

## **2006-746: ADDRESSING HOMELAND SECURITY IN A PROCESS SAFETY COURSE**

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# Addressing Homeland Security in Process Safety

## Abstract

Chemical plants, like other potential terrorist targets, are subjects of intense scrutiny as the federal government and other agencies seek to protect the public from harm. Engineering students must be kept aware of the role they will be expected to play in maintaining security in a plant environment and to protect the public from the worst of unexpected occurrences. With the rapid changes in chemical plant security that began well before 2001 and continue today, chemical engineering educators must be provided with current information pertinent to existing classes that will empower tomorrow's engineers to function effectively.

A module developed to integrate topics in homeland security into a course in Ethics, Safety, and Professionalism is described. This module introduces students to the role of government, industry groups, and individual plants in maintaining as safe an environment as reasonably possible in an age of terrorism. The focus of the module is to tie elements of the course and curriculum previously discussed to a rapidly changing contemporary issue. Topics tied to the module include the role of government (executive and legislative roles and current activities in both with regard to plant safety, previously introduced in the context of safety and environmental law), green engineering (just-in-time production, waste minimization), fail-safes, and risk analysis (HAZOP and other methods). New topics include site vulnerability analysis, ventilation security, and cybersecurity. Extensive documentation is provided, as well as references to current information available regarding plant security.

## Introduction

Among the effects of terroristic attacks in recent years is a heightened awareness of the need to secure chemical plants from deliberately initiated catastrophic failures. While terrorism is not a new concern of the chemical industry, the current state of world affairs suggest that new chemical engineers should enter industry understanding how approaches to plant and process safety address terrorism. Additionally, they should understand the role of government in establishing minimal requirements for safety, be aware of the role of industrial lobbying groups in the legislative process, and place the response by the chemical industry to terroristic threats in the context of history and current events.

A module intended for a course in process safety was developed to address these concerns. The specific course incorporates safety, ethics, and professionalism in a one semester hour survey course. Following coverage of typical safety topics including toxicology, industrial hygiene, hazards identification, risk assessment, and others, a topic entitled "Safeguarding plants from terror" was integrated into the course. In addition to addressing the goals above, topics previously covered in class were to be re-emphasized. The module is intended to primarily achieve the objective of tying contemporary issues to objectives already independently assessed.

This paper is intended to introduce resources available and provide a basic background on homeland security in chemical plants to chemical engineering faculty interested in bringing this contemporary issue into their classroom. This particular implementation is only suitable to

this particular course offering for a particular year, but the resources provide a basis for adaptation to any similar course. This module description follows describes the lecture structure for and material covered in a single 75 minute class period focused on discussion as a class activity, with routine safety oriented problems from other sources assigned as homework (i.e., a safety oriented problem on mass transfer). Assessment on this topic is blended with other topics in the course on exams, so the impact of this module has not been measured independently. The module as described has been offered twice, with significant revision and addition between the offerings. The observations of the instructor are included in the summary statement.

## Module Description

The module begins by asking three questions:

- What atypical risks related to terrorism are there to chemical plants?
- Are current safeguards adequate?
- Who is responsible for protecting chemical plants and their communities from threats?

A brief discussion ensues, with students led to conclude that the risks associated with terrorism are essentially the same as they would ordinarily need to consider. The key difference is that the initiating events are extraordinary. Consequently, the approaches taken using risk analysis to address only issues of highest probabilities and/or greatest impact must consider these unlikely but possible events. The same tools they had already studied in the broader context of plant and process safety were still applicable.<sup>1</sup>

The third question addresses an issue which was introduced when discussing OSHA, NIOSH, EPA, and other government agencies which have an impact on plant operations and design. Civics is not a typical topic in chemical engineering curricula, but an understanding of the legislative and executive processes which impact the rules is key to effective management of chemical plants. Additionally, in a free-market economy government plays an important role in setting the baseline for expenditures on things like worker safety and environmental protection. Understanding the reason laws are required when engineering codes of ethics already address appropriate decisions is emphasized, highlighting the inherent conflict between a competitive marketplace and the highest ethical standards of practice in engineering.

Following this discussion, the most noticeable changes in the security posture of chemical plants immediately following the September 2001 attacks are described. These included increased surveillance, improved security fencing, vehicle inspections, stricter access control, and improvements in communications between plants and local government. Of particular note to the students was the fact we had no plant tours during the 2001-2002 school year due to evolving access policies.

The response of the United States Congress was considered next. In particular, students were given copies of portions of bills introduced to the U.S. Senate beginning in 2001 dealing with chemical plant security.<sup>2,3</sup> From the summaries, students were asked to identify what the law would contribute to security. This provided an opportunity to review the legislative process, the structure of the executive branch, and the distinct differences between a law and

administrative rules responding to that mandate. The role of a congressional resolution was also considered in recent discussions.<sup>4</sup>

Once the topic of the executive branch implementing laws passed by Congress, the push by the Environmental Protection Agency (EPA) to play a lead role in security in the months following the September 2001 attacks was highlighted.<sup>5</sup> Discussion centered on the possible motivation for EPA to become involved—was it the original mandate of EPA, the qualifications of EPA personnel, or was it the billions of dollars expected to fund the agencies participating in these efforts? Other agencies with roles in security as it pertains to chemical plants were also discussed as the genesis of NIOSH and OSHA were also reviewed.

As the course has been offered in subsequent years, additional events have been added to the course. For example, in 2002 the Senate had a Republican majority. Consequently, a new proposal for chemical plant security legislation was proposed.<sup>3</sup> Additionally, by this time the Department of Homeland Security (DHS) was established as a cabinet-level department. From these specific historical points the motivation for security laws were discussed. The key reasons for a federal law covering homeland security were proposed as follows:

- National security is a Constitutionally established role of the federal government, providing for a “common defense” as well as to “promote the general welfare”
- A free-market requires a “level playing field” to ensure that competitive companies conform to at least a minimal set of standards for safety and security
- The federal government must coordinate the efforts of various agencies at the national, state, and local level
- Public perception of a proactive government plays a key role in political considerations of electability

The last point was considered a key motivating factor for at least publicly talking about plant security. The lack of new law (under both Democratic and Republican controlled Senates) to specifically address chemical security seems indicative of a situation where current laws and regulations appear to be sufficient. Nonetheless, the topic of chemical plant security emerged again during the presidential campaign of 2003-2004. During the presidential candidate debate of September 30, 2004, Senator John Kerry of Massachusetts said, “The President also unfortunately gave in to the chemical industry, which didn’t want to do some of the things necessary to strengthen our chemical plant exposure.”<sup>6</sup> While apparently intended as a criticism of his opponent, those involved in the chemical industry might construe this statement as an accusation that their industry was unwilling to protect plants against terror.

This event provided an opportunity to introduce industry lobbying groups to students. The American Chemistry Council (ACC)<sup>7</sup> released a statement on October 1, 2004, reaffirming industry support of security legislation and emphasizing how much has been done to date to secure plants.<sup>8</sup> Through the remainder of the module, additional industrial groups, such as the Chlorine Institute (CI)<sup>9</sup> and the Synthetic Organic Chemical Manufacturers Association (SOCMA)<sup>10</sup>, as well as groups like the American Chemical Society<sup>11</sup> and the American Institute of Chemical Engineers (AIChE)<sup>12</sup> were introduced. Their role as the “voices” of the chemical industry, expert advisors to government, and advocates for their constituents were discussed.

The press release from a lobbying group was not sufficient to address Senator Kerry's statement for this class, so a more complete discussion of what was being done by the chemical industry to secure plants in the absence of specific legislation was required. For example, a report from the Associate Press (AP) that the DHS was working with "over 300 facilities considered the most vulnerable if attached to put in place enhanced measures that go above and beyond the requirements of any legislation."<sup>13</sup> The transcript of a discussion on NBC's "Meet the Press" on the topic of chemical security was distributed in class.<sup>14</sup>

Moving backwards in time, a General Accounting Office report from March 2003 was discussed.<sup>15</sup> This report was prepared at the request of several members of Congress to establish the need for additional efforts for securing chemical facilities. The unusually descriptive title indicates "Voluntary Initiatives Are Under Way at Chemical Facilities, but the Extent of Security Preparedness Is Unknown." The Brookings Institution<sup>16</sup>, "a private organization devoted to analyzing public policy issues at the national level," reported concern regarding chemical plants in 2000. The Rand Corporation<sup>17</sup>, "a nonprofit research organization providing objective analysis and effective solutions that address the challenges facing the public and private sectors around the world," issued a report in the 1970's expressing the same concern.

Clearly, the chemical industry was aware of the potential impact of terror on plant safety for several decades. The next question to be addressed is whether the industry has in place practices and policies which effectively address the threat. The thesis was proposed that chemical plants in the United States already follow policies which would minimize the impact of any attack, and those procedures are a result of environmental concerns; previous accidents; previous laws and regulations; and inherently safe design principles.<sup>18</sup> These assertions were discussed in terms of the topics covered previously in class, such as HAZOP, risk analysis, hazard identification, and numerous other methods surveyed. It was the consensus of the class that if those methods are followed that existing approaches may be sufficient. It was, however, noted that low probability events such as multiple simultaneous catastrophic failures would need to be given greater attention than ordinary approaches to risk analysis might otherwise suggest.

New formal approaches designed specifically for security have been introduced since September 2001. ACC, CI, and SOCMA published "Site Security Guidelines for the U.S. Chemical Industry"<sup>19</sup> in October of 2001. This document emphasizes the balance between chemical security and risk "commensurate with threat and likelihood of occurrence." The Center for Chemical Process Safety<sup>20</sup>, an AIChE/Industry alliance, distributed "Guidelines for Analyzing and Managing the Security Vulnerabilities of Fixed Chemical Sites"<sup>21</sup> in August 2001. The approaches recommended by CCPS are "performance-based"; specific procedures are not prescribed, but rather approaches that identify and characterize the risk. Then it suggests that planning should be "risk-based", with the highest level of consideration given to the most hazardous materials with greatest potential impact and with least difficulty of attack.

These basic recommendations of the CCPS text are consistent with the methods discussed previously in this course. Some of the specifics of the proposed methods were discussed next. First, we looked at the list of threats, which included concerns prior to 2001: disgruntled employees or contractors (which ties into one theory previously discussed in a case study of the Bhopal disaster), criminals, violent activists, and terrorists, whether they be political, religious, or environmental. The need to consider insiders, outsiders, and collusion in evaluating threat

risks was also discussed. We then considered causes of vulnerabilities, factors contributing to the attractiveness of targets, and the topologies of strategies for securing plants.

To summarize the discussion, a list of protocols to minimize the impact of terrorism was presented. It should be noted that none of these protocols are new. Some are modified to consider higher likelihoods of improbable events.

- Communication between a plant, the community, and government agencies
- Just-in-time production, waste minimization, best practices with hazardous materials, inherently safe design, “green” engineering
- HAZOP analysis
- Redundant control systems with fail-safes
- Venting systems with neutralization equipment
- Mechanical interlocks

Some newer concerns for safety planning were also enumerated. These included preventing theft of materials, threats to infrastructure, office ventilation systems<sup>22</sup>, mail handling, and network connectivity/automation<sup>23</sup>. More specific detail regarding cybersecurity was featured during the last offering of this course due to the particular interest of the instructor.

### **Other Sources of Information**

In addition to the specific resources cited previously, several other resources are available. For example, Piluso et al. have published an article describing Matlab modules in process security in a design context.<sup>24</sup> Information regarding proposed legislation and congressional resolutions may be located through the Library of Congress.<sup>25</sup> Transcripts and statements from a 2005 series of Senatorial committee hearings may be obtained from the Senate Committee on Homeland Security and Governmental Affairs.<sup>26</sup> *Chemical Engineering Progress* frequently provides updates regarding pending legislation and regulations affecting plant security.<sup>27,28,29</sup> Government agencies such as the Federal Bureau of Investigation, Centers for Disease Control, Department of Homeland Security, and the EPA all publish information related to plant security.

### **Summary and Conclusions**

This module successfully incorporated an applied civics lesson into the curriculum; reinforced the applicability of lessons in risk assessment, environmental best practices, and safety systems and protocols; introduced the role of industrial lobbyists, and gave the current status of industrial and government response to terrorist threats. Students responded positively to the module, though the instructor was frustrated by the student’s lack of background in the fundamentals of how their government functions as evidenced by the confusion evident during discussion. Future offerings will include specific assessment using pre- and post- surveys to assess changes in student awareness of both civics and homeland security as seen from the perspective of chemical plant security.

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