

Unit XII-B

COURSE TITLE	Building Design for Homeland Security	TIME	135 minutes
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UNIT TITLE	Case Study
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OBJECTIVES	<ol style="list-style-type: none">1. Explain building security design issues to a building owner for consideration prior to a renovation or new construction.2. Explain the identification process to arrive at the high risk asset-threat/hazard pairs of interest.3. Justify the recommended mitigation measures, explaining the benefits in reducing the risk for the high risk situations of interest.
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SCOPE	The following topics will be covered in this unit:
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1. Activity: Preparation and presentation of the highest risks identified by the assessment groups, the vulnerabilities identified for these risks, and recommended mitigation measures to reduce vulnerability and risk. The top three risks will be prioritized as well as the top three recommended mitigation measures with rationale and justification. This includes any consideration for changes to the Risk Matrix from knowledge gained in Units IX, X, and XI.
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REFERENCES	<ol style="list-style-type: none">1. FEMA 426, <i>Reference Manual to Mitigate Potential Terrorist Attacks Against Buildings</i><ol style="list-style-type: none">a. Pages 2-51 to 2-58b. Pages 3-50 to 3-52c. Chapter 5d. Appendix D2. FEMA 452, <i>Risk Assessment: A How-To Guide to Mitigate Potential Terrorist Attacks Against Buildings</i>, pages 5-1 to 5-183. Case Study – Appendix U: Urban, HazardCorp Building4. Student Manual, Unit XII-B (info only – do not list on SM)5. Unit XII-B visuals (info only – do not list on SM)
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REQUIREMENTS	<ol style="list-style-type: none">1. FEMA 426, <i>Reference Manual to Mitigate Potential Terrorist Attacks Against Buildings</i> (one per student)2. FEMA 452, <i>Risk Assessment: A How-To Guide to Mitigate Potential Terrorist Attacks Against Buildings</i> (one per student)
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3. Instructor Guide, Unit XII-B
4. Student Manual, Urban Case Study (U) (one per student)
5. Overhead projector or computer display unit
6. Unit XII-B visuals
7. Risk Matrix poster and one box of dry-erase markers (one per team)
8. Chart, paper, easel, and markers (one per team)

UNIT XII-B OUTLINE

	<u>Time</u>	<u>Page</u>
XII. Case Study	135 minutes	IG XII-B-1
1. Introduction and Unit Overview	20 minutes	IG XII-B-5
2. Activity: 45 minute Preparation and 60 minute Presentation by Groups	105 minutes	IG XII-B-21
3. Review of School Solutions (Mitigations Measures, Blast, CBR, and Cost)	10 minutes but variable based on time available	IG XII-B-22
4. <u>Activity</u> : Case Study – Student Presentation of Results		IG XII-B-47

PREPARING TO TEACH THIS UNIT

- **Tailoring Content to the Local Area:** There is no specific content that can be linked to the local area. All actions of this instruction focus on the Case Study, Appendix U, HazardCorp Building.

The Instructor will review the Case Study, Appendix U, HazardCorp Building, DoD Antiterrorism Standards, DHS Interagency Security Committee criteria, and understand the parameters for the Design Basis Threat and Levels of Protection and their impact upon the assessment. Additionally, review of the school solution mitigation measures, blast analysis, CBR analysis, and costs will ensure a smooth presentation in a time-constrained environment.

The first part of this instruction unit is not so much to repeat the Case Study contents of Unit 1, but to provide an opportunity for review and allow questions before students prepare their presentations within their assessment groups.

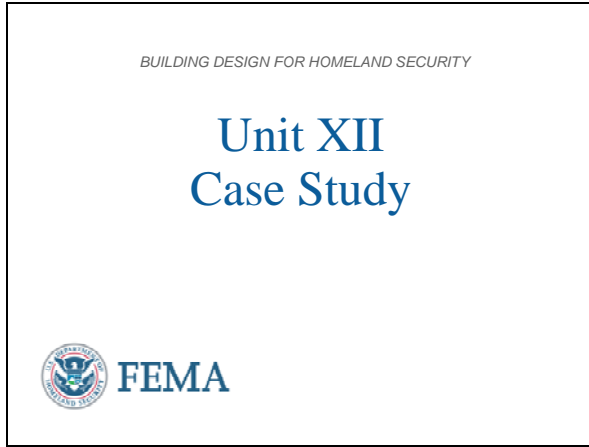
- **Optional Activity:** There are no optional activities in this unit.
- **Activity:** The students will prepare and present the top three risks identified by the assessment group, the vulnerabilities identified for these risks, and the top three

recommended mitigation measures to reduce vulnerability and risk. The group will prioritize the top three risks as well as the top three recommended mitigation measures with rationale and justification. Includes any consideration for changes from the knowledge obtained in Units IX, X, and XI.

- Refer students to their Student Manuals for worksheets and activities.
- Direct students to the appropriate page (Unit XII-B) in the Student Manual.
- Instruct the students to read the activity instructions found in the Student Manual.
- Tell students how long they have to work on the requirements.
- While students are working, all instructors should closely observe the groups' process and progress. If any groups are struggling, immediately assist them by clarifying the assignment and providing as much help as is necessary for the groups to complete the requirement in the allotted time. Also, monitor each group for full participation of all members. For example, ask any student who is not fully engaged a question that requires his/her viewpoint to be presented to the group.
- At the end of the working period, reconvene the class. Ask for volunteer groups to determine the order of presentation. Capture the answers provided by the students for future update of the course.
- After the students have completed their presentations, **as time permits**, present the “school solution” mitigation measures, blast analysis, CBR analysis, and associated costs and decision process. Be prepared to answer any student questions.
- Ask for and answer questions.
- See Editor Notes in 01Unit I (U) IG.doc for inserting slide thumbnails into this document and working with the table features for formatting rows on pages.

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VISUAL XII-B-1



Introduction and Unit Overview

This is Unit XII Case Study activity. This unit will review the HazardCorp Building site and building portfolio, DoD Antiterrorism Standards, and DHS Interagency Security Committee criteria, and the parameters for the Design Basis Threat and Levels of Protection.

Students will prepare and present the top three risks identified by the assessment groups, the vulnerabilities identified for these risks, and the top three recommended mitigation measures to reduce vulnerability and risk. The groups will prioritize the top three risks as well as the top three recommended mitigation measures with rationale and justification. Consider any changes to the Risk Matrix due to knowledge gained in Units IX, X, and XI.

VISUAL XII-B-2



Unit Objectives

At the end of this unit, the students should be able to:

1. Explain building security design issues to a building owner for consideration prior to a renovation or new construction.
2. Explain the identification process to arrive at the high risk asset-threat/hazard pairs of interest.
3. Justify the recommended mitigation measures, explaining the benefits in reducing the risk for the high risk situations of interest.

VISUAL XII-B-3

HAZARDCORP BUILDING

Building

- Functions
- Infrastructure

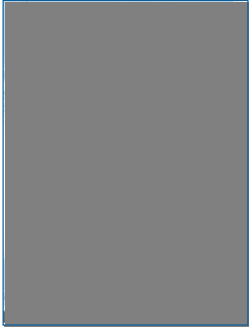

Threats/Hazards

- Design Basis Threat
- Levels of Protection

Vulnerabilities

- Impact
- Mitigation

Report



BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-3

HazardCorp Building (HZC)

This Case Study instruction unit will be a comprehensive review and practical application of **FEMA 426**.

In this unit, the following topics will be presented:

- Company Functions
- Company Infrastructure
- Threats/Hazards (including Design Basis Threat and Levels of Protection)
- Vulnerabilities (including Impact and Mitigation)

VISUAL XII-B-4

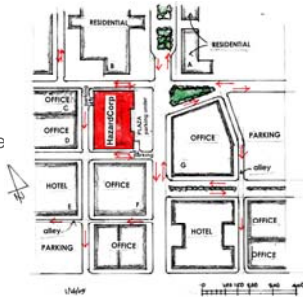

HAZARDCORP

50-story mixed-use, high-rise office building

- 8,000 occupants
- 1,000 visitors
- Over 2,000,000 square feet of rentable space

"Neighbors" include:

- Offices
- Residential



BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-4

HazardCorp Building (HZC)

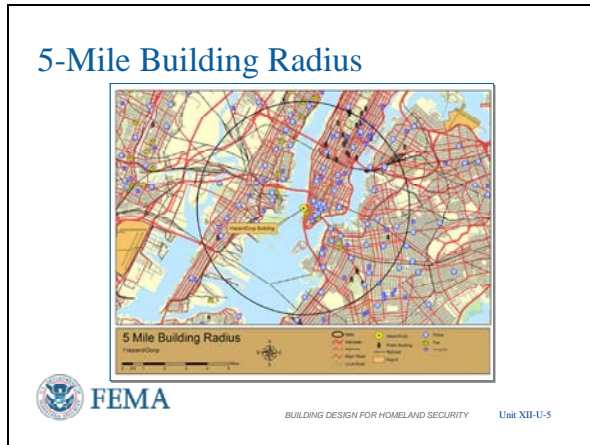
The HazardCorp Building and Building Management provide office space to a wide range of tenants in their 50 story high-rise structure.

The HazardCorp Building supports approximately 8,000 occupants (tenants and staff) on any given day and about 1,000 visitors. The building has mixed uses with some tenants having multiple layers of security and others open to the general public or walk-in clients. The latter is especially true of the retail space on the first floor and the meeting rooms on the second and third floors around the lobby atrium.

With over 2 million square feet of rentable space HZC is a small community in and of itself and Building Management must provide the services to keep this community functioning.

In the Urban environment there are close-by neighbors that any mitigation measure may impact, and, thus, HZC may need to

VISUAL XII-B-5



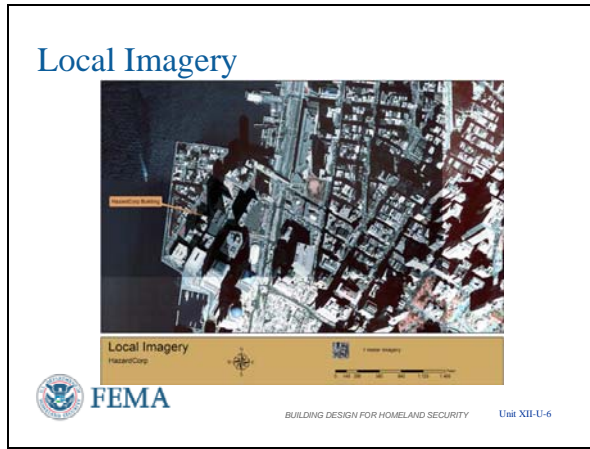
coordinate with these neighbors when implementing mitigation measures.

HZC 5-Mile Building Radius

The HazardCorp Building is located in the downtown business district of a major urban city.

- Several commercial iconic properties, several government offices, and various high-density attractions within 5-mile radius
- Significant water access to various locations and because of the water, ground access is constrained by bridges, tunnels, and ferries.
- While two major airports are over 5 miles from the building, what is not shown are 8 heliports and two skyports inside the 5-mile radius.
- A metropolitan subway also serves the business district and the nearest station is two blocks from the building.
- The area around Hazard City is the No. 4 intermodal port in the Western Hemisphere. Intermodal means the ability to move freight from ship to train to truck and back again.
- There is extensive railroad trackage, some as close as within 1-1/2 miles of the building.
- There is extensive petroleum and chemical storage west of the building location in addition to ships transiting the harbor areas.

VISUAL XII-B-6



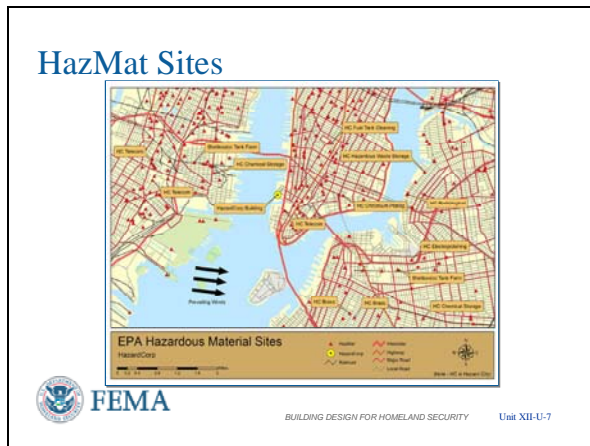
HZC Local Imagery

The HazardCorp Building is bounded by city streets with high traffic volumes and is within 0.05 miles of a nearby river.

There is a high density of population in the area, which swings between commercial and residential based upon time of day.

Due to the urban density seen, the potential for collateral damage due to a nearby incident must always be a consideration.

VISUAL XII-B-7

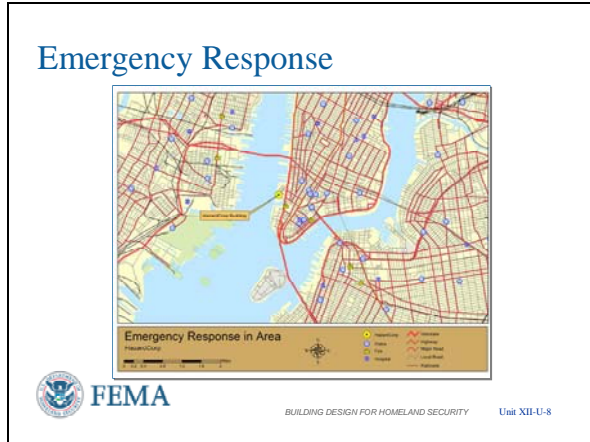


HZC Hazardous Material Sites

There are a significant number of hazardous materials use and waste sites in near proximity to the HazardCorp Building.

- The vast majority are small generators such as gas stations, dry cleaning, and other commercial businesses. Large generators are identified by labels as seen on the slide.
- Prevailing winds would push toxic releases from the two largest petroleum and chemical storage sites toward HZC. Winds shift out of the northwest during the winter and shift out of the southwest during the summer.
- Rail and maritime transportation move significant hazardous materials through the area.
- Maritime shipping lanes to the west of the building see large shipments of fertilizer, petroleum products, and liquid natural gas.
- More than 2,000 trucks loads of hazardous materials are transported each day within city limits.
- Airports have combined 1.06 million aircraft movements, 81 million passengers, and move 2.7 million tons of cargo each year.
- Average 100 hazardous materials spills

VISUAL XII-B-8



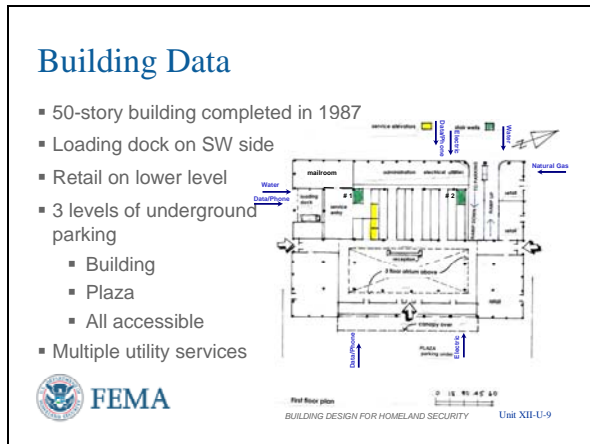
and releases each year in Hazard City

HZC Emergency Response

The local emergency response capabilities show primary police and medical facilities within 2 miles of the HazardCorp Building.

- Multiple police jurisdictions in the area meaning all police locations would probably not respond to an incident at HazardCorp Building.
- Fire facilities are more limited, with 2 fire stations nearby. However, the other fire stations, while 2-3 miles from the building, must travel along transportation chokepoints to get over water, resulting in longer response times.
 - The building is ringed by 20- to 24-inch water mains with a single hydrant on each side of the building just off the sidewalk curb.
- Multiple means of ingress and egress to the HazardCorp building site, mostly on secondary roads for the last 0.2 miles.

VISUAL XII-B-9



HZC Building Data and Functional Layout

- Outside the building the trash containers, USPS mailboxes, newspaper vending machines, Fed-Ex/UPS/DHL boxes and the like are kept to the edge of the sidewalk on the far east side of the plaza.
- The plaza is otherwise bare, except for 8 area lights on poles with a circular bench around the base of each light pole.
- Multiple utilizes services following different routes into building, with some at loading dock and underground parking ramps.
- Loading dock inside the building on the first floor
- Trash is handled by a large dumpster located in the loading dock area with no

NOTE – Emphasize the columns locations in the atrium area.

- **Exterior** wall columns at 15-foot spacing
- **Interior** column spacing is approximately

INSTRUCTOR NOTES


30 feet from the 4th to 49th floor.

- **Atrium** columns from west to east have 60-foot spacing.

VISUAL XII-B-10

HAZARDCORP Occupancy

FLOOR	TENANT OCCUPANCY
49-50	Mechanical Floors
31-48	National financial services company
29-30	Bank offices
27-28	Federal government offices (IRS, DOD, CIA)
26	Mechanical room
25	Office of Emergency Management
23-24	Financial service company
20-22	Insurance company
19	State Employment Commission
15-18	Vacant
14	Financial management company
8-13	Federal government offices (SEC, Secret Service)
6-7	Bank offices
4-5	Storage, switch gear, generators, transformers
3	Open to first floor lobby, rentable meeting space, building management
2	Open to first floor lobby, rentable meeting space
1	Lobby, retail, fuel storage, switchgear, building administration, loading dock
UG1	Parking
UG2	Parking
UG3	Parking

 **FEMA**

BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-10

CONTENT/ACTIVITY

- special provisions in building structure.
- Underground parking under building and plaza open to the general public. There is one entrance/exit ramp under the building and one under the plaza.
- Mailroom is renovated to DoD standards, receives all mail and shipping to building, provides full inspection of contents, and distributes to tenants and, by agreement, to specific tenants in other buildings within 2 block radius.
- The lobby has a 3 story atrium which affects the continuity of columns for foundation to roof.
- Retail space is also on the first floor with access to the lobby internal to the building. Retail space also has exterior entrances.

HZC Occupancy

Note the following:

- Other than some service entrances and fuel tanks, most utilities and associated equipment are located on the first floor and above, with most of it above the first floor.
- Federal government offices are located on floors 8-13 and 27-28 which may benefit from applying ISC protection criteria.

VISUAL XII-B-11

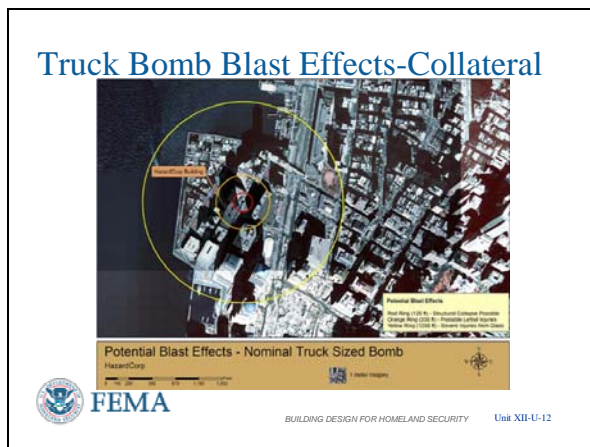


HZC Car Bomb Blast Effects

The nominal range to effects chart radius of influence of a car bomb detonation at the front entrance (plaza side) indicates that the building would experience some damage, but likely not suffer progressive collapse.

- The car bomb is restricted to the drop off area on the east side of the plaza. If detonated in the street closer to the building the amount of damage could be higher due with the vehicles in controlled parking providing some protection.
- Car bomb could be in a limousine which frequent area and are seen parking and standing for long periods of time. The limousine could have a larger weapon yield than a standard sedan.
- The front façade of the building is approximately 80 feet from the car bomb and only a portion of the red and orange rings are inside the building.

VISUAL XII-B-12



HZC Truck Bomb Blast Effects - Collateral

A truck bomb detonation on a nearby street (another building is the target) would cause significant damage to the HazardCorp Building, primarily glass breakage and potentially some structural damage based upon the ultimate size of the bomb.

- Depending on adjacent building height, effects from reflected blast could increase the collateral damage and potential for casualties.
- Random estimate of truck traffic within 1,000 feet of building indicates 30 delivery trucks (18-foot-long enclosed bodies) transit area per hour and similar number of smaller delivery vans between 0600 and 1800. These numbers reduce to about 10 delivery trucks and 10 delivery vans on average per hour between 1800 and 0600.

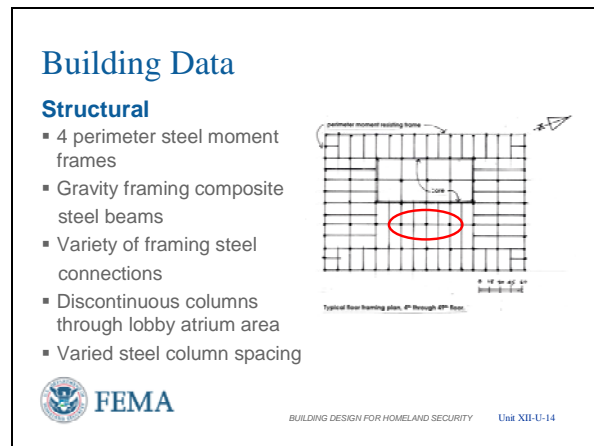
VISUAL XII-B-13



HZC Truck Bomb Blast Effect - Loading Dock

A truck bomb detonation at the HazardCorp Building Loading Dock would result in significant structural damage along with the strong potential for progressive collapse. The constraint of the Loading Dock will direct more blast into the service entry affecting critical infrastructure, especially in the core area, although the open side of the Loading Dock will also vent much blast pressure.

VISUAL XII-B-14



HZC Building Data (Structural)

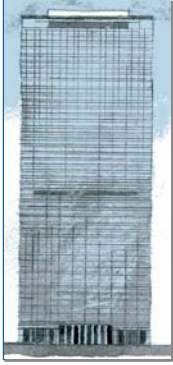
The structural system is steel moment frame, with a variety of configurations due to the unique aspects of the building.


- The atrium results in discontinuous columns from foundation to roof with transfer trusses holding up the 4th floor and the more closely spaced columns above.
- Point out the columns that are **NOT** supported by columns in the atriums (circled in red). Thus the columns on the west and east side are prime for not being able to take the redistribution of load if one member is lost.

VISUAL XII-B-15

Building Data Envelope

- Aluminum / Glass curtain wall exterior cladding
 - First three floors 3/8 inch thermally tempered glass
 - Other glazing 1/4 inch or 3/8 inch annealed single pane glass
- Exterior Doors – glass to match lower floors
- Overhang over main plaza entrance



 FEMA

BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-15

HZC Building Data (Envelope)

The building exterior is clad with an aluminum/glass curtain wall attached to the face of the building structure.

- Floors 1-3: 3/8-inch thermally tempered single pane glass, including doorways on the first floor
- Floors 4-8: 1/4-inch annealed double strength single-pane glass (double strength for wind load)
- Floors 9 and above: 3/8- inch annealed double-strength single pane glass (thicker for higher wind loading at higher elevation)
- The glazing pane size is 5 feet by 5 feet for vision glass and the same size or smaller for spandrel glass over structural elements due to the different floor heights.
- The framing for the exterior glass is heavy weight aluminum with great ductility and strength resulting in each pane of glass reacting independently
- The overhang on the plaza side entrance to the lobby will capture much of any blast wave and upward lift is expected to result in collapse upon resettling after the passing of the blast wave.

VISUAL XII-B-16


Building Infrastructure

Fire Suppression

- Sprinklers on every floor of building
- Standpipes in every stairway, including building and plaza parking
- Yard main loops all around building
- Fire department connections – west and north side of building

Electric Power

- 13,800 volt looped service feeds substation in building
- 4th floor transformers – 480/277 volt distribution

 FEMA

HZC Building Infrastructure (Fire Suppression and Electric Power)

Good sprinkler protecting throughout the building with alternate distribution paths and connections. Certain floors have additional fire suppression measures due to their specific tenant needs.

Electric power is somewhat unique in that the Hazard City Electric Company substation is inside building at high voltage. The building transformers are on the 4th floor to transform the 13,800 volts down to 480/277 volt distribution within the building. Also, the substation is loop fed off the grid so that

VISUAL XII-B-17


Building Infrastructure

Generators/Fuel Systems

- Building management and tenant systems
- Located in various parts of building

HVAC

- All air using heat pumps and supplemental electric heat (including lighting)
- Tied to fire suppression whereby floors above and below fire are overpressurized and fire floor is exhausted

 BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-17

there is redundancy of high voltage supply to the substation.

HZC Building Infrastructure (Generators/Fuel Systems and HVAC)

There is extensive generator backup to the building and specific tenants and varying fuel supply for these various systems located in various parts of the building.

- There are 4 fuel tanks located under the Loading Dock
- There is a wide variance in duration of fuel capacity if all generators are working at maximum load.

HVAC is all air distribution using heat pumps for pinpoint air conditioning requirements not covered by the building systems as well as supplemental electric heating.

Note that the lighting system is an integral component of the heating system, so that lights should be left on all the time during the heating season.

HVAC has a responsive feature of overpressurizing adjacent floors not involved in a fire and exhausting the floor on which the fire has been detected. Thus, the HVAC controls are complex and spread throughout the building.

VISUAL XII-B-18


Building Infrastructure

Water

- Two feeds, one under loading dock
- Storage tanks on mechanical floors

Natural Gas

- 4-inch main to first floor restaurants



BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-18

HZC Building Infrastructure (Water and Natural Gas)

Water serving the building has two feeds from the utility mains that ring the building.

- One feed is under loading dock
- Potable water tanks on 3 mechanical room floors provide very limited backup for the number of people in the building.


Natural gas serves the restaurants on the first floor and is used for heating water and cooking in this location only.

VISUAL XII-B-19

Building Infrastructure

Communications

- Three T-3 lines from three providers
- Empty conduits for expansion installed
- Tenants have additional services
- VOIP, satellite, and landline phones in building for outside communication
- Fire Watch phone in stairwells
- Repeaters for handheld radios
- Cell phone coverage spotty



BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-19

HZC Building Infrastructure (Communications)

Between Building Management and tenants there are multiple redundancies for internet data connections and voice telecommunication connections outside the building.

There are also multiple redundancies for internal communications within the building.

Future expansion or speedy repair is built-in with many spare conduits along service entrance routes.

Note that cell phones (which have antenna normally designed to distribute at ground level) have spotty coverage in the building due to the effect of the steel between the cell phone and the nearest cell tower.

VISUAL XII-B-20


Building Infrastructure
Physical Security
Security personnel

- 1 person -- Central Security
- 2 rovers

Reception staff

- 2 persons 0600-1800 on business days
- 1 person 1800-0600 on business days or all day on non-business days

Lobby – access to atrium, mailroom, meeting rooms and retail space



BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-20

HZC Building Infrastructure (Physical Security)


Security staff is adequate for current procedures, but will require additional personnel based upon recommended/required mitigation measures dealing with access control.

Currently, the tenants have the main security role for their purposes.

Other than the tenant utilities/infrastructure systems spaces, the building is open to the public with the lobby, 2nd and 3rd floor meeting rooms of the atrium, the mailroom and the retail spaces open to the public.

VISUAL XII-B-21

Threats/Hazards
Threats include:



Terrorism

- No direct threat specifically identified for HazardCorp Building
- Government, military, finance, and banking tenants in building could be targeted if perceived as soft target
- Collateral damage potential due to nearby potential targets in the area

Intelligence Collection, especially by cyber attack

- Government classified information
- Commercial information



BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-21

Threats/Hazards (Terrorism and Intelligence Collection)

Terrorism

- No known specific targeting of HazardCorp Building
- Certain tenants could be assessed by domestic or international terrorists as valuable targets.
- *Orange Threat Definition:* Credible intelligence indicates that there is a high risk of a local terrorist attack, but a specific target has not been identified.

Intelligence

- Tenants with Government security clearances are potential targets for foreign intelligence services.
- Threat includes commercial processes, financial information, and technology development that are the focus of commercial tenants of HazardCorp Building.

VISUAL XII-B-22


Threats/Hazards
Threats (continued):

Crime

- City has much higher crime rate than national averages in most categories

Natural Hazards

- Tornadoes/hurricanes/severe weather – ~ 15/year
- Evacuation zone for storm surges
- Earthquakes – Infrequent and low intensity -- old seismic zone 2A
- Lightning – 25 strikes/year on average



BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-22

Threats/Hazards (Crime and Natural Hazards)

Crime

- Almost all statistics for the Hazard City Business District are well above national averages

Natural hazards are especially diverse.

- 15 tornadoes/hurricanes/severe weather conditions per year
- Flooding from weather conditions has occurred, but also from water main breaks.
- HazardCorp Building is in evacuation zone for storm surges caused by severe weather, winds, and tides.
- Moderate seismic activity
- Active lightning area

VISUAL XII-B-23


Threats/Hazards
Threats (continued):

HazMat

- Chemical and fuel tank farms across river
- Rail lines across river
- Shipping on river
- 2,000 trucks each day within city
- 100 spills and releases each year in city

Other Technological Hazards

- 600 water main breaks per year in city



BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-23

Threats/Hazards (Hazardous Material and Other Technological Hazards)

Due to transportation, shipping, and storage in the area there are many hazardous materials that are technological hazards if an accident would occur.

- Average 100 hazardous materials spills and releases each year in Hazard City

In addition to storm surges, there are many water line breaks each year throughout the city due to the age of the piping.

- Thus, anything below grade is at risk, like the Underground Parking and the fuel tanks under the Loading Dock.

VISUAL XII-B-24

Design Basis Threat

Explosive Blast: Car Bomb 500 lb TNT equivalent. Truck Bomb 5,000 lb TNT equivalent (Murrah Federal Building class weapon)

Chemical: Large quantity petroleum fire toxic plume from tank farm. Large and small quantity HazMat release (chlorine) from tank farm, tanker truck, and rail car.

Biological: Anthrax delivered by mail or in packages, smallpox distributed by spray mechanism mounted on truck or aircraft in metropolitan area

Radiological: Small “dirty” bomb detonation within the 10-mile radius of the HAZARDCORP building



BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-24

Design Basis Threat (1 of 2)

Explosive Blast: Car Bomb – approximately 500 lb TNT equivalent. Truck Bomb – approximately 5,000 lb TNT equivalent (Murrah Federal Building class weapon)

Chemical: Large quantity gasoline spill and toxic plume from tank farm, small quantity (tanker truck and rail car size) spills of HazMat materials (chlorine)

Biological: Anthrax delivered by mail or in packages, smallpox distributed by spray mechanism mounted on truck or aircraft around metropolitan area.

Radiological: Small “dirty” bomb detonation within the 10-mile radius of the HIC building.

VISUAL XII-B-25

Design Basis Threat

Criminal Activity/Armed Attack: High powered rifle (sniper attack) or handgun shooting (direct assault on individuals).

Cyber Attack: Focus on IT and building systems infrastructure (SCADA, alarms, etc.) accessible via Internet access



BUILDING DESIGN FOR HOMELAND SECURITY Unit I-U-36

Design Basis Threat (2 of 2)

Criminal Activity / Armed Attack
Small arms weaponry that can be used outside or inside the building.

Cyber Attack
If connected to the internet, these building systems are more vulnerable. However, the threat is still there by other means and all avenues of Cyber Attack must be covered.

VISUAL XII-B-26

Levels of Protection
DHS Interagency Security Committee Criteria
 Level IV Building – over 450+ employees
 – over 150,000 sq ft

- Perimeter Security
- Entry Security
- Interior Security
- Administrative Procedures
- Blast/Setback Standards



BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-26

Levels of Protection -- DHS

DHS Level IV Interagency Security

Committee Criteria


- Perimeter Security
- Entry Security
- Interior Security
- Administrative Procedures
- Blast/Setback Standards

This information based upon rented space is in the rear of the Appendix U Case Study.

VISUAL XII-B-27

Levels of Protection
 DoD Antiterrorism Standards

Level of Protection	Potential Structural Damage	Potential Door and Glazing Hazards	Potential Injury
Low	Moderate damage – Building damage will not be economically repairable. Progressive collapse will not occur. Space in and around damaged area will be unusable.	Glazing will fracture, potentially come out of the frame, but at a reduced velocity, does not present a significant injury hazard. (Very low hazard rating). Doors may fail, but they will rebound out of their frames, presenting minimal hazards.	Majority of personnel in damaged area suffer minor to moderate injuries with the potential for a few serious injuries, but fatalities are unlikely. Personnel in areas outside damaged areas will potentially experience minor to moderate injuries.



FEMA 426, Adapted from Table 4-1: DoD Minimum Antiterrorism Standards for New Buildings, p. 4-9, updated for UFC 4-010-01, 22 Jan 2007
 BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-27

Levels of Protection – DoD

DoD Low LOP, Primary Gathering Building

- 50 or more people regularly in structure AND
- Population density of greater than one person per 430 gross square feet (244 gross square feet/person for this building)


- Potential Structural Damage
- Potential Door and Glazing Hazards
- Potential Injury

In 2007 the level of protection against potential injury was increased such that fatalities are unlikely, vice a potential of up to 10%. Ditto, there is a potential for few serious injuries.

VISUAL XII-B-28

Levels of Protection
DoD Antiterrorism Standards


Location	Building Category	Stand off Distance or Separation Requirements			
		Applicable Level of Protection	Conventional Construction Stand-off Distance	Minimum Stand-off Distance	Applicable Explosives Weight
Controlled Perimeter or Parking and Roadways without a Controlled Perimeter	Primary Gathering Building	Low	45 m	25 m	Car Bomb
			148 ft	82 ft	

 Adapted from DoD Unified Facilities Criteria (UFC), "DoD Minimum Antiterrorism Standards for New Buildings", UFC 4-010-01, 22 Jan 2007
BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-28

VISUAL XII-B-29

Levels of Protection
UFC 4-010-01 APPENDIX B (Updated 2007)
DoD MINIMUM ANTITERRORISM STANDARDS FOR NEW AND EXISTING BUILDINGS

Standard 1	Stand-off Distances
Standard 2	Unobstructed Space
Standard 3	Drive-Up/Drop-Off Areas
Standard 4	Access Roads
Standard 5	Parking Beneath Buildings or on Rooftops
Standard 6	Progressive Collapse Avoidance
Standard 7	Structural Isolation
Standard 8	Building Overhangs
Standard 9	Exterior Masonry Walls
Standard 10	Windows and Skylights
Standard 11	Building Entrance Layout
Standard 12	Exterior Doors

 BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-29

Levels of Protection – DoD (cont.)

DoD Low LOP, Primary Gathering Building Stand-off Distance

This is WITHOUT a Controlled Perimeter where VBIEDs (Vehicle Borne Improvised Explosive Devices) would be detected.

This is the normal situation in an urban setting. The Ring of Steel in London, England, seeks to provide a Controlled Perimeter such that the larger size vehicle bomb can be detected and the Design Basis Threat inside the Ring of Steel could be reduced.

Levels of Protection (1 of 2)

UFC 4-010-01 Appendix B
(22 January 2007)

DoD Minimum Antiterrorism Standards for New and Existing Buildings Standards 1-12


What standards are applicable to the Case Study?

- Std 1 – Stand-Off Distances
- Std 2 – Unobstructed Space
- Std 4 – Access Roads
- Std 5: Parking Beneath Buildings or on Rooftops
- Std 8 – Building Overhangs
- Std 10 – Windows and Skylights
- Std 11 – Building Entrance Layout
- Std 12 – Exterior Doors

VISUAL XII-B-30

Levels of Protection (continued)

UFC 4-010-01 APPENDIX B (Updated 2007) DoD MINIMUM ANTITERRORISM STANDARDS FOR NEW AND EXISTING BUILDINGS	
Standard 13	Mail Rooms
Standard 14	Roof Access
Standard 15	Overhead Mounted Architectural Features
Standard 16	Air Intakes
Standard 17	Mail Room Ventilation
Standard 18	Emergency Air Distribution Shutoff
Standard 19	Utility Distribution and Installation
Standard 20	Equipment Bracing
Standard 21	Under Building Access
Standard 22	Mass Notification

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BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-30

Levels of Protection (2 of 2)

UFC 4-010-01 Appendix B
(22 January 2007)

DoD Minimum Antiterrorism Standards for
New and Existing Buildings Standards 13-22

What standards are applicable to the Case Study?

- Std 18 – Emergency Air Distribution Shutoff
- Std 19 – Utility Distribution and Installation
- Std 20 – Equipment Bracing
- Std 21 – Under Building Access

In addition to the standards, review the DoD [Recommendations for New and Existing Buildings, Appendix U](#).

Case Study Activity

In this unit, the students will finalize the assessment, determine high priority risk concerns, recommend appropriate mitigation options, and present findings to the class.

Activity Requirements

- Working in assessment groups, refer to the Case Study and imbedded GIS portfolio to determine answers to the worksheet questions.
- Then review results to identify vulnerabilities and possible mitigation measures, and rank and prioritize the findings. (As a minimum, the 3 highest risks in terms of ratings and the 3 highest mitigation measures recommended in order of priority for funding)

VISUAL XII-B-31

Unit XII Case Study Activity

Finalization and Presentation of Group Results


Purpose

- Groups finalize their assessments
- Decide on high priority risk concerns
- Determine appropriate mitigation measures
- Present findings to class

Requirements

Based on findings from previous activities, complete the worksheet table

Prepare to present conclusions and justify decisions to class in a 5- to 7-minute presentation

 FEMA
BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-31

Members of the instructor staff should be available to answer questions and assist groups as needed.


At the end of 45 minutes or so, reconvene the class and facilitate group reporting.

VISUAL XII-B-32

Vulnerability/Mitigation
Basis of Mitigation Measures
Recommendations ultimately require an understanding of benefit (capability) versus cost to implement

Blast Modeling

- Various scenarios run at Tier III level for comparison using Design Basis Threats
 - Truck bomb is worst case
 - Car bomb also analyzed for comparison
 - Some interesting and unexpected results
- More analysis required for final design



BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-32

Vulnerability Mitigation – Basis of Measures - Blast

Need to understand benefit versus cost.


Blast modeling concentrates upon worst case, but must work all scenarios. Since both positive and negative blast wave phases are used in retrofitting existing buildings, results were interesting and, in some cases unexpected.

The higher tier assessment indicates the first cut of possible approaches, but more analysis is needed to work with the architects and engineers in achieving a final design.

VISUAL XII-B-33

Vulnerability/Mitigation
Basis of Mitigation Measures
Plume Modeling (CBR or HazMat)

- Tier II / Tier III performed for selected Design Basis Threats external to building, less urban canyon effect
- Additional Tier III analysis required inside building
 - Understand internal pressure changes during building operation
 - Understand on HVAC and other changes implemented in response plans affect the building
 - Supports design of CBR measures



BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-33


Vulnerability Mitigation – Basis of Measures - Plume

Plume modeling for CBR or HazMat follows similar approaches to indicate actions to consider, then followed by more detailed analysis to achieve the final design.

VISUAL XII-B-34

Vulnerability/Mitigation
Basis of Mitigation Measures
Cost Estimates are ROM (Rough Order of Magnitude)

- Assumes 10% Overhead and 10% Profit
- Assumes Area Cost Factor of 1.0 (DoD) or 100 (RS Means)
 - DoD Range: **0.84** (Huntsville AL) to **1.67** (Anchorage AK)
 - RS Means Range: **82.5** (Baton Rouge LA) to **131.9** (New York)
 - Adjusted for July 2006
- Anti-Terrorism / Force Protection equipment and construction costing information is still immature



BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-34

Vulnerability Mitigation – Basis of Measures – Cost

When comparing benefit versus cost, the cost is equally difficult to determine due to the still immature nature of anti-terrorism / force protection costing information.


The costing used in this presentation assumes 10% overhead, 10% profit, an Area Cost Factor of 1.0, and adjusted for July 2006.

For your actual situation you can then adjust the dollar values given for your conditions.

VISUAL XII-B-35

Vulnerability/Mitigation
Site / Vehicle Bomb
Maximize available stand-off

- Plaza side barriers at property line to prevent direct approach into lobby – K12 rating / 408 LF
 - Planters — \$ 92K
 - Plinth walls — \$207K
 - Bollards — \$104K



BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-35

Vulnerability/Mitigation (Site / Vehicle Bomb)


The plaza side of the building has the drop-off area and significant street frontage

- Since no traffic calming is possible, K12 rating after analysis is selected
- 408 LF of frontage
- Looking at options available, the planters are selected due to the price
- Street furniture would be part of this approach, but that would be applicable to all approaches

VISUAL XII-B-36

Vulnerability/Mitigation
Site / Vehicle Bomb
Maximize available stand-off

- Other three sides
 - Continue controlled parking on street
 - Signage — \$10K
 - Bollards if no controlled parking
 - K12 rating – North and South 340 LF – \$90K
 - K8 rating – West 248 LF – \$65K



BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-36

Vulnerability/Mitigation (Site / Vehicle Bomb)

The other three sides of the building would continue with controlled parking which would require signage to be installed.


If controlled parking could not be instituted, then bollards will have to be installed with the K ratings as indicated.

Due to cost the controlled parking seems the best option, and, in fact, provides greater stand-off than the bollards.

VISUAL XII-B-37

Vulnerability/Mitigation
Site / Vehicle Bomb
Protect loading dock / building

- Hardened vehicle barriers, K12 rating, 3 each
 - Pop-Up – \$405K
 - Drop Arm – \$150K



BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-37

Vulnerability/Mitigation (Site / Vehicle Bomb)


Protect Loading Dock / Building – The final perimeter stand-off control around the property line

- Need K12 rated barriers
- Drop Arm barriers are the choice to control access from the curb
- Less expensive and easier to maintain under all forms of weather

VISUAL XII-B-38

Vulnerability/Mitigation
Site / Vehicle Bomb
Reroute Traffic

- Traffic Study – \$20K
- MOUs with tenants / neighbors / police
- Variable road closure or area-wide access control based upon intelligence (Ring of Steel)
- Change west side alley to north travel direction to avoid queuing on main roads for entry to UG building parking



BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-38

Vulnerability/Mitigation (Site / Vehicle Bomb)

Reroute Traffic


- Traffic Study is the starting point
- Memorandums of Understanding (Agreements) with tenants, neighbors, and police to reroute
- Possibly use Ring of Steel concept and cover a wider area of the area
- As a minimum, change traffic flow for the west side street from south to north to have more space for queuing vehicles that will seek to access underground parking
 - Slower processing due to access control
 - Space for inspection at higher threat conditions when required
 - Additional Security at Loading Dock could control access to the street
 - May need Drop Arm (like at Loading Dock) across street for access control to street
 - Could relocate the installation of vehicle barriers from the under building parking entrance / exit to the entrance and exit points of the west side street

VISUAL XII-B-39

Vulnerability/Mitigation
Site - Security / Vehicle Bomb

Segregate UG parking for access control

- Controlled under building – tenants/vetted only
- Public under plaza – premium in urban area
- Hardened vehicle barriers at building ramps
 - Drop Arms K8 rating, 2 each – \$96K
- Signage to denote public and tenant/staff UG parking entrances – \$2K




BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-39

VISUAL XII-B-40

Vulnerability/Mitigation
Architectural - Security / Vehicle Bomb

Access control for loading dock

- Additional security at loading dock, includes screening at curb
 - 2 personnel, 8 hour shift – \$188K/year
- Pre-screening away from building
 - Pre-engineered bldg – \$ 36K
 - 2 personnel, 8 hour shift – \$188K/year
- Time of day access (2000 to 0400)
 - 4 personnel, 8 hour shift – \$376K/year
- Apply individually or collectively



BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-40

- Must upgrade barriers to K12 at ends of street
- See next slide for access control of under building parking

Vulnerability/Mitigation (Site / Vehicle Bomb)

Segregate Underground Parking

- Under building – tenants, staff, and vetted only
- Under plaza – retain public access as parking in urban area is a premium
- K8-rated drop arm vehicle barriers on both entrance and exit lanes
- Signage to denote which underground parking entrance to use

Vulnerability/Mitigation (Architectural – Security / Vehicle Bomb)

Access control for loading dock


- Additional personnel is high cost, but can perform screening at curb as part of procedures
- Alternate – pre-screen away from building
 - Requires facility
 - Required more personnel
 - Add more stand-off (Ring of Steel concept)
- Time of day access
 - Requires additional personnel to cover
 - Personnel may be able to be shifted
 - Reduces target value as fewer people in building
- Mix or match measures to achieve final solution

VISUAL XII-B-41

Vulnerability/Mitigation
Architectural - Security / Vehicle Bomb

Access control for segregated under building parking

- Electronic or manned access control under building
 - Electronic (Card Scanner & PIN) – \$12K
 - Manned
 - Small Shelter – \$5K
 - 2 Personnel, 24/7 – \$790K/year

 FEMA BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-41

Vulnerability/Mitigation (Architectural – Security / Vehicle Bomb)

Access control for segregated under building parking


- Electronic access control
- Manned access control
- Electronic access control less expensive
- Can shift from under building parking ramps to ends of west side street per rerouting traffic measure
 - Match with relocated vehicle barriers
 - Must evaluate queuing potential all at loading dock area
 - Additional personnel at loading dock during day could perform access control, especially if deliveries shifted to night

VISUAL XII-B-42

Vulnerability/Mitigation
Architectural / Vehicle Bomb

Strengthen overhead anchorage elements

- HVAC diffusers, light fixtures, etc.
 - First three floors – \$950K
- Canopy at main entrance
 - Requires additional design information
 - Ballpark \$950K

 FEMA BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-42

Vulnerability/Mitigation (Architectural / Vehicle Bomb)

Strengthen overhead anchorage elements


- First 3 floors will see the brunt of any vehicle blast situation – add anchorage, especially in atrium area
- Canopy of main entrance at plaza needs similar strengthening – needs more information for design

VISUAL XII-B-43

Vulnerability/Mitigation
Architectural - Security / Vehicle Bomb

Move Control Center to 4th floor or install backup location on 4th floor

- >> \$1M
- Security – Alarms, Communications, CCTV monitoring and recording
- Fire – Alarms, Communications, Mass Notification
- Building Systems – SCADA, EMCS, HVAC and elevator shut down, etc.



BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-43

Vulnerability/Mitigation (Architectural - Security / Vehicle Bomb)

Move Control Center to 4th floor

- Building Security
- Fire Control
- Building Management Systems

Alternate is a backup control center on 4th floor

Not exactly an inexpensive action!

VISUAL XII-B-44

Vulnerability/Mitigation
Architectural - Security / Access Control

Lobby redesign

- Channel all entrances to screening location(s) with up to 12 checkpoints for throughput – \$2.5M

Close off retail space access to Lobby

- Convert to crash bar with alarm, 3 doors – \$1.5K
- Lobby redesign may overcome need

Armed guards manning screening equipment in lobby

- Up to 36 guards with 3 guards per checkpoint at peak times based upon throughput – \$8.7M/year



BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-44

Vulnerability/Mitigation (Architectural - Security / Vehicle Bomb)

Lobby redesign

- Close off all entrances to public except main entrance at plaza
- Other entrances get electronic access like elevators and stairwells under building for tenants and staff
- Close off retail space access to lobby
- Channel visitors through x-ray and magnetometers
 - Requires personnel based upon throughput required at peak times

VISUAL XII-B-45


Vulnerability/Mitigation
Structural Systems / Vehicle Bomb

Perform blast analysis – perimeter building columns

- Existing – W14x455 steel columns, 96 total
- Upgrade on Floors 1 and 2 – Encase in 4,000 psi concrete and 1/4-inch steel wrap – \$980K

Harden loading dock to protect rest of building – below achieves low LOP

- 12-inch R/C, #8-4 inches O.C. both faces, 1/2-inch steel plate on ceiling and floor – \$510K
- Adds protection of fuel tanks under loading dock, evaluate need for additional measures



BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-45

Vulnerability/Mitigation (Structural Systems / Vehicle Bomb)

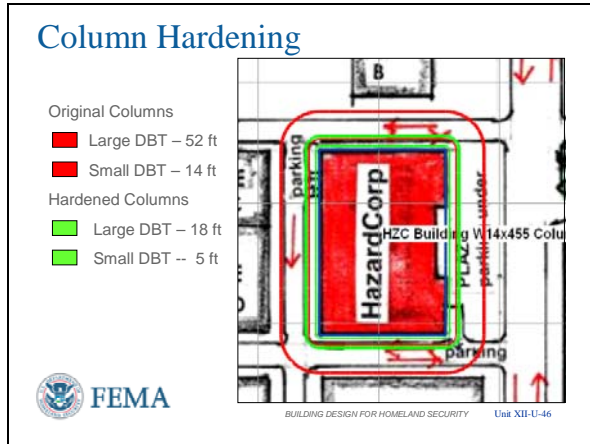
Blast analysis of exterior perimeter columns

- Encase on first two stories in concrete and wrap in 1/4-inch steel wrap (seismic upgrade technique)

Harden loading dock to protect rest of building

- Reinforced concrete walls on three sides with 1/2-inch steel plate on ceiling and floor
- Floor with steel plate may require

VISUAL XII-B-46



- additional treatment for traction under different conditions
- Additional protection may be needed for fuel tanks under loading dock

Column Hardening

The concrete and steel wrap has the following impact:

Large DBT

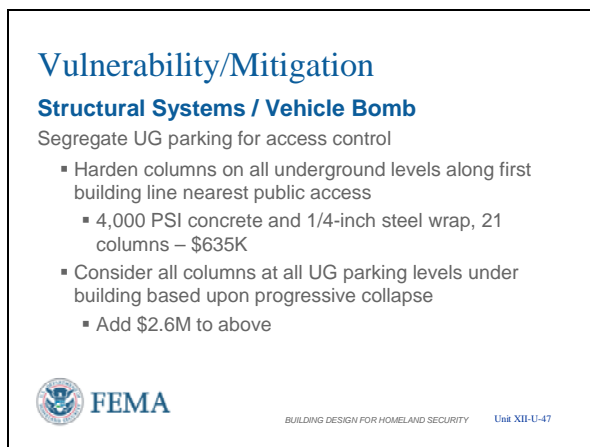
- Original Stand-off – 52 feet
- Hardened Stand-off – 18 feet

Small DBT

- Original Stand-off – 14 feet
- Hardened Stand-off – 5 feet

Vehicle barriers at curb and restricted parking coupled with column hardening provides desired level of protection as seen by the green contours.

VISUAL XII-B-47



Vulnerability/Mitigation (Structural Systems / Vehicle Bomb)

Harden columns along line between under building and public parking at building line


- Expect columns to be more substantial than first to third floors due to vehicle dynamic loading
- Same hardening technique applied
- Small DBT only if not less due to additional screening and vetting
- Resultant stand-off expected to be very small, but can increase thickness of wrap if more reduction is needed
- Consider hardening all columns underneath building to mitigate progressive collapse

VISUAL XII-B-48

Vulnerability/Mitigation
Structural Systems / Vehicle Bomb

Segregate UG parking for access control

- Hardened wall between vetted and public parking, 248 LF per level, 3 levels – totaled below
- 12-inch R/C, #8-4 inches O.C., both faces – \$2.06M
- One vehicle barrier per level, K4 rating or as designed, rolling I-beam, one lane wide – \$100K



BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-48

Vulnerability/Mitigation (Structural Systems / Vehicle Bomb)

Hardened wall between under building parking and public parking on all floors

- Reinforced concrete
- One vehicle barrier per parking level to all transit of vehicle between areas if exit ramps on either side became unusable for any reason
 - K4 rating or as designed
 - Rolling I-beam on building side of hardened wall and in front of columns
 - Only needed to be one vehicle passage wide for largest vehicle that can enter underground parking
 - Probably site fabricated due to difficulty in getting I-beam to each parking level

VISUAL XII-B-49


Vulnerability/Mitigation
Structural Systems / Vehicle Bomb

Perform blast analysis atrium columns – harden against progressive collapse

- Existing – W14x455 steel columns, 16 total
- Upgrade on Floor 1 only – Encase in 4,000 psi concrete and 1/4-inch steel wrap – \$467K

Provide architectural stand-off around columns

- Gypsum board on metal studs
- 1 foot off column (GSA 6 inches required)
- 16 columns, first floor only – \$50K



BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-49

Vulnerability/Mitigation (Structural Systems / Vehicle Bomb)

Atrium columns

- Encase in concrete to add mass and steel wrap to hold concrete together (consistent with other column hardening)
- Only need the first floor as the DBT will be a hand-carried bomb
- Add architectural stand-off by putting gypsum board on metal studs at 1 foot off column
- Additional analysis may indicate that the architectural stand-off is sufficient and the concrete and steel wrap may not be needed, especially if vehicle barriers are installed that prevent entry into the lobby.

VISUAL XII-B-50

Vulnerability/Mitigation

Building Envelope / Vehicle Bomb

Perform blast analysis – glazing and frame upgrades

- Existing 172 windows/floor, nominal 5 foot x 5 foot
 - Floors 1-3, 3/8-inch TTG SP (life safety)
 - Floors 4-8, 1/4-inch DS SP (wind loading)
 - Floors 9-50, 3/8-inch DS SP (wind loading at height)
- Upgraded – Note Federal floors are 8-13 and 27-28
 - Floors 1-7, 1-inch TTG LAM SP – \$12M
 - Floor 8, 3/8-inch TTG SP from Floors 1-3 with 15-mil FRF – \$560K
 - Floors 9-13, 27-28 existing with 15-mil FRF – \$710K



BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-50

Vulnerability/Mitigation (Building Envelope / Vehicle Bomb)

Note that the window glass changes depending upon where you are in the building based upon life safety or wind loading design requirements.

Also the Federal Agency floors are upgraded to meet ISC criteria

On Floors 1-7 the cost of upgrading the window framing to greater than the commercial standard 1-inch thickness is usually excessive. Thus, a 1-inch thick single pane glass, usually E-rated for energy conservation is the cost trade-off.

Also, reused the glass from Floors 1-3 on Floor 8 for a significant savings

The remaining upper floors are then protected with 15-mil Fragment Retention Film and silicone sealant all around between FRF and framing.

The following slides will show the benefits of these upgrades.

VISUAL XII-B-51

Window Hardening – Floor 1

Original glazing meets ISC minimum

Original Glazing

- Large DBT– 678 ft
- Small DBT– 277 ft

Hardened Glazing

- Large DBT– 205 ft
- Small DBT– 77 ft

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BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-51

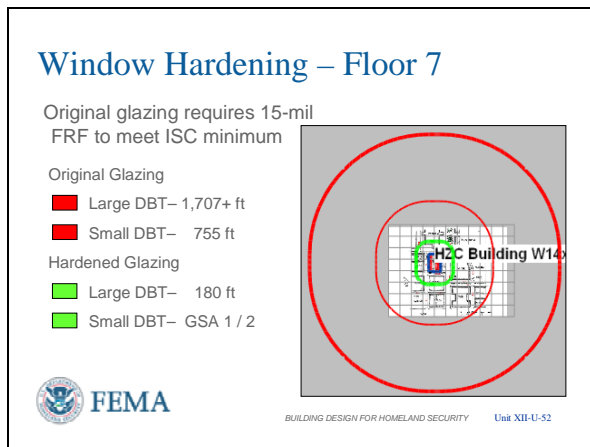
Window Hardening – Floor 1

While the original glazing meets ISC minimums, it does not provide the level of protection sought

Floor 1 is shown here, Floors 2-7 will have slightly smaller stand-off benefits due to the blast reflection angles impacting these higher floors.

The 1-inch thick Thermally Tempered Glass Laminated Single Pane has the following impact:

VISUAL XII-B-52



Large DBT

- Original Stand-off – 678 feet
- Hardened Stand-off – 205 feet

Small DBT

- Original Stand-off – 277 feet
- Hardened Stand-off – 77 feet

Hardening must be done in conjunction with other measures. Main benefit is the reduction in collateral damage that can occur as seen by the smaller green contours versus the red contours.

NOTE: The glass upgrade must be balanced with equivalent hardening of the **curtain window wall framing and framing connections to the building structure.**

Window Hardening – Floor 7

While the original glazing (1/4-inch double strength single pane) on Floor 7 with 15-mil FRF meets ISC minimums, it does not provide the level of protection sought

Floor 7 is shown here as Floor 7 is the highest floor of this upgrade of Floors 1-7.

The 1-inch thick Thermally Tempered Glass Laminated Single Pane has the following impact:

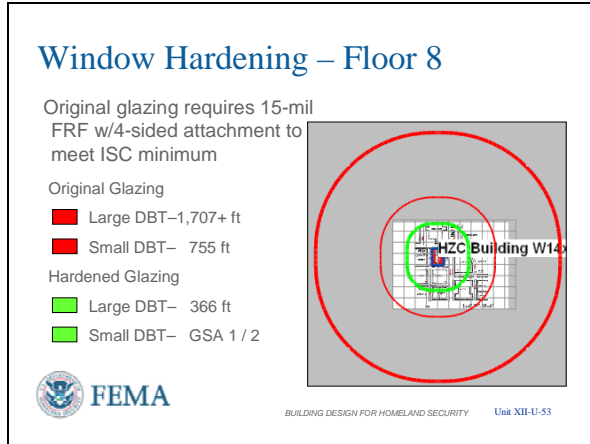
Large DBT

- Original Stand-off – 1,707+ feet (this is the limit of the analysis software)
- Hardened Stand-off – 180 feet (vice 205 feet on Floor 1)

Small DBT

- Original Stand-off – 755 feet
- Hardened Stand-off – GSA 1 / 2 meaning the glass does not leave the frame (vice 77 feet on Floor 1)

VISUAL XII-B-53



Window Hardening – Floor 8

Floor 8 is the highest floor with 1/4-inch double strength single pane glass. It is the floor where the glass from existing Floors 1-3 can be reused.

The 3/8-inch thick Thermally Tempered Glass Single Pane with 15-mil FRF and 4-sided attachment with silicone sealant has the following impact:

Large DBT

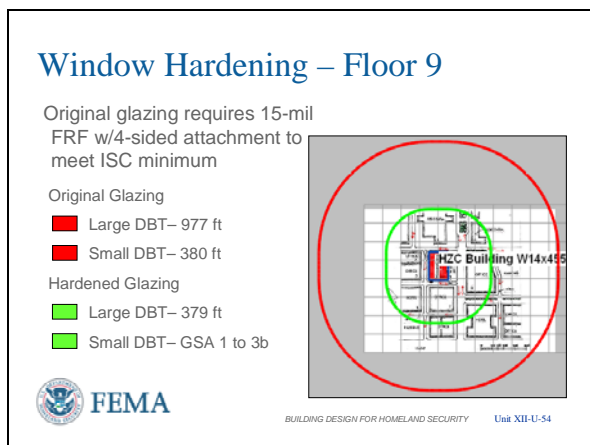
- Original Stand-off – 1,707+ feet (this is the limit of the analysis software)
- Hardened Stand-off – 366 feet

Small DBT

- Original Stand-off – 755 feet
- Hardened Stand-off – GSA 1 / 2 meaning the glass does not leave the frame (vice 77 feet on Floor 1)

This is equivalent to Floor 7 upgrade for small DBT, but twice the stand-off for large DBT. Thus, it is also for collateral damage.

VISUAL XII-B-54



Window Hardening – Floor 9

Floor 9 is the start of the elevated wind loading design – 3/8-inch double strength single pane glass. It is also the lowest Federal agency floor.

The 3/8-inch thick Double Strength Single Pane with 15-mil FRF and 4-sided attachment with silicone sealant has the following impact:

Large DBT

- Original Stand-off – 977 feet
- Hardened Stand-off – 379 feet (vice 366 feet on Floor 8)

VISUAL XII-B-55

Window Hardening – Floor 13

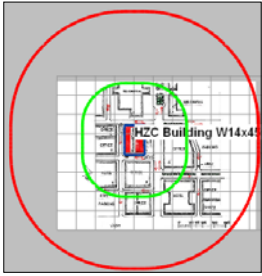
Original glazing requires 15-mil FRF w/4-sided attachment to meet ISC minimum


Original Glazing

- Large DBT– 970 ft
- Small DBT– 359 ft

Hardened Glazing

- Large DBT– 358 ft
- Small DBT– GSA 1 / 2



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BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-55

Small DBT

- Original Stand-off – 380 feet
- Hardened Stand-off – GSA 1 to 3b meaning a one foot change in the software provides a great change in GSA rating (vice GSA 1 / 2 on Floor 8)

This hardening attempts to maintain equivalent hardening and balances the economy of scale using one upgrade over a range of floors.

Window Hardening – Floor 13

Floor 13 is the upper floor of the first range of Federal agency floors.

The 3/8-inch thick Double Strength Single Pane with 15-mil FRF and 4-sided attachment with silicone sealant has the following impact:

Large DBT

- Original Stand-off – 970 feet (vice 977 feet on Floor 9)
- Hardened Stand-off – 358 feet (vice 379 feet on Floor 9)

Small DBT

- Original Stand-off – 359 feet
- Hardened Stand-off – GSA 1 / 2 (vice GSA 1 to 3b on Floor 9)

VISUAL XII-B-56

Window Hardening – Floor 27


Original glazing requires 15-mil FRF w/4-sided attachment to meet ISC minimum


Original Glazing

- Large DBT– 923 ft
- Small DBT– 82/174 ft

Hardened Glazing

- Large DBT– 109/222 ft
- Small DBT– GSA 1 / 2



 **FEMA**

BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-56

Window Hardening – Floor 27

Floor 27 is the lower floor of the upper range of Federal agency floors.

The 3/8-inch thick Double Strength Single Pane with 15-mil FRF and 4-sided attachment with silicone sealant has the following impact:

Large DBT

- Original Stand-off – 923 feet (vice 970 feet on Floor 13)
- Hardened Stand-off – 109 / 222 feet (vice 358 feet on Floor 13)

Small DBT

- Original Stand-off – 82 / 174 feet (vice 359 feet on Floor 13)
- Hardened Stand-off – GSA 1 / 2 (vice GSA 1 / 2 on Floor 13)

NOTE: The larger hardened stand-off distance is where the glass breaks and the negative phase of the blast wave pulls the glass out of the building. The smaller hardened stand-off distance is where the glass breaks and is propelled into the building at a GSA 3a or greater rating. Thus, the smaller distance is the critical one for occupants of the building, while the larger distance affects people on the sidewalk and streets below.


VISUAL XII-B-57

Vulnerability/Mitigation
Utility Systems / Vehicle Bomb

Harden all utilities entering site as transiting UG parking, 1 foot x 1 foot cross section

- 3/8-inch steel plate welded with access panels and hangars – \$250/LF

Set up preplanned contingency fuel deliveries for emergency generators with other supplier(s)



BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-57

Vulnerability/Mitigation (Utility Systems / Vehicle Bomb)

Harden Utilities

- All utilities transit the underground parking levels either horizontally or vertically or both
- Enclosing the utility lines in steel will cost about \$250/LF

Set up preplanned contingency fuel deliveries


- Will cover consumption later
- Have two additional suppliers other than the normal supplier who will provide fuel if called
- Ensure these alternate suppliers would deliver from localities that will **NOT** be affected by the same incidents that can affect the primary supplier
- All suppliers should be on backup power to ensure fuel pumps can fill fuel trucks

VISUAL XII-B-58

Vulnerability/Mitigation
Mechanical Systems / CBR Attack

Install emergency shut down switches – all fans

- At each floor accessible to fire wardens – \$22K per floor
- Security Control and backup location – \$22K per floor in addition to fire warden capability
- Total for building – \$2.2M



BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-58

Vulnerability/Mitigation (Mechanical Systems / CBR Attack)

HVAC / Air Handling Shutdown


Due to the complexity of the HVAC system with pressurizing and exhausting the simplest approach would be to have the Fire Warden on each floor to shout down all air handling equipment.

To back up the Fire Wardens requires additional cost to connect all systems to Security Control.

VISUAL XII-B-59

Vulnerability/Mitigation
Mechanical Systems / CBR Attack
Install elevator controls in Security Control and backup location

- Evacuation support (up or down)
- Shut down to prevent pumping of contaminants throughout building
- Total for 31 elevators – \$775K



BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-59

Vulnerability/Mitigation (Mechanical Systems / CBR Attack)

Elevator Control / Shutdown


Just like the HVAC / Air Handling Systems need to be shut down on a moments notice, the 31 elevators require the same consideration

However, this requires some procedures put in place as to announcements about elevator use so that people can exit at the next floor prior to shutting down all elevators (do not trap people in elevators)

VISUAL XII-B-60

Vulnerability/Mitigation
Mechanical Systems / CBR Attack (Chemical and Radiological)
Evaluate carbon filters for chlorine-type spills

- Analysis of heavier or lighter than air contaminants
- \$135K per air handler (two to four air handlers per floor)



BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-60

Vulnerability/Mitigation (Mechanical Systems / CBR Attack) (Chemical)

Consider carbon filters for Chemical Attack (vapors vice particles), such as Chlorine release that impacts the HZC Building.

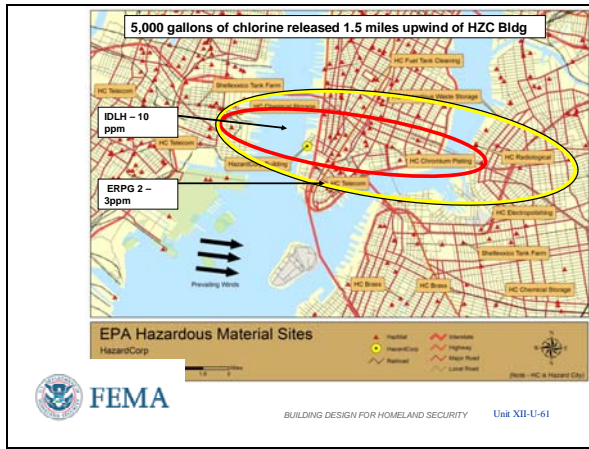
Carbon filters are not cheap and they require procedures for use and maintenance to ensure they are capable when needed.

Balance filters versus Sheltering-in-Place as shown in the plume modeling in the following slides.

Note, if chlorine is the only vapor concern, it is of little consequence installing carbon filters since the first air intake is on the 4th floor of the HazardCorp Buildings and chlrorine is much heavier than air.

- But would have to check the mail room as this upgrade was a retrofit and the fresh air intake may not be on the 4th floor.

VISUAL XII-B-61



IDLH -- Immediately Dangerous to Life or Health

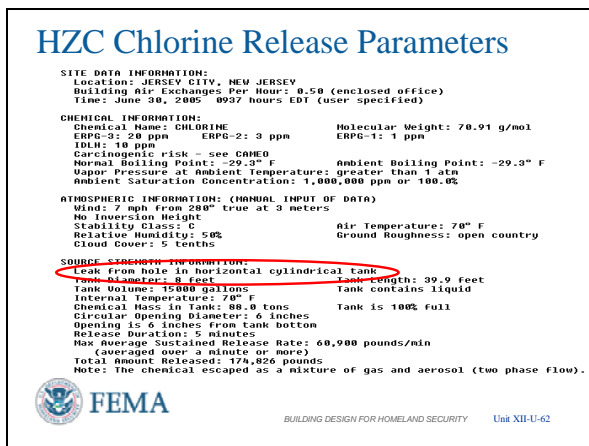
EPRG -- Emergency Response Planning Guides

Chlorine Spill – Chlorine Railroad Tank Car at Chemical Storage Facility (Plume Modeling)

In this case, the prevailing winds from the west take the chlorine leak plume from a railroad tank car at the chemical storage facility towards the HZC Building.

- Immediately Dangerous to Life or Health (**IDLH**) refers to a concentration, formally defined as the maximum exposure concentration of a given chemical from which one could escape within 30 minutes without any escape-impairing symptoms or any irreversible health effects. The IDLH for chlorine is 10 ppm.
- The **ERPG-2** is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hr without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action. The ERPG-2 for chlorine is 3 ppm.

VISUAL XII-B-62



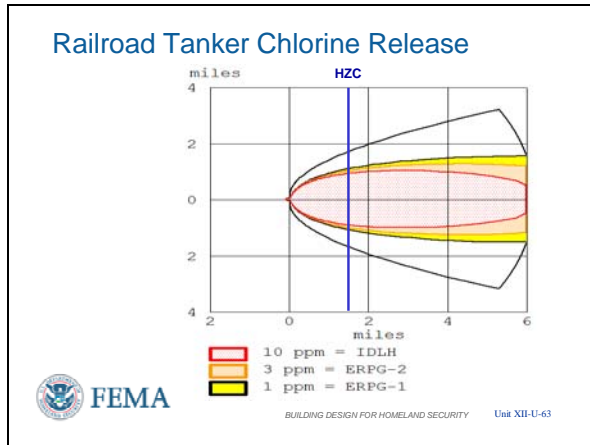
NOTE to instructor: Chlorine is approximately 2.5 times heavier than air.

HZC Chlorine Release Parameters

This slide shows the information available from the CAMEO toxic industrial chemical (TIC) modeling program of EPA and NOAA and can be downloaded at <http://archive.orr.noaa.gov/cameo/aloha.html>.

- Chlorine will not readily disperse into the atmosphere. It will hug the ground as it disperses and will settle in the lowest elevations.
- Notice this release is a rapid release of 15,000 gallons (87 tons) of chlorine through a 6-inch hole in the tank. The entire release occurs in approximately five minutes.

VISUAL XII-B-63



The **ERPG-3 (not shown)** is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects.

Chlorine Release Footprint

This is a basic plume footprint for the rapid release of chlorine [15,000 gallons (87 tons) at 225 psi over 5 minutes].

The blue line indicates the relative building location versus spill site (about 1.5 miles).

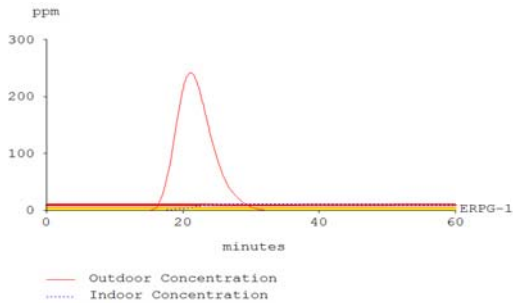
Immediately Dangerous to Life or Health (IDLH) [30 minutes] was defined earlier.

Emergency Response Planning Guides (ERPG) are defined in thin three categories

- The **ERPG-1** is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hr without experiencing other than mild transient adverse health effects or perceiving a clearly defined, objectionable odor.
- The **ERPG-2** is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hr without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action.

VISUAL XII-B-64

Chlorine Concentration at HZC



BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-64

Chlorine Concentrations at HZC

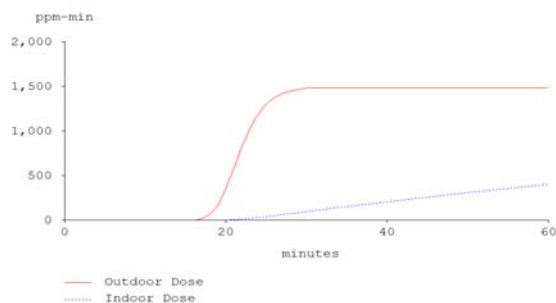
Bottomline: In all circumstances it is best to remain indoors unless or until the facts related to the release are clear and it can be determined safe evacuation is possible. For even more protection move to upper floors, especially if air intakes are also elevated and above the shelter floor - turn the HVAC on high (pressurize) until the odor of chlorine is noticed.

NOTE: A chlorine concentration of 1,000 ppm is immediately fatal.

If configured, HVAC carbon filters can be put into operation or go to shelter-in-place configuration and turn on pressurization units.

VISUAL XII-B-65

Chlorine Dose at HZC



BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-65

Chlorine Dose at HZC

Bottomline: Once again it is clear that remaining indoors is the best option until or unless it is clear evacuation can be accomplished safely. In an urban environment, complete evacuation from the plume area would take more than 18 minutes; thus, sheltering-in-place is the recommended procedure to follow in this case.

Any efforts to maintain a positive pressure in the building and seal exterior openings (particularly at the lowest levels) could further reduce infiltration and, therefore, the occupant dosage. Then once the odor of chlorine is detected coming from the HVAC ducts (this occurs at ERPG 1 concentrations) the HVAC should be turned off because it would indicate chlorine is being drawn into the facility and air circulation should cease.

- Notice all of these actions require two things.

- First some rapid awareness and notification that a potentially dangerous event has taken place. This typically requires some linkage with emergency responders (radio, computer, telephonic).
- Secondly it is important to have rapid HVAC controls to respond, whether to turn the system off or to ramp it up to maximum capacity.

This cumulative dose chart demonstrates the reason evacuation should occur as soon as possible after the plume passes. Notice the outdoor dose increases dramatically from 18-25 minutes (during plume passage) but after 25 minutes there is no further increase, whereas the indoor dose continues to increase. This is due to the fact that any chlorine that enters the building during plume passage will continue to be circulated in the building for several hours since total air exchange in a building normally takes 3 to 4 hours. In fact the dose for a person who remains indoors for the duration can eventually be nearly identical to the person who remains outdoors.


After the plume passes, this would be the time to purge the building to reduce indoor concentrations and the dose to people inside the building. While high concentrations are a concern for immediate effects, high dosage is a concern for long-term effects.

VISUAL XII-B-66

Vulnerability/Mitigation
Mechanical Systems / CBR Attack (Chemical and Radiological)

Upgrade filters to MERV 11, 12 or 13 to remove particulates / CBR

- Confirm pressure drop can be handled or upgrade fan equipment
- \$50K to \$1.2M+ per floor



BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-66

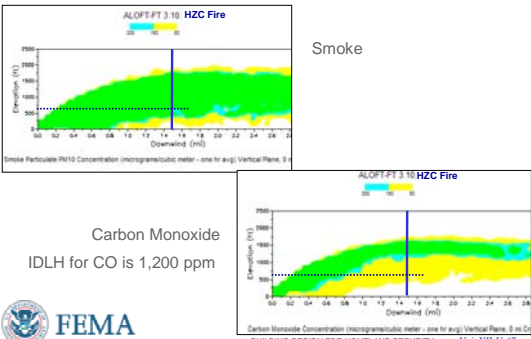
Vulnerability/Mitigation (Mechanical Systems / CBR Attack) (Chemical and Radiological)

To remove particulates, upgrading the filter to MERV 11, 12, or 13 is beneficial

- Must confirm that Mechanical System can handle the pressure drop and there is sufficient space
- OR must confirm the fan equipment must be upgraded and there is sufficient space
- Difficult to estimate costs due to the many variable involved.


VISUAL XII-B-67

Fire Plumes – Smoke & CO



Smoke

Carbon Monoxide
 IDLH for CO is 1,200 ppm



BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-67

Fire Plumes – Smoke and Carbon Monoxide

Two points to consider are smoke particles that MERV 13 filters will capture and carbon monoxide, a lighter-than-air gas that kills by overcoming the oxygen in a room. The prevailing wind direction will push fire products toward the HazardCorp Building. In this case the fire is in the same general area as the chlorine release on an earlier slide.

The vertical line on the graphs indicates the location of the HZC Building and the horizontal line indicates the total height of that building (626 feet)

The smoke particles will be in higher concentrations at the upper floors of the HZC Building as shown in the upper left graphic. Filtering of these smoke particles is not only a concern from a human health standpoint, but also for sensitive electronic equipment, such as computer and communications. The lower floors of HZC Building may be totally unaffected.

Alternately, the carbon monoxide will be at a

NOTE to instructor: Carbon Monoxide (CO) is slightly lighter than air (vapor density of 0.97 versus air at 1.0) and due to the heat of the fire the CO is even lighter so it disperses readily.

NOTE to instructor: It is very difficult to model fires and the resultant smoke/toxic gas plumes, especially with the canyon effect that occurs in urban areas with high rise buildings.. These graphs are from a model called ALOFT-PC (A Large Open Fire plume Trajectory model) by National Institute of Standards and Technology (NIST). It can be

downloaded online at
<http://fire.nist.gov/bfrlpubs/fire96/art053.htm>
1

It must be noted that this model (as the name indicates) is only for fires resulting from a fuel spill. The user selects the type of fuel and the dimensions of the spill.

The major problem downwind is the fallout of particulates (witness the film footage of the 9/11 attacks in New York City). It is often assumed that high particulate filtration is only for biological agent attacks. They should also be considered where damage from particulates would cause serious problems due to loss of computers, electronics or communications equipment.


VISUAL XII-B-68

Vulnerability/Mitigation

Mechanical Systems / CBR Attack (Chemical and Radiological)

Install chemical/radiological detectors

- Activate HVAC shutdown and alarm
- \$15K to \$100K per floor for each type, with radiological less expensive

 **FEMA**

BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-68

reduced concentration and only on the highest floors, although not high enough to be instantly fatal. Like for particulate, the lower floors are completely unaffected and would allow for evacuation. Evacuation of personnel is normally the best course of action. Sheltering-in-place is not recommended in this case.

In most cases fires present little risk to persons except for those trapped indoors or extremely close to the event where carbon monoxide, heat or particulates can have severe or even fatal effects.

Fortunately the heat of the fire carries smoke and toxic gases rapidly up into the atmosphere.

Vulnerability/Mitigation (Mechanical Systems / CBR Attack) (Chemical and Radiological)

Install Chemical and/or Radiological Detectors

- These detectors do have a level of acceptable reliability, especially Radiological Detectors
- Cost depends upon amount of air movement (and sampling concentrations / trigger settings)
- Radiological detectors are less expensive than Chemical Detectors
- Not only sound an alarm, but also automatically shut down HVAC and close fast dampers on air intakes.


VISUAL XII-B-69

Vulnerability/Mitigation
Mechanical Systems / CBR Attack
Redesign HVAC for lobby

- Separate system, like mailroom – \$620K

Design safe rooms / shelter-in-place locations with filtered air units operated when shelter activated

- \$200K per floor for 170 people



BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-69

Vulnerability/Mitigation (Mechanical Systems / CBR Attack)

Lobby HVAC Redesign

- Separate system like mailroom
- Must cover Atrium and close off other parts of building

Safe Room / Sheltering-in-Place

- Closed off areas – see FEMA 455
- Filtered air units that can overpressurize the safe room
- May install on selected floors


VISUAL XII-B-70

Vulnerability/Mitigation
Mechanical Systems / CBR Attack (Biological)
Evaluate Ultraviolet Germicidal Irradiation (UVGI)

- \$4.9M for complete facility

CBR General
Establish Occupant Emergency Plans for CBR external and internal releases

- Part of Building Management overhead



BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-70

Vulnerability/Mitigation (Mechanical Systems / CBR Attack) (Biological)

Evaluate UVGI

- Costly due to the many systems on each floor where it can be installed
- Consider for the primary systems on each floor that predominantly does air recirculation vice fresh air intake, although both have their place
- Has health benefits for work force


CBR General

- Occupant Emergency Plans needed for actions to take during external and internal CBR releases
- For terrorist OR technological accident releases

VISUAL XII-B-71

Vulnerability/Mitigation
Security Systems / Generic Measures
Expanded and upgraded CCTV coverage

- Perimeter – \$415K
- Stairwells (not pan/tilt/zoom) – \$800K
 - UG Parking, Lobby, Federal Floors
 - Include coverage of access keypads
- UG parking – \$555K
- With appropriate sensors (motion, noise, door contact) to aid monitoring



BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-71

Vulnerability/Mitigation (Security Systems / Generic Measures)


Expand and upgrade CCTV coverage

- Perimeter (entrances, streets, plaza)
- Stairwells (fixed is satisfactory – include access keypads)
- UG Parking (color pan-tilt-zoom and complete coverage)
- Include sensors to assist personnel monitoring the CCTV so as to avoid boredom or miss critical activity

VISUAL XII-B-72

Vulnerability/Mitigation
Security Systems / Generic Measures
Panic / duress alarms – for general public

- Place sign at each keypad
- Reprogram system to indicate duress/problem by pressing 911*
- Keypads linked to CCTV monitoring system for alarm
- Keypads added to plaza UG parking levels with CCTV coverage



BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-72

Vulnerability/Mitigation (Security Systems / Generic Measures)

Expand Panic /Duress Keypads for General Public Use

- Signage
- Alternate input 911* for example rather than just the Duress PIN
- Exapnd to Plaza Underground Parking
- Include CCTV coverage of keypads

VISUAL XII-B-73


Vulnerability/Mitigation
Equipment Ops and Maintenance / General Measures

Confirm sufficient fuel capacity for emergency generators to cover longest historical outage

- Starting estimate: 0.08 gal/KW/hr
- Once per year measure consumption at normal to high load
- Coordinate timely resupply

Confirm battery capacity for UPS on all systems

- Once per year measure capacity



BUILDING DESIGN FOR HOMELAND SECURITY Unit XII-U-73

Vulnerability/Mitigation (Equipment Ops and Maintenance / Generic Measures)

Confirm Fuel Capacity against Maximum Consumption Annually

- Rules of Thumb for initial analysis
-

Confirm UPS Battery Capacity Annually

- 10 minutes to 2 hours stated in Case Study

- Everything connected that needs to be connected?
- 10 minutes capacity can go to zero minutes easily, especially if backup generator does not start on first attempt
- Most functions can last up to 4.75days at maximum generator load
- National Financial Services Company, if all generators needed at maximum load, only can run for 9.66 hours.
 - Even with triple redundancy this would only give 28.9 hours of capacity
 - Supply lines have some capacity, but pumping becomes a problem

Transition

This completes the Building Design for Homeland Security instruction. In this course, you have learned how to perform a multihazard risk assessment of a building and have become familiar with the key concepts of how to protect buildings from manmade threats and hazards:

- Asset Value
- Design Basis Threat
- Levels of Protection
- Layers of Defense
- Vulnerability Assessment

INSTRUCTOR NOTES

CONTENT/ACTIVITY

- Risk Assessment
- Mitigation Options

Using the approach and guidance provided in **FEMA 426**, the majority of building owners should be able to complete a risk assessment of their building in a few days and identify the primary vulnerabilities, mitigation options, and make informed decisions on the ability of their building to survive, recover, and operate should an attack or event occur.

Course certificates will be presented in the next unit.

**UNIT XII-B CASE STUDY ACTIVITY:
PREPARATION AND PRESENTATION OF GROUP RESULTS
(Urban Version)**

In this activity, students work with their groups to finalize their assessments, decide on high priority risk concerns, determine appropriate mitigation measures, and present findings to the class. The student presenter(s) will decide on the number of asset-threat/hazard pairs to present and the mitigation measures to apply. Of great importance is the groups rationale for the selection of these high risk asset-threat/hazard pairs and the rationale for the recommended mitigation measures. In light of limited resources that building owners/decision makers have to work with, the presenter(s) will identify the top three asset-threat/hazard pairs that their assessment identified and the top three mitigation measures that they would recommend to have funded using those limited resources. No Cost / Low Cost recommended mitigation measures are always welcome as procedural changes can derive significant benefit.

Requirements

1. Based on findings from the previous activities completed in the previous 11 instruction units, complete the following table. Ensure the top three risks and the top three mitigation measures are identified.
2. Select one or two presenters from the assessment team to present the team's conclusions and their recommendations with rationale and justifications to the class in a 5-7 minute presentation.

NOTE: There are no entries below for instructors as all potential information based upon school solutions to this point has already been included at the end of Units IX and X Instructor Guides. There are so many student assessment team approaches for selecting mitigation measures due to variations already seen that to provide a school solution for this instruction unit has very limited use.

The key to this instruction unit is the rationale of selection based upon the Risk Matrix developed by each student assessment team and how the mitigation measures selected are to be implemented.

Prioritized Asset-Threat/Hazard Pair of Interest	Prioritized Mitigation Measures	Rationale

Prioritized Asset-Threat/Hazard Pair of Interest	Prioritized Mitigation Measures	Rationale