AC 2007-2480: BUILDING SECURITY AND BIO-CHEMICAL TERRORISM ? AN INTERDISCIPLINARY COURSE

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Building Security and Bio-Chemical Terrorism – An Interdisciplinary Course

Abstract

The terrorist attacks on September 11, 2001 and the subsequent anthrax incidents raised several questions as to how the U.S. Government can better protect its citizens and cities against the use of chemical and/or biological agents (CBA) as weapons of mass destruction (WMD). The enemy that U.S. faces today is hydra-headed with no clearly defined frontline that makes it difficult to fight. In fact, the U.S. currently finds itself in an asymmetric warfare. Its geographical isolation is no longer a sufficient barrier for preventing attacks on its citizens and cities. Most Americans spend, at least 90% of their time in buildings – Schools, offices, homes etc. Buildings are vulnerable targets for bio-chemical terrorism because the high population densities allow for maximum effect. In addition, confined space means relatively small amount of CBA can have a substantial impact. Coupled with these, the economic and psychological impact of an attack can be very high. A review of engineering courses reveals that securing buildings against bioterrorism has not been sufficiently addressed in the engineering curricula. Everyday that we delay in making building owners and building professionals such as architects and civil engineers aware of the consequences of their inaction in addressing the threat posed by bioterrorism, not only do we undermine one of the most important goals of securing our homeland, but also contribute to a weakness that terrorists can exploit to their advantage. Building professionals therefore must be educated on the potential threats of bioterrorism, and how these may be mitigated. The paper describes an interdisciplinary course in an aspect of buildings security - bioterrorism - and how it can be offered as a course to building professionals to help combat the growing threats of bioterrorism.

Introduction

The 9/11 terrorist attacks and the subsequent anthrax incidents in the U.S. suggest that much more efforts are needed to protect buildings against CBA attacks. Buildings are attractive targets because of the high density of people in them at any given time and the fact that most people in the U.S. are known to spend about 90% of their time indoors; homes, schools, offices etc.[1]

In response to the fears, chaos and destruction that followed the September 11 attacks, federal, state, and local authorities have issued safety and other protective measures to safeguard high profile buildings and facilities against CBA attacks. Some private building owners and operators have also taken steps to increase security. In fact, building owners and building designers no longer share the illusion that their buildings are "immune" against terrorist attacks, but rather have accepted the fact that these buildings are indeed vulnerable.[2]

Today, terrorist attacks can impact anyone, at any time, at any location, and can take several forms.[3] Unfortunately, not all buildings are well protected, and hence designers and owners may have to worry about more than mere moral culpability for the loss of life that ensues. They also face potential civil lawsuits, since September 11th-style attacks against buildings are now foreseeable under the *"Totality of the Circumstances"* test.[4] Building owners and designers can no longer circumvent the legal liability by arguing that a release of chemical or biological agents in a building's heating, ventilating, and air-conditioning (HVAC) system, for instance, was unforeseeable.

For those who would like to hedge the risk of an attack, the situation is also bleak. Indeed, the Terrorist Risk Insurance Act (TRIA) has been enacted to insure, among others, commercial buildings against terrorist attacks. TRIA is, however, restricted to the use of conventional weapons and attacks by foreign terrorists.[5] That is to say, attacks by either domestic terrorists or involving chemical, biological, radiological, and nuclear (CBRN) weapons, are excluded from this act. It is therefore incumbent upon every commercial building owner to find ways of preventing CBA incidents from occurring, or to reduce the impact of CBA incidents should they occur.

Typical engineering curriculums involving buildings have focused on building design, HVAC systems, building envelope etc, with hardly any emphasis dedicated to bio-security. A recent review of engineering courses reveals that securing buildings against bioterrorism has not been sufficiently addressed in the engineering curricula. As a matter of fact, the courses offered in the traditional academic programs in science and engineering do not address CBA issues in the context of homeland security. Especially, there is not much to offer to building professionals. Indeed, our review of courses offered by some prominent universities in the Southeastern part of the United States, as well as those offered by other institutes and centers related to Homeland Security, reveal that issues that are of paramount importance to building professionals are yet to be addressed. Even where attempts were made to provide these courses, they were mostly offered to prepare local officials and health care workers in dealing with emergency situations in the event of bio-terrorist attacks.

We believe fervently, that the academic or educational loophole in securing buildings against bioterrorism can only be remedied through the proper educational or curricular restructuring, especially, in science and engineering, to educate building professionals or students pursing careers in building - architectural, mechanical, civil, chemical engineering etc. - in this aspect of homeland security. This will help them meet the bio-security related challenges, from both the perspective of preparedness and mitigation. We acknowledge the fact that students of today are loaded with heavy course-loads; still, doing nothing to protect the homeland is not a viable option.

Everyday that we delay in making building owners and building professionals such as architects, civil and mechanical engineers aware of the consequences of their inability in addressing the threat posed by bioterrorism, not only do we undermine one of the fundamental goals of homeland security, but also contribute to a weakness that terrorists can exploit to their advantage. Building professionals therefore must be educated on the potential threats of bioterrorism, and how these may be mitigated. Given the intricate nature of bioterrorism and how it can impact building design, operation and system, any course meant to educate people on protecting buildings against bioterrorism cannot be effective, unless it is addressed in an interdisciplinary fashion.

This paper describes an interdisciplinary course in building security against bioterrorism, aimed at educating building professionals and other stakeholders in the building industry against any potential threat of bioterrorism. A course outline will be briefly discussed, which spans from; the introduction, dispersion and transport of CBA; emergency response plans; mitigation measures; guidance, standards and tools; risk management; decontamination and remediation, and

economic analysis. It is not the intent of this paper to discuss the course plan in any great details, since the course planning and implementation is still an ongoing exercise. It is, however, hoped that as the course evolves over time a detailed assessment and discussion will then be presented at an opportune time in future.

Course Contents

The "Building Security and Bio-Chemical Terrorism" course can be taught to undergraduate seniors and graduate students in both science and engineering, as well as to social and political scientists. Although we limit the discussion over here to science and engineering curricula, the course material can, with minor modifications, be suitable for social science and political science curricula. It can be taught in a traditional lecture or as a case study. The issue of bioterrorism is so broad and diverse that to make the course very useful and attractive to students in science and engineering we consider the following topics as essential for a 3-credit course.

Course Description:

The purpose of this course, as stated explicitly above, is to educate building professionals and other stakeholders in the building industry to be positioned to deal with protecting buildings against chemical and/or biological attacks. The course covers the following topics: introduction to Chemical and Biological Agents (CBA) and their methods of dispersion and transportation; how a plan can be developed to mitigate the threat of bioterrorism; use of safe construction and design, and other mitigation strategies such as high efficiency particulate air filters, ultraviolet germicidal irradiation (UVGI) system and air cleaners; risk management as a tool to mitigate bioterrorism; decontamination and remediation after bioterrorist attacks; legal issues involving bioterrorist attacks on buildings; and economic impacts of bioterrorism. The course may be outlined as discussed below. It should, however, be emphasized that the order of the lecture is not rigid, but can be arranged in several other combinations without loss of information.

Course Outline:

Module 1: Introduction, Dispersion and Transport of Chemical and Biological Agents (CBA)
This module covers topics such as CBA and their effects on building security. We also discuss what CBA are, the various types of chemical and biological agents, the distinction between chemical agents and biological agents, how they may be introduced, dispersed and transported in buildings. In addition, we discuss what makes buildings attractive targets for bioterrorism, and then introduce some of the mitigating measures to deal with bio-security.

Module 2: Emergency Response Plan for Building Occupants
This module covers the design and implementation of response plan to protect buildings against CBA incidents. A discussion of the scenarios under which CBA may be released is made. We then discuss the plan in more details to include the responsibilities of both building occupants and building managers as well as the conditions under which building should be evacuated or occupants be allowed to shelter-in-place (SIP) during an emergency bioterrorist incidents. Furthermore, this section of the course deals with the types of SIP, how they may be implemented. Case studies of the use of SIP in real life situations are also discussed.

Module 3: Control Strategies for Mitigating Bioterrorism
This section covers the control strategies for reducing contaminant exposure in indoor air. These strategies include Ventilation and Pressurization; Filtration and Air-cleaning Systems; as well as Ultraviolet Germicidal Irradiation (UVGI) Systems. The implementations, limitations and applicability of each system will also be discussed. ASHRAE Standards 52.1 & 52.2 will be discussed in relation to the selection of particulate air filters useful for dealing with bio-aerosols and other particulate matter. This selection will be based on the minimum efficiency rating values (MERV) and their effectiveness within any given size range. We will also assess the recommendations of the ASHRAE 2003 Homeland Security Report and its impacts on building security against bioterrorism. The effectiveness of the building envelope in preventing or reducing contaminants from entering or leaving the building, is also crucial and will be examined.

Module 4: HVAC System Design and Operating Issues for Homeland Security
This module discusses the HVAC design considerations that should be made for the system to be effective against CBA incidents. It also examines the effects of the HVAC system operation and how it should function to avoid the system being the medium through which contaminants may be brought into and/or disseminated within the building. The actions that should be taken for any particular scenario of contaminant release will also be a subject for discussion.

Module 5: Risk Management
The risk management portion of the course will discuss a guide to mitigate potential CBA terrorist attacks against buildings using risk management techniques. The discussion will include risk identification, risk assessment, controls, as well as performance monitoring.

Module 6: Decontamination and Remediation
When all planning and protection fails, there should be means to deal with any fallout of bioterrorist attacks. The cleanup and associated issues for sites contaminated with CBA are of concern. Topics will include decontamination process - detection, contamination, decontamination, and disposal. Guidelines on how to prepare decontaminated areas at suspected CBA sites will also be of interest. In addition, the economic assessment of decontamination and remediation will also be discussed.

Module 7: Special Topics
Legal Issues: Attacks involving CBA agents are now foreseeable.[4] Therefore, there is the need to address bioterrorism, since owners of building could be found liable for any attack involving CBA. There are also issues with the economic effects of having to relocate business or lost productivity; physical destruction or loss of assets; loss of lives and ensuing legal wrangling; and psychological effects of attacks.

Public Participation in Constructing a Safer Building: In addition to the legal liability, builders and owners must follow certain minimum standards for the construction of safer buildings. These may include federal, state and international building codes and how they may be modified to reduce the threat from bio-terrorism. All of these will be subjects for discussion.

Guidance and Tools: Discussion of guidance and tools that can be used to address the threat of bioterrorism. Guidance and Standards will be examined from organizations including ASHRAE (American Society of Heating, Refrigerating, and Air-Conditioning, Engineers); LBNL (Lawrence Berkeley National Laboratory); NFPA (National Fire Protection Association); AIA (American Institute of Architects), NAFA (National Air Filtration Association); DOD (Department of Defense); FEMA (Federal Emergency Management Agency); NIOSH (National Institute for Occupational Safety and Health); NIH (National Institutes of Health); and CDC (Centers for Disease Control). Tools that will be discussed include multi-zonal and computational fluid dynamic (CFD) models.

Suggested Course Textbooks

The authors are of the opinion that this course is better delivered in a team-taught manner, due to the fact that most of the issues related to bioterrorism in buildings involve several topics or subjects – HVAC controls, filtrations, chemical and biological agents and their dissemination, building design considerations, decontamination, risk management, economics etc. Consequently, recommending any particular course textbook(s) will be an arduous task just for the very reasons that the course involves too many issues/topics which are sometimes unrelated, and hence make selecting any particular textbook(s) difficult. That notwithstanding, the following course textbooks (not an exhausted list) can serve as a way forward:

1. Kowalski, W. J., 2002, Immune Building Systems Technology. New York, NY: McGraw-Hill

2. Demkin, J.A. Ed., 2004, Security Planning and Design – A Guide for Architects and Building Design Professionals. The American Institute of Architects (AIA), Hoboken, NJ: John Wiley & Sons, Inc.

3. NRC, 2005, Reopening Public Facilities after a Biological Attack – A Decision Making Framework. National Research Council, Washington, DC: The National Academies Press

Conclusion

The threat posed by chemical and/or biological agents is very intricate. As such, there is the need to educate building professionals on how best to design and operate buildings to mitigate or reduce this threat. A review of a cross-section of science and engineering curricula reveals that, broadly speaking, issues involving bio-security has not been addressed sufficiently in most of these programs. This paper introduced an interdisciplinary course that addresses the protection of buildings against bioterrorism. This course is undergoing some revision, but we still believe that it is a step in the right direction to educate building professional and other stakeholders in the building industry on how best to secure their assets and workplaces against bioterrorism.

Acknowledgement

Funding from the US Environmental Protection Agency under contract number EP-C-05-013 is acknowledged.

References

1. "An office Building Occupant's Guide to Indoor Air Quality," US Environmental Protection Agency (EPA), Office of Air and Radiation (OAR), Indoor Environments Division, EPA-402-K-97-003, October 1997.
2. Yeboah, F.E., Chowdhury, F. Ilias, S. Singh, H. and L. Sparks, 2007, "Protecting Buildings against Bioterrorism – Review of Guidance and Tools" ASHRAE Transactions Vol. 113, Part 1 (Forthcoming)
3. "Unified Facilities Criteria (UFC) - DoD Minimum Antiterrorism Standard for Buildings," U.S. Department of Defense, Washington, DC, UFC 4-010-01, October 8, 2003.
4. Pharr, S. M. and K. E. Menzel, 2005, "Thinking about the Unthinkable: Landowner and Design Professional Liability for September 11-style Attacks," Pharr & Boynton, Winston Salem, NC, Matter/Doc No.: 00-9999/00040721.DOC, October 17, 2005
5. "Terrorism Insurance and the Evolving Terrorist Threat," Research Brief, RAND Center for Terrorism Risk Management Policy, Santa Monica, CA, 2005.