UFC 4-023-10
1 June 2016

UNIFIED FACILITIES CRITERIA (UFC)

SAFE HAVENS

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UNIFIED FACILITIES CRITERIA (UFC)

SAFE HAVENS

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**/)

Change No.	Date	Location

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 Civil Engineer Center (AFCEC) 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/.

Refer to UFC 1-200-01, *General Building Requirements*, for implementation of new issuances on projects.

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UNIFIED FACILITIES CRITERIA (UFC)
NEW DOCUMENT SUMMARY SHEET

Subject: UFC 4-023-10, Safe Havens

Supersedes: None

Document Description and Need:

- **Purpose:** In some DoD facilities, a safe haven may be required to provide additional protection to DoD personnel and their dependents for man-made and natural threats. This UFC specifies the development of design criteria for these threats and provides guidance for satisfying those criteria when designing a safe haven.

- **Application and Use:** This UFC applies to the design of a safe haven for all DoD buildings and facilities that require additional protection from man-made and natural threats. The safe haven may also be used as a fallback position for the destruction of classified information during an attack. This UFC will be employed when the project planning team (as defined in UFC 4-020-01) and/or the facility owner require that a safe haven be incorporated into the building or facility. The primary use of this UFC is to design the safe haven for man-made threats and that the guidance provided herein for natural threats is for information purposes and the planner/designer shall design the facility for the natural threats as necessary in accordance with UFC 1-200-01, General Building Requirements.

- **Need:** No guidance previously existed for the design of safe havens within the DoD or any of its components.

Impact: The following benefits will result from publication of UFC 4-023-10.

- Consistency in the planning and design of safe havens will be implemented across DoD.

- Safe haven design will be based on careful consideration, identification, and evaluation of man-made and natural threats.

- The design of a safe haven will employ the best existing design guidance for man-made and natural threats.

- The safety of DoD personnel and dependents will be increased, for both CONUS and OCONUS applications.

Unification Issues
There are no unification issues.

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CHAPTER 1 INTRODUCTION

1-1 PURPOSE AND SCOPE.

This UFC provides planning and design requirements and guidance for a safe haven. It is not intended to create the requirement for a safe haven, but to assist in meeting the planning and design criteria requirements. The requirement for a safe haven may come from Department of Defense (DoD) policy, service policy, installation requirements, or user requirements when supported by policy.

1-2 APPLICABILITY.

This UFC provides planning and design criteria and guidance for DoD components and participating organizations. The primary use of this UFC is to design the safe haven for man-made threats and that the guidance provided herein for natural threats is for information purposes and the planner/designer shall design the facility for the natural threats as necessary in accordance with UFC 1-200-01, General Building Requirements. This document applies to all construction, renovation, and repair projects for safe havens.

For some applications, specific design or facility type criteria may be available, in those applications; the more stringent criteria will apply.

1-3 DEFINITION OF SAFE HAVEN.

A safe haven is a structure, or protected area within a structure, that provides protection from man-made threats, natural threats, or combination for short durations and infrequent intervals.

1-4 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.

1-5 VULNERABILITY AND RISK ASSESSMENT.

1-5.1 Man Made Threat.

Manmade threats range from focused attacks by trained aggressors using explosives, direct and indirect fire weapons, forced entry tools, and chemical or biological agents, to haphazard attempts to disrupt or occupy a facility by protestors with political or social motivations.

In accordance with DoD security and antiterrorism (AT) policies, a vulnerability and risk assessment must be conducted prior to beginning any security project. Upon identifying facility or asset vulnerabilities to threats, physical security measures such as a safe

haven, a hardened and secure facility, fences, gates, and Electronic Security Systems (ESS) may be deployed to reduce vulnerabilities. In summary, this document assumes the planning phases, including the risk analysis, are complete prior to beginning design. For information on Security Engineering Planning and Design process, refer to UFC 4-020-01 and UFC 4-020-02FA (described in the section "Security Engineering UFC Series" in this chapter). The engineering risk analysis conducted as part of UFC 4-020-01 should be consistent with the terrorism risk analysis conducted by the installation security/AT staff.

1-5.2 Natural Threat.

For natural threats such as hurricanes, tornadoes, typhoons, earthquakes, and tsunamis, refer to UFC 3-301-01 *Structural Engineering,* and American Society of Civil Engineers (ASCE), Federal Emergency Management Agency (FEMA), and International Code Council (ICC) criteria referenced herein for guidance for assessing natural threats.

1-6 POLICY REQUIREMENTS.

The requirement to provide a safe haven comes from DoD Instruction/Directives, Geographic Combatant Commander (GCC) Instructions, Service Instruction/Directives, and Regional or Installation requirements. Consult Headquarters, Major Command, Regional, and Installation personnel to establish project requirements.

1-6.1 Department of Defense.

- DoD policy provides guidance to ensure individuals designated as High Risk Personnel (HRP) or serving in a designated High Risk Billet (HRB) are provided an appropriate level of protection.

- Department of Defense Instruction O-2000.22 *Designation and Physical Protection of DoD High-risk Personnel (HRP)*: The Protection-Providing Organization (PPO) will conduct a Personal Security Vulnerability Assessment (PSVA) for each HRP. The resulting PSVA will provide recommendations for the protection of the HRP which may include a safe haven. The PPO refers to the U.S. Army Criminal Investigative Command, the Naval Criminal Investigative Service, the U.S. Air Force Office of Special Investigations, the Defense Criminal Investigative Service, the Pentagon Force Protection Agency, and the National Security Agency. For additional information on HRP, refer to UFC 4-010-03, *Security Engineering: Physical Security Measures for High-Risk Personnel.*

1-6.2 Geographic Combatant Commander (GCC) Requirements.

GCCs issue requirements for antiterrorism and physical security for installations within their area of responsibility. Ensure any such requirements are incorporated in addition to the requirements found in DoD and Service Directive/Instructions. Resolve any differences in the requirements by applying the most stringent requirement.

1-7 REFERENCES.

Appendix A contains a list of references used in this document. The publication date of the code or standard is not included in this document. The most recent edition of referenced publications applies, unless otherwise specified.

1-8 DOD SECURITY ENGINEERING UFC SERIES.

This UFC is one of a series of security engineering Unified Facilities Criteria documents that cover minimum standards, planning, preliminary design, and detailed design for security and antiterrorism. The manuals in this series are designed to be used sequentially by a diverse audience to facilitate development of projects throughout the design cycle. The manuals in this series include the following, and the intended process for applying them is illustrated in Figure 1-1.

1-8.1 DoD Minimum Antiterrorism (AT) Standards for Buildings.

UFC 4-010-01 establishes standards that provide minimum levels of protection against terrorist attacks for the occupants of all DoD inhabited buildings. UFC 4-010-01 is intended to be used by security and antiterrorism personnel and design teams to identify the minimum AT requirements that must be incorporated into the design of all new construction and major renovations of inhabited DoD buildings. UFC 4-010-01 also includes recommendations that should be, but are not required to be incorporated into all such buildings.

1-8.2 Security Engineering Facilities Planning Manual.

UFC 4-020-01 outlines the processes for developing the design criteria necessary to incorporate security and antiterrorism design criteria into DoD facilities and for identifying the cost implications of applying those design criteria. Those design criteria may be limited to the requirements of the minimum AT standards, or they may include protection of assets other than those addressed in the minimum AT standards (people), aggressor tactics that are not addressed in the minimum AT standards or levels of protection beyond those required by the minimum AT standards.

The cost implications for security and AT are addressed as cost increases over conventional construction for common construction types. The changes in construction represented by those cost increases are tabulated for reference, but they only represent construction that will meet the requirements of the design criteria. The manual also addresses the tradeoffs between cost and risk. The Security Engineering Facilities Planning Manual is intended to be used by planners as well as security and AT personnel with support from planning team members.

1-8.3 Security Engineering Facilities Design Manual.

UFC 4-020-02FA provides interdisciplinary design guidance for developing preliminary systems of protective measures to implement the design criteria established using UFC 4-020-01. Those protective measures include building and site elements, equipment, and the supporting manpower and procedures necessary to make them all work as a

system. The information in UFC 4-020-02FA is in sufficient detail to support concept level project development, and as such can provide a good basis for a more detailed design. The manual also provides a process for assessing the impact of protective measures on risk. The primary audience for the Security Engineering Design Manual is the design team, but security and antiterrorism personnel can also use it.

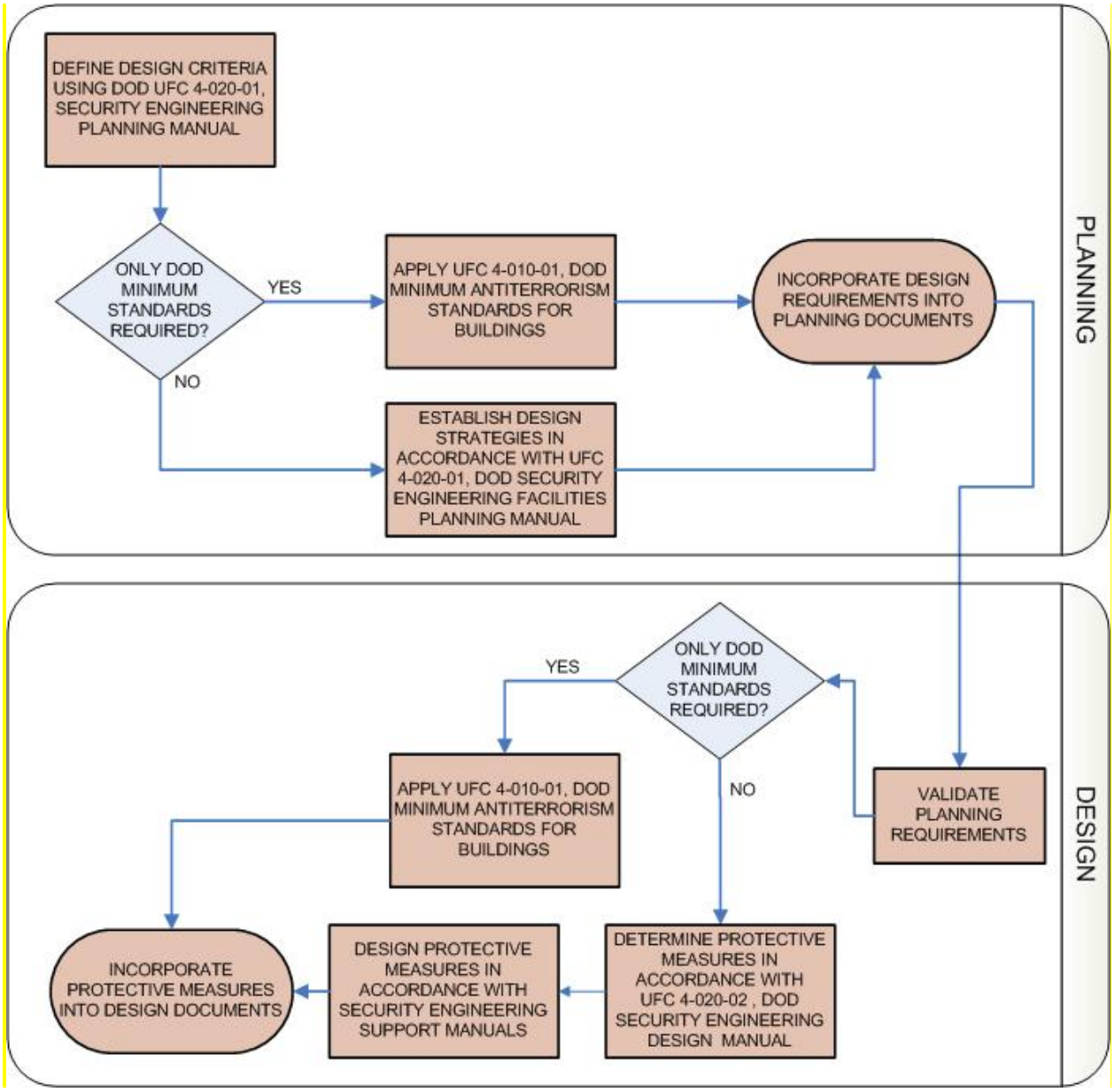
1-8.4 Security Engineering Support Manuals.

In addition to the standards, planning, and design UFC mentioned above, there is a series of additional UFCs that provide detailed design guidance for developing final designs based on the preliminary designs developed using UFC 4-020-02FA. These support manuals provide specialized, discipline specific design guidance. Some address specific tactics such as direct fire weapons, forced entry, or airborne contamination. Others address limited aspects of design such as resistance to progressive collapse or design of portions of buildings such as mail rooms. Still others address details of designs for specific protective measures such as vehicle barriers or fences. The Security Engineering Support Manuals are intended to be used by the design team during the development of final design packages.

1-8.5 Security Engineering UFC Applications.

The application of the security engineering series of UFCs is illustrated in Figure 1-1. UFC 4-020-01 is intended to be the starting point for any project that is likely to have security or AT requirements. By beginning with UFC 4-020-01, the design criteria will be developed that establishes which of the other UFCs in the series will need to be applied. The design criteria may indicate that only the minimum AT standards need to be incorporated, or it may include additional requirements, resulting in the need for application of additional UFCs. Even if only the minimum AT standards are required, other UFCs may need to be applied if sufficient standoff distances are unavailable. Applying this series of UFCs in the manner illustrated in Figure 1-1 will result in the most efficient use of resources for protecting assets against security and AT related threats.

Figure 1-1 Application of UFC Documents for Planning and Design



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CHAPTER 2 DESIGN CRITERIA DEVELOPMENT

2-1 INTRODUCTION.

Each safe haven must be sized, configured, and outfitted based on the project requirements. This section is intended to make planners aware of safe haven requirements that may affect the facility scope and budget. It is not intended to document the standard planning processes related to project development.

2-2 OVERVIEW OF PLANNING AND DESIGN PROCESS.

Determining the requirements for a safe haven requires an interdisciplinary team knowledgeable of local considerations. The interdisciplinary team must work together to determine project requirements. The team must consider cost, user constraints such as operations, manpower requirements or limitations, and sustainment costs when determining the requirements for the overall solution. The planning team should include the following:

- Supported Command
- Protection Providing Organization (PPO) representative (If for HRP)
- Security
- Safety
- Logistics
- Engineering (Planning and Design)
- Cultural resources/historic preservation officers (if historical building)

The process for determining the requirements for man-made and natural threats is provided further in this chapter. Physical security and structural design requirements and procedures required to meet these criteria are provided in Chapter 3.

2-3 PLANNING CONSIDERATIONS.

To define the design criteria for the safe haven, a preliminary determination of some of the physical attributes of its facility must be known.

2-3.1 Time

The location of a safe haven is an important part of the planning and design process, especially for natural threats such as tornados and some man-made threats that are presented in a relatively short time after the threat is annunciated.

2-3.1.1 Transit Time.

The planner and designer shall consider the time required for all occupants of a building or facility to reach the safe haven. The National Weather Service (NWS) has made great strides in predicting tornadoes and hurricanes and providing warnings that allow time to seek shelter. For tornadoes, the time span is often short between the NWS

warning and the onset of the tornado. It is recommended that a safe haven for a natural threat be designed and located in such a way that the following access criteria are met. All potential users of the safe haven should be able to reach it within 5 minutes per FEMA P-361 *Safe Rooms for Tornadoes and Hurricanes: Guidance for Community and Residential Safe Rooms*. For hurricanes, these restrictions do not apply, because warnings are issued much earlier, allowing more time for preparation. Note that the typical walking speed is 3 to 4 ft/s (0.9 to 1.2 m/s) per Manual on Uniform Traffic Control Devices (MUTCD). For man-made threats, discuss transit time to the safe haven with the security professional based on the design basis threat.

Transit time may be especially important when safe haven users have disabilities that impair their mobility. Those with special needs may require assistance from others to reach the safe haven; wheelchair users may require a particular route that accommodates the wheelchair.

2-3.2 Travel Route.

The designer must consider the time factors above to provide the shortest possible access time and most accessible route for all potential safe haven occupants. To ensure that personnel are able to reach the safe haven within the required amount of time and that all personnel are provided a safe haven, it may be necessary to construct multiple safe havens at a given facility.

The route to the safe haven must be free from obstruction. If it is necessary for personnel to reach the safe haven by motorized conveyance, such as by automobile or shuttle, space around the safe haven must be provided for drop-off and parking.

2-3.3 Duration of Occupancy.

As specified in FEMA P-361, for short-duration natural events (tornadoes and earthquakes), the duration of occupancy is 2 hours. For the design of a safe haven that must protect against hurricanes, typhoons, and the airborne contamination tactic of a medium or high threat severity level, the duration of occupancy is a minimum of 24 hours. For all other man-made threats, the duration of occupancy is equal to the response time of the security forces. For instance, if 1 hour is required for security forces to respond and there are no natural threats or threat of airborne contamination, the duration of occupancy is 1 hour.

2-3.4 Occupancy Level.

The occupancy level for a safe haven is based on the maximum number of personnel required to occupy the safe haven. In the case of a HRP, the occupancy would be one. In the case of a Sensitive Compartmented Information Facility (SCIF), the occupancy would be the occupancy of the SCIF.

2-3.5 Floor Area.

2-3.5.1 Occupants.

The amount of required floor space depends upon the design threat, event duration, and the number and types of occupants. Natural events, such as hurricanes, or man-made threats, such as the air contamination tactic, may require longer occupancy times and therefore more floor area per person. For additional discussion on occupancy, means of egress, access, and accessibility see FEMA P-361.

If the building/facility in which the safe haven will reside must be designed for a hurricane or typhoon or if the threat severity level for the airborne contamination in accordance with UFC 4-020-01 is Medium or High, then use the floor area for long duration occupation in Table 2-1 to calculate the total required floor area. Otherwise, use the floor area for short duration occupation in Table 2-2.

Table 2-1 Floor Area for Long Duration (adapted from FEMA P-361)

Type of Person	Floor Area per Person, ft^2 (m^2)
Adult standing	20 (1.9)
Adult seated	20 (1.9)
Children under age 10	20 (1.9)
Wheelchair users	20 (1.9)
Bedridden persons	40 (3.8)

Table 2-2 Floor Area for Short Duration (adapted from FEMA P-361)

Type of Person	Floor Area per Person, ft^2 (m^2)
Adult standing	5 (0.46)
Adult seated	5 (0.46)
Children under age 10	5 (0.46)
Wheelchair users	10 (0.93)
Bedridden persons	30 (2.8)

2-3.5.2 Equipment for Destruction of Classified Materials.

If the safe haven will be used for destruction of classified materials, contact the responsible security office or the Facility Security Officer (FSO) to identify the equipment and procedure that is required to destroy or neutralize the classified materials and sensitive information. Determine the floor area and power requirements for this equipment. Check that the equipment can be safely used in a closed environment and that the generated waste can be accommodated within the space.

Note, for a SCIF or top secret open storage area that has been designated as a safe haven, the safe haven must be designed to provide sufficient space and delay time for the occupants to destroy documents. The occupants for such a safe haven must be limited to those personnel already occupying the space and those who are cleared and necessary for the destruction of the sensitive information. Additional safe havens may be required within the building to accommodate additional personnel.

2-3.5.3 Floor Area.

Calculate the required floor area by adding the floor area for occupants from the previous section on floor area to the floor area for the equipment used to destroy classified materials from Section on equipment for destruction of classified materials. The floor area must also include sufficient area for operational supplies for the safe haven, discussed in Chapter 4 on additional safe haven supplies.

2-3.6 Height.

For all safe havens, the minimum distance from the floor to ceiling is 7.5 feet (2.3 meters), as prescribed in NFPA 101 *Life Safety Code*.

2-3.7 Location, Type, and Number of Safe Havens.

Identify candidate safe haven locations with the guidance on site selection presented in siting section of Chapter 3, including maximum transit time to reach the safe haven as discussed previously. Note that a safe haven may serve multiple purposes, such as a conference room, cafeteria, gymnasium, restroom, classroom, or temporary lodging, and this possibility should be considered in the preliminary site selection.

After identification of the candidate safe haven types and locations, consider the issues of accessibility, power, ventilation (including special filtration for airborne contaminants, if necessary), water, communications, and waste storage. If the candidate safe haven location is still valid, proceed with the requirement determination of the design criteria in the following sections.

2-4 DESIGN CRITERIA FOR MAN-MADE THREATS.

To create the design criteria for man-made threats, employ the processes in UFC 4-020-01 to determine the level of protection (LOP) and the design basis threat (DBT). The man-made tactics relevant to safe haven design and discussed in UFC 4-020-01 include the following:

- Moving vehicle bomb
- Stationary vehicle bomb
- Hand delivered device
- Indirect fire weapons
- Direct fire weapons
- Forced entry
- Visual surveillance
- Airborne contamination
- Waterborne contamination
- Waterfront attack

The covert entry, acoustic eavesdropping, and electronic emanations eavesdropping tactics are not typically threats to a safe haven and need not be considered. In the event of retreat to a safe haven, personnel are alerted to the presence of a threat, and covert entry is unlikely to be employed by an aggressor. Per UFC 4-020-01, the acoustic eavesdropping and electronic emanations eavesdropping tactics are assumed to be employed by foreign intelligence services. As safe havens will only be used for destruction of classified material and not for creation or transmission, these two threats are removed from further consideration. In the event of a SCIF or classified conference room being designated as a multi-use safe haven, the creation and transmission of classified information will only be done during normal operations when the room is not being used as a safe haven. When such a room is being utilized as a safe haven, classified material will only be destroyed, not created or transmitted. Further, for the purposes of applying the UFC 4-020-01 procedures, the aggressors will not include unsophisticated criminals, sophisticated criminals, organized criminal groups, and vandals. For the Forced Entry tactic, specify the required protection time based on the response time of the security forces determined in security forces evaluation in addition to the DBT and the LOP.

2-5 DESIGN CRITERIA FOR NATURAL THREATS.

Natural threats include hurricanes, tornados, tsunamis, and earthquakes. Design to resist loads created by natural phenomena is discussed in design procedures for natural threats in Chapter 3.

2-5.1 Hurricane and Typhoon.

Hurricanes and typhoons are tropical cyclones in the western hemisphere and in the western North Pacific Ocean, respectively. In this UFC, the term hurricane also encompasses typhoons, for simplicity.

Hurricanes create three types of loads on a building. Wind-induced forces, high speed debris impact, and hydrodynamic forces from either flooding or storm surge. Ensure compliance with the most stringent of UFC 3-301-01 and FEMA P-361 for wind-speed data.

2-5.2 Tornado.

A tornado is a violently rotating column of air, in contact with the ground. According to FEMA P-361, tornados may load a structure in three ways: wind-induced forces, debris impact, and forces induced by change in atmospheric pressure. Forces induced by change in atmospheric pressure result from the large pressure gradient between the atmospheric pressure and the air pressure within the funnel of a tornado. As the tornado passes over a structure, it can cause outward pressures on a structure, due to the instantaneous pressure differences between the structure interior and exterior.

ICC 500-2014*ICC/National Storm Shelter Association (NSSA) Standard for the Design and Construction of Storm Shelters* provides design guidance for community shelters and residential safe rooms including wind speeds and other design criteria. Regarding wind speed and other structural design criteria ensure compliance with the most stringent of the UFC 3-301-01, FEMA P-361, and ICC 500-2014.

2-5.3 Earthquake.

Structures in earthquake regions are subjected to ground motions that generate inertial forces on the structure. Therefore, the ground motion is the critical parameter for seismic design. Use UFC 3-301-01 and 3-310-04 *Seismic Design for Buildings* to obtain data for ground motion data.

2-5.4 Tsunami.

A tsunami consists of waves generated by seismic activity, including sudden displacements of the seafloor or volcanic activity. When these waves reach shore, they can cause dramatic flooding in coastal areas. The result is that structures in affected areas can be subjected to hydrodynamic forces.

If tsunamis are a design threat, the building/facility in which the safe haven will reside must be designed in accordance with the guidance presented in UFC 3-310-04 and FEMA P-646 *Guidelines for Design of Structures for Vertical Evacuation from Tsunami.*

2-6 OTHER APPLICABLE DESIGN REQUIREMENTS.

Depending upon the location of the safe haven, additional design requirements may be imposed by the American Embassy Chief of Mission, the host nation’s military and police, and host nation agreements. Work with the Planning Team to identify these additional requirements.

Geographic combatant commanders may also establish additional guidance to ensure uniform and consistent application of these standards within their areas of operations or to account for any special circumstances.

2-7 FINAL DESIGN CRITERIA.

The design criteria developed in previous sections and the other applicable design requirements above must be combined such that the maximum criteria controls for all

cases of overlap. Develop a final design criteria requirement that includes, as a minimum, the following items:

- Relevant man-made tactics, and corresponding DBT and LOP
- Required response time for Forced Entry tactic
- Identification of natural threats and all corresponding load criteria (such as maximum wind speed, earthquake load cases, debris impact, and hydrodynamic forces)
- Other applicable design requirements as described above

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CHAPTER 3 DESIGN PROCESS

3-1 INTRODUCTION.

The design of a safe haven must meet the criteria that were developed in Chapter 2. Note that design to resist a given threat may provide protection against some other threat. For example, walls designed to resist a forced entry tactic for a high LOP will be more than sufficient to resist a hand-delivered weapon tactic at a low LOP. After examining the DBTs and LOPs for all applicable tactics, the tactic requiring the most stringent design will govern. Different tactics may govern various components of the safe haven, and each component must be validated to handle all applicable tactics. In addition, there are often multiple ways by which to satisfy the design criteria. Any method that is rational, based on fundamental principles of engineering mechanics and dynamics, and/or validated with experimental data is permissible. Any design approach that is not specified or referenced in this document must be approved by the Planning Team or by an authorized representative of the facility owner.

3-2 INITIAL CONSIDERATIONS.

3-2.1 Siting.

3-2.1.1 General Conditions.

A safe haven can be defined as standalone, such as a buried shelter or the entire structure, or internal, such as a protected area within a building. Specific guidance for standalone and internal safe havens is discussed in the following section on structural integration. The location of the safe haven must permit personnel to reach the safe haven from their work areas within 5 minutes after annunciation of a threat. Personnel will follow signage to reach the appropriate safe haven. The safe haven must also provide sufficient space for the protected assets, such as personnel and associated supplies or classified material. Furthermore, the site must provide a sufficient number of entry points into the safe haven, with appropriate access control. Finally, to facilitate egress of occupants from the safe haven once the threat has passed, site elevation must not be greater than an elevation that can be accessed by ladders available to the local fire department.

It is recommended that a standalone safe haven, as described in this document not be located near multi-story buildings or other relatively large structures, if possible, since collapse of these structures could damage the safe haven.

3-2.1.2 Natural Threat.

To prevent flooding, see FEMA P-361 and ICC 500 for siting facility with regards to Special Flood Hazard Area (SFHA). FEMA P-361 notes that smaller structures, such as poles for light fixtures and power lines, antenna towers, and satellite dishes, and roof mounted mechanical equipment should not be located near a safe haven. Smaller structures, trees, and waste receptacles can become hazardous debris in extreme weather events.

3-2.1.3 Explosives Tactics.

For explosives tactics, it is recommended that smaller structures, trees, and waste receptacles not be located near an internal or standalone safe haven, to prevent hazardous debris. Also, positioning a safe haven below ground provides protection against explosives tactics. To impede delivery of a vehicle-borne explosive, it is recommended that the building/facility in which the safe haven will reside be located at an appropriate standoff distance from railways, roadways, and parking facilities based on the DBT and required LOP.

Finally, the structural design of the building/facility in which the safe haven will reside must provide the required LOP for the DBTs for the assets that will occupy the safe haven at the available standoff distances. If at a given location the LOP requirements cannot be satisfied, the safe haven may be moved to satisfy them, or the building/facility in which the safe haven will reside can be hardened to provide the required LOP. Vehicle barriers may also be installed to increase standoff distance. Note that the construction of vehicle barriers will vary significantly, depending on whether the DBT includes moving vehicle bombs or is limited to stationary vehicle bombs.

3-2.1.4 Standoff Weapons.

To impede aggressor use of direct fire weapon threats, a safe haven must be located to minimize the number of vantage points for attack, such that an aggressor is denied line of sight. This objective can be accomplished by placing obstructions between the vantage points and the safe haven, or by providing an internal safe haven with no external windows. As with the explosives tactics, below-grade placement of the safe haven provides protection against ballistic tactics. However, if the safe haven is at a high elevation, an aggressor must shoot upwards at the position, causing the projectile to strike the structure at less than 90 degrees, diminishing its penetration into the structure.

Indirect fire weapons, such as mortars and small rockets, can be fired over obstacles to reach a target. These weapons do not require a direct line of sight to a target, but they do need a clear line of flight. While a safe haven may be located to minimize clear flight lines from these weapons, the best way to protect the safe haven from indirect fire is to harden its structure. The building/facility in which the safe haven will reside must be designed to protect the assets inside it from the detonation of the threat weapon at standoff distances that vary by level of protection. Per UFC 4-020-01, the structure must be designed to provide protection from the blast pressure from the exploding rounds and from warhead casing fragment penetration.

3-2.1.5 Airborne Contamination Tactic.

Trees, shrubberies, and any other vegetation must not be located within 10 feet (3 meters) of a standalone or internal safe haven, as vegetation can retain airborne contaminant agents. In addition, a below-grade safe haven is more vulnerable to the air contamination tactic. UFC 4-020-01 notes that aerosolized materials used for the air contamination tactic are heavier than air and tend to settle in the low-lying areas.

3-2.2 Structural Integration.

Depending on the facility, a standalone or an internal safe haven may be more effective. A standalone safe haven is physically separate from any other building. An internal safe haven is physically connected to another building but may be structurally independent.

3-2.2.1 Standalone Safe Haven.

Although a standalone safe haven is unlikely to be suitable for multi-use, as described in this document, the standalone safe haven does have several advantages:

- The safe haven may be sited away from likely targets, which can serve as potential debris hazards.
- The construction process of the safe haven can be simplified since it need not be integrated with another structure.
- It may be easier to implement at an existing facility.
- It may be concealed or camouflaged.
- An attack on the primary facility will likely not compromise the structural integrity of the safe haven.
- Physical separation from other buildings may prevent damage by the possible collapse of those buildings.
- Its ventilation and power systems are separate from the main facility.

3-2.2.2 Internal Safe Haven.

An internal safe haven has a different set of advantages:

- The design may only need to satisfy man-made threats, if the surrounding structure has been adequately designed for natural threats.
- Because it is within another structure, it is partially shielded from debris caused by either a man-made or a natural threat.
- Personnel do not have to be exposed when accessing the safe haven.
- An internal safe haven can likely be reached more quickly by building occupants, since they need not exit the building to enter the safe haven.
- With adequate planning, an internal safe haven may more readily serve two or more purposes such as a conference room, cafeteria, gymnasium, restroom, classroom, or temporary lodging.
- A separate air handling system can be included in the design of the safe haven for new construction to protect occupants from airborne contamination, without the expense of providing a special air handling system for the entire building to withstand the airborne contamination tactic if required.

For internal safe havens, use the available structure as much as possible to meet the required LOPs and DBTs. Existing walls can provide protection from forced entry, direct and indirect weapons, explosive devices, and potentially the airborne contamination tactic, if adequately sealed. Note that there will be an added delay for an internal safe haven, since the aggressors would have to penetrate the building first to reach the safe haven. The available structure should also be used as part of the design for natural threats.

3-2.3 Use of Safe Haven.

3-2.3.1 Single Use Safe Haven.

A single-use safe haven is used only in emergencies to provide protection in the event of an attack or natural event, and it has two advantages:

- Its restricted use can also permit it to have simplified electrical and mechanical systems, which can reduce construction costs.
- In addition, a single-use safe haven is always ready for occupants and will not be cluttered with furnishings and storage items.

The primary disadvantage of a single-use shelter is that it remains unused most of its design life.

3-2.3.2 Multi-Use Safe Haven.

A multi-use safe haven is designed to provide protection in an emergency but is also used as for other purposes in the absence of an emergency, such as a conference room, cafeteria, gymnasium, restroom, classroom, or temporary lodging. As noted in FEMA P-361 and FEMA 453, *Design Guidance for Shelter and Safe Rooms*, in contrast to single-use shelters, multi-use shelters can provide an immediate return on the financial investment required to construct them, because they can be used for non-emergency events.

A Sensitive Compartmented Information Facility (SCIF) is one example of a multi-use area that could be designed as an internal safe haven. If a SCIF is also designed to be a safe haven, SCI documents would not have to be transferred outside the SCIF and could be destroyed in place. Consult with UFC 4-010-05 *Sensitive Compartmented Information Facilities Planning, Design, and Construction,* ICS 705-1 and the IC Tech Spec-for ICD/ICS 705 that provide the standards for the physical and technical security standards that apply to a SCIF.

3-2.3.2.1 Multi-Use Signage.

Both the routine maximum occupancy and safe haven maximum occupancy must be posted in a multi-use structure.

3-2.4 System Integration.

The safe haven is part of the overall physical security scheme for the facility and must be coordinated with other physical security elements. For instance, communication equipment in the safe haven must be compatible with the other facility communications. The power source, backup power, and communications should be shared, if these resources are sufficiently protected against the DBTs.

3-3 ADJUSTMENTS IN SAFE HAVEN DESIGN.

During the application of the design procedures laid out in the following sections, the designer may decide to modify key physical parameters, such as size, location, or type of safe haven. For every modification and for each iteration through the design process, the engineer must revisit Chapter 2 to determine if these changes affect any of the final design criteria defined in Chapter 2.

3-4 DESIGN PROCEDURE FOR MAN-MADE THREATS.

The following paragraphs contain specific design procedures and design resources to be employed for the selected tactics determined by UFC 4-020-01. The following paragraphs may not applicable. UFC 4-020-01 is a planning tool and as such contains general design strategies to address these tactics. Some of the approaches from UFC 4-020-01 are incorporated in the following paragraphs.

Specific DoD design approaches for the tactics are available in UFC 4-020-02FA and Security Engineering Support Manuals as applicable. Any conflicts between this UFC and UFC 4-020-02FA and support manuals must be resolved by the project Planning Team.

3-4.1 Moving Vehicle.

When required, the building/facility in which the safe haven will reside must be designed to resist the pressure and impulse from the explosive weight associated with the DBT, and associated standoff of the moving vehicle threat. Employ standard blast design methods for the analysis and design of the building/facility in which the safe haven will reside and its components, including doors and windows, to resist the pressure and impulse. Blast design and analysis methods can be found in UFC 3-340-01, *Design and Analysis of Hardened Structures to Conventional Weapons Effects* and ASCE 59-11, *Blast Protection of Buildings.* Use the structural response limits specified in PDC-TR 06-08 *Single Degree of Freedom Structural Response Limits for Antiterrorism Design*. Approved design tools such as the *Single-degree-of-freedom Blast Effects Design Spreadsheet* (SBEDS) and *Single degree of freedom Blast Effects Design Spreadsheet for Windows* (SBEDS-W) both available from the US Army Corps of Engineers Protective Design Center may be employed if approved by the project planning team.

3-4.2 Stationary Vehicle.

The DBT for stationary vehicle bombs will be used to establish the design explosive weight. The standoff will be the distance from the building/facility in which the safe haven will reside to possible vehicle locations, as determined by a review of the site layout and the presence of components such as vehicle barriers, parking lots, and roadways. Note that multiple locations and standoff distances may need to be required for the design, depending upon the shielding provided by the terrain, buildings, and other obstructions between the vehicle bomb and the safe haven.

Use the same approach and response criteria as specified in the previous section to design the building/facility in which the safe haven will reside for a stationary vehicle bomb threat.

3-4.3 Hand Delivered Devices.

The DBT for hand delivered devices as determined with UFC 4-020-01 will be used to establish the design incendiary device or explosive type and weight. The standoff will be the shortest possible distance from the building/facility in which the safe haven will reside to the likely placement locations for the hand-delivered device; this could include direct contact with the structure.

Use the same approach and response criteria as specified above in moving vehicle bomb threat to design the building/facility in which the safe haven will reside for a hand delivered device.

3-4.4 Indirect Fire Weapons.

Consult UFC 4-020-01 for the general design approach and employ UFC 4-020-02FA as required for specific guidance to design the safe haven for the DBT and LOP.

3-4.5 Direct Fire Weapons.

Employ UFC 4-023-07 *Design to Resist Direct Fire Weapon Effects* as required to design the safe haven for the DBT and LOP.

3-4.6 Forced Entry.

Consult UFC 4-020-01 for the general design approach to design the safe haven to resist the design basis threat for the period of time determined in security forces evaluation. Use the procedures and guidance in UFC 4-020-02FA and UFC 4-020-03FA, *DoD Security Engineering: Final Design* to design the physical components of the safe haven, including walls, floors, ceilings, windows, doors, and other components.

3-4.7 Visual Surveillance.

UFC 4-020-01 recommends the following in the design against the visual surveillance threat when required; the safe haven is positioned, concealed, or camouflaged such that an aggressor cannot see it. In particular, safe haven entrances must be placed in

locations that are not easily seen. If windows are used, window blinds or curtains must be installed to prevent aggressors from being able to observe activity inside the safe haven.

This guidance may conflict with other design guidance, such as design for natural threats, for which signage will be needed to assist personnel in finding the safe haven. In this case, the Planning Team will resolve the conflicts.

3-4.8 Airborne Contamination.

Employ UFC 4-024-01 *Security Engineering: Procedures for Designing Airborne Chemical, Biological, and Radiological Protection for Buildings* to design the safe haven for the DBT and LOP.

3-4.9 Waterborne Contamination.

Employ the guidance in Chapter 4 of UFC 4-020-02FA to design the safe haven for the DBT and LOP.

3-4.10 Waterfront Attack.

When required employ the guidance in Chapter 4 of UFC 4-020-01 and UFC 4-025-01, *Security Engineering: Waterfront Security* to design the building/facility in which the safe haven will reside for the DBT and LOP appropriate for waterfront attacks. Use the same approach and response criteria as specified in the previous section on moving vehicles regarding blast design and analysis.

3-5 DESIGN PROCEDURE FOR NATURAL THREATS.

Natural threats, as discussed in Chapter 2, must be identified for both standalone and internal safe havens. If an internal safe haven is placed within a building which has the capacity to resist relevant natural threats, then only elements of the safe haven that are exposed to natural threats must be considered. In the case of standalone safe havens, all relevant natural threats must be considered. For both standalone and internal safe havens with exposed elements, employ the procedures in the following four sections. For regions where wind speeds and loads from hurricanes/typhoons and tornados overlap ensure the most stringent threat is used in design and construction of the required shelter.

3-5.1 Hurricane and Typhoon.

As discussed in Chapter 2, hurricanes and typhoons can apply wind-induced forces, debris impact, and hydrodynamic forces. To resist wind-induced forces and debris impact, the building/facility in which the safe haven will reside must be designed according to FEMA P-361, ICC 500 and UFC 3-301-01. Wind speed data for building sites outside the US must be obtained from Appendix E of UFC 3-301-01. Ensure compliance with the more stringent criteria in design and construction.

To resist hydrodynamic forces associated with flooding, the building/facility in which the safe haven will reside must be designed according to UFC 3-301-01 and Chapter 5 of ASCE 7-10. If the safe haven is built in a location that lacks a US Flood Hazard Map or the equivalent in the host nation, available flood data from local agencies must be used for design. See United States Geological Survey (USGS) website for additional flood information: http://water.usgs.gov/floods/

3-5.2 Tornado.

As discussed in Chapter 2, a tornado subjects a building to wind-induced forces, debris impact, and forces induced by change in atmospheric pressure. ICC 500-2014 provides minimum design and construction requirements for storm shelters that provide a safe refuge from storms that produce high winds, hurricanes, and tornadoes. Chapter C26 of ASCE 7-10 also provides references pertaining to tornadic design and these references should be consulted. Regarding wind speed and other structural design criteria ensure compliance with the most stringent of the UFC 3-301-01, FEMA P-361, and ICC 500-2014. Ensure compliance with the more stringent criteria in the design and construction of the shelter.

3-5.3 Earthquake.

The building/facility in which the safe haven will reside must be designed in accordance with the seismic provisions presented in UFC 3-301-01 and UFC 3-310-04. Seismic ground motion data for buildings/facilities built outside of the US must be obtained from UFC 3-301-01. See USGS Earthquake Hazard Program website for additional seismic information: http://earthquake.usgs.gov/hazards/

It should be noted that the objective in designing the building/facility in which the safe haven will reside to resist seismic loading is not for the building/facility to serve as an earthquake shelter, though it could serve as a shelter for aftershocks. Rather, the objective is to ensure that the building/facility survives likely seismic events. In this way, the safe haven as part of the overall building structure is designed, like any other building in a seismic zone, to continue functioning despite the occurrence of a seismic event.

3-5.4 Tsunami.

If required the building/facility in which the safe haven will reside must be designed to resist hydrodynamic forces caused by a tsunami according to UFC 3-310-04. If the building/facility in which the safe haven will reside is built in a location that lacks a US Flood Hazard Map or the equivalent in the host nation, available flood data from local agencies must be used for design. See United States Geologic Survey (USGS): http://walrus.wr.usgs.gov/tsunami and National Oceanic and Atmospheric Administration (NOAA): http://www.tsunami.noaa.gov/ websites for additional Tsunami information.

CHAPTER 4 OTHER DESIGN GUIDANCE

4-1 EMERGENCY ROUTE MARKING.

For natural threats, proper route marking is essential to personnel reaching the safe haven within the required time. Therefore, the facility must incorporate signage demarcating routes to the safe haven. The signage should also indicate the threats for which the safe haven was designed. Entry points to the safe haven must be clearly identified. Route marking may be accomplished by powered lighting, or more recently developed photo luminescent path marking. Maps illustrating routes to the safe haven must be posted in appropriate locations in the facility. Any written content on the maps must be in a language intelligible to all personnel in the facility. Signage must comply with ADA requirements, including those for the blind. If this guidance conflicts with other guidance, such as the need to camouflage the safe haven to prevent visual surveillance, the Planning Team will resolve the conflict. For additional guidance on route marking and signage see UFC 3-600-01, *Fire Protection Engineering for Facilities.*

Vehicle parking can be a problem, either from the standpoint of insufficient number of parking spaces or due to traffic congestion in reaching a safe haven. Thus, a sufficient number of safe havens must be provided so personnel can reach a safe haven on foot within the required 5 minutes timeframe.

4-2 EMERGENCY POWER.

4-2.1 Backup Power Source.

Follow Service guidance for approval of backup power authorization and design. When required, provide at least one independent backup power source that will be available to a safe haven such that loss of the primary power source does not cause the safe haven(s) to lose power. The backup power source of a safe haven must be protected from the identified threats and consequently must be independent of the conventional power grid. Potential backup power sources include the building's backup power supply, electric cells, and standalone internal-combustion generators. The type of power source and quantity of power required for a safe haven must be determined from its power use in emergency operating conditions. When multiple safe havens are provided within the same building, one backup power source can be shared by all the safe havens.

4-2.2 Duration.

Sufficient power must be available for a safe haven to operate for the duration of the controlling event, whether that controlling event is the moving vehicle bomb tactic, waterborne contamination tactic, tornado, hurricane, or some other threat. For example, if the controlling event is a tornado, a safe haven must be provided with sufficient energy to operate at its required power for 2 hours. If the controlling event is a hurricane, there must be sufficient power for 24 hours of operation.

4-2.3 Supported Systems.

The following systems must be supported by the power source for the duration of the controlling event, as a minimum:

- Lighting
- Ventilation
- Communication

Safe havens equipped to destroy classified information must have sufficient power to support the necessary equipment. Per UFC 4-020-01, power to these systems must be resistant to interruption due to a natural event or deliberate attack. The equipment required to destroy the classified material must be determined in conjunction with the responsible security office or the FSO.

4-2.4 Signage.

UFC 4-020-01 recommends that the possibility of sabotage be minimized by limiting signage identifying the location of the power source.

4-3 EMERGENCY LIGHTING.

4-3.1 Internal Lighting.

Primary lighting must be provided within the safe haven for personnel to perform essential tasks, such as tending to injured personnel and destroying classified materials. Reliable primary lighting can also serve to calm personnel within a safe haven. All lighting must conform to UFC 3-530-01 *Design: Interior and Exterior Lighting and Controls.*

Primary lighting must be supported by fixtures that are designed to resist the motions from the identified threats, such as earthquakes and blast. The motions that the fixtures must withstand must be determined from analysis of safe haven structural response to the threat. All safe havens must meet the minimum requirements for bracing, as discussed in UFC 4-010-01. Furthermore, the electrical wiring joining the primary lighting to the power source must be resistant to sabotage and attack.

4-3.2 Lighting of Entry Points.

To expedite ingress into the safe haven, all entry points must be illuminated. As a minimum, lighting at entry points must conform to UFC 3-530-01.

4-4 COMMUNICATION.

The following means of communication may be provided for a safe haven, depending on its particular requirements (FEMA P-361 and FEMA 453 *Design Guidance for Shelter and Safe Rooms*):

- Handheld or emergency radios connected to the security force, police, or fire and rescue
- Cellular or satellite telephones (may not operate during certain events and may require signal amplifier to function within the safe haven)
- Standard telephones
- Battery-powered radio transmitters or signal-emitting devices for signaling emergency personnel
- Duress alarm
- Audible sounding device (e.g. canned air horn) to signal rescue personnel
- Megaphone
- Public address system
- Portable computers with modem and internet capabilities
- Fax machine, copier, and scanner
- Signal flares
- National Oceanic Atmospheric Administration (NOAA) weather radios or receivers for commercial broadcast

4-5 ENTRY POINT MONITORING.

Depending on operational requirements, an audible cue may be required at the entry points of the safe haven for access control. The audible cue would sound any time that the doors at the entry point are opened. In addition, a guard may be stationed at each entry point. For multi-use safe havens having such operational requirements, the cue should be activated and guards should be posted once the threat exists.

4-6 FIRE SAFETY.

Safe havens must comply with all fire and life-safety code requirements per UFC 3-600-01 and the following minimum requirements. The fire and life safety system inside the safe haven must remain operational, if determined by the level of protection and design basis threat, and provide life-safety protection after an incident and allow for safe evacuation of the building when appropriate for the required occupancy level. See Chapter 2, Occupancy Level for discussion on occupancy level and square footage requirements of the safe haven.

4-6.1 Fire Suppression Systems.

Facilities that are multi-use safe havens or contain a multi-use safe haven must be protected with an automatic sprinkler system.

Any fire suppression systems specified for use within the safe haven must be appropriate for use in an enclosed environment with human occupancy.

Provide fire extinguishers for safe havens. Fire extinguishers must be flush mounted on the surface of the safe haven wall.

Based on the LOP and DBT, the fire protection water system for the safe haven must be protected from single-point failure in case of an event.

4-6.2 Additional Guidance.

In no case will a standpipe cabinet or fire extinguisher cabinet/enclosure be recessed into the interior face of the exterior wall of the safe haven. This requirement is necessary to ensure that the integrity of the safe haven wall is not compromised by the installation of standpipes and fire extinguishers.

Maintain a positive pressure in the safe haven. Duct openings must be protected by a Class A, 2-hr fire and smoke dampener.

The enclosure of the safe haven must have a 2-hour fire resistance rating.

4-7 PLUMBING.

If the plumbing system includes faucets that discharge into the safe haven, it must be protected against the waterborne contamination tactic, as discussed in Chapter 3. To eliminate vulnerability to the waterborne contamination tactic, it is recommended that bottled water be provided to the occupants.

4-8 SANITATION MANAGEMENT.

Normal design procedures and code requirements will prevail for management of sanitation within the safe haven. See FEMA P-361 and ICC 500 for guidance on the number and type of toilets and associated plumbing requirements.

4-9 ADDITIONAL SAFE HAVEN SUPPLIES.

The agency operating the safe haven will identify appropriate supplies based on items listed in Table 4-1 of FEMA 453 with additional discussion in P-361 and ICC 500, including food and water, if required. Any design requirements for storing these supplies must be considered in the safe haven design.

APPENDIX A REFERENCES

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

http://ascelibrary.org/

ASCE 7-10, *Minimum Design Loads for Buildings and Other Structures*

ASCE 59-11, *B*last *Protection of Buildings*

DEPARTMENT OF DEFENSE

http://www.dtic.mil/whs/directives/

DoD I 0-2000.22, *Designation and Physical Protection of DoD High Risk Personnel (HRP)*

DIRECTOR OF NATIONAL INTELLIGENCE

Intelligence Community Standard Number 705-1 (ICS 705-1), *Physical and Technical Security Standards for Sensitive Compartmented Information Facilities*

http://www.ncsc.gov/publications/policy/docs/ICS_7051_Physical_and_Technical_Security_Standards_for_Sensitive_Compartmented_Information_Facilities.pdf

https://www.wbdg.org/pdfs/dod_at/ics_705_1.pdf

IC Tech Spec-for ICD/ICS 705, *Technical Specifications for Construction and Management of Sensitive Compartmented Information Facilities*

https://fas.org/irp/dni/icd/ics-705-ts.pdf

FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA)

http://www.fema.gov/.

FEMA P-361, *Safe Rooms for Tornadoes and Hurricanes: Guidance for Community and Residential Safe Rooms*

FEMA 453, *Safe Rooms and Shelters: Protecting People Against Terrorist Attacks*

FEMA P-646, Guidelines *for Design of Structures for Vertical Evacuation from Tsunami*

FEDERAL HIGHWAY ADMINISTRATION

http://mutcd.fhwa.dot.gov/

Manual on Uniform Traffic Control Devices for Streets and Highways

INTERNATIONAL CODE COUNCIL (ICC)

www.iccsafe.org

ICC 500-2014, International Code Council (ICC) and National Storm Shelter Association (NSSA), *Standard for the Design and Construction of Storm Shelters*

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA)

http://www.tsunami.noaa.gov/

National Oceanic and Atmospheric Administration - Tsunami

NATIONAL FIRE PROTECTION ASSOCIATION

http://www.nfpa.org/

NFPA 101 *Life Safety Code*

UNIFIED FACILITIES PROGRAM; DEPARTMENT OF DEFENSE,

http://DoD.wbdg.org/

UFC 1-200-01, *General Building Requirements*

UFC 3-301-01, *Structural Engineering*

UFC 3-310-04, *Seismic Design for Buildings*

UFC 3-340-01*, Design and Analysis of Hardened Structures to Conventional Weapons Effects*

UFC 3-530-01, *Design: Interior and Exterior Lighting and Controls*

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

UFC 4-010-01 *DoD Minimum Antiterrorism Standards for Building*

UFC 4-010-03, *Security Engineering: Physical Security Measures for High Risk Personnel*

UFC 4-010-05 *Sensitive Compartmented Information Facilities Planning, Design, and Construction*

UFC 4-020-01, *DoD Security Engineering Facilities Planning Manual*

UFC 4-020-02FA, *DoD Security Engineering: Concept Design*

UFC 4-020-03FA, *DoD Security Engineering: Final Design*

UFC 4-023-07, *Design to Resist Direct Fire*

UFC 4-024-01, *Security Engineering: Procedures for Designing Airborne Chemical, Biological, and Radiological Protection for Buildings*

UFC 4-025-01, *Security Engineering: Waterfront Security*

UFC 3-530-01, *Design: Interior and Exterior Lighting and Controls*

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

UNITED STATES ARMY CORPS OF ENGINEERS – PROTECTIVE DESIGN CENTER

https://pdc.usace.army.mil/library

PDC-TR 06-08, *Single Degree of Freedom Structural Response Limits for Antiterrorism Design*

UNITED STATES GEOLOGIC SURVEY (USGS)

http://water.usgs.gov/floods/

United States Geologic Survey (USGS) Water Resources of the United States

http://earthquake.usgs.gov/hazards/

United States Geologic Survey (USGS) Earthquake Hazards Program

http://walrus.wr.usgs.gov/tsunami/

United States Geologic Survey (USGS) Tsunami and Earthquake Research

Additional Resource Publications

UNITED STATES ARMY CORPS OF ENGINEERS – PROTECTIVE DESIGN CENTER

https://pdc.usace.army.mil/library

PDC-TR 06-01, *Single Degree of Freedom Blast Design Spreadsheet (SBEDS) Methodology Manual*

PDC-TR 06-02, *Single Degree of Freedom Blast Design Spreadsheet (SBEDS) User's Guide*

PDC-TR 12-01, *Single Degree of Freedom Blast Design Spreadsheet for Windows (SBEDS-W) Methodology Manual*

PDC-TR 12-02, *Single Degree of Freedom Blast Design Spreadsheet for Windows (SBEDS-W) User's Guide*

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APPENDIX B EXAMPLE PROBLEM

B-1 SCENARIO.

- 7-story reinforced concrete Navy operations building in Casablanca, Morocco (Figure B-1 and Figure B-2)
- Design is 40% complete
- No controlled perimeter
- Primarily military occupants
- Heavy winds, seismic; no tornado or tsunami
- Top Secret information exists and must be destroyed
- Internal safe haven, so classified material does not have to be transported outside the facility

NOTE: The scenarios, requirements and mitigating measures presented in this example may not be typical for a safe haven and are used to navigate the reader through the process (occupancy, asset needing protection, design basis threat, level of protection required, mitigating measures employed) of planning and designing a safe haven. In reality, the threat may be minimal; requiring minimum mitigating measures for a minimum number of occupants i.e. the occupancy of a safe haven for high risk executive may require the protection of just one person. The primary use of this UFC is to design the safe haven for man-made threats and that the guidance provided herein for natural threats is for information purposes and the planner/designer shall design the facility for the natural threats as necessary in accordance with UFC 1-200-01, General Building Requirements.

Figure B-1 Overall Building Elevation

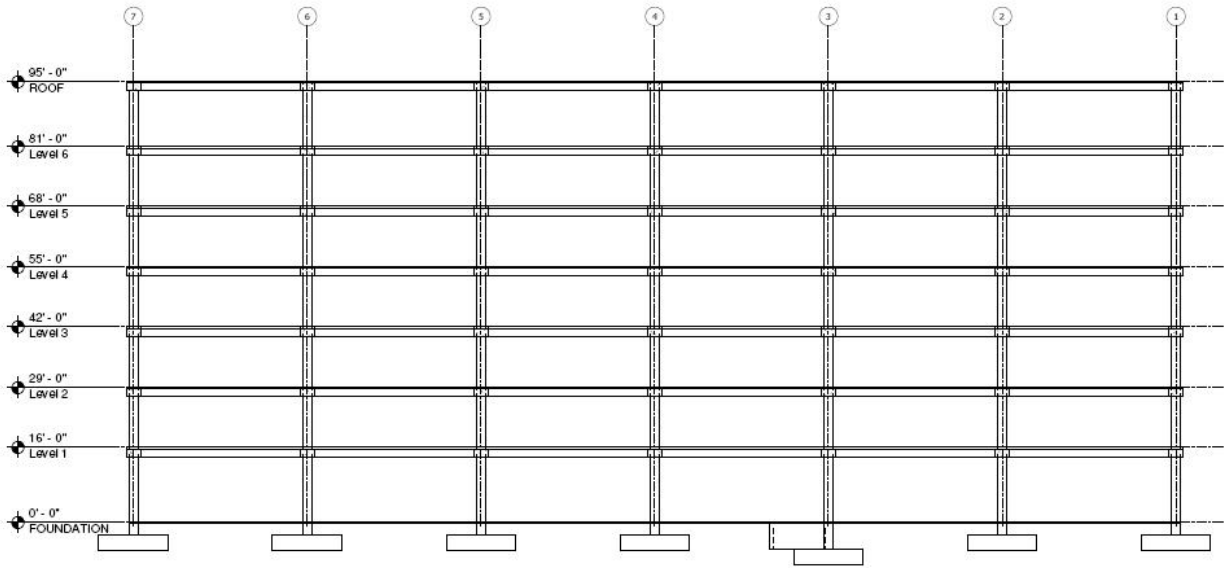
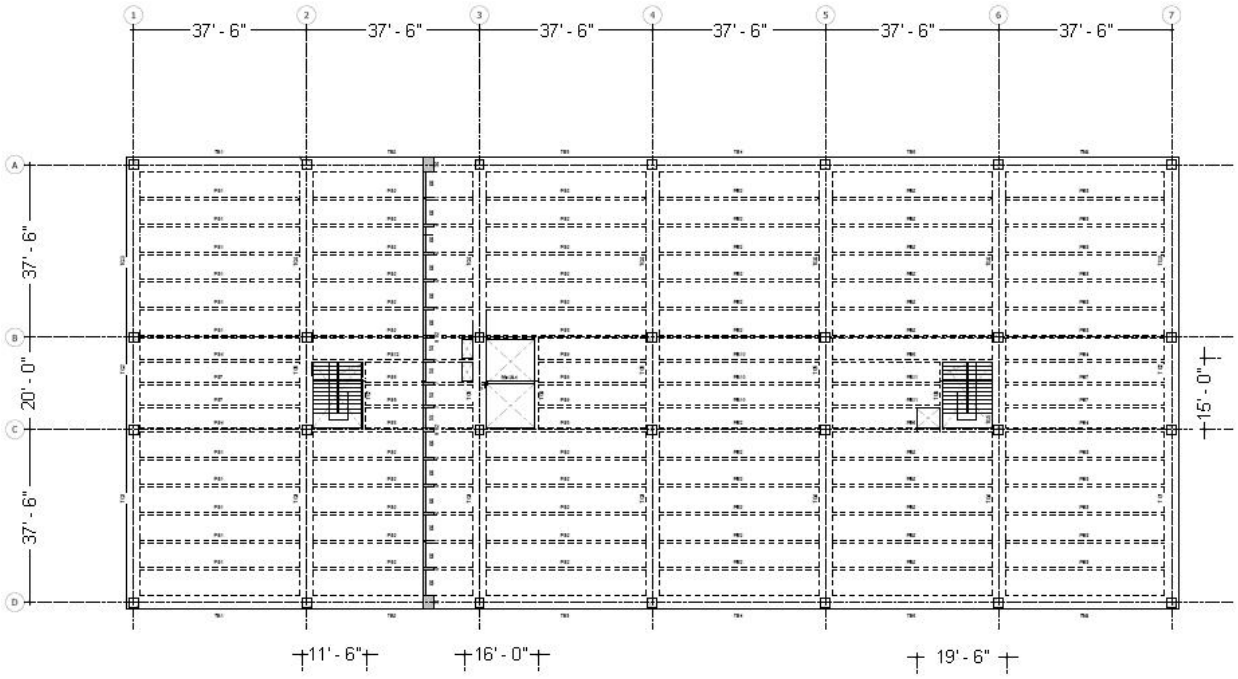


Figure B-2 Overall Building Plan



B-2 DESIGN CRITERIA DEVELOPMENT.

B-2.1 Procedures.

Follow procedure outlined in UFC 4-023-10.

B-2.2 Data Collection.

- Facility/Building Type: Headquarters and Operations
- Presence and Type of Classified Material and Sensitive Information:
  - Top Secret information storage
- Security Forces Evaluation: Security forces response time = 2 minutes

B-2.3 Planning Considerations.

Transit time: The distance from the furthest corner office on the 7th floor to the safe haven is approximately 204 feet (62 meter), based on the following distances: building corner to the stair well = ~56 feet (17 meter), 6 flights of stairs = 18 feet (5.5 meter) based on a 45-degree stair and a 13 feet (4 meter) story height and from the stairwell to the safe haven = ~40 feet (12 meter). The average distance from the parking area to the safe haven is approximately 288 feet (88 meter) based on the following distances: from parking lot to building entrance = 148 feet (45 meter) and from the building entrance to the safe haven = 140 feet (43 meter). Thus, the transit time will be less than 2 minutes, based on the longest distance from the parking area to safe haven and an estimated travel speed of 3 to 4 ft/s (0.9 to 1.2 m/s).

Duration of Occupancy: 2hrs- Short duration requirement based on the DBT and the security forces response time and evaluation of the situation.

Occupancy Level: Based on the distances involved, all occupants will be able to reach the safe haven in less than 5 minutes.

Floor Area:

Occupants:	135 adults standing	=	675 ft^2 (62.7 m^2)
	200 adults sitting	=	1000 ft^2 (93 m^2)
	5 wheelchair users	=	50 ft^2 (4.6 m^2)
	Total floor area	=	1725 ft^2 (160 m^2)

Equipment for destruction of classified materials, as specified by the building occupant and Facility Security Officer (FSO):

Storage safes	=	18 ft^2 (1.7 m^2)
Approved shredders	=	24 ft^2 (2.2 m^2)
Waste receptacles	=	50 ft^2 (4.6 m^2)
Work space	=	100 ft^2 (9.3 m^2)
Total floor area	=	192 ft^2 (17.8 m^2)

There are approved classified material shredders available with sheet capacity up to 16 sheets and speeds up to 44 ft/min (13 meters/min). The FSO will select the appropriate type and number of shredders based on the amount of sensitive information to destroy within the safe haven in the event of an emergency. In this example, the FSO has determined that six shredders are necessary in the safe haven, each taking up 4 ft^2 (0.37 m^2). All equipment listed above for the destruction of classified materials will be located in a separate secure room within the safe haven to prevent tampering or accidental damage.

Area for Operational supplies= 12 ft^2 (1.1 m^2)

Preliminary floor area:

Total floor area	=	1725+192+12 = 1929 ft^2 (179 m^2)
Height: 13-ft (4-m) per drawings (minimum is 7.5-ft [2.3 m])		

Preliminary Location, Type and Number of Safe Havens: The 75 ft x 50 ft (23 m x 15 m), 3750 ft^2 (348 m^2) cafeteria on the second floor, interior of the building will be the designated safe haven, as shown in Figure B-3 and Figure B-4. The design of the cafeteria will meet all criteria in UFC 4-023-10. This will be an internal, multi-use safe haven -- one for the complete building. There are four entrances/exits for the cafeteria, all of which satisfy ADA and life safety requirements.

Figure B-3 Elevation Showing Second Floor Cafeteria as Safe Haven

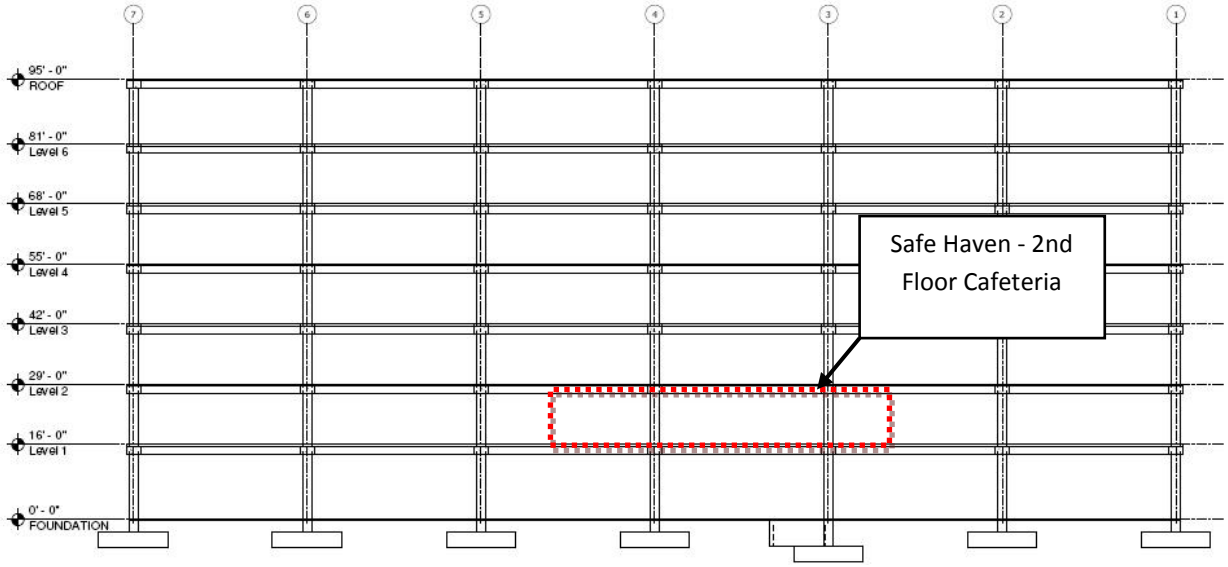
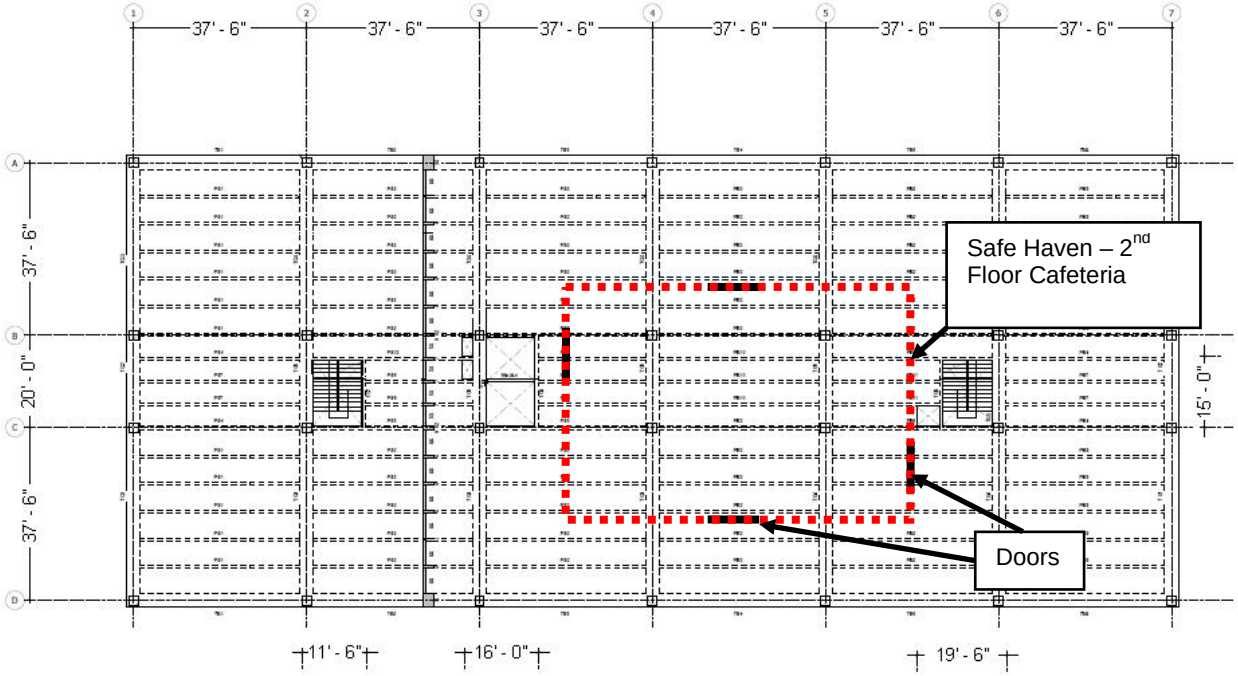


Figure B-4 Plan View of Second Floor with Cafeteria as Safe Haven



B-2.4 Design Criteria Development for Manmade Threats.

Use the processes in UFC 4-020-01 to determine the required LOP and DBTs for the safe haven design. Based on the worksheets prepared using UFC 4-020-01 (summary worksheet shown in Figure B-5), the calculated DBTs and LOPs are summarized in Table B-1 with an indication of the asset controlling the result. The weapons and tools associated with each threat and its corresponding DBT are also listed in the table.

Table B-1 DBTs and LOPs Determined Using UFC 4_020-01

Tactic	DBT, Controlling Asset*	LOP, Controlling Asset*	Weapons/Tools
Hand Delivered Devices	**Medium, P**	**Low, P**	**IID, IED up to 2.2 lb. (1 kg) TNT, hand grenades**
Indirect Fire Weapons	**Low, P**	**Low, P**	**IID**
Direct Fire Weapons	**Low, P**	**Low, P**	**UL752 Level 3 (.44 magnum)**
Forced Entry	**Medium, P**	**High, SI**	**Unlimited hand tools, limited battery-powered tools**
Airborne Contamination	**Low, P**	**Low, P**	**Biological & radiological particulates release, chemicals/toxic industrials**

P = Population; SI = Sensitive Information
IID = Improvised Incendiary Device, IED = Improvised Explosive Device

Figure B-5 UFC 4-020-01 Design Criteria Summary Worksheet

DESIGN CRITERIA SUMMARY WORKSHEET

Project or Building: Safe Haven Example | Analyst: Bowles | Date: 12/2/08

Assets	Asset Category	Asset Value Rating	Tactics: Explosive and Incendiary Devices – Moving Vehicle Devices DBT	Moving Vehicle Devices LOP	Stationary Vehicle Devices DBT	Stationary Vehicle Devices LOP	Hand Delivered Devices DBT	Hand Delivered Devices LOP	Standoff Weapons – Indirect Fire Weapons DBT	Indirect Fire Weapons LOP	Direct fire weapons DBT	Direct fire weapons LOP	Entry Tactics – Forced Entry DBT	Forced Entry LOP	Covert Entry DBT	Covert Entry LOP	Surveillance and Eavesdropping – Visual Surveillance DBT	Visual Surveillance LOP	Acoustic Eavesdropping DBT	Acoustic Eavesdropping LOP	Electronic Emanations Eavesdropping DBT	Electronic Emanations Eavesdropping LOP	Contamination Tactics – Airborne Contamination DBT	Airborne Contamination LOP	Waterborne Contamination DBT	Waterborne Contamination LOP	Waterfront Attack DBT	Waterfront Attack LOP
Population	A	.7	L	L	L	L	M	L	L	L	L	L	M	L									L	L				
Sensitive Info	Q	.95											L	H														

DBT = Design Basis Threat severity level LOP = Level of Protection

B-2.5 Design Criteria Development for Natural Threats.

Winds

Wind load of 130 mph (210 kph) based on FEMA P-361

Exposure = B, assumed

Importance factor = 1.15, based on UFC 3-301-01.

Earthquake

Magnitude = 6.4, based on historic data (earthquakes in Morocco)

Peak accelerations = 1.3 – 2.6 ft/sec^2 (0.4 – 0.8 m/sec^2)

The building/facility in which the safe haven will reside must be designed as Risk Category IV.

B-2.6 Other Applicable Design Requirements.

No additional design requirements.

B-2.7 Final Design Criteria.

Table B-2 Final Design Criteria Summary

Manmade			
Tactic	**DBT, Controlling Asset***	**LOP, Controlling Asset***	**Weapons/Tools**
Hand Delivered Devices	**Medium, P**	**Low, P**	**IID, IED up to 2.2 lb. (1 kg) TNT, hand grenades**
Indirect Fire Weapons	**Low, P**	**Low, P**	**IID**
Direct Fire Weapons	**Low, P**	**Low, P**	**UL752 Level 3 (.44 magnum)**
Forced Entry	**Medium, P**	**High, SI**	**Unlimited hand tools, limited battery-powered tools**
Airborne Contamination	**Low, P**	**Low, P**	**Biological & radiological particulates release, chemicals/toxic industrials**
Natural			
Threat	**Magnitude**		
Earthquake	**6.4**		

*P = Population, SI = Sensitive Information
IID = Improvised Incendiary Device, IED = Improvised Explosive Device

B-3 DESIGN PROCESS.

B-3.1 Procedure.

Follow procedure in UFC 4-023-10.

B-3.2 Initial Considerations.

Building Code: UFC 1-200-01

Siting: Use of the second floor cafeteria makes it internal and multi-use. There will be a separate room within the cafeteria for sensitive material storage or destruction.

Structural Integration: The safe haven is within the building, which has been designed to withstand external bombs, required wind loads, and designated earthquake loads. Thus, the internal safe haven automatically has protection against these loads (except for non-structural items). It also is partially shielded from debris threats. Personnel can reach the safe haven quickly and not be exposed to external threats while in transit. Since the safe haven is to contain GSA-rated safes for storage of classified material, the weight of this equipment must be taken into account when designing the floor system.

Use of Safe Haven: The cafeteria will be used on a daily basis in the absence of an emergency. The routine and maximum occupancy and required evacuation diagram will be posted according to UFC 3-600-01 and NFPA 101.

System Integration: All security elements, communication equipment, and power sources will be shared and/or compatible with the other facility resources and equipment.

B-3.3 Adjustments in Design.

Any design adjustments made during the design process will be rechecked against the criteria in UFC 4-023-10 Chapter 2.

B-3.4 Design for Manmade Threats.

The relevant man-made tactics include

- moving vehicle devices
- stationary vehicle devices
- hand delivered devices
- indirect fire weapons
- direct fire weapons
- forced entry
- airborne contamination
- forced entry

- airborne contamination

However, the building is already designed for applicable moving vehicle and stationary vehicle device threats, so the internal safe haven design does not need to consider these two threats. Use the DBTs summarized in Table B-2 as the design charge weight or load.

B-3.4.1 Hand Delivered Devices.

Per UFC 4-020-01, the general design strategy for this tactic is to detect the device at building entry points, before the device can reach the safe haven, and ensure that any assets inside the building are protected in accordance with the low LOP identified for this tactic in Table B-2. For low LOP, detection is only provided through operational procedures. For exterior attacks on the building, detection is based on visual observation of the unobstructed space surrounding the building. For attacks at building entry points, detection is provided using operational safeguards to prevent the device from proceeding past trained personnel dedicated to detection of such devices. Personnel qualified to respond to detection of an explosive or incendiary device, such as an explosive ordnance disposal team, must also be available.

The 2.2 lb. (1 kg) improvised explosive device (IED) threat will be used as the DBT. Per UFC 4-020-01, for a medium threat level and low LOP (Table B-2), conventional construction with no special requirements can be used for the exterior building walls and roof. Conventional hollow metal doors and ¼-inch (6-mm) laminated glass windows suffice. The interior cafeteria walls must be at least 6-inch (100-mm) thick, moderately reinforced concrete.

B-3.4.2 Indirect Fire Weapons.

Methods provided in UFC 4-020-01, and UFC 4-020-02FA, *DoD Security Engineering: Concept Design and* UFC 4-020-03FA, *DoD Security Engineering: Final Design*, will be used to design the safe haven for a DBT of an improvised incendiary device (IID) at a low LOP. The general design strategy for the indirect fire weapon tactic is to protect assets inside by hardening the structure to resist the effects of the DBT. At a low LOP; this requires fire resistant construction sufficient to prevent an IID from penetrating the structure shell. Materials used within the hallways and rooms surrounding the cafeteria must be selected to resist burning, flame spread, and smoke development. For low LOP, conventional construction can be used for the walls, roof, and doors. Windows are required to be ¼-inch (6-mm) plus 2 x1/8-inch (3-mm) glass with 0.03-inch (0.75-mm) PVB in narrow elevated windows.

B-3.4.3 Direct Fire Weapons.

UFC 4-023-07 *Design to Resist Direct Fire Weapon Effects* will be used to design the safe haven to resist the DBT for a low LOP of an UL752 Level 3 (.44 magnum) handgun. The effective distance for this weapon is 328 feet (100 meters).

The design strategy for low LOP is to block sight lines to building occupants or assets. The philosophy of that strategy is that aggressors will not shoot at what they cannot

see. For an external or stand-alone safe haven, this strategy can be met using barriers of vegetation, fences, landforms, and walls placed to interrupt sight lines. For this internal safe haven example, blocking lines-of-sight will be accomplished using type A requirements for the walls, windows, and doors for the cafeteria, per UFC 4-020-01. The walls just need to be opaque for this requirement. The windows will be elevated per the requirement for indirect fire weapons tactic therefore providing no direct sight lines. Standard hollow metal doors are acceptable. There are no special design requirements for the roof since the safe haven is on the second floor of a 7-story building, and there are no direct sightlines to the roof.

B-3.4.4 Forced Entry.

The safe haven will be designed to resist the DBT of unlimited hand tools and limited battery-operated tools for a period of 2 minutes, the response time of the security forces provided in Section B-2.2 above. The guidance in UFC 4-020-02FA and UFC 4-020-03FA, will be used to design walls, doors, floors, and other necessary components.

Per UFC 4-020-01 for a medium threat severity level and a high LOP, the walls and roof will be designed as type E. The walls will be 8-inch (200-mm) reinforced concrete with #4 bars at 6 inches (150 mm) on center each way. Per UFC 4-020-02FA/ UFC 4-020-03FA, the required delay time for forced entry for this example would be 2 minutes. The roof will be 8-inch (200-mm) reinforced concrete with #4 bars at 6 inches (150 mm) on center each way on steel decking and with a built-up roofing system. The doors will be 10-inch steel clad solid wood (254-mm) swinging doors with ½-inch (13-mm) plate inside and out. There are no windows available to meet the requirements of this tactic, at the medium threat severity level and high LOP. Thus, either the cafeteria should be designed without windows, or the window openings must be limited to 96 sq. inches (0.06 sq. meters).

B-3.4.5 Airborne Contamination.

The methods and guidance in UFC 4-010-01, UFC 4-020-01 and UFC 4-024-01 *Security Engineering: Procedures for Designing Airborne Chemical, Biological, and Radiological Protection for Buildings* can be used to design the safe haven for the DBT specified in Table B-2. The design criteria summary worksheet (Figure B-5) indicates a low DBT and low LOP.

Limited chemical, biological, and radiological (CBR) protection is required in accordance with UFC 4-010-01 for all new inhabited facilities to provide very low and low levels of protection. Specific design strategies are to minimize air infiltration and to be able to limit dispersal of any agents that infiltrate the building. The very low and low levels of protection incorporate passive building component features at little or no additional cost when included in new facility designs and major retrofits. Protection measures that are recommended for all buildings and are required for new inhabited facility designs and major retrofits are a mass notification, public address, or alarm system; air distribution emergency shutoff; sealed mailrooms with separate, dedicated ventilation systems and exhaust fans; elevated outside air intakes; and restricted roof access. High efficiency particulate air (HEPA) filters will be used at air intakes, as required for the low LOP per

UFC 4-020-01. The HEPA filters will be installed in the central air-handling unit, filtering both the outside and recirculated air. A slight positive over pressurization of the building (Class II overpressure) will be maintained. The perimeter around the cafeteria/Safe Haven will be sealed with insulating foam.

Per UFC 4-024-01, a low design basis threat for airborne contamination is the threat of external release of biological particulates and toxic industrial chemicals (TICs). No toxic military chemical or radiological threat is expected.

If the presence of an airborne hazard is detected, there are four possible protective courses of actions: evacuation, sheltering in place, ventilation and purging, and the use of protective masks.

These actions do not provide protection on a continuous basis, of course, but are implemented singly or in combination for relatively short periods when a hazard is present or known to be imminent.

The use of protective masks in conjunction with evacuation is the most cost effective, efficient use of resources. New models of universal-fit escape masks have been developed for protection against chemical and biological agents. Such masks form a seal at the wearer's neck and therefore fit a wider range of sizes than traditional masks that seal around the face. These masks do not require special fitting techniques or multiple sizes and can be used by people with facial hair. They are designed to store compactly and are practical to store at employees' desks. Employees can also carry them on their belt. These masks have excellent protective capability and have a 5-year shelf life.

Sheltering in place for longer duration may require a collective protection (ColPro) strategy defined in UFC 4-020-01 and UFC 4-024-01 that can be used to ensure that agents introduced at entry points are kept out of the building and the safe haven. However with initial costs being high and the high expense to operate and maintain such as system makes this course of action not cost effective for the short duration required.

Designing to protect against a lower threat level equates to a higher risk of exposure and greater likelihood of defeat but entails lower costs. Designing to meet a higher threat level equates to a lower likelihood that the building will be compromised if attacked but entails high initial and operating costs.

The safe haven will be designed for the low LOP as required by UFC 4-010-01 and UFC 4-024-01 as described above. Protective masks will be provided to each employee, stored at their desks.

B-3.5 Design for Natural Threats.

The relevant natural threat is an earthquake, and typical wind loads must be considered as well. However, since the building structure is already designed for wind and seismic loads, these requirements have been met.

All non-structural components within the safe haven must be designed for seismic loads, per UFC 3-301-04, *Seismic Design of Buildings*.

B-4 OTHER DESIGN REQUIREMENTS.

B-4.1 Emergency Power.

If required, one internal-combustion generator in the cafeteria can provide backup power for the 2-hour duration, supporting lighting, ventilation, and communication systems. The generator must be vented to the outside without allowing airborne contamination to enter the safe haven. In general follow service guidance for approval of generator authorization and design.

B-4.2 Communication.

Hand-held radios and battery-powered radio transmitters for signaling emergency personnel will be provided in the safe haven. All communication devices will be tested at regular intervals defined by the Planning Team to ensure they are kept in working order, as described in FEMA P-361. A canned air horn will be in the safe haven to signal rescue personnel. Portable computers with internet capability, a fax machine, a copier, and a scanner are available in the cafeteria manager's office, inside the safe haven.

B-4.3 Entry Point Monitoring.

An audible cue device will be mounted at all four entrances. When turned on, the cue should sound any time the doors are opened.

B-4.4 Fire Safety.

Safe havens must comply with all fire and life-safety code requirements per UFC 3-600-01. The fire and life safety system inside the safe haven must remain operational and provide life-safety protection after an incident and allow for safe evacuation of the building when appropriate for the required occupancy level. "The routine and maximum occupancy and required evacuation diagram will be posted according to UFC 3-600-01 and NFPA 101."

B-4.5 Sanitation Management.

The cafeteria has 6 toilets, 3 each in one men's and one women's restroom, which more than meets the requirement of one toilet for every 75 occupants in the safe haven.

B-4.6 Additional Safe Haven Supplies.

The agency operating the safe haven will identify appropriate supplies based on items listed in Table 4-1 of FEMA 453, including food and water, if required. Any design requirements for storing these supplies must be considered in the safe haven design.

B-5 INTEGRATION.

Using the general population and sensitive information as the two main assets for the safe haven and considering all required tactics resulting from the design criteria analysis per UFC 4-020-01, the safe haven design is summarized in Table B-3.

Table B-3 Safe Haven Design Summary

Component	Governing Tactic	Construction Description
Walls	Forced Entry	8-inch (200-mm) reinforced concrete with #4 bars at 6 inches (150 mm) o.c. each way
Roof	Forced Entry	8-inch (200-mm) reinforced concrete with #4 bars at 6 inches (150 mm) o.c. each way, on steel decking, with a built-up roofing system
Doors	Forced Entry	10-inch (250-mm) steel clad solid wood swinging doors with ½-inch (13-mm) plate inside and out
Windows	Forced Entry	Limited to 96 sq. inches (0.06 sq. meters)
Non-structural	Earthquake	Peak acceleration of 2.6 ft/sec^2 (0.8 m/sec^2)