In the wake of the September 11, 2001, attacks, protection from hazards associated with terrorism response has become a high priority for the entire emergency responder community. For many of the discussion participants, September 11 provided a graphic example of the wide range of hazards and protection needs associated with terrorism response.

Most large fire departments that participated in this study expressed confidence in their ability to respond to typical hazardous materials (hazmat) events, such as hazardous cargo spills from trucks involved in highway accidents. In contrast, these same departments were greatly concerned about their ability to respond to large or multiple acts of terrorism. For instance, terrorism response could require participation of rank-and-file first responders who are typically underequipped and undertrained for such activities. In addition, response to an act of terrorism is likely to unfold more quickly, in more unexpected locations, and with much more uncertainty than response to an industrial hazmat incident. Concern about protection needs for more conventional hazardous materials response was also raised in the discussions, although it did not emerge as an area of major concern for most of the emergency responder departments we visited.²

This chapter addresses a limited set of shortcomings associated with protective gear for conventional hazmat response and major concerns over protection when dealing with a terrorist attack that may employ chemical, biological, radiological, or other hazardous materials. Identifying and monitoring hazardous materials were also mentioned as being important components to protecting

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¹In this report, conventional hazmat response refers to situations in which specially trained and equipped hazmat technicians are deployed in response to an initial assessment made by personnel at an incident scene. It is not normally part of the first response.

²As discussed in Chapter One, the sample of departments we used is biased toward larger departments relative to the national average.
emergency workers who are responding to a hazmat or terrorist event. This topic is further addressed in Chapter Seven.

CONVENTIONAL HAZARDOUS MATERIALS RESPONSE PROTECTION

Twenty-five of the 33 fire departments included in this study provide hazmat response capability. This finding follows an observation that arose in our discussions with responders—hazmat demands are increasing. As Figure 2.3 illustrated, there was an 86 percent increase in the number of fire department hazmat responses between 1986 and 2000. Participants also noted that hazmat response is becoming more diverse in the types of materials and situations that are involved, and it is no longer solely the domain of large fire departments.

As economic development and the presence of hazardous materials become more widespread in the United States (e.g., many rural communities now have industrial facilities or have a highway, rail line, or pipeline passing through their jurisdictions), more medium- and small-size departments are instituting hazmat response capabilities in response to emerging local needs. One participant drew an analogy to emergency medical service response: Just as the increase in medical calls has led many departments to increase the number of emergency medical service responders and provide EMS response capability from multiple stations, the emergency responder community may witness an increase in the number of hazmat responders and an expansion of their emergency response role.³

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Our mission has gone from “Put the wet stuff on the red stuff” to making our communities a safe place. We are doing many more things, and it is becoming more technologically demanding.

—Fire service leader

Despite the trend toward increased hazmat calls, many fire departments do not have a hazmat response capability. Instead, they rely on a neighboring locality’s capabilities. Community views on the merits of this approach varied. Some departments were satisfied with such arrangements, while others felt that more local capabilities were necessary. A participant from one such department expressed grave concerns regarding the low level of hazmat training for the firefighters in his department and the insufficient number of trained personnel regionally available to respond to a large industrial or transportation-related hazmat event.

³In several fire departments that participated in the study, all firefighters were also certified EMTs. In contrast, in only one department was every firefighter also a hazmat technician.
In assessing hazmat protection, a common theme in the discussions was that protection for conventional hazmat response was generally very good. Many participants attributed the quality of protection to the fact that, compared with firefighting, most hazmat response employs a less-urgent and more-methodical protocol-driven approach. This difference between firefighting and hazmat response may be because rescue is less often a component of hazmat response, and because hazmat response is newer and less tradition-bound than firefighting. As a result, personal protection technologies are designed with high levels of protection and training in mind. Ancillary gear requirements, such as pockets, the ability to be donned rapidly, and allowing for a high degree of agility are less of a priority. Nonetheless, some shortcomings with protection for conventional hazmat response were identified.

One concern that participants highlighted was the need for protection against substances or combinations of substances that present multiple hazards (i.e., “multicharacteristic” protection). Hazmat personal protection is designed primarily for chemical protection, but in many instances, the wearer is exposed to other hazards as well, the most common one being fire. Hazmat spills often occur as the result of vehicle collisions or structural collapse, in which the potential for fire may be high, and many hazardous chemicals are highly flammable. Referring to its poor flame resistance, one participant called a Level-A suit a “body-bag with a window.” While current standards do require hazmat suits to have a certain level of flash protection, manufacturers typically meet these standards by providing a flame-resistant overcover, a solution that was generally viewed as being suboptimal by the hazmat responders with whom we met. Other combinations of hazards related to terrorism for which adequate protection is a concern are discussed in the next section.

Secondary concerns among some departments were the difficulty in reusing hazmat suits and the uncertainty surrounding that reuse. The difficulty arises from the need to decontaminate, pressure test, and visually inspect suits after each use, and the uncertainty arises from lingering doubts about whether the suits are really clean. These concerns, along with the high cost of reusable hazmat suits, have resulted in a nearly wholesale shift in the emergency response community to inexpensive, “limited use” (typically interpreted to mean “disposable”) hazmat suits.

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4 The Environmental Protection Agency classifies four levels of protective clothing ensembles to be worn when dealing with hazardous materials. A Level-A suit fully encapsulates the body so that no vapor penetrates the suit; respiratory protection is provided through supplied air (such as an SCBA). A Level-B suit is a full-body chemical-resistant suit that may introduce vapors; respiratory protection and other protection features are normally the same as with a Level-A suit. A Level-C suit is a full-body chemical suit with the same properties as a Level-B suit, except that an air-purifying respirator is used instead of supplied-air respiratory protection. A Level-D suit protects against contact exposure only, and no respiratory protection is required.
TERRORISM PROTECTION

A recurrent major concern among emergency responders was protection from chemical, biological, radiological, and conventional explosive terrorism. The threat of terrorism directed toward U.S. citizens has heightened emergency responders’ awareness of the risks and hazards involved in responding to such incidents. This concern transcends service divisions and represents one of the largest gaps between perceived hazards and available protection we discovered during our discussions with emergency responders. The majority of responders feel vastly underprotected against the consequences of chemical, biological, or radiological terrorist attacks.

Shortcomings with Conventional PPT

WMD has dramatically changed how bomb technicians work.

—Bomb squad representative

While many municipalities have separate hazmat, bomb, and SWAT response capabilities, these resources could be quickly overwhelmed after a terrorist attack. In the past, a terrorist threat was typically conceived as a static event—for example, a package containing an explosive device delivered to a target location—for which bomb technicians have well-developed safety protocols and equipment that emphasize defensive tactics. In such cases, remote-controlled robots and disrupters (bomb deactivation devices) have protected responders by enabling them to avoid having to handle dangerous materials.

Participants also expressed concern about having adequate protection against new combinations of hazards and about responder roles that are emerging as a result of the terrorist threat. For example, there is rising concern about chemical or “dirty” bombs, in which an explosive is used to disperse a chemical or radiological agent. To prevent the release of WMD agents while dealing with such devices requires a return to the “live entry” and manual disarming practices of the past, which then requires a combination of chemical and explosive protection. Similarly, the increasing role of the “human element” in crime and terrorism, such as heavily armed assailants or terrorists seeking to create maximum impact, may require responders to use aggressive intervention tactics. These more-aggressive tactics may require ensembles with chemical, assault, and ballistic protection that still allow for vigorous physical activity. Protecting responders in these cases requires marrying hazmat and SWAT or bomb squad protective equipment. For example, conventional bomb suits have been modified to be worn over a Level-B hazmat suit in conjunction with an SCBA. Several of the bomb technicians we interviewed expressed the concern that this solu-
tion compromises the suit’s protection against explosives and limits the wearer’s mobility when it might be needed most.

Many participants also noted that hazmat gear is not designed for extended or repeated use, which would likely be the case with a WMD event. Chemical protective suits tear easily, and protective equipment degrades with repeated decontamination.

Finally, hazmat gear traditionally has been rarely used, and, thus, is not stockpiled in significant quantities. “Most departments are not equipped to deal with several hundred contaminated victims,” said one fire service official.

**Chemical Protection Needs of Front-Line Responders**

Participants from fire, police, and emergency medical services anticipated that they would play important roles in a terrorist-type event. Police noted that they would likely be the first on the scene, would execute enforcement activities if terrorists are present, would preserve the essential characteristics of the crime scene, and would manage the perimeter of the incident site, including facilitating the removal of injured or contaminated persons. Firefighters would have primary responsibility for containing hazardous substances, suppressing fires, and conducting search and rescue for victims. Emergency medical technicians and paramedics would likely assist with rescue operations and render medical care to injured individuals.

Because of the potential for rapid onset and large scale with such events, those activities may have to be carried out by front-line responders rather than specialized units. Consequently, many of the emergency response departments expressed a strong desire for chemical protection for the “regular” nonspecialist firefighter, patrol officer, paramedic, or EMT. Prompted by the increased threat of terrorism, available federal grant money, a strong sense of urgency to be fully prepared for response to terrorist attacks, and, in some cases, experience in responding to terrorism, several fire and police departments were considering or, in several cases, had acquired chemical and respiratory protection for all of their emergency responders.

> We are working toward respiratory protection for every police officer on the street.
> 
> —Law enforcement representative

After the problems with inadequate personal protection that were experienced in the aftermath of the 1995 attack on the Murrah Federal Building in Oklahoma City and the September 11, 2001, attacks, adequate chemical and respiratory protection for law enforcement is now seen as a critical component of proper
scene control (Jackson et al., 2002). Accordingly, several police departments indicated that they are equipping squad cars with chemical-protective gloves, suits, escape hoods, and respirators. Similarly, several fire departments currently stock some sort of chemical-protective suit on all apparatuses. A manufacturer noted that sales of chemical-protective suits to the (nonhazmat) fire service were on the rise. A few fire departments reported that they have also acquired emergency escape hoods. For every department that had acquired such protection, another was actively pursuing the same protection.

This trend toward increased chemical and respiratory protection reflects an important addition to the continually expanding role of the local emergency responder. This additional role has fundamental implications for individual responders in terms of how they view their responsibilities and for departments in terms of equipment and training needs, operational procedures, and regional mutual-aid agreements. This added role also has important implications for the federal government and other agencies that play a part in researching, guiding, and overseeing the development and implementation of personal protection for emergency responders. These implications include the need to reexamine the protective requirements and users’ operational needs in the design of protective equipment, operational protocols, training programs, and interagency coordination for responding to terrorist attacks.

Uncertainties Surrounding Chemical Protection

Departments don’t understand what [chemical protective clothing] is good for. They have a false sense of security.

—PPT supplier

One of the most significant findings from our discussions with the responder community on the topic of hazmat and terrorism protection is that departments are proceeding down the path of acquiring chemical and respiratory protection without having a clear understanding of what exactly they are preparing for and how to prepare for it. In some cases, participants admitted to these uncertainties but nonetheless felt that they could not wait for them to be sorted out before acting. Our discussions revealed that the issue of providing protection for chemical, biological, or radiological (CBR) terrorism is fraught with several uncertainties, including the following:

- The nature of the threats and hazards that emergency responders will face
- The types of protection that are appropriate and how to obtain them
- Whether the protective technologies will work
• How these technologies will be integrated into operational procedures.

The range of potential threats and event scenarios is vast. While departments in some regions of the country have conducted generalized threat assessments, few of the departments have assessed in much detail the anticipated hazards to which emergency responders would be exposed. As a result, there is considerable uncertainty about the hazards that emergency responders should be prepared to face after a terrorist attack. Such uncertainty frustrates efforts to design a protection program and acquire the necessary technology to support that program. Law enforcement departments, in particular, said they did not know what they should be protecting against, what level of protection was appropriate, or where to look for that appropriate protection.

Another fundamental uncertainty revolves around how well the available protective technologies will work for the anticipated situations. While hazmat protection is subject to rigorous standards and certification procedures, those requirements are designed primarily around the conventional hazmat response model. As a result, participants noted, much of the available hazmat protection is neither designed nor certified for this new role of CBR terrorism response. Thus, departments are looking outside the traditional supply channels to locate the appropriate equipment. Several departments felt compelled to forge ahead alone and use whatever guidance they could get to make purchasing decisions. For example, some departments were acquiring equipment based on standards from the International Standards Organization (ISO) and North Atlantic Treaty Organization (NATO) and other military standards, even though those standards do not apply to municipal emergency response departments in the United States. In other cases, departments were using personal connections to obtain unofficial equipment-performance evaluations that manufacturers have conducted but are unable or unwilling to publish. Several participants expressed frustration over the lack of appropriate standards and guidance in the area of CBR terrorism protection.

In response to some of these concerns, the NFPA has recently developed a protective clothing standard for chemical and biological warfare agents. This standard specifies three levels of protection based upon the ability of a protective garment to resist various substances and the durability of materials used in the garment. The goal of this standard is to establish personal protection requirements for ensembles that would (1) be available in quantity; (2) be in pristine condition; (3) be designed for single-exposure use; and (4) be easily donned and used by fire and emergency services personnel to reduce the

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5 The Environmental Protection Agency hazardous materials protective clothing classifications (Levels A-D) were defined primarily for workers at hazardous waste sites, where emergency conditions typically do not exist.
safety and health risks to those personnel during assessment, extrication, rescue, triage, and treatment operations at or involving chemical or biological terrorism incidents (National Fire Protection Association, 2001b). Because this standard was recently introduced, the emergency responder community may not have had a chance to fully evaluate it in the field.

Similarly, NIOSH has begun issuing respiratory protection standards for chemical, biological, radiological, and nuclear warfare agents. The SCBA standard was finalized in December 2001, and the first compliant SCBA was certified in June 2002. As with the NFPA chemical protection clothing standard, the influence of this standard on the emergency responder community may not be felt for some time. Standards for APRs and emergency escape hoods are currently under development.

Also unclear is how this protective technology is expected to be used. Speaking of their department’s response to anthrax calls in the autumn of 2001, one fire service leader commented, “We had 100 different approaches to these incidents.” A number of questions regarding this issue were raised in RAND’s discussions with participants:

- When is personal protective equipment to be used?
- Should personal protective equipment be used for operational purposes or for escape only?
- What activities do emergency responders envision conducting in a CBR event?
- Who will make these operational decisions?

For example, many emergency responder departments are equipping their vehicles with escape hoods that enable a responder to exit dangerous environments. However, there is currently much confusion over how a responder will know when to don the hood. In addition, if the escape hood is stored in a vehicle and the responder is away from the vehicle when a dangerous situation becomes apparent, the responder cannot access the hood. Law enforcement representatives also wondered if escape hoods would be used by police officers for operational purposes (e.g., rescues) rather than solely for exiting a hazard zone. In another example, an EMS representative noted that his service had equipped its trucks with chemical-weapon antidote auto-injector kits at great cost. However, he also raised concerns about their use and potential misuse: What if, he proposed, “You go to an incident and you think a nerve agent [is present]?” Responders will be tempted to use the kits at times when it isn’t necessary, he surmised. “It’s a problem.”
When considering the sort of activities emergency responders might conduct after a terrorist attack involving weapons of mass destruction, limitations arise from existing hazmat protection having been designed around the conventional hazmat response model. For example, firefighters cannot fight fires using current methods while wearing chemical-protective suits. Law enforcement officers, in particular, need to be able to run, access their weapons and other tools quickly, engage in covert operations, and make arrests, none of which is feasible while wearing the currently available hazmat protection equipment. Speaking of his agency’s efforts to acquire Level-C protective equipment for its officers, one police department leader stated, “Vendors have not come up with anything that is appropriate for law enforcement.”

An additional complication with existing and emerging chemical protection is the difficulty with logistics for specialized personal protective equipment. Many protective equipment components are assigned to vehicles rather than issued to individuals. The main reason is cost. For example, a firefighting apparatus may carry four chemical protective suits that are available to whomever happens to be riding on the apparatus. As a result, there is no way to ensure that the correct size suit is available for each person. Some departments address this problem simply by stocking nothing but extra-large sizes, while others stock a range of sizes. In any event, improper fit can affect both the effectiveness of the chemical protection as well as the wearer’s ability to fully function.

Most departments have not yet had an occasion to use their chemical-protective gear in an actual emergency, so the extent of the problems outlined above remain largely unknown. However, it is clear that in many cases there is a substantial gap between the perceived hazard and a clear understanding of the appropriate personal protective equipment and practices for dealing with that hazard.

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Equipment assigned to vehicles can be shared by all shifts, requiring less inventory. Also, respiratory protection assigned to vehicles for “emergency only” is often exempt from the costs of complying with a regulatory requirement dictating that equipment assigned to individuals can be used only after that individual satisfies a pulmonary fitness requirement and performs a fit test.
Chemical Protection Challenges and Alternatives

While several of the larger departments are acquiring chemical and respiratory protection, many departments reported that they were struggling to provide any such protection. Impediments to providing the protection include the additional equipment costs and the difficulty in dedicating the staff and time to conducting pulmonary physicals, fit testing, and training, especially in realistic scenarios. In some law enforcement departments, the only forms of respiratory protection they had available for their personnel were Vietnam War–era surplus military gas masks, which, according to one participant, were “usable, but for [protecting against] tear gas only, and some don’t work.” In other departments, the respiratory protection that was made available to police officers consisted of hand-me-downs from the local fire department.

Given the lack of respiratory protection, many participants mentioned the need to place greater emphasis on precautionary measures before entering the scene of an incident, such as identifying hazardous agents, determining wind direction and plume behavior, and assessing risks. Many participants also expressed the opinion that setting up incident staging areas in safe locations was imperative, and that first responders in particular were getting better at doing this. However, without specialized training, there is a limit to the ability of nonspecialist responders to take appropriate actions, even for basic functions such as hazard awareness. This is especially true in law enforcement, which one representative of big-city agency described as having no hazard awareness and no hazardous material operational training.