads are present. Similar protection must be provided for torpedo and air underwater weapons shops.

**4-32.5.5** Heat detection equipment of any type is acceptable if equipment meets the operating time limitations and is suitable in other respects, such as complying with explosion-proof requirements. When pneumatic-type detection equipment is used, not more than three detectors, and preferably only one, must be on a single circuit in the same heat influence area.

**4-32.5.6** All fire protection systems protecting ordnance operations must have complete supervision so that any deficiency that develops that would affect the speed or reliability of operation will give a distinct alarm separate from the waterflow alarm.

**4-32.5.7** Ultra-High-Speed Deluge Systems.

Comply with the requirements of NFPA 15, except as noted in this standard.

**4-32.5.7.1** Response Time.

- a. Response time must be the time for system operation from the presentation of an energy source at the detector to flow of water from the water spray nozzle.

- b. Ultra-high-speed deluge systems must be designed to have a response time of not more than 100 ms, unless a risk assessment or other data indicates a need for a faster response time.

**4-32.5.7.2** Timers.

- a. Timers or similar devices to stop waterflow after a predetermined time are permitted if they are fail-safe (i.e., water continues to flow in the event of a timer failure).
- b. Timers or similar devices that shut off the waterflow after a predetermined time (typically 1 to 2 minutes) when the optical fire detectors no longer detect a fire are permitted. In case of a failure, it must be fail-safe.

**4-32.5.7.3** Design.

Due to the speed of water coming from all the nozzles, ultra-high-speed deluge systems depend on the detection system, piping network, nozzles and water supply characteristics. Only designers, engineers, and installers who are knowledgeable of the system's limitations and capabilities must provide the design, specification, and installation of the deluge system.

**4-32.5.7.4** Water Demand.

Water supplies for ultra-high-speed deluge systems must be adequate to supply the total demand of the largest *Fire Area* at the specific residual pressure required by the system for a period of at least 15 minutes unless a hazard analysis indicates a longer flow time is needed. Provide a flow rate of at least 0.50 gpm/ft.<sup>2</sup> (20.4 L/m/m<sup>2</sup>) over the entire area protected by the ultra-high-speed deluge system unless a hazard analysis indicates a higher flow rate is needed.

**4-32.5.8** Small Self-Contained Deluge Systems.

Note: Currently, two types of small self-contained deluge systems are in use in military *Ordnance Facilities*. They may be used with the ultra-high-speed deluge systems discussed in this section, or alone if an adequate water supply is not available for the *Facility*. These small self-contained deluge systems are primarily intended for personnel protection, although they provide some building/equipment protection.

**4-32.5.8.1** When used, self-contained deluge systems must be connected to the existing water supply.

**4-32.5.8.2** Portable, self-contained ultra-high speed deluge system must meet the following:

- a. Multiple nozzles.
- b. Multiple optical fire detectors.

- c. Pressurized water tank (typically 100 gal (380 L) of water).
- d. Response time must not exceed 100 ms (detection to water at the nozzle).

Note: The portable system is intended to protect short-term operations.

**4-32.5.8.3** Pressurized sphere ultra-high-speed deluge system must meet the following:

- a. One or more optical fire detectors.
- b. At least one pressurized (typically 500 psi (3,447 kPa)) water sphere (typically 2.6 to 7.9 gal (10 to 30 L)) with a rupture disc and internal squib, and an electronic controller.
- c. Response time must be less than 10 ms (detection to water at the nozzle).

**4-33 OXYGEN.**

**4-33.1** General.

**4-33.1.1** Comply with NFPA 55 and NFPA 400, except as modified by this UFC.

**4-33.2** Gaseous oxygen (GOX).

**4-33.2.1** Bulk GOX Systems.

**4-33.2.1.1** Comply with provisions of NFPA 55 for the installation and location of bulk GOX.

**4-33.2.1.2** Bulk GOX must be located either above ground and outdoors, or installed in a building of fire-resistant construction that is adequately vented and is used exclusively for storing GOX.

**4-33.2.1.3** Containers and associated equipment for Bulk GOX should not be located beneath or be exposed to the failure of electric power lines or piping containing any flammable liquid or gas.

**4-33.2.2** GOX System Design.

**4-33.2.2.1** GOX systems must be designed to control potential ignition energy mechanisms.

**4-33.2.2.2** Automatic safety devices such as system safety valves, flow regulators, and equipment safety features must be installed to automatically control hazards.

**4-33.2.2.3** Alarms and warning systems must monitor the parameters of the storage, handling and use of GOX that may endanger personnel and cause property damage.

**4-33.2.2.4** System flow velocity in GOX must not exceed 100 feet/second.

**4-33.2.2.5** Quick-acting valves must not be used to start or stop GOX systems.

**4-33.2.2.6** Remotely operated shutoff valves must be operated only using inert gas or air, and oxygen gas must never be used to operate valves.

**4-33.3** Liquid Oxygen (LOX).

**4-33.3.1** Liquid Oxygen Tanks.

**4-33.3.1.1** Comply with the applicable provisions of NFPA 51 and NFPA 99, regardless of occupancy.

**4-33.3.1.2** Fixed tanks having combined capacity of 100 gal (380 L) or less or portable tanks, must comply with applicable provisions NFPA 51 and NFPA 99, regardless of occupancy.

**4-33.3.1.3** Where tanks have a single or combined capacity of more than 100 gal (380 L), tanks must be fixed except as modified in the paragraph entitled "Oxygen Bulk Tanks".

**4-33.3.2** Oxygen Bulk Tanks.

Use fixed bulk tanks or portable high-pressure bulk units having a single or combined capacity of more than 100 gal (380 L) that conform to NFPA 55 and NFPA 99 except as modified below:

**4-33.3.2.1** Locate bulk oxygen storage out of doors or in a detached noncombustible structure used solely for this purpose and separated as follows:

- a. 75 ft (23 m) from:
  - 1) Aboveground ignitable-liquid tanks of 1,000 gal (3.8 m<sup>3</sup>) or greater capacity.
  - 2) Aboveground tanks of liquefied flammable gases of over 1,000 gal (3.8 m<sup>3</sup>) aggregate water capacity.
  - 3) Low-pressure flammable-gas storage holders of 5,000 ft<sup>3</sup> (140 m<sup>3</sup>) or greater capacity.
  - 4) Unsprinklered combustible buildings.
  - 5) Combustible yard storage.
  - 6) Wood exterior walls.
- b. 25 ft (7.6 m) from:
  - 1) Aboveground ignitable-liquid tanks of less than 1,000 gal (3.8 m<sup>3</sup>) capacity.

- 2) Aboveground tanks of liquefied flammable gases of 1,000 gal (3.8 m<sup>3</sup>) or less aggregate water capacity.
  - 3) Filling or vent connections to underground ignitable liquid tanks.
  - 4) Low-pressure flammable-gas storage holders of less than 5,000 ft<sup>3</sup> (140 m<sup>3</sup>) capacity.
  - 5) Sprinklered buildings or buildings with both noncombustible construction and light or ordinary hazard occupancy.
  - 6) High-pressure bulk flammable-gas storage.
  - 7) Ignitable-liquid unloading stations.
- c. 5 ft (1.5 m) from:
- 1) 1) Noncombustible construction having blank walls 10 ft (3 m) above and 10 ft (3 m) on each side of the equipment.

**4-33.3.2.2** Regulators and other control equipment are permitted to be located indoors in a noncombustible building detached or cut off from main buildings or combustible storage. Cutoffs should have at least a 1 hour fire resistance rating.

**4-33.3.2.3** Locate outdoor oxygen-storage equipment on a base of crushed stone or concrete./2/

**4-33.3.3** \2\Storage/Parking of LOX Carts/2/.

Separation distances for LOX \2\2/carts are as follows:

**4-33.3.3.1** A minimum of 100 feet (30.5 m) from aircraft parking, fueling, or servicing areas.

**4-33.3.3.2** A minimum of 100 feet (30.5 m) from any flammable or combustible liquids handling, servicing, processing, or storage area.

**4-33.3.3.3** A minimum of 50 feet (15.3 m) from any building.

**4-33.3.4** \2\Parking of LOX Vehicles/2/.

Parking for \2\LOX/2/ vehicles that service fixed tanks must be designed in accordance with the separation requirements of NFPA 55 for fixed bulk tanks except as modified in the paragraph entitled "\2\ Storage/Parking of LOX Carts"/2/.

**4-33.3.5** LOX Storage for Propellant Applications.

Use liquid oxygen storage for propellant applications that comply with 29 CFR 1910.109 except as modified in the paragraph entitled "LOX Tank and Cart Storage/Parking".

**4-33.4** Combined LOX and GOX *Facilities*.

LOX and GOX can use the same *Facility* provided they meet the requirements for each.

#### **4-34 PERSONNEL HOUSING AND SIMILAR LODGING FACILITIES.**

##### **4-34.1** General.

This section is applicable to all personnel housing and similar lodging facilities where sleeping occurs, regardless of the number of occupants sleeping.

Note: These facilities are commonly referred to as *Billeting* and include barracks, dormitories including apartment style, lodges, temporary or transient living facilities, and sleeping quarters. For duty, and similar rooms, see "Fire and Smoke Protection Features" chapter.

##### **4-34.2** Automatic Sprinkler Protection.

Complete automatic sprinkler protection must be provided, regardless of floor area or construction type.

##### **4-34.3** Smoke Detection.

###### **4-34.3.1** Provide smoke detectors in accordance with NFPA 101.

**4-34.3.2** A smoke detector must be provided for each sleeping room and the shared/common space of a suite regardless of occupancy or the presence of other detection or protection systems in the *Facility*.

**4-34.3.2.1** Upon detection of smoke, an audible signal must be activated in all sleeping rooms and the shared/common space(s) within the *Dwelling Unit*, send a distinct sleeping room smoke detector signal to the *Facility* fire alarm control panel and to the *Installation* fire reporting system, but not activate the *Facility* notification appliances.

Note: The signal to the FACP and fire reporting system may be an alarm or supervisory signal, as determined by the *DFPE*.

**4-34.3.2.2** The audible signal in the dwelling unit must be low frequency as required by NFPA 72.

**4-34.3.3** Primary and secondary power for the smoke detectors must be provided from the fire alarm control panel. Detectors that are not powered from the fire alarm control panel are not permitted.

**4-34.3.4** Activation of a smoke detector in a room dedicated as an ABA/ABAAG accessible room must also activate all visible notification appliances in the room.

**4-34.3.5** Sounder bases must not be provided in open sleeping bays with voice evacuation notification. Activation of smoke detector in open sleeping bays must activate building-wide notification appliances.

**4-34.4** Cooking Areas.

**4-34.4.1** A range top extinguishing system is not required for cooking equipment provided with residential appliances in fully sprinklered *Facilities*. This applies to both the *Dwelling Units* and in common areas.

**4-34.4.2** In non-sprinklered areas, a range top extinguishing system must be provided for cooking equipment, regardless of the location in the building.

**4-35 PESTICIDE STORAGE AND HANDLING FACILITIES.**

**4-35.1** General.

**4-35.1.1** Locate facilities or operations involving the storage, mixing, or handling of non-flammable pesticides a minimum of 100 feet (30.5 m) from the nearest *Facility* or occupied structure.

**4-35.1.1.1** Facilities of Type I construction as defined by the IBC, may be located less than 100 feet (30.5 m) from the nearest *Facility* or occupied structure, but not less than 30 feet (9.1 m) in any case.

**4-35.1.1.2** Facilities protected by an automatic sprinkler system may be located less than 100 feet (30.5 m) from the nearest *Facility* or occupied structure, but not less than 30 feet (9.1 m) in any case.

**4-35.1.2** Existing facilities involving the storage, mixing, or handling of non-flammable pesticides are permitted in a *Facility* when all the following are provided:

- a. The *Facility* is completely protected, including the pesticide area, by an automatic sprinkler system.
- b. The pesticide area is separated by not less than one-hour fire-rated construction from the remainder of the *Facility*.

**4-35.1.3** Comply with local environmental regulations related to containment of fire sprinkler water discharge.

**4-36 PETROLEUM, OILS & LUBRICANTS (POL) FACILITIES.**

**4-36.1** General.

**4-36.1.1** Petroleum fuel facilities consist of but not limited to facilities that receive, store, distribute, or dispense liquid fuels. This includes all storage tanks from bulk storage tanks to individual storage tanks and includes fuel tanks supporting diesel generators, day tanks, and protected aboveground tanks.

**4-36.1.2** POL *Facilities* must comply with UFC 3-460-01.

**4-36.1.3** Warehouses that store flammable or combustible liquids, regardless of container size or configuration, must comply with the requirements in this UFC.

**4-36.2** Fuel Testing Laboratories.

Laboratories must comply with the requirements of UFC 3-460-01 and NFPA 45.

**4-36.3** Fuel Piers.

Protection for piers with fixed piping systems used for the transfer of flammable or combustible liquids must be in accordance with the following:

- a. UFC 4-152.01.
- b. UFC 4-150-02.
- c. NFPA 30.
- d. NFPA 30A.
- e. NFPA 307 (if liquids are handled in bulk quantities across general purpose piers and wharves).
- f. "Guide on Marine Terminal Fire Protection and Emergency Evacuation", Oil Companies International Marine Forum.

#### **4-37 POWER GENERATING AND UTILIZATION EQUIPMENT.**

**4-37.1** Power Generating Plants.

Power generating plants must comply with NFPA 850.

**4-37.2** Substations.

**4-37.2.1** Comply with NFPA 70, NFPA 850 and FMDS 5-4.

**4-37.3** Stationary Combustion Engines, Gas Turbines, and Generators.

Internal combustion engines, gas turbines, and generators must comply with NFPA 37 and NFPA 110.

**4-37.4** Indoor Transformers.

Indoor transformers must be installed and located in accordance with NFPA 70.

**4-37.5** Outdoor Transformers.

**4-37.5.1** Outdoor Transformers must be installed and located in accordance with NFPA 70 and ANSI/IEEE 979, except as modified by this UFC.



**4-37.5.2** Where transformers are located on or above noncombustible roofs, suitable curbed and drained concrete mats or welded steel plates must be underneath units and located so as not to expose roof structures.

**4-37.5.3** Oil-filled transformers must not be installed on combustible roofs.

**4-37.5.4** Buildings or equipment exposed by outdoor liquid-insulated transformers must be protected either by separation, a fire barrier, or automatic fire suppression.

**4-37.5.4.1** When separation is utilized, the separation distance between *Facilities* and transformers must be as indicated in Table 4-4. The horizontal distance is measured from the edge of the transformer to the *Facility*.

**4-37.5.4.2** The separation distance between other equipment (including adjacent transformers) must be as indicated in Table 4-5.

**4-37.5.4.3** When fire barriers are utilized, comply with the following:

- a. Barriers must be of concrete block or reinforced concrete construction adequate for 2-hour fire resistance.
- b. The exposed wall must extend the horizontal and vertical distances from the transformer specified in Table 4-4.
- c. Roofs exposed to oil-insulated transformers must be Class A rated for the horizontal distance noted in Table 4-4 for non-combustible construction.
- d. For equipment, barriers must extend 1-foot (305 mm) vertically and 2 feet (610 mm) horizontally beyond transformer components that could be pressurized as the result of an electrical fault. This will typically include bushings, pressure relief vents, radiators, tap changer enclosures, and other similar devices.

**4-37.5.4.4** When automatic fire suppression is utilized, it must comply with the following:

- a. A discharge density of 0.30 gpm/ft<sup>2</sup> (12.2 L/min/m<sup>2</sup>) must be provided over transformer surfaces, except areas under the transformer.
- b. The water supply must be adequate for 2 hours and must include a hose stream demand of 500 gpm (1900 L/min).
- c. Components of the water spray system, such as piping, spray nozzles, and other components must be a minimum of 18 in. (0.45 m) from the transformer.
- d. Piping must not pass over the top of the transformer or be exposed by tank relief vents.
- e. Do not direct water spray nozzles at bushings.

- f. For multiple transformer installations, the water spray system must be designed based on simultaneous operation of the water spray systems for the transformers not meeting the separation distances of Table 4-4.
- g. When the ground around the transformer is non-absorbing, water spray must be provided at a density of 0.30 gpm/ft<sup>2</sup> (12.2 L/min/m<sup>2</sup>) for the diked area or for a distance of 10 feet (3 m) from the transformer in all directions.

**4-37.5.4.5** When utilizing fire barriers or automatic fire suppression, the following additional requirements must be applied:

- a. There must be no window openings in first-story walls within a horizontal distance of 10 feet (3 m) from the transformers. Existing window openings must be closed using brick or concrete block.
- b. Overhanging eaves, where they exist, must be noncombustible.

**Table 4-4 Separation Distance Between Outdoor Insulated Transformers and Buildings**

Liquid	Liquid Volume gal (m <sup>3</sup> )	Horizontal Distance <sup>a</sup>			Vertical Distance ft. (m)
		2-hr Fire- Resistant Construction ft. (m)	Non- Combustible Construction ft. (m)	Combustible Construction ft. (m)	
Less Flammable	≤10,000 (37.9)	5 (1.5)	5 (1.5)	25 (7.6)	25 (7.6)
	>10,000 (37.9)	15 (4.6)	15 (4.6)	50 (15.2)	50 (15.2)
Mineral Oil	<500 (1.9)	5 (1.5)	15 (4.6)	25 (7.6)	25 (7.6)
	500 - 5,000 (1.9 - 19)	15 (4.6)	25 (7.6)	50 (15.2)	50 (15.2)
	>5,000 (19)	25 (7.6)	50 (15.2)	100 (30.5)	100 (30.5)

<sup>a</sup> If FM-approved transformers are used; the separation distances must follow the requirements of FM Global Data Sheet 5-4, which allows for reduced separation distances.  
Less Flammable: See NFPA 70.

**Table 4-5 Separation Distance Between Outdoor Fluid Insulated Transformers and Equipment (Including Other Transformers)**

Liquid	Fluid Volume gal (m <sup>3</sup> )	Distance ft. (m)
Less Flammable	≤10,000 (37.9)	5 (1.5)
	>10,000 (37.9)	25 (7.6)
Mineral Oil	<500 (1.9)	5 (1.5)
	500 - 5,000 (1.9 - 19)	25 (7.6)
	>5,000 (19)	50 (15.2)
Less Flammable: See NFPA 70.		

**4-38 RANGES AND REMOTE LOCATIONS.**

**4-38.1** Water Supply.

When the AHJ determines a water supply is necessary for the range or remote location, follow the method of calculating minimum water supply as defined in NFPA 1142.

**4-38.2** Fire Department Vehicle Access.

Ranges and other remote locations are not required to meet the requirements of the “Fire Department (Emergency) Vehicle Access” section of this UFC or NFPA 1141.2/

**4-39 RELOCATABLES.**

**4-39.1** General.

**4-39.1.1** Relocatable facilities must have the same fire protection and construction requirements as non-relocatable facilities.

**4-39.1.2** Provide a minimum separation of 50 feet (15.3 m) between groups of high hazard occupancies, as defined by NFPA 101 and 15 feet (4.6 m) for all other groups.

Note: For Navy, refer OPNAVINST 11010.33 for regulations and restrictions on the use of relocatable facilities.

**4-39.2** Location.

**4-39.2.1** Do not group critical relocatable facilities, such as electronic equipment vans, to form areas greater than 6,000 ft<sup>2</sup> (557 m<sup>2</sup>) for non-sprinklered facilities and 12,000 ft<sup>2</sup> (1,115 m<sup>2</sup>) for sprinklered facilities.

**4-39.2.2** Do not group relocatable facilities having high hazard occupancies, as defined by NFPA 101, to form areas greater than 4,000 ft<sup>2</sup> (372 m<sup>2</sup>) for non-sprinklered facilities and 8,000 ft<sup>2</sup> (743 m<sup>2</sup>) for sprinklered facilities.

**4-40 SENSITIVE COMPARTMENTED INFORMATION FACILITY (SCIF).**

**4-40.1 General.**

Note: SCIF's should not be confused with radio-frequency shielded enclosures and/or anechoic chambers.

**4-40.1.1** See UFC 4-010-05 for additional information.

**4-40.1.2** As part of the initial design process for a SCIF, the Certified TEMPEST Technical Authority (CTTA) and the security Accrediting Official (AO) must establish both TEMPEST and physical security building element controls prior to designing means and methods of implementing fire protection systems into the SCIF.

**4-40.2 Physical Security Door Hardware.**

**4-40.2.1** All security door hardware installed on a means of egress door, must comply with the provisions of NFPA 101.

**4-40.2.1.1** Sliding deadbolts are strictly prohibited.

**4-40.2.1.2** A spin-dial combination lock, similar to the Lockmaster CDX-10, equipped with a life safety push-button feature, is acceptable provided the button feature is enabled at all times the SCIF is occupied.

**4-40.2.1.3** Door personnel "access control systems" must not restrict free egress at all times. Badge ID readers may be installed on the interior side of a door for personnel "audit" purposes only, but must not be connected to any physical security door hardware (i.e. electric door strikes, magnetic locks, etc.) that would restrict single-motion door operation.

**4-40.3 Fire Alarm and Mass Notification System (MNS).**

**4-40.3.1** See UFC 4-010-05 for requirements pertaining to the installation of fire alarm and MNS devices within a SCIF.

**4-40.3.2** Self-amplified fire alarm audio speakers, and associated wiring circuits, can be installed within a SCIF with concurrence of the CTTA.

Note: Self-amplified speakers are limited to 0.5 - 24VRMS audio input signal levels. Typically, most fire alarm voice systems are designed for 70.7VRMS audio circuits, and therefore careful economic consideration must be made on how to introduce the fire alarm audio signals into a SCIF.

**4-40.4 Fire Sprinkler Systems.**

**4-40.4.1** See UFC 4-010-05 for requirements pertaining to the installation of fire sprinkler piping penetrations into a SCIF.

**4-40.4.2** Any security mitigation method imposed directly on a sprinkler pipe must comply with NFPA 13.

**4-40.4.3** Metallic dielectric unions or grounding clamp(s) and wire(s) are permitted.

**4-41 TENSIONED-MEMBRANE STRUCTURES.**

**4-41.1** General.

**4-41.1.1** Tensioned-membrane (fabric) structures must meet the requirements of NFPA 101 and NFPA 102 as well as all life safety, fire protection, and allowable area requirements for the specific occupancy, in accordance with the other provisions of this UFC.

**4-41.1.2** Tensioned-membrane (fabric) structures must also meet the requirements of the applicable use paragraph in this UFC.

Note: The applicable use paragraph may require automatic sprinklers or a fire alarm system which may affect the structural design requirements.

**4-41.2** Allowable Area and Separation Distance.

**4-41.2.1** Table 4-6 provides the maximum allowable area and separation requirements for all tension fabric structures intended to exceed 12 months of use.

**4-41.2.2** The separation area must be a clear zone adjacent to the tension fabric structure.

**4-41.2.2.1** The clear zone cannot be used for storage and must be clear of vegetation (maintained lawn is permitted).

**4-41.2.2.2** The clear zone may be used as a street or driveway, but not for vehicle parking.

Note: For Navy, see OPNAVINST 11010.33 for regulations and restrictions on the use of relocatable facilities.

**Table 4-6 Basic Allowable Area for Tensioned-Membrane/Fabric Structures**

SEPARATION DISTANCE	TYPE of CONSTRUCTION - In Square Feet (Square Meters)			
	Noncombustible Material		Combustible Material	
	Sprinkler Protection	No Sprinkler Protection	Sprinkler Protection	No Sprinkler Protection
20 feet (6 m)	36,000 (3,344)	12,000 (1,114)	24,000 (2,229)	8,000 (743)
40 feet (12 m)	72,000 (6,689)	24,000 (2,229)	48,000 (4,459)	16,000 (1,486)

60 feet (18 m)	UNLIMITED	UNLIMITED	UNLIMITED	UNLIMITED
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**4-41.3** Tensioned-Membrane (Fabric) Hangars.

Tensioned-membrane (fabric) hangars must comply with the paragraph entitled "Aircraft Facilities".

**4-42 TRASH/RECYCLING COLLECTION AND DISPOSAL AREAS.**

**4-42.1** Central Trash/Recycling Collection and Dumpsters.

Place central trash/recycling collection units and dumpsters 15 feet (4.6 m) or more away from wood frame or metal *Facilities* or from openings in masonry-walled *Facilities*.

**4-42.2** Collection, Baling, Processing and Storage Rooms.

Rooms for collection, baling and storage must be separated from the remainder of the building by a 1-hour fire barrier and protected with automatic sprinklers.

Where the *Facility* is not protected with automatic sprinklers, the sprinkler system is permitted to be connected to the domestic water system when permitted by NFPA 13.

**4-42.3** Trash/Recycling Chutes.

Provide automatic sprinklers in all trash/recycling chutes installed within a *Facility*

**4-43 VEHICLE PARKING, STORAGE, MAINTENANCE, AND REPAIR FACILITIES.**

**4-43.1** General.

**4-43.1.1** Facilities used for parking or storage of motor vehicles must comply with NFPA 88A.

**4-43.1.2** Facilities used for maintenance and repair of motor vehicles must comply with NFPA 30A.

**4-43.1.3** Facilities used for the fueling and dispensing of compressed natural gas (CNG) or liquefied natural gas (LNG) for vehicles or vessels must comply with NFPA 52.

**4-43.2** Refueler Vehicle Facilities.

Facilities that are covered and enclosed on at least three sides and that are used for the parking, storage, maintenance, and repair of aircraft refueler vehicles must comply NFPA 30A and be provided with the following features:

**4-43.2.1** Automatic sprinkler system or a closed-head foam-water AFFF sprinkler system throughout.

For Army, AFFF is not permitted for new systems.

**4-43.2.2** Class I Division 1 electrical equipment and wiring throughout the entire pit area (below floor level) in accordance with NFPA 70.

**4-43.2.3** Class I Division 2 electrical equipment and wiring throughout the entire servicing area and areas not suitably cut-off in accordance with NFPA 70.

Note: This includes the area up to the underside of the roof.

#### **4-44 WAREHOUSE AND STORAGE FACILITIES.**

**4-44.1** General.

**4-44.1.1** Comply with UFC 4-440-01, except as modified by this UFC.

**4-44.1.2** This section applies to *Facilities* (except ordnance) with a ceiling height greater than 12 feet (3.7 m) used for storage, shipping, receiving, packing, and processing of materials.

**4-44.1.3** Storage of hazardous materials, including flammable or combustible liquids, must comply with this section and the requirements of the section "Hazardous Materials and Hazardous Waste" in this UFC.

**4-44.2** Sprinkler Protection.

**4-44.2.1** Complete automatic sprinkler protection must be provided for warehouses and storage *Facilities*, regardless of floor area or construction type.

**4-44.2.1.1** Automatic sprinkler systems may be omitted for *Facilities* with an area less than 5,000 ft<sup>2</sup> (465 m<sup>2</sup>) with approval of the *DFPE*.

Note: See the "Planning" section of this UFC for guidance on determining if sprinkler protection may be omitted for smaller *Facilities*.

**4-44.2.1.2** \2\The use of extended coverage control mode specific application sprinklers is permitted./2/

**4-44.2.2** Sprinkler protection must include covered loading docks.

**4-44.2.3** Sprinkler protection must follow the design requirements found in NFPA 13. The design density, area of application and hose stream requirements of the "Fire and Smoke Protection Features" chapter of this UFC do not apply to high-pile storage as defined by NFPA 13.

**4-44.2.3.1** Sprinkler protection, at a minimum, must be based on Class IV, non-encapsulated commodities, as defined by NFPA 13, unless a more severe class of storage is anticipated, and must be based on the maximum potential height of storage. The maximum potential height of storage is based on the roof or ceiling height.

**4-44.2.4** If provided, in-rack sprinklers must be supplied from risers that are separate from the ceiling sprinklers, except in existing facilities.

**4-44.2.5** Racks with solid shelves over 12 feet (3.7 m) in height must be protected with in-rack sprinklers at every tier or shelf level.

**4-44.2.6** Sprinkler riser control valves must be readily accessible to the fire department from the exterior.

**4-44.2.7** Duration.

The water supply must be capable of providing the minimum duration requirements of NFPA 13 for the protection method selected.

**4-44.2.8** Hose Stream Allowance.

Provide a hose stream allowance as required by NFPA 13 for the protection method selected.

**4-44.2.9** Roof Slope.

Maximum roof slope must be in accordance with NFPA 13.

**4-44.3** Bin Storage.

**4-44.3.1** Requirements.

**4-44.3.1.1** Protect in accordance with NFPA 13, except as noted below.

**4-44.3.1.2** The ceiling density must be increased by 10 percent or one additional level of in-rack sprinklers where combustible bins are stored in racks.

**4-44.3.1.3** Mini-storage and retrieval systems and carousel storage must be protected in accordance with FM Global Data Sheet 8-33 or FM Global Data Sheet 8-34.

**4-44.4** Column Protection.

Steel columns must be protected as required by NFPA 13.



**4-44.5**      *Fire Areas.*

**4-44.5.1**      Warehouse *Fire Areas* must not exceed 60,000 ft<sup>2</sup> (5,574 m<sup>2</sup>). Warehouse *Fire Areas* may be increased to 120,000 ft<sup>2</sup> (11,148 m<sup>2</sup>) when all of the following provisions are met:

**4-44.5.1.1**    Ceiling sprinkler design area must be increased by 10 percent. This requirement does not apply when ESFR sprinklers are utilized.

**4-44.5.1.2**    Dedicated looped *service mains* must be provided with enough sectional valves to isolate each *Service Lateral* around the warehouse.

**4-44.5.2**      Separation of *Fire Areas*.

**4-44.5.2.1**    *Fire Areas* must be separated from other *Fire Areas* by 4-hour fire walls in accordance with the IBC Chapter entitled "Fire and Smoke Protection Features".

**4-44.5.2.2**    Other occupancies, such as offices or shops, must be separated from the warehouse and storage area by a minimum of 1-hour fire-rated construction, unless a higher rating is required by the IBC.

**4-44.6**      Conveyor and Mechanical Handling System Penetrations.

**4-44.6.1**      When mechanical handling systems such as conveyors, penetrate fire barriers, the opening must be protected by a fire door or fire shutter.

**4-44.6.2**      When a fire door or shutter is not feasible due to the operation of the conveyor, the *DFPE* must be consulted to determine the appropriate protection criteria.

**4-45**      **WATERFRONT FACILITIES.**

Waterfront and harbor facilities must comply with all of the following, as applicable:

- a. NFPA 303.
- b. NFPA 307.
- c. NFPA 312.
- d. UFC 4-152-01.
- e. UFC 4-150-02.
- f. UFC 4-151-10.
- g. UFC 4-213-10.
- h. UFC 4-213-12
- i. NAVSEA OP-5 (for Navy/Marines only).

## CHAPTER 5 GENERAL BUILDING HEIGHTS AND AREAS

### 5-1 GENERAL.

Allowances or exceptions that require the *Facility* to be protected throughout by an approved automatic sprinkler system may only be applied where the system is an approved, electrically supervised automatic sprinkler system as described in NFPA 101. References to IBC Section 903.3.1.1 are replaced with NFPA 13. References to IBC Section 903.3.1.2 are replaced with NFPA 13R.

### 5-2 BUILDING HEIGHT LIMITATIONS.

Conform to the requirements of IBC Chapter 5.

### 5-3 BUILDING AREA LIMITATIONS.

Conform to the requirements of IBC Chapter 5.

Note: IBC Chapter 5 does not permit area increases for sprinkler systems if the sprinkler system is designed per NFPA 13R.

### 5-4 OCCUPANCY SEPARATION.

#### 5-4.1 General.

**5-4.1.1** Occupancy separation must comply with the IBC Chapter 5. Do not use NFPA 101 for occupancy separation requirements, except as noted below.

**5-4.1.2** NFPA 101 must be utilized for occupancy separations of medical funded projects, healthcare, ambulatory healthcare and all facilities required to comply with The Joint Commission standards.

### 5-5 INCIDENTAL USE.

NFPA 101 must be utilized for protection from hazards. IBC requirements for separation of incidental uses are not permitted.

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## CHAPTER 6 TYPES OF CONSTRUCTION

### 6-1 GENERAL.

Conform to the requirements of IBC Chapter 6, except as modified by this UFC.

### 6-2 SEPARATION BETWEEN BUILDINGS.

Conform to the requirements of the IBC, except as modified by this UFC.

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## CHAPTER 7 FIRE AND SMOKE PROTECTION FEATURES

### 7-1 GENERAL.

Conform to the requirements of NFPA 101 except as noted below.

Where IBC Chapter 5 or 6 specifically references IBC Chapter 7, utilize the specific IBC Chapter 7 reference.

Note: For example, IBC Section 508.4.4.1 specifically references IBC Sections 707 and 711. When utilizing IBC Section 508.4.4.1, utilize IBC Sections 707 and 711, otherwise IBC Sections 707 and 711 are not to be used unless specifically referenced.

### 7-2 MARKING AND IDENTIFICATION.

Conform to the requirements of the IBC for marking and identification of fire walls, fire barriers, fire partitions, smoke barriers, smoke partitions or any other wall required to have protected openings.

For Navy, Marines, and NRO, stenciling must be provided and spaced no more than 10 foot, measured edge to edge horizontally along the wall or partition.

### 7-3 NON-LOAD BEARING PARTITIONS AND BARRIERS.

Comply with NFPA 101 for fire resistance ratings of non-load bearing partitions and barriers, except occupancy separation as indicated in Chapter 5.

### 7-4 PROTECTION OF STRUCTURAL MEMBERS.

#### 7-4.1 General.

Comply with IBC Chapter 7 for protection of structural members, except as noted below.

#### 7-4.2 Sprayed Fire-Resistant Materials.

**7-4.2.1** Sprayed fire-resistant materials must be medium or high density cementitious or an intumescent thin-film coating.

Note: Intumescent thin-film coating is not the same material as intumescent paint.

**7-4.2.2** Mineral fiber or low-density cementitious materials are not permitted.

**7-4.2.3** Provide UL-listed floor/ceiling and UL-listed roof/ceiling assemblies that do not require the underside of the roof or floor deck to have spray-applied fireproofing. The assembly must be designed so only columns, beams, and trusses receive spray-applied fireproofing to achieve the rating for the assembly.

### 7-4.3 Ceilings.

Listed floor/ceiling or roof/ceiling assemblies that utilize suspended gypsum wallboard or acoustical tile ceilings must not be used to achieve required fire resistance rating of building structural elements.

## 7-5 SMOKE AND HEAT VENTS.

### 7-5.1 General.

**7-5.1.1** Smoke and heat vents must not be provided unless specifically required by this UFC.

Note: Smoke and heat vents should be considered in *Facilities* where a high rate of heat release is anticipated during a fire such as indoor firing ranges with rubber impact zones.

**7-5.1.2** Where provided in *Facilities* without automatic sprinklers, smoke and heat vents must be arranged to operate automatically in accordance with NFPA 204.

**7-5.1.3** Where provided in *Facilities* with automatic sprinkler protection, smoke and heat vents must be arranged to operate in the manual mode only.

Note: Skylights can be used as a method of providing manual smoke and heat vents.

## 7-6 HIGH VOLUME LOW SPEED (HVLS) FANS.

Comply with NFPA 13, except all HVLS fans must be interlocked to shut down immediately upon any fire alarm activation.

## 7-7 PLASTIC PIPE AND CONDUIT.

### 7-7.1 Penetrations.

Penetrations by plastic pipe or conduit through fire-rated walls, partitions, shafts, and floors must be fire stopped by an approved or listed method in accordance with ASTM E814 or UL 1479.

### 7-7.2 Prohibited Locations.

Plastic pipe and conduit must not be installed in exit stair enclosures, or in air plenum spaces, unless specifically listed for that application.

## CHAPTER 8 INTERIOR FINISHES

### 8-1 GENERAL.

Conform to the requirements of NFPA 101.

### 8-2 DROP-OUT PANELS.

Drop-out panels, as defined in NFPA 13, must not be used.

### 8-3 INSULATION.

#### 8-3.1 Requirements.

**8-3.1.1** Use thermal and acoustical insulation with a flame spread (FS) rating not higher than 75, and a smoke developed (SD) rating not higher than 150 when tested in accordance with ASTM E84 (NFPA 255).

**8-3.1.2** Exposed insulation in concealed spaces of sprinkled buildings must be specified to have a flame spread of 25 or less and a smoke developed rating of 50 or less (including  $\sqrt{2}$ /covering).

Note 1: This is to prevent the space from being defined as a combustible concealed space, which would require sprinkler protection in accordance with NFPA 13.

Note 2: Acceptable types of insulation blankets per Federal Spec HH-521F are Type I, Type II (Class A only), and Type III (Class A only).

#### 8-3.2 Exceptions to Insulation Criteria.

For certain types of insulation installation, the exceptions described in paragraphs entitled "Flame Spread – No Smoke Developed Rating Limitation" and "No Flame Spread or Smoke Limitation" below will apply.

##### 8-3.2.1 Flame Spread - No Smoke Developed Rating Limitation.

Compliance with the SD rating limitation is not required, and a FS rating up to 100 is permitted for insulation, including insulating sheathing installed within wall assemblies. In such installations, conform to the requirements for interior finish with a minimum fire resistance rating of 15 minutes when tested in accordance with ASTM E119.

##### 8-3.2.2 No Flame Spread or Smoke Limitation.

Compliance with FS and SD limitations are not required for the following applications:

- a. Insulation installed above poured concrete or poured gypsum roof decks, nominal 2-in. (50.8 mm) thick tongue-and-groove wood plank roof decks, or precast roof deck panels or planks that are approved by a Nationally



Recognized Testing Laboratory (NRTL), as noncombustible roof deck construction.

- b. Insulation installed above roof decks where the entire roof construction assembly, including the insulation, is UL-listed as Fire Classified, or FM-approved for Class I roof deck construction or equal listing or classification by a NRTL.
- c. Insulation contained entirely within panels where the entire panel assembly used in the construction application meets the cited FS and SD limitations.
- d. Insulation isolated from the interior of the building by masonry walls, masonry cavity walls, insulation encased in masonry cores, or concrete floors.
- e. Insulation installed over concrete floor slabs and completely covered by wood tongue-and-groove flooring without creating air spaces within the flooring system.
- f. Insulation completely enclosed in hollow metal doors.
- g. Insulation installed between new exterior siding materials and existing exterior siding or wood board, plywood, fiberboard, or gypsum exterior wall sheathing.

Note: The exception to SD limitations described in this paragraph is not applicable to correctional facilities.

## CHAPTER 9 FIRE PROTECTION SYSTEMS

### 9-1 FIRE DEPARTMENT (EMERGENCY) VEHICLE ACCESS.

#### 9-1.1 All-Weather Ground Access.

All *Facilities* greater than 5,000 ft<sup>2</sup> (465 m<sup>2</sup>), or more than two stories in height, must have at least one means of all-weather ground access to allow emergency vehicles unimpeded access to the *Facility*. All-weather ground access must be paved, start from the road, and terminate no farther than 33 feet (10 m) from an exterior door accessible for fire department ingress (i.e. a stair door or some other exterior door that provides access to the *Facility* interior). The route between the access surface and exterior door must be able to be traversed without the use of a ladder.

An engineered all-weather surface that is not paved may be provided if approved by the *DFPE*.

#### 9-1.2 Aerial Apparatus Access.

New facilities four stories or more in height and all new warehouses must be provided with suitable all-weather ground access for aerial apparatus on a minimum of two sides of the perimeter of the structure. The access must be parallel to at least one entire side of the *Facility* with windows to allow aerial access to the entire side. The distance between the aerial apparatus access and the *Facility* must be based on the responding aerial apparatus and *Facility* height and be approved by the *DFPE*.

Note: The intent of this paragraph is to provide aerial apparatus access to two sides of the building, with one side having access along the entire side of the building so that the aerial apparatus has multiple locations to set up operations. Aerial apparatus access must be coordinated with fire department ingress noted above.

#### 9-1.3 Vehicle Access.

All force protection equipment, such as bollards or gates, must not require more than one person to remove or open. Access may require fire apparatus to drive over a curb. Any locking device controlling vehicle access must be under control of the fire department or 24-hour security personnel located at the specific *Facility*. Dimensions of fire lanes and turnarounds must comply with NFPA 1. Vehicle access must be coordinated with the *Installation* or responding fire department.

#### 9-1.4 Fire Department Connection.

Facilities with fire department connections for fire suppression systems must be provided with suitable all-weather ground access surface for any apparatus within 150 feet (45 m) of such fire department connections.

**9-2 FIRE FLOW FOR FACILITIES.**

**9-2.1** Sprinklered *Facilities*.

*Fire Flow* for sprinklered *Facilities* must be a minimum of 1,000 gpm at 20 psi (3,785 L/min at 138 kPa). Where the *Fire Flow* cannot be met, the *DFPE* is permitted to approve a reduction in *Fire Flow*. *Fire Flow* is calculated independently of the *Fire Water Demand*.

**9-2.2** Non-sprinklered *Facilities*.

*Fire Flow* must be in accordance with NFPA 1, except the following special *Facilities*.

**9-2.2.1** Ship Berthing and Drydock *Facilities*.

Refer to the paragraph entitled "Waterfront *Facilities*" for *Fire Flow* requirements for ship berthing and drydock facilities.

**9-2.2.2** Family Housing.

The *Fire Flow* for non-sprinklered family housing must be as follows:

- a. One-story - 500 gpm (1,900 L/min) for 90 minutes.
- b. Two-story - 750 gpm (2,840 L/min) for 90 minutes.
- c. Three-story and above - 1,000 gpm (3,785 L/min) for 90 minutes.

**9-2.2.3** Aircraft Parking and Refueling *Facilities*.

A minimum *Fire Flow* of 1,000 gpm (3,785 L/min) for a 2-hour duration is to be provided for all such *Facilities*.

**9-2.2.4** Yard and Outdoor Storage.

**9-2.2.4.1** Yard and outdoor storage must comply with the requirements of NFPA 80A, and FM Global Data Sheet 1-20.

**9-2.2.4.2** Aisle widths and separation distances must be maintained to limit the exposure to nearby *Facilities* and to facilitate manual firefighting operations.

**9-2.2.5** Vehicle Parking Areas.

A minimum *Fire Flow* of 500 gpm (1900 L/m) for a 2-hour duration must be provided for all such areas.

**9-3 SERVICE MAINS AND LATERALS.**

**9-3.1** General.

**9-3.1.1** *Service Mains and Service Laterals* must comply with AWWA M31, NFPA 24 and UFC 3-230-01, except where specifically modified by this UFC.

**9-3.1.2** For service laterals that do not utilize PVC pipe, the velocity must not exceed 10 feet per second (3 m/s).

**9-3.1.3** This section applies to both dedicated (fire only) and combined (domestic and fire) water distribution systems.

**9-3.1.4** For *Service Mains* served by fire pumps or *Service Laterals* serving fire pumps, velocities must be calculated using 150 percent of the rated capacity of the fire pump.

**9-3.1.5** Provide appropriate corrosion protection based on pipe material and corrosive properties of the water supply and earth.

**9-3.1.6** Where cathodic protection is indicated based upon present conditions, comply with the following: For the Army, comply with UFC 3-570-02A, for the Navy and Marines, comply with UFC 3-570-02N, and for Air Force, comply with AFI 32-1054 and UFC 3-570-06.

**9-3.2** *Service Mains.*

**9-3.2.1** *Service Mains* must be sized to accommodate *Fire Flow* plus domestic and industrial demands that cannot be restricted during fires.

**9-3.2.2** *Service Mains* must be looped to provide at least 50 percent of the required *Fire Flow* in case of a single break.

**9-3.2.3** *Service Mains* must not be dead-end.

**9-3.2.4** *Service Mains* must be sized so that the minimum residual pressure available, at 150 percent of a *Facility* fire pump rating, if provided, is not less than 20 psi.

**9-3.3** *Service Laterals.*

**9-3.3.1** Not more than two fire hydrants can be located on a *Service Lateral*.

**9-3.3.2** Minimum size *Service Lateral* for fire sprinkler systems must be not less than 6-in. (150 mm) in diameter.

**9-3.3.2.1** For NFPA 13R systems, the *Service Lateral* is permitted to be 4-in. (100 mm) if supported by hydraulic calculations.

**9-3.3.2.2** For NFPA 13D systems, the minimum *Service Lateral* size must be based on hydraulic calculations.

**9-3.3.3** The minimum residual pressure in a *Service Lateral* must not be less than 20 psi at the greater of *Fire Flow* or *Fire Water Demand*. This residual pressure must be maintained at the inlet of the backflow preventer or suction side of the fire pump, whichever is closer to the *Service Main*.

**9-3.3.4** A *Service Lateral* supplying a fire pump must be able to support 150 percent of the fire pump rated capacity without falling below the required net positive suction head (NPSH) at the suction side of the pump. Where NPSH cannot be met at 150 percent of the fire pump rated capacity, the *DFPE* is permitted to reduce the required flow at NPSH, but in no case is it permitted to be less than the required fire suppression system demand.

Note: Piping downstream of the fire pump is not a *Service Lateral*. Piping downstream of the fire pump must be sized based on the *Fire Water Demand* of the *Facility* or the minimum required by NFPA 20, whichever is greater, not 150 percent of the fire pump rated capacity.

**9-3.4** Valves.

**9-3.4.1** Control valves must be provided in each source of water supply, such as tanks and pumps.

**9-3.4.2** A control valve must be provided on the *Service Lateral* downstream of the connection to the *Service Main*.

**9-3.4.3** A sufficient number of sectional valves must be provided on the *Service Main*, so that not more than a combined total of five hydrants or the *Service Laterals* to not more than three separate buildings are out of service due to a single break.

**9-3.4.4** Sectional valves on *Service Mains* may be key-operated type. New valves must open by counter-clockwise rotation of the stem.

**9-3.4.5** Supervision.

When provided, PIV's must be supervised using a lock or tamper seal, at a minimum.

**9-3.5** Fire Hydrants.

**9-3.5.1** Fire hydrants must be UL-listed, FM-approved, or listed or classified by an NRTL and must have two 2 1/2-in. (65 mm) hose outlets and one 4 1/2-in. (115mm) outlet with national standard fire hose threads in accordance with NFPA 1963.

Comply with the *Installation* fire department or local responding fire department when they require a different arrangement or hose threads.

**9-3.5.2** Wet barrel or California-type hydrants are preferable in areas where there is no danger of freezing. Dry barrel or traffic-type hydrants must be used in areas where there is a danger of freezing. Hydrants must be aboveground type and match the type used on the *Installation*.

**9-3.5.3** In DoD *Installations* serviced by only local fire departments, hydrant hose threads must meet local requirements.

**9-3.5.4** See AWWA Manual M 17 and AWWA Manual M 31 for additional information.

Note: Overseas *Installations* with current below grade hydrants in accordance with local national policy are acceptable.

**9-3.5.5** \1V1/Hydrant caps/barrels must be color coded to prevent cross-connection. In the absence of an *Installation* established color code standard, the following colors must be used; red for non-potable water, yellow for potable water, and purple for reclaimed/reuse water. All hydrants must also be marked based on the *Fire Flow* capacity, in accordance with NFPA 291 or by the *Installation* established marking standard

**9-3.5.6** Clearly mark each new hydrant with an identification number assigned by the *Installation*.

**9-3.5.7** Construction Requirements.

- a. Installation must be in accordance with NFPA 24 except as modified by this UFC.
- b. Hydrants must be installed adjacent to paved areas, accessible to fire department apparatus.
- c. *Service Lateral* supplying hydrants must be minimum 6-in. (150 mm) and valved at the connection to the *Service Main*.
- d. Barrels must be long enough to permit at least 18-in. (450 mm) clearance between the center of the 4 1/2-in. (115 mm) outlet and grade.
- e. The ground must be graded so that any surface drainage is away from the hydrant.
- f. The 4 1/2-in. (115 mm) outlet must be perpendicular to the street to allow straight connection to the pumper.
- g. Landscaping, fencing, bollards and similar must be located a minimum of 24-in. (610 mm) from the horizontal centerline of the hydrant and not directly in front of any outlet.
- h. For fire hydrants adjacent to airfield pavement, \2\the tops of the fire hydrants should not be installed more than 24 inches (610 mm) above the level of the adjacent airfield pavement but in no case must the tops of

the fire hydrants be installed higher than 30 inches (760 mm) above the airfield pavement./2/

**9-3.5.8** Spacing Requirements.

**9-3.5.8.1** A sufficient number of hydrants must be provided so that *Fire Flow* can be met without taking more than 1,250 gpm (4,740 L/min) from any single hydrant.

**9-3.5.8.2** All parts of the *Facility* exterior must be within 350 feet (106 m) of a hydrant with consideration given to accessibility and obstructions.

**9-3.5.8.3** Hydrants must be located with consideration given to emergency vehicle access.

**9-3.5.8.4** Hydrants must be spaced in accordance with the following requirements:

- a. At least one hydrant must be located within 150 feet (45 m) of the fire department connection.
- b. Hydrants protecting warehouses must be spaced \2\along the sides of the *Facility* with fire department access/2/ at 300 feet (91 m) maximum intervals.
- c. Exterior storage and military/tactical equipment/vehicle parking must be provided with hydrants spaced at 300 feet (91 m) maximum intervals around the perimeter.

Note: Military/tactical equipment/vehicle parking applies to large parking areas typically found at reserve facilities or similar locations. This does not apply to small parking areas.

- d. Hydrant spacing must be spaced at 600 feet (182 m) maximum intervals for non-sprinklered family housing.
- e. Hydrant spacing must not exceed 1,000 feet (305 m) in areas where all family housing is provided with sprinkler protection.
- f. \2\ Fire hydrants protecting aircraft parking and servicing aprons must be spaced at 300 feet (91 m) maximum intervals along one side./2/

**9-3.5.9** Protection.

Hydrants located adjacent to parking areas, vehicle traffic areas or other areas subject to mechanical damage, must be protected by bollards. The bollards must be located so they are not directly in front of an outlet. The bollards must allow clearance to attach hoses, allow for the removal of the hydrant caps, and for the hydrant to be opened and closed without obstructions. Refer to UFC 3-260-01 where bollards are required for hydrants located adjacent to aircraft parking and servicing aprons.

**9-3.6** Pressure-Regulating Valves (PRVs).

PRVs must not be provided on *Distribution Mains, Service Mains* or *Service Laterals*.

#### **9-4 FACILITY ON-SITE WATER STORAGE.**

##### **9-4.1** General.

**9-4.1.1** On-site fire protection water storage must comply with NFPA 22, except where specifically modified by this UFC.

**9-4.1.2** The discharge or suction line(s) from each individual tank or reservoir section must be sized to deliver the maximum required flow.

##### **9-4.2** Quantity.

**9-4.2.1** The total usable supply stored must be equal to 120% of the Facility's maximum required *Fire Water Demand* for the applicable duration specified in this UFC plus any applicable domestic or industrial demand.

**9-4.2.2** In calculating the fire protection water storage requirement, a reduction in storage capacity is acceptable if an adequate replenishment source is available. Factors that must be evaluated include the reliability of the makeup supply, its sustained flow capacity, its method of operation (automatic or manual), and flow limitations imposed by the capacity of treatment operations.

##### **9-4.3** Replenishment of Storage.

The water storage must be capable of being self-replenished to its required volume within 48 hours, during normal domestic and industrial consumption of the supplying utility.

##### **9-4.4** Monitoring.

**9-4.4.1** The water level must be remotely monitored in accordance with NFPA 22 and NFPA 72 by the *Installation Fire Alarm Reporting System*.

**9-4.4.2** In locales subject to freezing, water temperature of aboveground storage tanks must likewise be monitored by the *Installation Fire Alarm Reporting System*.

#### **9-5 FIRE PUMPS.**

##### **9-5.1** General.

**9-5.1.1** Fire pumps must comply with NFPA 20, except where specifically modified by this UFC.

**9-5.1.2** Fire pumps must be located in a detached, noncombustible pump house or located in a fire-rated room in accordance with NFPA 20 with direct access from the exterior.



**9-5.1.3** Maintenance access must be provided to the pump and driver so that either can be removed from the fire pump room. Access is permitted to be via double doors or overhead door directly to the exterior. This is in addition to the normal means of egress required by NFPA 101.

**9-5.1.4** Provide a minimum of 3 feet (915 mm) of clearance on one side of the fire pump assembly for maintenance and in front of the pump controller or the minimum required by NFPA 70. A clear width of 3 feet must be provided from the room entry to the fire pump assembly and controller.

**9-5.1.5** Provide a minimum of 3 feet (915 mm) access to and in front of all equipment and 6-in. (150 mm) behind the equipment, (e.g., control valves, check valves, etc.).

**9-5.1.6** Provide labeling on the surfaces of the piping in the pump room to show the water flow direction and pipe function (e.g., "Suction", "Discharge", "To Fire Dept. Connection", "To Bypass", "To Test Header", "To Standpipe", "To Sprinkler System"). Provide white painted stenciled letters and arrows, a minimum of 2-in. (50 mm) in height and visible from at least three sides when viewed from the floor.

**9-5.1.7** The maximum fire suppression system demand must not exceed 140 percent of rated pump capacity. The pressure at the inlet of the pump at 150 percent of the rated pump capacity must not be less than the required net positive suction head in accordance with NFPA 20. Where NPSH cannot be met at 150 percent of the fire pump rated capacity, the *DFPE* is permitted to reduce the required flow at NPSH, but in no case is it permitted to be less than the required fire suppression system demand.

**9-5.1.8** Terminate all drainage piping and test piping from the fire pump or associated appurtenances (e.g., circulation relief valve, bowl drains, etc.), including backflow preventers, to a floor drain or to the exterior of the *Facility* so it will not cause damage.

**9-5.1.8.1** Provide concrete pads or splash blocks where discharge location is to other than a concrete slab. Splash blocks must be large enough to mitigate erosion and must not become dislodged during a full flow of the drain. Ensure all discharged water drains away from the *Facility* and does not cause property damage

**9-5.1.8.2** Discharge to the exterior must not interfere with exiting from the *Facility*. Water discharge must not cross an exit or exit discharge.

**9-5.1.8.3** Drainage piping of less than 3/4-in. (20 mm) may discharge to a floor drain.

**9-5.1.9** Full flow relief valve piping must discharge safely in accordance with NFPA 20. If an on-site water storage tank or reservoir is provided, the piping must discharge back to the tank or reservoir.

**9-5.1.10** For DLA, a reserve fire pump of the same size must be provided when the total value at risk is greater than \$100 million.

**9-5.2** Pump Type.

A fire pump may be either a horizontal or vertical centrifugal pump, or a vertical turbine pump; whichever is most economical and appropriate for the intended use.

**9-5.3** Pump Start and Shutdown.

**9-5.3.1** Fire pumps must be arranged to start automatically.

**9-5.3.2** Fire pumps must be arranged to automatically shut down after reaching the stop pressure and the expiration of a minimum 10-minute run timer. Stop pressure must be at least 5 psi below maximum churn pressure at the lowest available static pressure.

Note: The lowest available static pressure should be utilized in determining churn pressure so that the stop pressure can be achieved with low pressure. The 5 psi differential is used to allow for gauge error.

**9-5.3.3** Fire pump activation (run) must transmit an alarm condition to the *Installation* receiving station, or remote receiving station, but not activate the *Facility* notification appliance circuits (i.e. no audible/visual notification in the protected *Facility(s)*).

**9-5.4** Pump Drive.

**9-5.4.1** Electric power must comply with NFPA 20. Where electric power is available from a *Reliable Power Source* of adequate capacity, electric motor driven fire pumps must be used.

**9-5.4.2** When a *Reliable Power Source* is not available, electric motor driven fire pumps must be provided with a secondary power source (i.e. emergency generator with automatic transfer switch). See Chapter 2 for the definition of *Reliable Power Source*.

**9-5.4.3** A diesel engine driven fire pump is permitted in lieu of an electric motor driven fire pump when a *Reliable Power Source* is not available.

Note: Air Force preference is to utilize electric motor driven fire pump(s) with a secondary power source when a *Reliable Power Source* is not available.

**9-5.4.4** Diesel engine driven fire pumps must not be arranged to start automatically upon loss of normal power.

**9-5.5**            Controllers.

**9-5.5.1**          Soft start, reduced voltage controllers are required for electric motor driven fire pumps equal to or greater than 100 hp or when the fire pump is connected to an emergency generator.

**9-5.5.2**          Any starting method permitted by NFPA 20 is acceptable for electric motor driven fire pumps less than 100 hp and not connected to an emergency generator/2/ must comply with UFC 3-520-01.

**9-5.5.3**          Limited service controllers are permitted when approved by a NRTL and NFPA 20.

**9-5.5.4**          Variable speed controllers are permitted when approved by a NRTL.

**9-5.6**            Pump Bypass.

Provide a bypass in accordance with NFPA 20 around all fire pumps that take suction from a *Service Lateral*.

**9-5.7**            Electric Circuits for Diesel Engine Driven Pumps.

Provide separate hard-wired electric circuits for the pump controller, engine starting system battery charger and hard-wired electric circuit for the engine block heater.

**9-5.8**            Test Connections.

**9-5.8.1**          Provide a test header manifold on the *Facility* exterior that permits flow testing directly from the header. Coordinate the location of test header with other disciplines to ensure flow from test header does not discharge onto other equipment or cause property damage.

**9-5.8.2**          Provide a flow meter installed in accordance with NFPA 20.

**9-5.8.2.1**        The flow meter must be installed in series with the test header unless it is piped to discharge into a water storage tank or reservoir.

**9-5.8.2.2**        Where a water storage tank or reservoir provides suction to the fire pump, the flow meter discharge must be piped back to a water storage tank or reservoir.

**9-6**              **FIRE SUPPRESSION SYSTEMS.**

**9-6.1**            General.

**9-6.1.1**          This section applies to all fire suppression/extinguishing systems including, but not limited to: automatic sprinkler systems; water spray systems; foam systems; standpipe systems; dry chemical extinguishing systems; wet chemical extinguishing

systems; clean agent fire extinguishing systems; water mist fire protection systems; carbon dioxide systems; and, halon 1301 systems.

**9-6.1.2** Fire suppression systems must be designed and installed in accordance with the applicable NFPA standard, except where specifically modified by this UFC.

**9-6.2** Connections to *Fire Alarm Reporting Systems*.

**9-6.2.1** Where fire suppression systems are installed in or at *Facilities on Installations with Fire Alarm Reporting Systems*, the fire suppression systems must be connected to the *Fire Alarm Reporting System* for transmission of alarms, supervisory and trouble signals.

**9-6.2.2** Where installed in areas without an *Installation Fire Alarm Reporting System*, the fire suppression system must be connected to a remote supervising station for alarm, supervisory and trouble signals.

**9-6.3** Plans and Calculations.

**9-6.3.1** All working (shop) drawings, regardless of the type of fire suppression system, must meet the drawing requirements in NFPA 13 for Working Drawings, unless the system specific standard has requirements for working drawings.

**9-6.3.2** For new or modified systems, working (shop) drawings and calculations must be prepared by an individual that has obtained National Institute for Certification in Engineering Technologies, Automatic Sprinkler Systems, Level III certification or Special Hazards Suppression Systems, Level IV certification, as applicable to the project. The *QFPE* must review the shop drawings, hydraulic calculations and material submittals. The shop drawings must bear the *Review Stamp* of the *QFPE* prior to submitting the fire extinguishing system shop drawings to the *DFPE*.

For Army projects, construction (shop) drawings and calculations must be prepared by, or prepared under the immediate supervision of, the *QFPE*. The *QFPE* must affix their professional engineering stamp with signature to the shop drawings, calculations and material data sheets, indicating approval prior to submitting the fire extinguishing system shop drawings to the *DFPE*. The *QFPE* must monitor the installation of the fire protection systems and certify in writing that the fire protection systems have been constructed and operate as intended in the design plans and specifications.

**9-6.3.3** When twenty or less sprinklers are modified or relocated, shop drawings, hydraulic calculations and material submittals are not required to be submitted.

**9-6.3.4** The preparer of the shop drawings must perform calculations (i.e. hydraulic calculations, agent flow calculations) in accordance with the applicable NFPA standard, demonstrating that the design will provide an adequate supply for the fire suppression systems. Calculations must be submitted no later than the first shop drawing submission.

**9-6.3.5** Hydraulic calculations must include a minimum pressure drop across backflow preventers of 12 psi (82.7 kPa).

**9-6.3.6** When nitrogen is utilized in dry or preaction sprinkler systems, a C-factor of 120 is permitted to be used in hydraulic calculations.

**9-6.3.7** The dimension from the edge of standpipes and fire suppression system risers to the nearest adjacent wall(s) must be indicated on the drawings when located in stairs or other portions of the means of egress.

**9-6.3.8** The *QFPE* must consult with the *DFPE* or *Installation* fire safety agency to clarify location of fire department connection(s) or type of hose threads.

Note: The *Installation* fire safety agency will typically be the fire department.

**9-6.4** Waterflow Testing.

Conduct waterflow tests, in accordance with the procedures contained in NFPA 291 to determine available water supply for the water-based fire extinguishing systems. The flow test must be performed under the direction of the *QFPE*.

Note: Hydraulic calculations should be based on a waterflow test that was performed no more than 6 months prior to submission of the calculations.

**9-6.5** *Fire Water Demand.*

Domestic demand and hose stream are not required to be included in the *Fire Water Demand* when supplied from a utility or source separate from that supplied to the fire suppression system (i.e. tank for fire, water main for hydrant or domestic). Domestic or industrial demands are not included in the *Fire Water Demand* where means are provided to restrict these demands during a fire incident.

**9-6.6** Backflow Prevention and Cross Connection Control.

The installation of backflow prevention and cross connection control must comply with AWWA Manual M 14.

**9-6.6.1** Potable Water Supply.

For new fire suppression systems using water only, follow the *Installation* requirements for proper type of backflow prevention.

**9-6.6.2** Installation.

**9-6.6.2.1** Install a reduced pressure type backflow prevention device where antifreeze, foam or other chemicals are added into the system.

**9-6.6.2.2** For locations subject to freezing, backflow preventers must be located in the *Facility* or within a heated enclosure. Provide a low temperature supervisory alarm connected to the *Facility* FACP for heated enclosures. Heat trace must not be used unless a heated enclosure cannot be provided.

**9-6.6.2.3** Install horizontal backflow preventers so that the bottom of the assembly is no greater than 24-in. (610 mm) above the finished floor/grade. Install vertical backflow preventers so that the upper operating handwheel is no more than 6 feet (1.8 m) above the finished floor/grade.

**9-6.6.3** Prior to the installation of backflow preventers in an existing fire suppression system, a thorough hydraulic analysis, including hydraulic calculations and flow test, must be performed to ensure that the water supply is still adequate for the system with the backflow preventer. If the backflow preventer causes the demand to exceed the water supply, the backflow preventer must not be installed until the water supply is corrected to support the new demand.

**9-6.6.4** When installed as part of a fire pump system, piping and fittings suitable for potable water must be used upstream of the backflow preventer in accordance with local environmental requirements. The backflow preventer must be located where required by NFPA 20 unless the local environmental requirements differ.

**9-6.6.5** Test Header.

**9-6.6.5.1** All new water-based fire suppression systems must have test valves installed downstream of the backflow preventer. These valves must be angle or globe valves with 2.5-inch male National Standard Hose Threads with cap and chain. Provide one valve for each 250 gpm, and fraction thereof, of system design flow (e.g., a volumetric waterflow rate of 450 gpm would require two valves).

**9-6.7** Meters.

Where meters are installed on a *Service Lateral* serving fire suppression systems, hydrants, or standpipe systems, they must be listed by a NRTL as fire service meters.

**9-6.8** Painting and Labeling.

**9-6.8.1** Labeling must be in accordance with MIL-STD-101, except as modified by this section.

**9-6.8.2** Provide labeling on the surfaces of all feed and cross mains to show the pipe function (e.g., "Sprinkler System", "Fire Department Connection", "Standpipe"). For pipe sizes 4-inch and larger (100 mm), provide white painted stenciled letters and arrows, a minimum of 2-in. (50 mm) in height and visible from at least two sides when viewed from the floor. For pipe sizes less than 4-inch (100 mm), provide white painted stenciled letters and arrows, a minimum of 0.75-in. (18 mm) in height and visible from the floor.

**9-6.8.3** All fire suppression system valves must be marked with permanent tags indicating normally open or normally closed.

## **9-7 AUTOMATIC SPRINKLER SYSTEMS.**

**9-7.1** General.

**9-7.1.1** Automatic sprinkler systems must comply with NFPA 13, except where specifically modified by this UFC.

**9-7.1.2** When automatic sprinkler protection is required by this UFC, it is meant that a wet pipe sprinkler system is to be provided, unless environmental concerns indicate otherwise (e.g., freezing conditions).

**9-7.1.3** Sprinkler systems must use equipment and devices listed by a NRTL.

**9-7.2** Application Requirements.

**9-7.2.1** Complete automatic sprinkler protection must be provided for the following *Facilities*:

**9-7.2.1.1** Single-story, Type I or II construction *Facilities* greater than 15,000 ft<sup>2</sup> (1,394 m<sup>2</sup>) gross floor area

**9-7.2.1.2** Multi-story *Facilities*, regardless of floor area or construction type.

**9-7.2.1.3** Single-story, Type III, IV and V construction greater than 5,000 ft<sup>2</sup> (465 m<sup>2</sup>)

**9-7.2.1.4** As specified by other sections of this UFC.

**9-7.2.1.5** As required by the IBC for area, height or construction type modifications.

**9-7.2.1.6** See the paragraph entitled "Automatic Sprinkler Systems" in the "Planning (Contract Document Development)" section of the "Introduction" Chapter in this UFC.

**9-7.2.2** The requirement for automatic sprinkler protection for tension fabric structures must be determined by the DFPE

**9-7.2.3** New or modified automatic sprinkler protection for existing *Facilities* must comply with the requirements of the "Existing Facilities" chapter of this UFC.

**9-7.2.4** Sprinkler protection must be provided for additions or *Modifications* of existing *Facilities* if the entire gross floor area of the *Facility* (including the addition, if provided) exceeds the area limitations noted above or is multi-story.

**9-7.2.4.1** If sprinkler protection is required, the system must be designed to support future sprinklers for the remainder of the *Facility*.

**9-7.3** Design Requirements.

**9-7.3.1** *Facilities* requiring sprinkler protection must be provided with sprinkler systems that are designed using the Area/Density Method of NFPA 13, except the discharge requirements for non-storage occupancies must be in accordance with Table 9-3, unless otherwise specified in this UFC.

Note: Common DoD hazard classifications that are not noted in NFPA 13 can be found in Appendix B.

**9-7.3.1.1** Residential occupancies must comply with the residential design criteria in NFPA 13, NFPA 13R or NFPA 13D, as applicable.\2\

**9-7.3.1.2** /2/Storage occupancies, in mixed use *Facilities*, must follow the miscellaneous storage and storage provisions of NFPA 13.

**9-7.3.2** Wet pipe, single-interlock preaction, and non-interlock preaction sprinkler systems must use the requirements for “wet” listed in Tables 9-3 and 9-4. Dry pipe, double-interlock preaction and deluge systems must use the requirements for “dry” listed in Tables 9-3 and 9-4.

**9-7.3.3** Where NFPA 13 uses the term ordinary hazard group 1 or ordinary hazard group 2, the density, k-factor, hose stream and duration must be in accordance with the ordinary hazard classification listed in Tables 9-3 and 9-4.

**9-7.3.4** Where NFPA 13 uses the term extra hazard group 1 or extra hazard group 2, the density, k-factor, hose stream and duration must be in accordance with the extra hazard classification listed in Tables 9-3 and 9-4.

**Table 9-3 Sprinkler Design Demand and Minimum K-Factor**

Hazard Classification		(gpm/ft <sup>2</sup> )/ft <sup>2</sup> (mm/min)/m <sup>2</sup> [minimum K factor]							
		Ceiling Height up to 30 ft (9.1 m)		Ceiling Height >30-45 ft (9.1 m - 13.7 m)		Ceiling Height >45-60 ft (13.7 m - 18.3 m)		Ceiling Height >60 - 100 ft (18.3 m - 30.5 m)	
		Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
Light	Design	0.1/1500 (4/140)	0.1/1500 (4/140)	0.2/2500 (8/230)	0.2/3500 (8/330)	0.2/2500 (8/230)	0.2/3500 (8/330)	12 @ 7 psi	NA
	K-factor	5.6 (80)	5.6 (80)	11.2 (160)	11.2 (160)	11.2 (160)	11.2 (160)	25.2 (360)	NA
Ordinary	Design	0.2/2500 (8/230)	0.2/3500 (8/330)	0.2/2500 (8/230)	0.2/3500 (8/330)	0.2/2500 (8/230)	0.2/3500 (8/330)	12 @ 7 psi	NA
	K-factor	8.0 (115)	8.0 (115)	11.2 (160)	11.2 (160)	11.2 (160)	11.2 (160)	25.2 (360)	NA



Extra	Design	0.3/2500 (12/230)	0.3/3500 (12/330)	0.3/3600 (12/340)	0.3/4600 (12/430)	0.5/3000 (20/280)	0.5/4000 (20/370)	12 @ 7 psi	NA
	K-factor	11.2 (160)	11.2 (160)	11.2 (160)	11.2 (160)	11.2 (160)	11.2 (160)	25.2 (360)	NA
Note: For ceiling heights > 60 feet, the design demand is based on the number of sprinklers at an end sprinkler pressure (i.e. 12 sprinklers at 7 psi end pressure).									

**9-7.3.5** Hose stream requirements must be in accordance with Table 9-4 unless otherwise modified by this UFC.

**Table 9-4 Hose Stream Demand and Duration**

Hazard Category	Hose Demand, gpm (lpm)		Duration, min
	Ceilings 60 ft (18.3 m) or less	Ceilings greater than 60 ft (18.3 m)	
Light	250 (950)	500 (1900)	60
Ordinary	250 (950)	500 (1900)	60
Extra	500 (1900)	500 (1900)	90

**9-7.3.6** The design areas noted above or in NFPA 13, as applicable, must be increased by 30 percent for sloped ceilings that exceed a slope of 2 in 12.

**9-7.3.7** The design area reductions in NFPA 13 for quick-response sprinklers are not permitted.

**9-7.4** Sprinkler Coverage.

**9-7.4.1** In *Facilities* protected by automatic sprinklers, sprinklers must provide coverage throughout the *Facility*.

**9-7.4.1.1** Sprinklers may be omitted where permitted by NFPA 13, NFPA 13R or NFPA 13D, as applicable.

**9-7.4.1.2** Sprinklers may be omitted from small rooms in specific occupancies in accordance with NFPA 101.

**9-7.4.2** Sprinklers must be provided in electrical rooms, regardless of the fire resistance rated separation.

**9-7.4.3** The use of extended coverage sprinklers is not permitted \2\except as noted below.

**9-7.4.3.1** Extended coverage sprinklers may be used for the protection of loading docks.

**9-7.4.3.2** Extend coverage sprinklers maybe used for the protection of historic structures and unique spaces subject to the written approval of the DFPE./2/

**9-7.4.4** Listed or approved residential sprinklers are permitted to be used at their listed/approved spacing and coverage.

**9-7.5** Hydraulic Calculations.

**9-7.5.1** Sprinkler systems must be designed using hydraulic calculations.

**9-7.5.1.1** Sprinkler systems permitted by this UFC to be supplied from the domestic plumbing may be designed using the pipe schedule method in NFPA 13.

**9-7.5.1.2** The addition of no more than twenty sprinklers to an existing system is permitted to be designed using the pipe schedule based on the layout of the existing system.

**9-7.5.2** Where the sprinkler system is supplied by interconnected risers, the sprinkler system must be hydraulically calculated using the hydraulically most demanding single riser. The calculations must not assume the simultaneous use of more than one riser.

**9-7.6** Piping.

**9-7.6.1.1** Galvanized piping is only permitted for deluge sprinkler systems, valve trim piping and drain piping exposed to the *Facility* exterior.

**9-7.6.1.2** Black steel pipe must be used for the addition, repair or relocation of existing galvanized pipe in wet pipe, dry pipe or preaction systems.\2\

**9-7.6.2** /2/Piping 2-in. (50 mm) and less must be minimum schedule 40. Piping larger than 2-in. (50 mm) must be minimum schedule 10. \2\For DLA, use Schedule 40 steel piping for all sprinkler systems and all pipe sizes.

**9-7.6.3** CPVC is only permitted for residential occupancies.

**9-7.6.4** /2/Plain end fittings with mechanical couplings and fittings that use steel gripping devices to bite into the pipe are prohibited.

**9-7.6.5** Steel piping with wall thickness less than schedule 40 must not be threaded.

**9-7.6.6** Saddle tees using rubber gasket fittings are only permitted when connecting to existing piping for additions or modifications. Saddle tees must use a connection method that completely wraps around the pipe.

**9-7.6.7** Fittings, mechanical couplings, and rubber gaskets must be from the same manufacturer.

**9-7.6.8** The use of flexible sprinkler hose with fittings intended for direct connection to sprinklers must be approved by the AHJ.

**9-7.6.9** Changes in pipe sizes must be made through tapered reducing pipe fittings.

**9-7.6.10** Threaded fittings must use Teflon tape or manufacturer's approved joint compound.

**9-7.7** Nitrogen Generation Systems.

**9-7.7.1** Design the nitrogen generation system so all equipment is installed within the confines of the riser room with the exception of a connection for a manual gas analyzer.

**9-7.7.2** Provide a nitrogen generation system that is capable of delivering a minimum of 98 percent nitrogen composition throughout all of the system piping within 14 days from the commencement of the inerting process.

**9-7.7.3** The nitrogen generation system must be self-contained with "drop-in" operability with a simple one step direct connection of the nitrogen gas supply line to each zone.

**9-7.7.4** The use of stand-alone compressed nitrogen bottle system is not permitted.

**9-7.7.5** A process that involves continuous venting of the piping network is not permitted.

**9-7.7.6** Any air maintenance device used in conjunction with the nitrogen generation system must be listed or approved for use on sprinkler systems.

**9-7.8** Preaction Systems.

**9-7.8.1** Preaction systems must utilize nitrogen complying with the "Nitrogen Generation Systems" section of this UFC.

**9-7.9** Dry Pipe Systems.

**9-7.9.1** Dry pipe systems must utilize nitrogen complying with the "Nitrogen Generation Systems" section of this UFC.

**9-7.9.2** The delivery of water from the dry pipe valve to the system test connection must not exceed 60 seconds. Water delivery times must be measured starting at the normal nitrogen pressure on the system.

**9-7.9.3** All rubber gasket grooved-end pipe fittings for dry pipe systems must be listed or approved for dry pipe systems.

**9-7.10** System Requirements.

**9-7.10.1** Provide a minimum clearance of 3 feet (915 mm) access to and in front of all equipment and 6-in. (150 mm) behind the equipment (e.g., control valves, backflow preventer, check valves, floor control valve assemblies, waterflow switches, etc.).

**9-7.10.2** Thrust rod all pipe penetrations through the grade floor slab, unless flanged or welded joints are used throughout the below slab piping. All pipe penetrations through the grade floor slab must be sleeved and sealed.

**9-7.10.3** The *QFPE* must coordinate with the Structural Engineer to determine the proper seismic design category for the project, in accordance with the IBC or ASCE guidelines. Seismic restraint is not required for Seismic design category A or B, except as otherwise required in this UFC.

Note: See UFC 3-310-04 for more information.

**9-7.10.4** Drain and Test Connections.

**9-7.10.4.1** Provide a permanently piped drain/test connection for each waterflow switch, including the waterflow switch for elevator power shunt.

**9-7.10.4.2** Terminate all main drains and inspector's test connections piping to the exterior of the *Facility* so it will not cause damage. Discharge to the exterior must not interfere with exiting from the *Facility*. Water discharge or runoff must not cross an exit or exit discharge path. Do not discharge to the roof.

**9-7.10.4.3** Termination points interior to the building are permitted to be approved by the *DFPE* when exterior termination is not practical.

**9-7.10.4.4** Provide concrete splash blocks at all drain and inspector's test connection discharge locations if not discharging to a concrete surface. Splash blocks must be large enough to mitigate erosion and must not become dislodged during a full flow of the main drain. Ensure all discharged water drains away from the *Facility* and does not cause property damage.

**9-7.10.4.5** Any drains, test connection pipe, etc., that penetrate the exterior wall must do so no greater than 2 feet (610 mm) above finished grade, and at no time below grade.

**9-7.10.4.6** The drain/test connection must be piped to a location that will accept full flow and will not cause property damage when water is discharging.

Note: Comply with any applicable state or local environmental requirements pertaining to the handling of sprinkler discharge water.

**9-7.10.5** Individual floor control assemblies are to be provided for each respective floor when there are three or more floor levels. Floor area meeting the IBC definition of a mezzanine is not considered a floor level when applying this requirement.

**9-7.10.6** Provide a dedicated control valve assembly for piping serving rooms that require shunt-tripping of equipment power prior to or simultaneously to the application of water. Locate the control valve assembly outside of the area it serves in an easily accessible identified location.

**9-7.10.7** Normally open valves required by NFPA 13, NFPA 13R or NFPA 13D to be supervised must be electrically supervised (i.e. tamper switch).

**9-7.10.8** Normally closed valves required by NFPA 13, NFPA 13R or NFPA 13D to be supervised must be locked or sealed, unless otherwise required by this UFC.

**9-7.10.9** Provide listed or approved sprinkler guards for sprinklers that are less than 7 feet (2.1 m) above finished floor (in unfinished areas) or subject to mechanical damage or can be grabbed from the floor level.

**9-7.10.10** Sprinklers installed in any detention areas, regardless of the *Facility* occupancy classification, must be listed/approved institutional sprinklers.

**9-7.10.11** Piping up to the backflow preventer, when the fire protection system is connected to a domestic water source, must be disinfected. Disinfection of all other aboveground fire protection system piping is not required.

**9-7.11** Family Housing.

When sprinkler systems are provided in family housing in geographic locations having a 99.6% dry bulb temperature less than 32°F (0°C) per UFC 3-400-02 Engineering Weather Data, sprinkler piping is prohibited from being located in attic spaces or exterior walls (except for the incoming service). Locate upper story piping only in interior walls and utilize sidewall sprinklers.

## **9-8 WATER SPRAY SYSTEMS.**

Water spray systems must comply with NFPA 15 and the "Fire Suppression Systems" requirements of this UFC.

## **9-9 FOAM SYSTEMS.**

**9-9.1** General.

**9-9.1.1** Foam systems must comply with NFPA 11 and NFPA 16, and the "Fire Suppression Systems" requirements of this UFC, except as modified below.

**9-9.1.2** For Army, AFFF is not permitted to be used for new systems.

**9-9.1.3** New systems must use potable water or a water source that is supplied from a potable water system (i.e. a water storage tank that is filled from a potable water system). The use of saltwater, brackish or other untreated water source must be approved by the *AHJ*.

**9-9.1.4** Foam storage tanks must be labeled indicating vendor, model, type, and quantity of foam held within the tank via permanent sign.

**9-9.1.5** \2\Consider all local environmental regulations to determine the control, treatment and/or remediation measures for the discharge of fire suppression effluent./2/

**9-9.2** Piping.

**9-9.2.1** Foam solution piping must be schedule 40 steel pipe.

**9-9.2.2** Foam concentrate piping must be stainless steel pipe with roll grooved fittings, welded joints and fittings, or flanged joints and fittings. If using welded joints and fittings, consideration must be given to the maintenance of the system and provide flanged joints at certain locations to allow for the ease of maintenance and equipment removal. Gasket material must be approved by the foam concentrate manufacturer.

**9-9.2.3** Any concealed concentrate piping must use welded or flanged fittings.

**9-9.2.4** Trim piping on all deluge valves, flow control valves, and alarm check valves must be brass.

**9-9.2.5** Foam concentrate lines must be located above grade.

**9-9.3** Aqueous Film-Forming Foam (AFFF) Concentrate.

**9-9.3.1** Foam Systems that utilize AFFF must only use AFFF concentrate meeting Military Specification MIL-F-24385F.

**9-9.3.2** AFFF concentrate must also be designated by the manufacturer as consisting of short chain C-6 fluorochemicals manufactured using a telomere-based process meeting the goals of the U.S. Environmental Protection Agency 2010/15 PFOA Stewardship Program.

**9-9.4** Foam Concentrate Pumps.

Foam concentrate pumps must be used where the distance from the tank to the proportioner exceeds 50 feet (15.3 m), or the manufacturer recommended distance based on water supply, whichever is less.

**9-9.5** Foam Concentrate Storage Tanks.

**9-9.5.1** Foam concentrate storage tanks can be atmospheric or horizontal bladder.

**9-9.5.2** Do not use vertical bladder tanks.

**9-9.5.3** Atmospheric tanks must be translucent or opaque, double-walled, polyethylene.

**9-9.6** Foam Concentrate Control Valves.

**9-9.6.1** For automatic control of foam concentrate, provide valves listed or approved for use with foam concentrate.

**9-9.6.2** Isolation control valves must be full port ball type with an operating handle that indicates the on/off position of the valve. Unit must be socket weld or flanged type. Valve body and ball must be 316 stainless steel complying with ASTM A351.

**9-9.6.3** All foam system valves affecting foam delivery must be electrically supervised for correct position.

**9-9.7** Foam Concentrate Spill Control.

**9-9.7.1** Spill control must be provided around foam storage tank(s) to help prevent spilled/leaked foam concentrate from reaching any drains.

**9-9.7.2** Spill control must consist of a minimum 4-in. (100 mm) high concrete berm or similar and sized for the full volume of the tank. Double-walled polyethylene tanks can qualify as acceptable spill control provided there are no taps or outlets in the sides or bottom of the tank.

**9-9.8** Test Liquid.

Surrogate test liquid (alternate test liquid) is permitted to be used for initial acceptance testing and routine testing if the liquid and test method is approved by a *DoD Component*.

**9-9.9** Foam Discharge.

Foam solution discharge for maintenance and testing purposes must be in accordance with local *Installation* environmental requirements.

**9-10** **STANDPIPE SYSTEMS.**

**9-10.1** General.

When required, standpipe systems must comply with NFPA 14 and the "Fire Suppression Systems" requirements of this UFC, except as modified below.

Residual pressure requirements for *Facilities* under 150 feet (45 m) in height may be met by fire department apparatus when hydraulic calculations demonstrate that fire department apparatus can provide the required pressure via the building fire department connection(s) with 150 psi at the FDC.

**9-10.2** Class I Standpipe Systems.

**9-10.2.1** A Class I standpipe system must be provided in all required exit stairs of *Facilities* four stories or more in height.

**9-10.2.2** For *Facilities* less than four stories in height, provide a Class I standpipe system where all portions of the building (on any floor) cannot be reached from an exterior door in less than 450 feet (140 m).

**9-10.2.2.1** When required by this section, standpipes must be installed in all required exit stairs and on both side of horizontal exits.

**9-10.2.3** Standpipes and hose valves must not encroach into the means of egress especially on stair landings.

**9-10.3** Class II and III Standpipes.

Class II and III standpipes, as defined in NFPA 14 are not permitted.

## **9-11 DRY CHEMICAL EXTINGUISHING SYSTEMS.**

Note: Fixed dry chemical extinguishing systems are appropriate for the protection of certain types of special occupancies, hazards, and facilities such as dip tanks, and other operations involving flammable liquids.

**9-11.1** General.

Dry chemical extinguishing system must comply with NFPA 17 and the "Fire Suppression Systems" requirements of this UFC, except as modified below.

**9-11.2** Limitations.

Dry chemical agents must not be used to protect sensitive electronics. Dry chemical extinguishing systems must not be used for the protection of cooking equipment.

## **9-12 WET CHEMICAL EXTINGUISHING SYSTEMS.**

Note: Fixed wet chemical extinguishing systems are suitable for protection of certain types of special occupancies, hazards, and facilities, such as cooking surfaces, cooking exhaust systems, and dip tanks.

**9-12.1** General.

Wet chemical extinguishing systems must comply with NFPA 17A and the "Fire Suppression Systems" requirements of this UFC, except as modified below.

**9-12.2** Testing.

Testing must be performed by liquid discharge, utilizing the manufacturer's recommended flushing concentrate, to demonstrate equal distribution of chemical and no leakage at pipe joints.



## 9-13 CLEAN AGENT FIRE EXTINGUISHING SYSTEMS.

Note: Clean agent fire extinguishing systems are suitable for protection of certain types of special occupancies, hazards, and facilities.

### 9-13.1 General.

**9-13.1.1** Clean agent fire extinguishing systems must comply with NFPA 2001 and the "Fire Suppression Systems" requirements of this UFC, except as modified below.

**9-13.1.2** Clean agent fire extinguishing systems are not permitted to substitute for required automatic sprinkler systems.

**9-13.1.3** Fire extinguishing agents that have been identified for future manufacturing or use limitations must not be used, regardless if current installation is permitted by regulatory authorities in the country of application.\1V1/

### 9-13.2 Requirements.

**9-13.2.1** Provide stand-alone (not dependent upon the *Facility* fire alarm system for operation) control panels that are listed for releasing device service and monitored by the *Facility* fire alarm system.

**9-13.2.2** Careful consideration must be given to compartment under/over-pressurization during the discharge of total flooding clean agent systems. Pressure relieving vents, located near the finished ceiling, may be necessary to regulate rapid pressure changes during discharge. Comply with the manufacturer's recommended procedures relative to enclosure venting.

**9-13.2.3** Provide a manually activated \2\permanent/2/ exhaust system to facilitate the extraction of any remaining clean agent after the required hold time of the total flooding clean agent system.

**9-13.2.3.1** The exhaust system can be integrated into the HVAC system for the enclosure, but in no case \2\2/ designed for less than six air changes per hour.

**9-13.2.3.2** The manual activation switch must be located outside of the protected area.

**9-13.2.3.3** Permanent signage must be provided indicating "Fire Suppression Exhaust System – Fire Department Use Only".

## 9-14 WATER MIST FIRE PROTECTION SYSTEMS.

Note: Water mist fire protection systems are suitable for protection of certain types of special occupancies, hazards, and facilities. Water mist fire protection systems are not a substitute for required automatic sprinkler systems.

### 9-14.1 General.

**9-14.1.1** Water mist fire protection systems must comply with NFPA 750 and the "Fire Suppression Systems" requirements of this UFC, except as modified below.

**9-14.1.2** Provide stand-alone (not dependent upon the *Facility* fire alarm system for operation) control panels that are listed for releasing device service and monitored by the *Facility* fire alarm system.

## **9-15 CARBON DIOXIDE SYSTEMS.**

Note: Carbon dioxide (CO<sub>2</sub>) systems are normally effective against flammable liquid (Class B) and energized electrical (Class C) fires.

**9-15.1** General.

**9-15.1.1** Carbon dioxide system must comply with NFPA 12 and the "Fire Suppression Systems" requirements of this UFC, except as modified below.

**9-15.1.2** New total flooding systems are not permitted in normally occupied areas.

**9-15.1.3** Do not locate CO<sub>2</sub> piping in any area where a pipe break or leak could make a normally occupied area untenable.

**9-15.1.4** Careful consideration must be given to compartment under/over-pressurization during the discharge of total flooding CO<sub>2</sub> systems. Comply with NFPA 12 and the manufacturer's recommended procedures relative to enclosure venting.

**9-15.1.5** Provide a manually activated exhaust system to facilitate the extraction of any remaining CO<sub>2</sub> after the required holding time of the total flooding CO<sub>2</sub> system. The exhaust system can be integrated into the HVAC system for the enclosure but in no case \2\2/ designed for less than six air changes per hour. The manual activation switch must be located outside of the protected area.

## **9-16 HALON 1301 SYSTEMS.**

**9-16.1** General.

Installation of a new Halon 1301 system is prohibited except by special approval of \1\Service Signature Authority/1/.

**9-16.2** Halon Turn-In Procedures.

For projects involving the demolition of existing Halon 1301 systems, refer to the following for turn-in requirements: <http://www.dla.mil/aviation>

**9-17 PORTABLE FIRE EXTINGUISHERS.**

**9-17.1** General.

General purpose portable fire extinguishers are not required when the *Facility* is provided with complete automatic sprinkler protection and a fire alarm system in accordance with this UFC.

**9-17.1.1** Portable fire extinguishers must be provided in all *Medical Facilities* and *Detention Facilities*, regardless of the *DoD Component*.

**9-17.2** Location.

**9-17.2.1** When provided, portable fire extinguishers must be located in accordance with NFPA 10.

**9-17.2.2** If provided in *Electronic Equipment Areas*, clean agent type portable fire extinguishers must be used.

**9-17.2.3** Portable fire extinguishers utilizing carbon dioxide (CO<sub>2</sub>) are only permitted to be used in enclosed rooms if they exceed 1,000 ft<sup>2</sup> (92.9 m<sup>2</sup>).

**9-18 /2/FIRE ALARM SYSTEMS.**

**9-18.1** General.

**9-18.1.1** Fire alarm systems (detection and notification) must comply with the applicable provisions of NFPA 72 and the ABA, except as modified by this UFC.

**9-18.1.1.1** Buildings or portions of the building that are not required to comply with ABA/ABAAG, must still comply with NFPA 72.

**9-18.1.2** Fire alarm systems must be independent, stand-alone systems that are not an integral part of a security, energy monitoring and control system (EMCS), or other system.

**9-18.1.2.1** The fire alarm system must be combined with a *Facility* mass notification system or with a combination *Facility* mass notification and public address system when mass notification is required by UFC 4-021-01. The fire alarm system, or combined *Facility* mass notification and fire alarm system, may be separate from a public address system.

**9-18.1.2.2** The fire alarm system is permitted to be connected to the EMCS or similar system to affect shutdown of HVAC units that require shutdown according to UFC 4-010-01 and UFC 4-021-01, but are otherwise not required to be controlled by the fire alarm system.

**9-18.1.2.3** Fire alarm systems may be connected to security systems or an EMCS for monitoring purposes only, but must in no way rely on those other systems for operation or reporting.

**9-18.1.3** Wireless interior fire alarm systems and devices are not permitted.

**9-18.2** Plans and Calculations.

For new or modified systems, construction (shop) drawings and calculations must be prepared by an individual that has obtained National Institute for Certification in Engineering Technologies, Fire Alarm Systems, Level III certification, at a minimum. The *QFPE* must review the shop drawings, calculations and material submittals. The shop drawings must bear the *Review Stamp* of the *QFPE* prior to submitting the fire alarm system shop drawings to the *DFPE*.

For Army, construction (shop) drawings and calculations must be prepared by, or prepared under the immediate supervision of, the *QFPE*. The *QFPE* must affix their professional engineering stamp with signature to the shop drawings, calculations and material data sheets, indicating approval prior to submitting the fire alarm system shop drawings to the *DFPE*. The *QFPE* must monitor the installation of the fire alarm system and certify in writing that the fire alarm system has been constructed and operates as intended in the design plans and specifications.

**9-18.3** *Fire Alarm Reporting System.*

**9-18.3.1** *Fire Alarm Reporting Systems* must conform to NFPA 72 and NFPA 70.

**9-18.3.2** The *Facility* fire alarm system must be connected to the *Fire Alarm Reporting System*.

**9-18.3.3** The following signals, at a minimum, must be transmitted via the *Fire Alarm Reporting System*:

- a. Alarm signal by device type (e.g., waterflow, manual pull station, sleeping room smoke detector).
- b. General supervisory signal.
- c. General trouble signal.

**9-18.3.4** New exterior fire alarm boxes are not required at DoD *Installations*, nor is it required to replace existing boxes that are not needed for the transmission of automatic alarms.

**9-18.3.5** *Fire Alarm Reporting Systems* must provide the following where applicable:

- a. Transmission of coded signals to fire department headquarters or other central locations;

- b. Permanent record of alarm signal, time, and date;
- c. Automatic supervision of alarm initiating circuits;
- d. Automatic testing of radio signaling devices;
- e. A dedicated transmitter that will transmit alarm, supervisory and trouble signals for each *Facility*; and
- f. Transmitters must be listed or approved for use with the existing *Fire Alarm Reporting System*.

**9-18.4** Control Panels.

**9-18.4.1** The fire alarm control panel must be analog/addressable, site programmable panel, and must have, or be capable of, the following:

- a. The ability to store at least 400 events in the history log. These events must be stored in a non-volatile memory and remain in the memory until the memory is downloaded or cleared manually.
- b. Resetting of the control panel must not clear the memory from being retrieved on the integral LCD display.
- c. An integral LCD 80 character (minimum) alphanumeric display.
- d. Provide all smoke detectors connected to the FACP with an adjustable alarm verification feature. Initially set the alarm verification at 20 seconds.

Existing fire detection systems that are controlled by *Facility* management, energy or utility management systems are permitted to remain.

**9-18.4.1.1** A conventional control panel is permitted to be used for systems monitoring sprinkler system alarm, supervisory and trouble conditions only as permitted by NFPA 101 (e.g. a warehouse).

**9-18.4.2** In new construction or major *Renovations*, the control panel cabinets and remote annunciator cabinet located in finished areas must be recessed or semi-recessed. Associated battery cabinets must be recessed or installed in a closet, electrical room, or other, similar room.

**9-18.4.3** Locate the control panel and supplemental control panels in a year-round environmentally conditioned space within the *Facility* that complies with the environmental conditions required in the panel approval or listing.

Note: Environmental condition values (temperature and humidity) are taken from UFC 3-400-02.

**9-18.4.4** If the fire alarm control panel is not located at the designated primary entrance, provide a remote annunciator at the designated primary entrance unless directed otherwise by the contract documents. Provide remote annunciator with control

functions the same as the main control panel. Control functions must be accessible only by user code or secured behind a locked panel.

**9-18.5**        Detection.

Note: Detection systems, especially smoke detection systems, require significant maintenance. It is critical that the required detectors are properly installed and maintained. Providing detectors in locations that are not required increases the already high maintenance costs of alarm systems and strains the maintenance program for critical detection systems. If a *Facility* warrants protection and criteria does not require detection, protection must be accomplished by a wet pipe sprinkler system. Wet pipe sprinklers provide superior protection with little maintenance.

**9-18.5.1**        General.

**9-18.5.1.1**      Fire detection systems must be provided in areas required by this UFC or where required by NFPA standards and must be limited to these applications unless an *Exemption* is approved\1V1/.

**9-18.5.1.2**      The area of protection for smoke detection devices permitted by NFPA 72 must be reduced by 50 percent where destratification (ceiling) fans are used (e.g., this may require additional smoke detectors for that area being protected).

**9-18.5.1.3**      The above reduction is in addition to any other reductions in spacing required by NFPA 72 (e.g., high ceiling, high air-flow).

**9-18.5.2**        Requirements.

Detection systems must be arranged to alert *Facility* occupants and to transmit an alarm signal via a *Fire Alarm Reporting System*.

**9-18.6**         Notification.

**9-18.6.1**        Notification must be provided throughout the entire *Facility* where required by NFPA 101 or when automatic detection or suppression systems are required by this UFC.

**9-18.6.2**        Where a mass notification system is required, fire alarm notification must be via a voice evacuation system and must serve as the method of notification for the mass notification system.

**9-18.6.3**        Audible and Visible Notification Appliances.

- a.        Provide a minimum of one notification appliance circuit per floor. Each notification appliance circuit must include 25 percent spare capacity.
- b.        Sleeping room speakers must produce a 520 Hz signal temporal three (T3) signal for fire in accordance with NFPA 72.

- c. Provide a 520 Hz signal temporal four (T4) signal for carbon monoxide in accordance with NFPA 720 when required by the "Carbon Monoxide (CO) Detection" section of this UFC.
- d. The provision of a sounder base does not negate the requirement of the *Facility's* audible notification appliances for each sleeping room.
- e. The performance requirements for audible notification must be met with all doors, fire shutters, movable partitions, and other similar devices closed.
- f. Visible notification must be provided in all normally occupied, public and common use areas (e.g., break rooms, corridors, auditoriums or conference rooms).
- g. Visible notification must be provided in all normally unoccupied areas (such as mechanical rooms, electrical rooms, janitor rooms, storage areas, communication closets and other similar spaces) greater than 900 ft<sup>2</sup> (84 m<sup>2</sup>).
- h. Visible notification is required in any normally unoccupied area where the ambient noise is loud enough to require hearing protection (e.g., compressor room).
- i. Visible notification must be provided in all offices that are designed for, or may contain, more than four persons at any one time. For Air Force, visual notification must be provided in all offices that are designated for, or may contain, two or more persons at any one time.

Note: This must be determined by the furniture plan. If four or more chairs with work surfaces are assigned to the room, visible notification is required. For Air Force if two or more chairs (with or without work surfaces) are assigned to the room, visual notification is required.

- j. Visible notification is not required in single person offices, unless the office is assigned to a person with a hearing impairment that would require a visible notification appliance.
- k. Visible notification is not required in bathrooms serving single person offices, unless the office is assigned to a person with a hearing impairment that would require a visible notification appliance.
- l. Visible notification appliances must be provided with a clear lens marked "Alert". The use of "Fire" is not permitted.

**9-18.6.4** Mass Notification System (MNS).

Refer to UFC 4-021-01.

**9-18.6.5** Voice Message.

For systems using voice evacuation or combined with the mass notification system, the default fire alarm voice evacuation message should be a female voice and state the following:

(Temporal 3 Alert Tone) "May I have your attention please. May I have your attention please. A fire emergency has been reported in the building. Please leave the building by the nearest exit or exit stairway. Do not use the elevators". <provide a 2 second pause> "May I have your attention please..." (repeat the message).

Installations with formally established and approved/published in accordance with the Service/Agency policy standard signals and messages are permitted to utilize those standard signals and messages. The general format must be a specific alert signal tone(s) followed by a voice announcement(s) and then repeats the cycle for a specific number of cycles or continuously as appropriate for the message.

Note 1: For single-story *Facilities*, delete "or exit stairway. Do not use the elevators" from the voice message.

Note 2: See "Appendix E" for guidance on other messages.

#### **9-18.7** Initiating Devices.

##### **9-18.7.1** Sprinkler Waterflow.

Provide a separate address for each sprinkler waterflow switch.

##### **9-18.7.2** Sprinkler System Supervisory Air or Gas.

Monitor high and low air or gas pressure on dry pipe and preaction systems on a per riser room basis as a supervisory function with the *Facility* fire alarm system.

##### **9-18.7.3** Valve Tamper.

No more than five adjacent valve tamper switches within the same room are permitted to be monitored by the same addressable device or supervisory circuit.

##### **9-18.7.4** Manual Pull Station.

**9-18.7.4.1** Manual pull stations must be provided at all exits, regardless of occupancy. Manual pull stations must be located within five feet of the exit door. The 200 foot travel distance to a manual pull station noted in NFPA 101 is not applicable.

**9-18.7.4.2** Provide addressable double-action type manual pull stations with mechanical reset features. If the manual pull station requires a key for reset, it must be the same key as required for the fire alarm control panel.



**9-18.7.4.3** Conventional single-action manual pull stations are permitted in hazardous areas, wet and damp locations, and other areas where specialty listings are required. Where a conventional manual pull station is used, it must be provided with a separate address.

**9-18.7.5** Smoke Detection.

**9-18.7.5.1** Provide 24 Vdc photoelectric smoke detectors in all sleeping rooms and duty rooms located in business or other occupancies. Not applicable to inpatient sleeping rooms of healthcare occupancies.

**9-18.7.5.2** Upon detection of smoke, an audible signal must be activated in the respective sleeping room, dwelling unit/suite or duty room, send a distinct signal to the *Facility* fire alarm control panel, if required by other sections of this UFC, and to the *Installation* fire reporting system, but not activate the *Facility* notification appliances.

**9-18.7.5.3** See Chapter 4 for Open Bay Personnel Housing.

**9-18.7.5.4** The audible signal must be low frequency as required by NFPA 72.

**9-18.7.6** Under-floor Smoke Detector Identification.

When under-floor smoke detectors are provided, provide a framed CAD drawn floor plan showing the location of the devices in the room and their corresponding address. Locate a single framed drawing of the location of the smoke detectors outside of the space and adjacent to the main entrance.

**9-18.8** Power Disconnect.

For disconnecting power supplies, provide listed control relays located within 3 feet (915 mm) of the shunt trip breaker. Operation of relay must be controlled by a listed fire alarm control unit. Relay must function within the voltage and current limitations of the fire alarm control unit. Relay contacts must be listed for the connected load.

**9-18.9** Wiring, Circuits and Conduit.

**9-18.9.1** Class B pathways for addressable detection, notification, and signaling line circuits meet all minimum/necessary DoD performance requirements.

**9-18.9.2** All conductors must be installed in conduit (EMT minimum).

**9-18.9.3** Conductors.

**9-18.9.3.1** Pull all conductors splice free; conductors must be continuous from device to device. The use of wire nuts, crimped connectors, or twisting of conductors is prohibited.

**9-18.9.3.2** Run all wiring to and within control panels in the vertical or horizontal plane, make all turns at 90 degree angles, and tightly bundle, wrap, and identify all conductors individually with permanent markings. Conductor markings must be printed labels, permanently affixed to the conductor via shrink wrap.

**9-18.9.4** Conductor Type.

**9-18.9.4.1** Wiring may be solid copper or stranded as permitted by NFPA 70.

**9-18.9.4.2** All signaling line circuits must be minimum 18 AWG. Initiating device and notification appliance circuits must be minimum 16 AWG.

**9-18.9.4.3** Initiating device circuits used for optical flame detection devices must use shielded cable.

**9-18.9.5** Device Termination.

All devices must have screw terminals. Where devices are only provided with pigtails from the manufacturer, pigtails must be landed on terminal strips mounted within the junction box.

**9-18.9.6** Conductor Terminations.

All terminations must be at a terminal strip or the device screw terminals. Terminal strips are only permitted where direct connection to a device is not possible. (e.g., pigtails off a rate-compensating heat detector).

**9-18.9.7** Identification.

**9-18.9.7.1** All conduit, junction/back boxes, covers and couplings, when provided, must be factory painted red in unfinished areas (e.g., above ceilings, mechanical rooms, etc.).

**9-18.9.7.2** All conduit, junction/back boxes, covers and couplings, when provided, are permitted to be painted to match the room finishing in finished areas. The inside cover of the junction box must be identified as "Fire Alarm" and the conduit must have painted red bands 3/4-in. (20 mm) wide at 20 feet (6 m) intervals and on both sides of all floor, wall, and ceiling penetrations.

**9-18.10** Surge Suppression.

**9-18.10.1** Provide surge suppression (SPD) for all signaling line circuits, indicating device circuits, or notification appliance circuits that leave or enter a *Facility's* exterior enclosure.

**9-18.10.2** SPD must be provided at the first location where connections are made that is close to where the circuit enters or leaves the *Facility*, prior to connection to any other devices when feasible.

**9-18.10.3** SPD is not required for devices connected directly to the *Facility* exterior when the *Facility* itself is provided with lightning protection (i.e. an electric bell or speakers mounted on the exterior wall of the *Facility*.)

**9-18.11** Power.

**9-18.11.1** Provide primary power in accordance with UFC 3-520-01. This includes the provision of a lock-on circuit breaker.

**9-18.11.2** Provide SPD on all 120 Vac circuits to control panels, subpanels, transmitters, amplifier panels, and booster panels. SPD must have both a UL 1449 and UL 1283 listing and must be located in an adjacent hinged terminal box.

**9-18.11.3** Secondary Power.

Provide rechargeable batteries per NFPA 72 to operate the fire alarm system under supervisory conditions for 48 hours and all alarm devices for an additional 15 minutes. Where the fire alarm system also serves as a mass notification system, refer to UFC 4-021-01 for additional requirements.

**9-18.12** Releasing Control Panels.

**9-18.12.1** In addition to the requirements specified above for fire alarm control panels, panels used for control or release of fire suppression systems must be listed by a NRTL for releasing service.

**9-18.12.1.1** Provide a separate releasing panel independent of the *Facility* fire alarm system panel to activate the system.

**9-18.12.1.2** A combined fire alarm/releasing panel is permitted for small *Facilities* with the approval of the *DFPE*.

**9-18.12.2** Electronic solenoids used for release of the suppression system must be listed by a NRTL for use with both the releasing panel and the suppression equipment.

**9-18.12.3** Provide rechargeable batteries per NFPA 72 to operate the releasing panel under supervisory conditions for 48 hours and alarm conditions for an additional 15 minutes. Include the full current draw of the solenoid in the battery calculations.

**9-18.12.4** When more than one panel is used, each panel must be monitored independently by the *Facility* fire alarm control panel.

**9-18.12.5** Locate the panel adjacent to, but not in, the hazard/area served. The releasing panel and supplemental control panels must be located in a year-round environmentally conditioned space that complies with the environmental conditions required in the listing.

**9-18.12.6** When required, pre-discharge and discharge alarms must consist of audible and visible notification appliances that are different than the *Facility* fire alarm system notification appliances.

**9-19 CARBON MONOXIDE (CO) DETECTION.**

**9-19.1** General.

**9-19.1.1** Provide carbon monoxide detection in facilities with combustible fuel burning equipment (e.g., air handling units, heaters, stoves, fireplaces).

**9-19.1.2** Carbon monoxide detection must conform to the requirements of NFPA 720 and the manufacturer's requirements, except as modified by this UFC.

**9-19.1.3** Carbon monoxide detectors must be powered by the fire alarm control panel (i.e. 24 Vdc). Where a fire alarm system is not provided, 120 Vac \2\ carbon monoxide alarms/2/ are permitted.

**9-19.2** Installation.

**9-19.2.1** Detectors must be located in each room/space where the fuel burning appliances(s) are located.

**9-19.2.2** \2\Where HVAC equipment utilizes fuel burning equipment, one detector must be located downstream of the fuel burning equipment./2/

**9-19.3** Notification.

**9-19.3.1** Where a fire alarm voice evacuation system is provided, activation of a carbon monoxide detection device must initiate a unique voice notification message.

**9-19.3.1.1** The alert signal portion of the voice alarm message for carbon monoxide detection must be a 520 Hz temporal 4 (T-4) signal. The alert signal must repeat twice before the voice announcement.

**9-19.3.1.2** A sample message is as follows: (Temporal 4 Alert Tone)  
"Attention....Attention....Carbon monoxide has been detected in the building. Please leave the building by the nearest exit." (Temporal 4 Alert Tone)

**9-19.3.2** Where a voice evacuation system is not provided, activation of a carbon monoxide detector must initiate an audible alarm distinctly different from other audible alarm signals in the *Facility*. Distinct visible notification is not required.

**9-19.3.3** When part of the fire alarm system, activation of a carbon monoxide detector must send a separate "carbon monoxide detector" alarm signal to the *Fire Alarm Reporting System*.

**9-19.3.4** Sleeping room audible appliances must provide a 520 Hz temporal 4 (T4) signal for carbon monoxide in accordance with NFPA 720. The provision of a sounder base does not negate the requirement of the *Facility's* audible notification appliances for each sleeping room."

**9-20 SMOKE CONTROL SYSTEM**

**9-20.1** General.

**9-20.1.1** Design must be in accordance with NFPA 92.

**9-20.1.2** Design parameters must be documented and be based on industry standards of practice, such as the SFPE Handbook of Smoke Control Engineering. Other source documents, such as peer-reviewed research articles, may be used with approval of the *DFPE*.

**9-20.1.3** Controls must be designed and listed as required by NFPA 92.

**9-20.1.4** Fire alarm control unit must be ANSI/UL 864, category UUKL listed.

**9-20.1.5** HVAC controls must be ANSI/UL 864, category UUKL listed where required by NFPA 92.

**9-20.1.6** Fire alarm system sequence of operations matrix must include all automatic and firefighter's smoke control station functions.

**9-20.1.7** Design must include a preliminary test plan.

**9-20.2** Installation.

**9-20.2.1** Prior to installation and programming, provide a single submittal that includes all smoke control system components.

**9-20.2.2** Submittal must document all aspects of integration between the involved systems and trades, such as the interface between the fire alarm and HVAC systems.

**9-20.2.3** Documentation must include the physical interface and logic interface. Physical interface description must include location of control devices and wiring diagrams for all components. Logic interface description must include the complete sequence of operations, from input to final output.

**9-20.2.4** Submittal must include an updated test plan, tailored to the specific devices and arrangements to be installed. Test plan must include all proposed test procedures.

**9-20.3** Testing.

**9-20.3.1** Testing must be in accordance with NFPA 92.

**9-20.3.2** Individual components must be tested in accordance with the relevant UFC. For example, fire alarm system components must be tested in accordance with UFC 3-600-01 and NFPA 72. Fans must be tested in accordance with Air Movement and Control Association (AMCA) Publication 203.

**9-20.3.3** Submit a revised test plan that incorporates any as-built conditions that differ from the smoke control submittal, prior to the start of any acceptance testing.

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## CHAPTER 10 MEANS OF EGRESS

### 10-1 GENERAL.

#### 10-1.1 Requirements.

Comply with NFPA 101 for all components and features related to means of egress. IBC must not be used for any means of egress features, except as specifically noted below.

#### 10-1.2 Accessible Means of Egress.

Comply with NFPA 101 for accessible means of egress.

### 10-2 MEANS OF EGRESS MARKING.

#### 10-2.1 Requirements.

**10-2.1.1** Incandescent or fluorescent fixtures are not permitted for new installation or replacement of fixtures.

**10-2.1.2** Use of the graphic emergency exit symbols with and without directional arrows (NFPA 170 or Host Nation equivalents) in lieu of the text "EXIT" is permitted.

**10-2.1.3** In locations outside the United States and its territories and possessions, additional markings may be required to remain consistent with local national standards; colors must be consistent with local national standards, and bilingual signs are recommended.

#### 10-2.2 Radioluminous Exit Signs.

Radioluminous exit signs are not permitted in DoD *Facilities*.

#### 10-2.3 Photoluminescent Exit Signs and Markings.

**10-2.3.1** Photoluminescent exit signs and egress path markings are permitted and must be designed and installed per the requirements of NFPA 101. The charging light source must be continually illuminated at all times with normal power. The charging light source must not be on a switched circuit.

**10-2.3.2** The illumination source must be energized at all times during building occupancy. Such lighting must not be controlled by automatic timers, automatic sensors including area occupancy sensors, or accessible manual switches. Controls for such lighting must be accessible only to authorized personnel.

**10-3 OCCUPANT LOAD.**

**10-3.1** Occupant load factors.

Occupant load must be calculated in accordance with NFPA 101, except as noted in Table 10-1 below:

**Table 10-1 Supplemental Occupant Load Factors**

Use	Occupant Load Factor (sf/person)
Waiting spaces other than those in theaters and assembly occupancies where persons are admitted to the building at times when seats are not available	15 net
Exhibit galleries, museums	30 net
Courtrooms, hearing rooms – other than fixed seating areas	40 net
Conference rooms with tables and chairs	15 net
Community shelters (e.g., spaces designated for 'shelter in place' for ½/2/hurricane, disaster recovery, or similar)	20 net
½Community shelters for tornado	7 net/2/
Recreation – indoor tennis courts	50 gross
Recreation – squash, racquetball	4 per court
Locker rooms	50 gross or maximum anticipated number, whichever is higher
Bowling centers	5 persons per lane plus 7 net for additional areas
Dormitories (bunks)	50 gross
Mechanical, electrical, other building equipment spaces	500 gross
IT equipment rooms including those with small work areas in accordance with NFPA 75 or telecommunications rooms in accordance with NFPA 76	300 gross
Manufacturing areas	200 gross
Parking garages	200 gross
Telecommunications buildings (standalone)	500 gross
Aircraft hangars – aircraft storage and servicing areas	500 gross
Magazines and bunkers	Maximum anticipated number of personnel



**10-3.2** Maximum occupant load.

The maximum occupant load for any space or *Facility* must not exceed one person per 7 ft<sup>2</sup> (0.65 m<sup>2</sup>) of net floor space or the maximum capacity of the required egress components, whichever is less.

**10-4 STAIR TO ROOF ACCESS.**

Stair to roof access must be in accordance with the IBC.

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## CHAPTER 11 ACCESSIBILITY

### 11-1 GENERAL.

For fire protection requirements, no changes to the IBC Chapter 11 provisions.

## CHAPTER 12 INTERIOR ENVIRONMENT

### 12-1 GENERAL.

For fire protection requirements, no changes to the IBC Chapter 12 provisions.

## CHAPTER 13 ENERGY EFFICIENCY

### 13-1 GENERAL.

For fire protection requirements, no changes to the IBC Chapter 13 provisions.

## CHAPTER 14 EXTERIOR WALLS

### 14-1 GENERAL.

For fire protection requirements, no changes to the IBC Chapter 14 provisions.

## CHAPTER 15 ROOF ASSEMBLIES AND ROOFTOP STRUCTURES

### 15-1 ROOF COVERINGS.

Use roof coverings approved and listed by a NRTL. Class C roof coverings, as defined in the UL Roofing Materials and Systems Directory are only permitted for single and duplex style housing and *Facilities* less than or equal to 5,000 ft<sup>2</sup> (465 m<sup>2</sup>).

### 15-2 ROOF DECK ASSEMBLIES.

#### 15-2.1 General.

**15-2.1.1** For non-sprinklered *Facilities* or *Facilities* \2\greater than or equal to/2/ 8,000 ft<sup>2</sup> (743 m<sup>2</sup>), roof deck assemblies must be FM Class I approved, or UL-listed as fire classified or equal listing or classification by an NRTL.

**15-2.1.2** Where a non-combustible roof is installed over an existing combustible roof, the existing combustible roof materials must be removed or the space between the existing and new roof must be protected as a combustible concealed space per NFPA 13.

Note: FM Class I or II ratings and UL "Fire Classified" ratings are measures of the resistance, of the entire roof assembly, to ignition from exposure to a fire within the building, heating the underside of the roof deck. These two ratings cannot be equated and are not interchangeable.

**15-2.1.3** Where the HVAC or similar equipment is located on the existing roof and not removed, the space between the existing and new roof must be protected as and considered a combustible concealed space per NFPA 13.

**15-2.1.4** Roof top solar photovoltaic (PV) panels must be mounted to facilitate application of water from fire department vehicles to fires on the roof deck surface. Arrangement of PV panels must meet the requirements of UFC 3-440-01.

## **CHAPTER 16 STRUCTURAL DESIGN**

### **16-1 GENERAL.**

For fire protection requirements, no changes to the IBC Chapter 16 provisions.

## **CHAPTER 17 SPECIAL INSPECTIONS AND TESTS**

### **17-1 GENERAL.**

For fire protection requirements, no changes to the IBC Chapter 17 provisions.

## **CHAPTER 18 SOILS AND FOUNDATIONS**

### **18-1 GENERAL.**

For fire protection requirements, no changes to the IBC Chapter 18 provisions.

## CHAPTER 19 CONCRETE

### 19-1 GENERAL.

For fire protection requirements, no changes to the IBC Chapter 19 provisions.

## CHAPTER 20 ALUMINUM

### 20-1 GENERAL.

For fire protection requirements, no changes to the IBC Chapter 20 provisions.

## CHAPTER 21 MASONRY

### 21-1 GENERAL.

For fire protection requirements, no changes to the IBC Chapter 21 provisions.

## CHAPTER 22 STEEL

### 22-1 GENERAL.

For fire protection requirements, no changes to the IBC chapter 22 provisions.

## CHAPTER 23 WOOD

### 23-1 FIRE RETARDANT TREATED (FRT) WOOD.

Conform to the requirements of IBC for permitted use of FRT wood. FRT plywood must not be used in any part of the roof or roofing system.

\2\2/

## CHAPTER 24 GLASS AND GLAZING

### 24-1 GENERAL.

For fire protection requirements, no changes to the IBC Chapter 24 provisions.

## CHAPTER 25 GYPSUM BOARD, GYPSUM PANEL PRODUCTS AND PLASTER

### 25-1 GENERAL.

For fire protection requirements, no changes to the IBC Chapter 25 provisions.

## CHAPTER 26 PLASTIC

### 26-1 GENERAL.

For fire protection requirements, no changes to the IBC Chapter 26 provisions.

## CHAPTER 27 ELECTRICAL

### 27-1 GENERAL.

For fire protection requirements, no changes to the IBC Chapter 27 provisions.

## CHAPTER 28 MECHANICAL SYSTEMS

### 28-1 AIR HANDLING.

#### 28-1.1 General.

Fire protection features for air handling, heating, ventilation, and exhaust systems, such as duct smoke detectors, fire dampers and smoke dampers, must comply with the requirements of NFPA 90A, except as modified by this UFC.

Duct smoke detectors are not required where air distribution systems are incapable of spreading smoke beyond the enclosing walls, floors and ceilings of the room or space in which the smoke is generated.

∨Duct smoke detectors are not required when the air distribution system supplies a space or room that has area smoke detection./2/

#### 28-1.2 Plenums.

Plenums may be used as an integral part of an air handling system only if they conform to the requirements of NFPA 90A. Under no circumstances may combustible materials be located within the plenum space. Electrical wiring passing through the space, including telephone and communication wiring must be plenum rated or must be in metal conduit.

Rooms or areas that form a plenum space or that are used as a plenum must not be occupied for any purpose except during repairs or maintenance operations to the air handling equipment.

**28-1.3** Computer Room Air Conditioning (CRAC).

**28-1.3.1** CRAC units must not automatically shutdown if electronic equipment remains energized and heat generated in the room will be sufficient to activate sprinkler heads.

## **CHAPTER 29 PLUMBING SYSTEMS**

**29-1** **GENERAL.**

For fire protection requirements, no changes to the IBC Chapter 29 provisions.

## **CHAPTER 30 ELEVATORS AND CONVEYING SYSTEMS**

**30-1** **GENERAL.**

For fire protection requirements, no changes to the IBC Chapter 30 provisions.

Comply with requirements of the "Elevators" section of this UFC.

## **CHAPTER 31 SPECIAL CONSTRUCTION**

**31-1** **GENERAL.**

For fire protection requirements, no changes to the IBC Chapter 31 provisions.

## **CHAPTER 32 ENCROACHMENTS INTO THE PUBLIC RIGHT-OF-WAY**

**32-1** **GENERAL.**

For fire protection requirements, no changes to the IBC Chapter 32 provisions.

## **CHAPTER 33 SAFEGUARDS DURING CONSTRUCTION**

**33-1** **GENERAL.**

For fire protection requirements, no changes to the IBC Chapter 33 provisions.

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## CHAPTER 34 EXISTING FACILITIES

### 34-1 GENERAL.

#### 34-1.1 Minimum Requirements.

*Facilities*, as they exist, must meet the requirements of NFPA 101, for existing occupancies. *Facilities* that do not meet the requirements of NFPA 101 for existing occupancies must conform to one of the following:

- a. Upgrade the deficiency to meet the existing occupancy requirements, or
- b. Establish management protocols to provide a level of life safety equivalent to that required by NFPA 101 for existing occupancies, until an upgrade project can be completed. Management protocols must be in writing and approved by the *AHJ*.

#### 34-1.2 $\sqrt{2}$ /Work in Existing *Facilities*.

**34-1.2.1** Conform to the requirements of the Building Rehabilitation chapter of NFPA 101 for design and construction projects in existing buildings including the following categories of rehabilitation work; *Addition, Repair, Renovation, Modification, Reconstruction* and Change of Use or occupancy classification.

**34-1.2.2** Where multiple categories of rehabilitation work are planned as part of a single project, identify each category of rehabilitation work to be performed, including what is required and what will be provided, within each one.

**34-1.2.3** Phasing of construction and demolition operations must be planned so that the integrity of fire-rated separations, smoke-tight boundaries, means of egress, exit enclosures, and vertical openings are maintained to the highest level possible.

**34-1.2.3.1** The phasing plan must ensure that obstruction of the means of egress is avoided or minimized.

**34-1.2.3.2** If exits are obstructed during construction, provide alternate means of egress and exit routes during each phase of construction and identify the alternate routes on the construction drawings as part of the phasing plan(s).

**34-1.2.4** Minimize, to the extent possible, any impairments or disruptions to active fire protection features. Delineate phasing of construction to ensure that installations of new features (or systems) or modifications to existing ones are expedited.

**34-1.2.4.1** Where possible, maintain existing systems in service until the replacement work has been deemed operational.

**34-1.2.5** Prior to taking any actions to impair a fire protection feature or disrupt its performance, ensure alternative procedures have been prepared and incorporated and

confirm that official notification of system impairments and schedules have been given to the staff of the *Facility*.

**34-1.2.6** \2\See paragraph "Automatic Sprinkler Systems" in the "Fire Protection Systems" Chapter of this UFC for additional requirements./2/

**34-1.3** *Repair.*

**34-1.3.1** All work must be done using like materials or materials permitted by current UFC requirements.

**34-1.3.2** The work must not make the building or occupancy less conforming with this UFC and NFPA 101 than before the *Repair* project was undertaken.

**34-1.3.3** *Repairs* in historic structures must comply with either the full requirements for *Repairs* or as specifically modified for historic buildings in the Building Rehabilitation chapter of NFPA 101.

**34-1.4** *Renovation.*

**34-1.4.1** All work must conform to the existing occupancy provisions of NFPA 101. The work must not make the building or occupancy less conforming with this UFC and NFPA 101 than before the *Renovation* project was undertaken.

**34-1.4.2** *Renovations* in historic buildings must comply with either the full requirements for *Renovations* or as specifically modified for historic buildings in the Building Rehabilitation chapter of NFPA 101.

**34-1.4.3** The capacity of means of egress must be sufficient for the occupant load of the *Facility*, unless both of the following occur:

- a. The *AHJ* has established the number of occupants for which the exit capacity is adequate and measures are in place to prevent occupancy by a greater number of persons.
- b. Documentation is available that the egress capacity has been previously approved as being adequate.

**34-1.4.4** New interior finish must meet the requirements for new construction.

**34-1.4.5** The reconfiguration or extension of any existing systems must meet the requirements of a *Modification*.

**34-1.5** *Modification.*

**34-1.5.1** All work must conform to this UFC and NFPA 101 for new construction.

**34-1.5.2** *Modifications* in historic structures must comply with either the full requirements for *Modifications* or as specifically modified for historic buildings in the Building Rehabilitation chapter of NFPA 101.

**34-1.5.3** *Modification* of an entire building, or an entire occupancy within a building, must conform to the requirements of a *Reconstruction*.

**34-1.5.4** *Modifications* that exceed 50 percent of the area of a floor must conform to the requirements of a *Reconstruction*. \2\Modifications of any system(s) does not count towards the percentage of floor area.

Note: For example: if 20% of the floor area is being renovated and a HVAC system is being replaced for the entire building, the work performed in considered a *modification* based on the floor area *modification*./2/

**34-1.5.5** *Modifications* that are entirely mechanical, electrical, plumbing or fire protection only are not considered a *Reconstruction*, regardless of the extent of work.

**34-1.6** *Reconstruction*.

The entire building must conform to the requirements for new construction in this UFC and NFPA 101.

**34-1.7** *Addition*.

**34-1.7.1** All work associated with the *Addition* must conform to the requirements of this UFC and NFPA 101 for new buildings or occupancies.

**34-1.7.2** Any work performed outside the boundary of the *Addition* must conform to the Building Rehabilitation chapter of NFPA 101.

**34-1.7.3** The *Addition* must not create a condition in the existing building that does not conform with the existing occupancy provisions of NFPA 101.

**34-1.7.4** The *Addition* must not increase the building height or number of stories greater than that permitted by this UFC and the IBC for new construction.

**34-1.8** Change in Use.

**34-1.8.1** When a change in use occurs, the area of the change, and its associated means of egress, must comply with the requirements for new construction.

**34-1.8.1.1** When any uninhabited building, or portion thereof, is modified from its current use to that of an inhabited building, *billeting*, or a primary gathering building, as defined by UFC 4-010-01, for one year or more, the building must meet the requirements for new construction.

Note: Examples would include a warehouse (uninhabited) being converted to administrative (inhabited) use; an inhabited administrative building being converted to a primary gathering building or *Billeting*; or a non-compliant primary gathering building/*Billeting* being altered, modernized, modified, rehabilitated, or renovated and converted to *Billeting*/primary gathering building.

**34-1.8.1.2** When any building, or portion thereof, is modified from its current use to support a mission that will exist for one year or more, the building must meet the requirements for new construction.

Note: An example would include a *Facility* being used as a hangar that is going to be converted to a warehouse.

**34-1.8.1.3** Changing groups of occupants within the occupancy classification does not constitute a change of use; however, any deficiencies must be corrected prior to the new occupants occupying the space.

Note: An example of changing groups of occupants would include an *Installation* personnel function occupying the office space formerly used by an *Installation* contracting function.

**34-1.8.2** When a change in use results in a higher occupant load that exceeds the existing egress capacity, the *Facility* must meet the requirements for new construction as specified in this UFC.

**34-1.9** Vacant Buildings.

**34-1.9.1** When a vacant building is considered for reuse, the building must be evaluated for the occupancy that is planned to be in the building and all deficiencies must be corrected prior to occupancy. This includes a building to be reused for the same occupancy, i.e., last use was a warehouse and the new use will be a warehouse.

**34-1.9.2** The vacant building must be evaluated to the requirements for new construction in this UFC and NFPA 101.

## **34-2 PHASED PROJECTS.**

**34-2.1** General.

**34-2.1.1** *Modification* projects that will encompass more than 50 percent of the area of a floor or total area of the building, that are planned in a phased approach or have separate projects to improve various parts of the facility must conform to the requirements of *Reconstruction*.

**34-2.1.1.1** These requirements are not applicable if approved by the *AHJ*.

**34-2.1.1.2** These requirements are not applicable if the time from the start of design of the first phase to the start of design of the phase that exceeds 50 percent of the area is greater than five years.

### **34-3 COOKING AREAS.**

Cooking equipment in common areas in existing, non-sprinklered *Facilities* that are provided with residential type range top cooking surfaces must be equipped with an approved residential range top extinguishing system or the stoves must be equipped with burners and controls that have their temperature limited to a maximum temperature of 662 degrees F (350 degrees C). The range top extinguishing system must be connected to the *Facility* fire alarm system to sound a general *Facility* fire alarm and must automatically shut off all sources of fuel and electric power that produce heat to the equipment being protected by that unit.

### **34-4 DETENTION AND CORRECTIONAL FACILITIES.**

For *Renovation* projects, Navy facilities must also comply with MIL HDBK 1037/4.

### **34-5 ELECTRONIC EQUIPMENT AREAS.**

For existing facilities that contain non-plenum rated cables under the raised floor and do not have an automatic fire extinguishing system under the raised floor must provide a  $\sqrt{2}$ /clean agent fire extinguishing system for the area below the raised floor.

### **34-6 FAMILY HOUSING.**

**34-6.1** Projects that exceed 50 percent of the Replacement Cost.

**34-6.1.1** 1-hour fire-resistive construction must be provided between *Dwelling Units*, and between the *Dwelling Unit* and attached parking.

**34-6.1.2** Sprinkler protection must be provided throughout the *Facility*, designed and installed in accordance with NFPA 13R or NFPA 13D.

**34-6.1.3** Multiple-station, interconnected, hard-wired, 120 Vac smoke detectors must be provided inside each sleeping room and at least one on each floor, including basements.

**34-6.1.4** Air Force allows interconnected wireless smoke alarms for use in single-family and duplex housing.

**34-6.2** Projects that are less than 50 percent of the Replacement Cost.

**34-6.2.1** Multiple-station, interconnected, hard-wired, 120 Vac smoke detectors must be provided inside each sleeping room and at least one on each floor, including basements. Air Force allows interconnected wireless smoke alarms for use in single-family and duplex housing.

**34-6.2.2** Sprinkler protection must be considered for installation in the *Facility*.

## **34-7 FIRE PROTECTION SYSTEMS.**

**34-7.1** General.

See the paragraphs entitled "Fire Suppression Systems" and "Automatic Sprinkler Systems" in the "Fire Protection Systems" Chapter in this UFC for requirements related to backflow prevention devices.

## **34-8 FIRE ALARM SYSTEMS.**

**34-8.1** General.

**34-8.1.1** When the existing control panel is replaced, it must be replaced with a new addressable control panel.

**34-8.1.1.1** Existing devices are permitted to remain when listed for use with the new control panel or they are interfaced via listed monitor modules or control modules.

**34-8.1.1.2** Battery calculations must be submitted to verify the power supply provided is capable of supporting the electrical load of the new and existing devices.

**34-8.1.2** Where a new control panel is provided as part of a partial *Facility Renovation*, the renovated areas must comply with the requirements of this section. The existing circuits in the non-renovated areas of the *Facility* are permitted to be connected to the new fire alarm control panel via monitor modules or control modules.

## **34-9 HAZARDOUS MATERIALS**

Existing storage and use of flammable and combustible liquids must comply with NFPA 30.

Existing storage and use of other hazardous materials must comply with NFPA 400.

## **34-10 PERSONNEL HOUSING.**

**34-10.1** General.

**34-10.1.1** Existing Air Force non-sprinklered *Facilities* with the following features are considered acceptable until protection is compliant with the "Personnel Housing and Similar Lodging Facilities" section of this UFC is provided: Heat and smoke detection installed in each sleeping room and the shared/common space of a suite. Activation of the heat detector must sound a general building alarm and transmit a signal to the fire department or to a constantly monitored central location. Activation of the smoke detector must sound a local alarm within the room/suite. The smoke detector is permitted to be powered from an unsupervised 120 Vac source. The use of battery backup for secondary power is not required.

**34-10.2** Common Areas.

Cooking areas in existing, non-sprinklered *Facilities* that are provided with residential type range top cooking surfaces must be equipped with an approved residential range top extinguishing system or the stoves must be equipped with burners and controls that have their temperature limited to a maximum temperature of 662 degrees F (350 degrees C). The range top extinguishing system must be connected to the *Facility* fire alarm system, if provided, to sound a general *Facility* fire alarm and must automatically shut off all sources of fuel and electric power that produce heat to the equipment being protected by that unit.

**34-11 ROOF COVERINGS.**

For re-roofing existing nonconforming metal roof decks, roofing components (insulation, underlayment, etc.) must be specified as having a maximum flame spread rating of 75 and a maximum smoke-development rating of 150 in accordance with ASTM E84.

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## APPENDIX A REFERENCES

### AMERICAN CORRECTIONAL ASSOCIATION (ACA)

<http://www.aca.org/>

Planning and Design Guide for Secure Adult and Juvenile Facilities

### AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

<http://www.ansi.org>

ANSI B1.20.1, Pipe Thread

ANSI/IEEE 979, Guide for Substation Fire Protection

### AMERICAN WATER WORKS ASSOCIATION (AWWA)

<http://www.awwa.org>

AWWA Manual M 14, Recommended Practice for Backflow Prevention and Cross Connection Control

AWWA Manual M 17, Installation, Field Testing and Maintenance of Fire Hydrants

AWWA Manual M 31, Distribution System Requirements for Fire Protection

### ASME INTERNATIONAL

<http://www.asme.org/>

ASME A17.1, Safety Code for Elevators and Escalators

**AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)**

<http://www.astm.org>

ASTM A351, Standard Specification for Casting, Austenitic for Pressure-Containing Parts

ASTM E84, Standard Method of Test of Surface Burning Characteristics of Building Materials

ASTM E119, Standard Test Methods for Fire Tests of Building Construction and Materials

ASTM E136, Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C

ASTM E814, Standard Test Method for Fire Tests of Penetration Firestop Systems

**DEPARTMENT OF DEFENSE, WASHINGTON HEADQUARTERS SERVICE**

<http://www.dtic.mil/whs/directives/>

DoD 6055.9-STD, DoD Ammunition and Explosives Safety Standards

**DEPARTMENT OF THE AIR FORCE**

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

AFMAN 91-201, Explosives Safety Standard

AFTO 00-25-172, Ground Servicing of Aircraft and Static Grounding/Bonding

ETL 01-18, Fire Protection Engineering Criteria- Electronic Equipment Installations

AFI 32-1054, Corrosion Control

**DEPARTMENT OF THE ARMY**

385-100, Safety Manual

AR 385-64, Explosives Safety Program

EM-385-1-1, Safety and Health Requirements Manual

U.S. Army National Guard NGR 385-64, U.S. Army Ammunition and Explosives Safety Standards

AR 420-90, Facilities Engineering Fire and Emergency Services

## **DEPARTMENT OF DEFENSE**

[MIL-STD-3007](#), Standard Practice for Unified Facilities Criteria and Unified Facilities Guide Specifications

## **DEPARTMENT OF THE NAVY**

MIL-F-24385F, Fire Extinguishing Agent, Aqueous Film-Forming Foam (AFFF) Liquid Concentrate, for Fresh and Seawater

NAVSEA OP-5, Ammunition and Explosives Ashore Safety Regulations for Handling, Storing, Production, Renovation, and Shipping

OPNAVINST 11010.33, Procurement, Lease and Use of Relocatable Buildings

NAVAIR 00-80R-14, NATOPS Aircraft Firefighting and Rescue Manual

NAVAIR 00-80T-109, Aircraft Refueling NATOPS Manual

SS 521-AA-MAN-010, U.S. Navy, Diving and Manned Hyperbaric Systems Safety Certification Manual

## **FACTORY MUTUAL GLOBAL (FM)**

<http://www.fmglobal.com/>

FM Global Data Sheet 1-20, Protection Against Exterior Fire Exposure

FM Global Data Sheet 1-53, Anechoic Chambers

FM Global Data Sheet 5-4, Transformers

FM Global Data Sheet 7-91, Hydrogen

FM Global Data Sheet 8-33, Carousel Storage and Retrieval Systems

FM Global Data Sheet 8-34, Automatic Storage and Retrieval Systems

## **INTERNATIONAL CODE COUNCIL (ICC)**

<http://www.iccsafe.org>

IBC, International Building Code®

IFC, International Fire Code®

IRC, International Residential Code®

IWUIC, International Wildland Urban Interface Code®

## **NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)**

[www.nfpa.org](http://www.nfpa.org)

NFPA 1, Fire Code

NFPA 10, Standard for Portable Fire Extinguishers

NFPA 11, Standard for Low-, Medium-, and High-Expansion Foam

NFPA 12, Standard on Carbon Dioxide Extinguishing Systems

NFPA 13, Standard for the Installation of Sprinkler Systems

NFPA 13R, Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies

NFPA 13D, Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes

NFPA 14, Standard for the Installation of Standpipe and Hose Systems

NFPA 15, Standard for Water Spray Fixed Systems for Fire Protection

NFPA 16, Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems

NFPA 17, Standard for Dry Chemical Extinguishing Systems

NFPA 17A, Standard for Wet Chemical Extinguishing Systems

NFPA 20, Standard for the Installation of Stationary Pumps for Fire Protection

NFPA 22, Standard for Water Tanks for Private Fire Protection

NFPA 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances

NFPA 30, Flammable and Combustible Liquids Code

NFPA 30A, Code for Motor Fuel Dispensing Facilities and Repair Garages

NFPA 37, Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines

NFPA 45, Standard on Fire Protection for Laboratories Using Chemicals

NFPA 51, Standard for the Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes

NFPA 52, Vehicular Gaseous Fuel Systems Code

NFPA 54, National Fuel Gas Code

NFPA 55, Compressed Gases and Cryogenic Fluids Code

NFPA 58, Liquefied Petroleum Gas Code

NFPA 70, National Electrical Code®

NFPA 72, National Fire Alarm and Signaling Code®

ANSI/NFPA 75, Standard for the Fire Protection of Information Technology Equipment

NFPA 76, Standard for the Fire Protection of Telecommunications Facilities

NFPA 80A, Recommended Practice for Protection of Buildings From Exterior Fire Exposures

NFPA 88A, Standard for Parking Structures

NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems

NFPA 92, Standard for Smoke Control Systems

NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations

NFPA 99, Health Care Facilities Code

NFPA 99B, Standard for Hypobaric Facilities

NFPA 101, Life Safety Code®

NFPA 102, Standard for Grandstands, Folding and Telescopic Seating, Tents, and Membrane Structures

NFPA 170, Standard for Fire Safety and Emergency Symbols

NFPA 204, Standard for Smoke and Heat Venting

NFPA 220, Standard on Types of Building Construction

NFPA 241, Standard for Safeguarding Construction, Alteration, and Demolition Operations

NFPA 255, Standard Method of Test of Surface Burning Characteristics of Building Materials

NFPA 291, Recommended Practice for *Fire Flow* Testing and Marking of Hydrants

NFPA 303, Fire Protection Standard for Marinas and Boatyards

NFPA 307, Standard for the Construction and Fire Protection of Marine Terminals, Piers, and Wharves

NFPA 312, Standard for Fire Protection of Vessels During Construction, Conversion, Repair, and Lay-Up

NFPA 400, Hazardous Materials Code

NFPA 409, Standard on Aircraft Hangars

NFPA 704, Standard System for the Identification of the Hazards of Materials for Emergency Response

NFPA 720, Standard for the Installation of Carbon Monoxide (CO) Detection and Warning Equipment

NFPA 750, Standard on Water Mist Fire Protection Systems

NFPA 850, Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations

NFPA 909, Protection of Cultural Resource Properties - Museums, Libraries, and Places of Worship

NFPA 1141, Standard for Fire Protection Infrastructure for Land Development in Wildland, Rural, and Suburban Areas

NFPA 1142, Standard on Water Supplies for Suburban and Rural Fire Fighting

NFPA 1144, Standard for Reducing Structural Ignition Hazards from Wildland Fire

NFPA 1221, Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems

NFPA 1963, Standard for Fire Hose Connections

NFPA 2001, Standard on Clean Agent Fire Extinguishing Systems

NFPA 5000, Building Construction and Safety Code®

### **SOCIETY OF AUTOMOTIVE ENGINEERS**

<https://www.sae.org/>

SAE 1010, Steel Properties

### **SOCIETY OF FIRE PROTECTION ENGINEERS**

<http://www.sfpe.org>

SFPE Engineering Guide to Performance-Based Fire Protection Analysis and Design of Buildings

### **UNDERWRITERS LABORATORY (UL)**

<http://www.ul.com/>

UL 864, Standard for Control Units and Accessories for Fire Alarm Systems

UL 1283, Electromagnetic Interference Filters

UL 1449, Surge Protective Devices

UL 1479, Fire Tests of Through-Penetration Firestops.

### **UNIFIED FACILITIES CRITERIA (UFC) AND FACILITIES CRITERIA (FC)**

[http://www.wbdg.org/references/pa\\_dod.php](http://www.wbdg.org/references/pa_dod.php)

FC 4-740-14N, Navy and Marine Corps Child Development Centers

FC 4-760-10N, Navy Museums and Historic Resource Facilities

UFC 1-200-01, General Building Requirements

UFC 3-230-01, Water Storage, Distribution, and Transmission

UFC 3-400-02, Design: Engineering Weather Data

UFC 3-460-01, Design: Petroleum Fuel Facilities

UFC 3-520-01, Interior Electrical Systems

UFC 3-570-02A, Cathodic Protection

UFC 3-570-02N, Electrical Engineering Cathodic Protection

UFC 3-570-06, O&M: Cathodic Protection Systems

UFC 4-010-01, DoD Minimum Antiterrorism Standards for Buildings

UFC 4-020-01, DoD Security Engineering Facilities Planning Manual

UFC 4-021-01, Design and O&M: Mass Notification Systems

UFC 4-150-02, Dockside Utilities for Ship Service

UFC 4-151-10, General Criteria for Waterfront Construction

UFC 4-152-01, Design: Piers and Wharves

UFC 4-159-01N, Design: Hyperbaric Facilities

UFC 4-211-01N, Aircraft Maintenance Hangars, Type I, Type II, and Type III

UFC 4-211-02, Aircraft Corrosion Control and Paint Facilities

UFC 4-213-10, Design: Graving Drydocks

UFC 4-213-12, Drydocking Facilities Characteristics

UFC 4-451-10N, Design: Hazardous Waste Storage

UFC 4-510-01, Design: Medical Military Facilities

UFC 4-740-06, Youth Centers

UFC 4-740-14, Design: Child Development Centers



**UNITED STATES ACCESS BOARD**

<http://www.access-board.gov/>

ABA/ABAAG, Architectural Barriers Act and Architectural Barriers Act Accessibility Guidelines

**UNITED STATES DEPARTMENT OF LABOR, OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)**

<http://www.ecfr.gov/cgi-bin/text-idx?tpl=%2Findex.tpl>

29 CFR 1910.109, Explosives and Blasting Agents

**UNITED STATES HOUSE OF REPRESENTATIVES, OFFICE OF THE LAW REVISION COUNSEL**

<http://uscode.house.gov/>

USC Title 10, Chapter 8, Subchapter II, Military Child Care

USC Title 15, Section 272, Utilization of Consensus Technical Standards by Federal Agencies

USC Title 15, Section 2225, Hotel-Motel Fire Safety

USC Title 15, Section 2227, Fire Administration Authorization Act ("Fire Safety Act")

USC Title 42, Section 4151 Architectural Barriers Act Of 1968

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## APPENDIX B OCCUPANCY HAZARD CLASSIFICATION FOR DETERMINING AUTOMATIC SPRINKLER DENSITIES AND HOSE STREAM DEMANDS

### B-1 CLASSIFICATION OF OCCUPANCIES.

The principal occupancy classifications are light hazard, ordinary hazard, and extra hazard. Listed below are the classifications with examples of common DoD occupancies listed under each. Where an occupancy is not listed, the applicable NFPA standard must be used, along with engineering judgment, to determine the appropriate occupancy hazard classification.

#### B-1.1 Light Hazard Occupancies.

Occupancies or portions of occupancies where the quantity and combustibility of the contents are low and fires with relatively low rates of heat release are expected. Small, scattered amounts of flammable liquids in closed containers are allowable in quantities not exceeding 5 gal (20 L) per *Fire Area*. This classification includes but is not limited to the following occupancies:

- Clinics (dental, outpatient, patient areas only)
- Mess areas
- Dispensaries (patient areas only)
- Drill halls (not used for storage or exhibition)
- Disciplinary barracks
- Child Development Centers

#### B-1.2 Ordinary Hazard Occupancies.

Occupancies or portion of occupancies where quantity and combustibility of contents is moderate, storage does not exceed 12 feet (3.7 m), and fires with moderate rate of heat release are expected. Moderate, scattered amounts of flammable liquids in closed containers are allowable in quantities not to exceed 50 gal (189 L) per *Fire Area*. Small amounts of flammable liquids may be exposed as required by normal operations. This classification includes but is not limited to the following occupancies:

- Armories
- Sheet metal shops
- Bowling alleys
- Ship fitting shops
- Clubs (officer, enlisted personnel, etc.)
- Kitchens and bakery

- Small stores
- Fitness Centers
- Gymnasiums
- Theaters and auditoriums
- Welding shops
- Forge shops
- Laundries
- Mechanical rooms, with or without boilers or fuel-fired equipment
- Electrical rooms, other than transformer vaults
- Small storage rooms
- Commissaires
- Exchanges
- Aviation depots
- Electrical maintenance shops
- Engine and generator rooms
- Laboratories
- Refrigeration and air compressor rooms
- Machine rooms
- Printing shops (using inks having flash points above 110°F (44°C))
- Libraries
- Piers and wharves
- Vehicle repair garages
- Woodworking shops

**B-1.3 Extra Hazard Occupancies.**

DoD occupancies, that might be classified as extra hazard, are often addressed by unique occupancy specific criteria/guidance rather than being addressed generically as extra hazard.

#### **B-1.4 Special Occupancies.**

Special occupancies are *Facilities* or areas that DoD does not assigned a specific occupancy hazard classification because of special protection requirements. Refer to Chapter 4 for fire protection requirements for the following occupancies:

- Flammable and combustible liquids
- Aircraft hangars
- Engine test cells
- Missile assembly
- Ordnance plants
- Rubber tire storage
- Warehouses (piled or rack storage)
- Foam rubber or plastic storage

CANCELLED

## APPENDIX C PROCEDURE FOR PERFORMANCE-BASED FIRE SAFETY DESIGN

### C-1 EQUIVALENT LEVEL OF SAFETY AND PROTECTION.

Any proposed performance-based fire safety design must demonstrate, to the satisfaction of the *AHJ*, a level of safety equivalent to the minimum applicable prescriptive requirements of this UFC.

### C-2 FIRE SAFETY DESIGN DOCUMENTATION.

Any *Facility* designed using performance-based fire safety design methods must have supporting documentation, including a Fire Protection Engineering Design Brief, Performance-Based Design Report, Specification, Drawings, Building Operation & Maintenance Manuals, and Warrant of Fitness.

#### C-2.1 Fire Protection Engineering Design Brief.

This is a separate document from the project Basis of Design, prepared by the *QFPE* and containing general qualitative project information that has been agreed upon by the *Stakeholders*. As a minimum, the design brief includes the project scope, *Facility* and occupant characteristics, project goals and objectives, performance criteria, design fire scenarios, technical references and resources, at least two trial designs, documentation of project design engineers and their qualifications, and a record of agreement on the aforementioned components.

##### C-2.1.1 Project Scope.

This section describes the boundaries of the performance-based design as agreed upon by all *Stakeholders*, and includes realistic and sustainable design information regarding *Facility* use, design purpose and approach, project constraints, and applicable regulations. The project budget must be clearly defined, so that the limitations and available budget for the proposed solutions can be known.

##### C-2.1.2 Facility and Occupant Characteristics.

*Facility* characteristics include an accurate and complete description of the *Facility* construction, operations, systems, physical contents and occupants. Occupant characteristic description includes the number, age, *Facility* familiarity, gender, occupant loading, and potential for self-preservation of a *Facility's* occupants. Accurately identify any necessary occupant response and interaction needed to provide hazard mitigation or securing of specific process or operational equipment. The occupant load is the maximum number of people realistically expected to occupy an area, as agreed upon by the *Stakeholders*, but not less than the prescriptive occupant load densities of NFPA 101.

##### C-2.1.3 Goals.

Detail and document the goals of life safety, property protection, continuity of operations, and the limitation of the environmental impact of the fire, as defined by NFPA 101, and as additionally defined by the *Stakeholders*. Adequately address the allied fire safety goals of historic preservation and environmental protection from fire protection measures. Identify each goal - realistically, quantifiably, and remaining constant throughout the design process. Address each goal by each proposed trial design, regardless of the goal's individual importance.

#### **C-2.1.4 Objectives and Acceptable Levels of Risk.**

Clearly identify *Stakeholder* and design objectives associated with each of the required and user-defined goals.

**C-2.1.4.1** *Stakeholder* objectives are the specific project objectives based upon agreed fire safety goals and must be stated in terms of objectives, functional statements, or performance objectives. *Stakeholders'* objectives may be defined in terms of acceptable or sustainable loss or in terms of an acceptable level of risk. Where a design requires the determination of an acceptable level of risk, the *AHJ* must ensure that the appropriate *Stakeholders* make the determination. The level of risk may affect an entire base/community/command; therefore it is essential to ensure the persons determining the level of risk are authorized to do so.

**C-2.1.4.2** Design objectives are developed by the design engineer based on the *Stakeholder* objectives, and are stated in engineering terms. Use design objectives as the basis for the development of performance criteria, against which the predicted performance of a trial design will be evaluated.

#### **C-2.1.5 Performance Criteria.**

Develop quantitative performance criteria to represent the intent of each design objective and retained prescriptive requirement. Completely describe and document these criteria. The performance criteria reflect the event consequences that need to be avoided to fulfill the design objectives, and include realistic values that are capable of being evaluated or measured using existing engineering tools and methods.

**C-2.1.5.1** The performance criteria must be a combination of the life safety and property protection criterion, along with criteria developed from *Stakeholder* objectives.

Note: NFPA 101 and the SFPE Engineering Guide to Performance-Based Fire Protection Analysis and Design of Buildings provide guidance regarding the development and evaluation of appropriate performance criteria.

#### **C-2.1.6 Design Fire Scenarios.**

Document complete descriptions of the reasoning, intent, and details of all required and *Stakeholder* defined fire scenarios. Use realistic and accurate fire scenarios, with respect to all fire elements, including initial fire location, early rate of growth in fire

severity, and smoke generation. Indicate in the description of the fire scenarios all applicable data, characteristics and assumptions, which must remain consistent between all fire scenarios. Ensure the omission of certain details will not reduce the reality of the proposed design fire scenario. The *QFPE* must justify any design fire scenario data that is omitted or cannot be considered by available evaluation methods, and this justification must be noted and approved by the *AHJ*.

#### **C-2.1.7 Technical References and Resources.**

Thoroughly document all technical references, including methodologies, data and sources. Identify the scientific basis of each engineering calculation method or model. Develop, review and validate these methods using a consensus, peer-review process, or obtain from resource publications. Where the chosen methods do not permit the incorporation of all data or do not accurately address the incorporation of the data, perform a sensitivity analysis for any design, performance criteria, or fire scenario data that cannot be included or used in the chosen methods. Address all degrees of conservatism and factors of safety, and clearly identify the limitations of the calculation methods. Any method whose outcome is significantly altered by the omission of trial design or fire scenario details must not be approved, and the omission of critical data is prohibited. The use of proprietary and non-peer reviewed data or source is not permitted. The *AHJ* must approve the assessment methods, data, and sources, and confirm the validity of all technical references and resources prior to the design evaluation. Provide the technical reviewer, upon request, any technical references or resources.

**C-2.1.7.1** The performance criteria must be capable of being proved or measured using existing engineering tools and methods.

#### **C-2.1.8 Trial Designs.**

Identify and document the general details, including the proposed construction, systems, and protection methods. Include in the documentation the safety factors associated with each trial design, as agreed upon by the *Stakeholders*. Clearly identify the impact of the safety factors so that a reasonable decision can be made as to whether their level is appropriate and sufficient. State any retained prescriptive requirements. Where the interaction of emergency response personnel is a designed protection method, accurately identify and confirm the impact and responsibility of the emergency personnel.

The performance criteria must be equally considered and addressed by each trial design against each fire scenario.

Evaluate each trial design in each fire scenario using the agreed upon performance criteria.

#### **C-2.1.9 Project Team and Qualifications.**



Provide the qualifications and contact information for the entire design team, including the *QFPE* as part of the required documentation. A performance-based, fire safety design must be prepared by a *QFPE* with experience in performance-based fire safety design and specific experience with the engineering tools and methodologies that are anticipated for a particular project.

## **C-2.2 Performance-Based Fire Safety Design Report.**

This documentation must be prepared by the *QFPE*, and used for general guidance. The report must indicate that the *Facility* was designed using a performance-based fire safety design approach, and must convey the expected hazards, risks, and system performance over the entire *Facility* life-cycle. Include the project scope, design goals and objectives, performance criteria, design fire scenarios, critical design assumptions, critical design features, final design, cost benefit analysis, design engineer's qualifications and capabilities, and data and evaluation method references.

### **C-2.2.1 Cost Benefit.**

The performance-based fire safety design report must indicate how the performance-based design maximizes the benefits/cost ratio while maintaining a level of safety equivalent to the established prescriptive requirements. A performance-based design must not be undertaken where the prescriptive requirements provide the same level of safety for a lesser cost. Where multiple acceptable proposed design scenarios exist, the cost benefit analysis must aid in the identification and determination of the best solution.

## **C-2.3 Building O&M Documentation.**

The *QFPE* must produce Building Operation and Maintenance documentation for the facility based on the objectives, performance criteria, limitations, and final design. Include all associated specifications and design drawings, and a description of the required maintenance procedures that need to be performed to ensure continued compliance with performance-based fire safety design.

### **C-2.4 Warrant of Fitness.**

The host-tenant agreement must require that an annual Warrant of Fitness be prepared for any subsystem, system, or *Facility* that has been designed using performance-based fire safety design methods. Submit this warrant to the *AHJ* for review and assurance that the current facility characteristics comply with the requirements of the approved performance design. This warrant must reflect any existing or proposed changes in *Facility* occupancy, operation, features, systems, or emergency personnel response. Where emergency response is a critical element in the accepted fire safety design, reevaluate the design when changes are made to the operational procedures, location, or structure of the emergency response personnel.

## **C-3 REVIEW OF TRIAL DESIGNS.**

Provide every performance-based fire safety design with a technical review, and develop a Review Brief. Analyze each trial design to determine the compliance with the required performance criteria. The reviewer must be an individual capable of providing a thorough evaluation of the proposed design, and must have the same minimum qualifications as the *QFPE*. If the authority responsible for the review of the performance-based fire safety design does not have the required qualifications, they must direct the designer to submit the design to a qualified third party for review.

### **C-3.1 Review Brief.**

The Review Brief details how each proposed design compares with the required fire safety goals, objectives and performance criteria. The Brief provides a brief description of the details of each trial design, the technical resources and references, any concerns about steps in the design process and general concerns about the designer's performance-based fire safety design approach. The Brief indicates the acceptability of each design, the reasoning for each acceptance or rejection, and which design is recommended for final acceptance. It must also discuss levels of confidence over validation. The Brief must indicate how personnel and property protection are considered, which objectives the design stresses, a statement of what has been checked, the design solution, and the entire design approach and process.

### **C-3.2 Third Party Review.**

When required, an assigned third party must provide an objective review of the project, and must not provide the actual fire safety design. When a third party is reviewing the design, the *AHJ* remains a *Stakeholder* and ultimately is responsible for the approval of the final design. When a review is assigned to a third party, provide the *AHJ* with a Review Brief.

### **C-3.3 Compliant Fire Safety Design.**

A compliant fire safety design must meet the stated performance criteria when subjected to each design fire scenario. A subsystem, system or *Facility* design that complies with all requirements of the applicable prescriptive criteria is deemed as satisfying the minimum fire safety goals and objectives, and does not need to be evaluated against the design fire scenarios. Completely evaluate a performance-based fire safety design that incorporates only portions of applicable prescriptive criteria, as it is not considered to provide the minimum levels of protection.

Where a design does not meet the performance criteria, it may be revised and reevaluated. The revision must not reduce any agreed upon goals, objectives, performance criteria, or level of performance to ensure a proposed design complies with the stated requirements. Criteria may be changed based on additional analysis and the consideration of additional data.

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**APPENDIX D INTERNATIONAL BUILDING CODE AND NFPA 220 EQUIVALENTS**

This table provides the corresponding types of construction from the various codes.  
This table is for information only.

IBC	NFPA 220
	Type I (442)
Type I-A	Type I (332)
Type I-B	Type II (222)
Type II-A	Type II (111)
Type II-B	Type II (000)
Type III-A	Type III (211)
Type III-B	Type III (200)
Type IV (HT)	Type IV (2HH)
Type V-A	Type V (111)
Type V-B	Type V (000)

## APPENDIX E RECOMMENDED FIRE ALARM AND EMERGENCY NOTIFICATION MESSAGES

### GENERAL ANNOUNCEMENTS AND PAGING

AUDIBLE in the following sequence:

Pre-announcement Sound – Ding-Dong – Percussive pairs of 700 and 570 Hz tones each damped to zero (one cycle)

Announcement – spoken message.

VISIBLE none

### FIRE EMERGENCY / FIRE ALARM {GENERIC} MESSAGES:

AUDIBLE [Audible must sound for not less than 180 seconds (NFPA 72) ] in the following sequence:

Alert Sound – NFPA Temporal 3 (T-3) - 422-775Hz upward sweep over 850 ms for three-pulses each separated by 1 second followed by a 1.5 second delay (repeat 2 cycles)

Announcement: Voice – Tom (repeat 2 cycles):

Option 1: *A FIRE EMERGENCY HAS OCCURRED; PLEASE LEAVE THE BUILDING BY THE NEAREST EXIT.*

Option 2: *A FIRE EMERGENCY HAS OCCURRED; PLEASE LEAVE THE BUILDING BY THE NEAREST EXIT AND REPORT TO YOUR ASSEMBLY LOCATION*

Option 1E: *A FIRE EMERGENCY HAS OCCURRED; PLEASE LEAVE THE BUILDING BY THE NEAREST EXIT DO NOT USE THE ELEVATORS.*

Option 2E: *A FIRE EMERGENCY HAS OCCURRED; PLEASE LEAVE THE BUILDING BY THE NEAREST EXIT; DO NOT USE THE ELEVATORS AND REPORT TO YOUR ASSEMBLY LOCATION*

VISIBLE [Visible must flash/operate until system is reset]:

*White Strobe or other listed white appliance.*

*Textual message signs (if provided).*

## **CARBON MONOXIDE DETECTION {GENERIC} MESSAGES:**

AUDIBLE [Audible must sound for not less than 180 seconds (NFPA 72)] in the following sequence:

Alert Sound – Temporal 4 (T-4) pattern tone - 520Hz over 850 ms for four-pulses each separated by 1 second followed by a 1.5 second delay (repeat 2 cycles)

Announcement: Voice – Tom (repeat 2 cycles):

Option 1: *CARBON MONOXIDE HAS BEEN DETECTED IN THE BUILDING; PLEASE LEAVE THE BUILDING BY THE NEAREST EXIT.*

Option 2: *CARBON MONOXIDE HAS BEEN DETECTED IN THE BUILDING; PLEASE LEAVE THE BUILDING BY THE NEAREST EXIT AND REPORT TO YOUR ASSEMBLY LOCATION*

VISIBLE [Visible must flash/operate until system is reset]:

*White Strobe or other listed white appliance.*

*Textual message signs (if provided).*

Note: The Security / Force Protection messages are only shown as examples if prerecorded messages are desired. Security / Force Protection situations are a variety of circumstances and having a prerecorded message or a variety of messages that will satisfy all conditions will be very difficult and may provide inaccurate information for the situation at hand. Give careful consideration in determining if Security / Force Protection prerecorded messages are going to be used.

## **SECURITY / FORCE PROTECTION THREATS {GENERIC} MESSAGES**

### **SHELTER IN PLACE:**

AUDIBLE [Audible must sound for not less than 180 seconds] in the following sequence:

Alert Sound – Siren - 600-1250 hz up and down sweep in 4 seconds; 1.5 second delay (repeat 2 cycles)

Announcement: Voice – Tom (repeat 2 cycles):

Option 1: A [force protection emergency] [ ] HAS BEEN DECLARED; PLEASE TAKE SHELTER IN A DESIGNATED SAFE AREA IMMEDIATELY.

Option 2: A [force protection emergency] [ ] HAS BEEN DECLARED; PLEASE SEEK A DESIGNATED SAFE LOCATION IMMEDIATELY.

Option 1E: A [force protection emergency] [ ] HAS BEEN DECLARED; PLEASE TAKE SHELTER IN A DESIGNATED SAFE AREA IMMEDIATELY; DO NOT USE THE ELEVATORS.

VISIBLE [Visible must flash/operate until system is reset]:

*White Strobe or other listed white appliance.*

*Textual message signs (if provided).*

**EVACUATE:**

AUDIBLE [Audible must sound for not less than 180 seconds] in the following sequence:

Alert Sound – Hi-Lo - 780 to 600 hz alternately, 0.52 each (repeat 2 cycles)

Announcement: Voice – Tom (repeat 2 cycles):

Option 1: A [force protection emergency] [ ] HAS BEEN DECLARED;; PLEASE LEAVE THE BUILDING BY THE NEAREST EXIT.

Option 2: A [force protection emergency] [ ] HAS BEEN DECLARED; PLEASE LEAVE THE BUILDING BY THE NEAREST EXIT AND REPORT TO YOUR ASSEMBLY LOCATION

Option 1E: A [force protection emergency] [ ] HAS BEEN DECLARED; PLEASE LEAVE THE BUILDING BY THE NEAREST EXIT DO NOT USE THE ELEVATORS.

Option 2E: A [force protection emergency] [ ] HAS BEEN DECLARED; PLEASE LEAVE THE BUILDING BY THE NEAREST EXIT; DO NOT USE THE ELEVATORS AND REPORT TO YOUR ASSEMBLY LOCATION

VISIBLE [Visible must flash/operate until system is reset]:

*White Strobe or other listed white appliance.*

*Textual message signs (if provided).*

Note: The Weather / Natural Disaster Warnings (Tornado, Tsunami, Hurricane, Earthquake, Volcano, Etc.) messages are only shown as examples if prerecorded messages are desired. Weather / Natural Disaster situations will come in a variety of circumstances and having a prerecorded message or a variety of messages that will satisfy all conditions will be very difficult and may provide inaccurate information for the situation at hand. Give careful consideration in determining if Weather / Natural Disaster Warning prerecorded messages are going to be used.

### **WEATHER / NATURAL DISASTER WARNING(S) (TORNADO, TSUNAMI, HURRICANE, EARTHQUAKE, VOLCANO, ETC.) {GENERIC} MESSAGES**

AUDIBLE - [Audible must continue to sound for not less than 180 seconds] in the following sequence:

Alert Sound – NOAA Standard alert tone - 1050 hz (8 seconds)

Announcement: Voice – Donna (repeat 2 cycles) (Systems may have multiple weather/natural disaster warning messages depending on the individual installation requirements and potential weather threats):

#### **SHELTER IN PLACE:**

Option 1: A [weather] [ ] EMERGENCY HAS BEEN DECLARED; PLEASE TAKE SHELTER IN A DESIGNATED SAFE AREA IMMEDIATELY.

Option 2: A [weather] [ ] EMERGENCY HAS BEEN DECLARED; PLEASE SEEK A DESIGNATED SAFE LOCATION IMMEDIATELY.

Option 1E: A [weather] [ ] EMERGENCY HAS BEEN DECLARED; PLEASE TAKE SHELTER IN A DESIGNATED SAFE AREA IMMEDIATELY; DO NOT USE THE ELEVATORS.

Option 2E: A [weather] [ ] EMERGENCY HAS BEEN DECLARED; PLEASE SEEK A DESIGNATED SAFE LOCATION IMMEDIATELY; DO NOT USE THE ELEVATORS.

#### **EVACUATE:**



Option 1: A [earthquake] [ ] EMERGENCY HAS OCCURRED;  
PLEASE LEAVE THE BUILDING BY THE NEAREST EXIT.

Option 2: A [earthquake] [ ] EMERGENCY HAS OCCURRED;  
PLEASE LEAVE THE BUILDING BY THE NEAREST EXIT AND  
REPORT TO YOUR ASSEMBLY LOCATION.

Option 1E: A [earthquake] [ ] EMERGENCY HAS  
OCCURRED; PLEASE LEAVE THE BUILDING BY THE NEAREST  
EXIT; DO NOT USE THE ELEVATORS.

Option 2E: A [earthquake] [ ] EMERGENCY HAS  
OCCURRED; PLEASE LEAVE THE BUILDING BY THE NEAREST  
EXIT AND REPORT TO YOUR ASSEMBLY LOCATION; DO NOT  
USE THE ELEVATORS.

VISIBLE [Visible must flash/operate until system is reset]:

*White strobe or other listed appliance.*

*Textual message signs (if provided).*

## **ALL CLEAR RETURN TO NORMAL OPERATIONS MESSAGES**

AUDIBLE in the following sequence:

Pre-announcement Sound – Ding-Dong – Percussive pairs of 700 and 570 Hz  
tones each damped to zero (one cycle)

Announcement: Voice – Donna (*repeat two cycles*) – THE EMERGENCY HAS  
BEEN RESOLVED; RETURN TO NORMAL OPERATIONS

VISIBLE none

## **AUTOMATED MONTHLY TEST MESSAGES**

SCHEDULE the first Wednesday of each month at 1200 hours local.

AUDIBLE in the following sequence:

Pre-TEST Sound – NOAA Standard alert tone - 1050 hz (8 seconds)

Announcement: Voice – Tom – TEST, TEST, TEST, THIS IS AN EMERGENCY NOTIFICATION AUDIO SYSTEM TEST; YOU MAY CONTINUE NORMAL OPERATIONS, TEST, TEST, TEST.

VISIBLE [Visible must flash/operate during the pre-test sound and the announcement and then stop]:

*White strobe or other listed appliance.*

*Textual message signs (if provided).*

### **SPECIAL OCCUPANCIES**

#### **FIRE EMERGENCY / FIRE ALARM {Child Development Centers and Medical Facilities including Ambulatory} MESSAGES:**

AUDIBLE [Audible must sound for not less than 180 seconds] in the following sequence:

Alert Sound – Three Pulse Chime - 575Hz, three-0.5 second pulses separated by 0.5 seconds followed by a 1.5 second delay (repeat 3 cycles)

Announcement: Voice – Donna (repeat 2 cycles):

*For outside assembly. A FIRE EMERGENCY HAS OCCURRED;  
PLEASE LEAVE THE BUILDING BY THE NEAREST EXIT AND REPORT  
TO THE ASSEMBLY LOCATION*

*For those Centers with horizontal exiting: A FIRE EMERGENCY HAS  
OCCURRED IN THIS PART OF THE BUILDING; PLEASE MOVE TO  
THE [define area] SAFE AREA.*

VISIBLE [Visible must flash/operate until system is reset]:

*White Strobe or other listed white appliance.*

*Textual message signs (if provided).*

#### **CARBON MONOXIDE DETECTION: {Child Development Centers and Medical Facilities including Ambulatory} MESSAGES:**

AUDIBLE [Audible must sound for not less than 180 seconds] in the following sequence:

Alert Sound – Four Pulse Chime - 575Hz, four-0.5 second pulses separated by 0.5 seconds followed by a 1.5 second delay (repeat cycles)

Announcement: Voice – Donna (repeat 2 cycles):

*For outside assembly: CARBON MONOXIDE HAS BEEN DETECTED IN THE BUILDING; PLEASE LEAVE THE BUILDING BY THE NEAREST EXIT AND REPORT TO THE ASSEMBLY LOCATION*

*For those Centers with horizontal exiting: CARBON MONOXIDE HAS BEEN DETECTED IN THIS PART OF THE BUILDING; PLEASE MOVE TO THE [define area] SAFE AREA.*

VISIBLE [Visible must flash/operate until system is reset]:

*White Strobe or other listed white appliance.*

*Textual message signs (if provided).*

## **SECURITY / FORCE PROTECTION THREATS MESSAGES (Child Development Center and Medical Facilities including Ambulatory)**

### **SHELTER IN PLACE:**

AUDIBLE [Audible must sound for not less than 180 seconds] in the following sequence:

Alert Sound – Chime – Percussive 700 Hz chime tone for 10 seconds (one cycle)

Announcement: Voice – Donna (repeat 2 cycles):

Option 1: *A [force protection emergency] [ ] HAS BEEN DECLARED; PLEASE TAKE SHELTER IN A DESIGNATED SAFE AREA IMMEDIATELY.*

Option 2: *A [force protection emergency] [ ] HAS BEEN DECLARED; PLEASE SEEK A DESIGNATED SAFE LOCATION IMMEDIATELY.*

Option 1E: *A [force protection emergency] [ ] HAS BEEN DECLARED; PLEASE TAKE SHELTER IN A DESIGNATED SAFE AREA IMMEDIATELY; DO NOT USE THE ELEVATORS.*

VISIBLE [Visible must flash/operate until system is reset]:

*White Strobe or other listed white appliance.*

*Textual message signs (if provided).*

**EVACUATE:**

AUDIBLE [Audible must sound for not less than 180 seconds] in the following sequence:

Alert Sound – Chime – Percussive 700 Hz chime tone for 10 seconds (one cycle)

Announcement: Voice – Donna (repeat 2 cycles):

Option 1: A [force protection emergency] [ ]  
**EMERGENCY HAS OCCURRED; PLEASE LEAVE THE BUILDING BY THE NEAREST EXIT.**

Option 2: A [force protection emergency] [ ] **HAS BEEN DECLARED; PLEASE LEAVE THE BUILDING BY THE NEAREST EXIT AND REPORT TO YOUR ASSEMBLY LOCATION**

Option 1E: A [force protection emergency] [ ] **HAS BEEN DECLARED; PLEASE LEAVE THE BUILDING BY THE NEAREST EXIT DO NOT USE THE ELEVATORS.**

Option 2E: A [force protection emergency] [ ] **HAS BEEN DECLARED; PLEASE LEAVE THE BUILDING BY THE NEAREST EXIT; DO NOT USE THE ELEVATORS AND REPORT TO YOUR ASSEMBLY LOCATION**

VISIBLE [Visible must flash/operate until system is reset]:

*White Strobe or other listed white appliance.*

*Textual message signs (if provided).*

**FIRE EMERGENCY / FIRE ALARM {Aircraft Hangar} MESSAGES:**

AUDIBLE [Audible must sound for not less than 180 seconds] in the following sequence:

Alert Sound – NFPA Temporal Whoop - 422-775Hz upward sweep over 850 ms for three-pulses separated by 1 second followed by a 1.5 second delay (repeat 2 cycles)

Announcement: Voice – Tom (repeat 2 cycles):

ACTIVATION FROM SUPPRESSION SYSTEM, MANUAL FIRE ALARM STATION, OR DETECTION (if provided) IN THE AIRCRAFT SERVICING AREA

Option 1: *A FIRE EMERGENCY HAS OCCURRED IN THE AIRCRAFT SERVICING AREA; PLEASE LEAVE THE BUILDING BY THE NEAREST EXIT. DO NOT EXIT THROUGH THE AIRCRAFT SERVICING AREA.*

Option 2: *A FIRE EMERGENCY HAS OCCURRED IN THE AIRCRAFT SERVICING AREA; PLEASE LEAVE THE BUILDING BY THE NEAREST EXIT AND REPORT TO YOUR ASSEMBLY LOCATION. DO NOT EXIT THROUGH THE AIRCRAFT SERVICING AREA.*

Option 1E: *A FIRE EMERGENCY HAS OCCURRED IN THE AIRCRAFT SERVICING AREA; PLEASE LEAVE THE BUILDING BY THE NEAREST EXIT DO NOT USE THE ELEVATORS. DO NOT EXIT THROUGH THE AIRCRAFT SERVICING AREA.*

Option 2E: *A FIRE EMERGENCY HAS OCCURRED IN THE AIRCRAFT SERVICING AREA; PLEASE LEAVE THE BUILDING BY THE NEAREST EXIT; DO NOT USE THE ELEVATORS AND REPORT TO YOUR ASSEMBLY LOCATION. DO NOT EXIT THROUGH THE AIRCRAFT SERVICING AREA.*

ACTIVATION FROM SUPPRESSION SYSTEM, MANUAL FIRE ALARM STATION OR DETECTION (if provided) IN THE ADJACENT SUPPORT AREA

Option 1: *A FIRE EMERGENCY HAS OCCURRED; PLEASE LEAVE THE BUILDING BY THE NEAREST EXIT.*

Option 2: *A FIRE EMERGENCY HAS OCCURRED; PLEASE LEAVE THE BUILDING BY THE NEAREST EXIT AND REPORT TO YOUR ASSEMBLY LOCATION*

Option 1E: *A FIRE EMERGENCY HAS OCCURRED; PLEASE LEAVE THE BUILDING BY THE NEAREST EXIT DO NOT USE THE ELEVATORS.*

Option 2E: *A FIRE EMERGENCY HAS OCCURRED; PLEASE LEAVE THE BUILDING BY THE NEAREST EXIT; DO NOT USE THE ELEVATORS AND REPORT TO YOUR ASSEMBLY LOCATION*

VISIBLE [Visible must flash/operate until system is reset]:

*White Strobe or other listed white appliance.*

*Textual message signs (if provided).*

Messages will be generated by the text- to-speech system Speechify, Nuance, 2005 as used by NOAA for weather information and Emergency Alert System (EAS) messaging. The voices used will be “Tom” and “Donna” as identified for each message type. The current Nuance text-to-speech product is *Vocalizer 5.0*, Nuance, 2013.

NFPA 72 sound pressure levels applies to “public mode” notification devices “Alert Sound – NFPA Temporal Whoop - 422-775Hz upward sweep over 850 ms for three-pulses separated by 1 second followed by a 1.5 second delay”. Sound levels are measured:

- a. Maximum level at 10 feet horizontally perpendicular to the notification appliance at 5.5 feet above the finish floor.
- b. Minimum levels at no closer than ten feet from walls and other vertical obstructions at 5.5 feet above the finish floor.

NFPA 72 sound pressure levels apply to “private mode” fire alarm notification device as required in NFPA 72:

NFPA 72 sound pressure levels do not apply to other notification devices.

NFPA 72 voice intelligibility applies to all voice messages. Intelligibility measurements are not required in large open areas such as industrial work areas, warehouses, and aircraft servicing areas, garages, and similar facilities.

## APPENDIX F ABBREVIATIONS AND ACRONYMS

°F	degrees Fahrenheit
°C	degrees Celsius
A&E	Architectural and Engineering Services
ABA	Architectural Barriers Act
ABAAG	Architectural Barriers Act Accessibility Guidelines
ACA	American Correctional Association
ADP	Automatic Data Processing
AFCEC	Air Force Civil Engineer Center
AFFF	Aqueous Film-Forming Foam
AFMAN	Air Force Manual
AFTO	Air Force Technical Order
AHJ	Authority Having Jurisdiction
ANSI	American National Standards Institute
AR	Army Regulation
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATFP	Anti-Terrorism Force Protection
AWG	American Wire Gauge
AWWA	American Water Works Association
BIA	Bilateral Infrastructure Agreement
CAD	Computer Aided Drafting
CDC	Child Development Center

cm <sup>2</sup>	square centimeter(s)
CO	Carbon Monoxide
CO <sub>2</sub>	Carbon Dioxide
CRAC	Computer Room Air Conditioning
CSS	Central Security Service
DFPE	Designated Fire Protection Engineer
DLA	Defense Logistics Agency
DoD	Department of Defense
DoDI	Department of Defense Instruction
DPDT	Double-Pole, Double-Throw
ECB	Engineering Construction Bulletins
EM	Engineering Manual
EMCS	Energy Monitoring and Control System
ESFR	Early Suppression Fast-Response Sprinklers
ETL	Engineering Technical Letters
FAAA	Fire Administration Authorization Act
FACP	Fire Alarm Control Panel
FC	Facilities Criteria
FM	Factory Mutual Global
FPE	Fire Protection Engineer
FRT	Fire Retardant Treated Plywood
FS	Flame Spread Rating
ft	feet; foot
ft <sup>2</sup>	square feet; square foot
gal	gallon(s)



GH <sub>2</sub>	Gaseous hydrogen
GOX	Gaseous Oxygen
gpm	gallons per minute
HQUSACE	Headquarters, U.S. Army Corps of Engineers
HNFA	Host Nation Funded Construction Agreements
HP	Horsepower
HVAC	Heating, Ventilating and Air Conditioning
HVLS	High Volume Low Speed
HZ	Hertz
IBC	International Building Code
ICC	International Code Council
IEEE	Institute of Electrical and Electronics Engineers
IFC	International Fire Code
in	inch(es)
in <sup>2</sup>	square inch(es)
IRC	International Residential Code\2\
/2/kPa	kilopascal
L	liter(s)
LCD	Liquid Crystal Display
LEC	Electroluminescence
LED	Light Emitting Diode
LH <sub>2</sub>	Liquid Hydrogen
LOX	Liquid Oxygen
m	meter(s)
m <sup>2</sup>	square meter(s)

MAF	Missile Alert Facilities
MIL-HDBK	Military Handbook
min	minute
mm	millimeter(s)
ms	milliseconds
NARA	National Archives and Records Administration
NATOPS	Naval Air Training & Operating Procedures Standardization
NAVAIR	Naval Air Systems Command
NAVFAC	Naval Facilities Engineering Command
NAVSEA	Naval Sea Systems Command
NCEES	National Council of Examiners for Engineering & Surveying
NFPA	National Fire Protection Association
NGA	National Geospatial-Intelligence Agency
NGR	National Guard Regulation
NPSH	Net Positive Suction Head
NRO	National Reconnaissance Office
NRTL	Nationally Recognized Testing Laboratory (as defined on the OSHA website <a href="https://www.osha.gov/dts/otpc/nrtl/nrtllist.html">https://www.osha.gov/dts/otpc/nrtl/nrtllist.html</a> )
NSA	National Security Agency
OHESS	Office of Occupational Health, Environmental & Safety Services
OPNAVINST	Naval Operations Instructions
P.E.	Registered Professional Engineer
PIV	Post Indicator Valve
POL	Petroleum Oil Lubricant
PRVs	Pressure-Regulating Valves

psi	pounds per square inch
PV	Photovoltaic
QFPE	Qualified Fire Protection Engineer
RPA	Remotely Piloted Aircraft
s	second(s)
SAE	Society of Automotive Engineers
SD	Smoke Developed Rating
SFPE	Society of Fire Protection Engineers
SOFA	Status of Forces Agreements
SPD	Surge protection device
UAS	Unmanned Aerial System/2/
UAV	Unmanned Aerial Vehicle
UFAS	Uniform Federal Accessibility Standard
UFC	Unified Facilities Criteria
UL	Underwriters Laboratories Inc.
USC	United States Code
Vac	volts alternating current
Vdc	volts direct current
WHS	Washington Headquarters Services