Every day, millions of people worldwide take underground trains to get to and from work, to visit family and friends or just for leisure. Despite the vast numbers of passengers they carry, few subway systems have imposed strict passenger or baggage screening requirements like those used in air travel. As a consequence, it is no easy task to protect passengers from terrorism. Any CBRNe event in a subway system will pose significant challenges but those associated with a chemical attack have distinct characteristics. To save the most lives in the face of a deliberate chemical release, homeland security and transit authorities must get the most out of whatever detect-to-warn technology they deploy.

A number of US metro systems have or are considering location-independent detection equipment. Various products hold promise, but to optimally mitigate a subway chemical attack, any technology must be accompanied by a comprehensive concept of operations (Conops) to ensure adequate preparation and a swift, coordinated response.

The possibility of chemical terrorism in subways is real, as the 1995 sarin gas attack on the Tokyo subway system made clear. In that incident, the perpetrators dropped and punctured sarin packets on several lines of the Tokyo subway, killing 13 people, injuring hundreds and prompting thousands to seek medical care.

Complicating the threat, several hazardous chemicals are relatively easy to obtain. Throughout the US and in many other countries, toxic industrial chemicals (TICs) are manufactured, used, transported and stored in large quantities every day. Industry produces these chemicals to create a wide spectrum of commercial products such as fuels, plastics, fiberglass and common household cleaners. Many are powerful in their own right and others can be used to produce still more lethal agents. Additionally, though harder to acquire, chemical warfare agents (CWAs) may be within the reach of some terrorist organisations.

Dispersal, too, is relatively uncomplicated. Chemical agents can be released by attaching an explosive device to a TIC container. The heat and pressure that follow the blast may not significantly degrade the toxic characteristics of the agent, leaving people at risk.

Time is of the essence when responding to a chemical attack. Many TICs and CWAs cause tissue damage upon coming into contact with the skin. They also can cause death in a short space of time if they are absorbed into the body and enter the circulatory system, or if they are inhaled in sufficient quantities.

A multifaceted challenge
Several factors make it challenging to protect subway riders from a chemical attack. First, trains travelling through the transit tunnels produce a ‘push/pull’ airflow effect. This movement of air can send chemical agents from their release site toward unsuspecting passengers waiting on platforms or transiting through the system. Furthermore, limited egress in stations hampers evacuation and the rush to exit may result in severe or fatal crushing injuries.

The question that security and transportation officials face is how best to use location-independent detection equipment (which typically takes the form of commercial, off-the-shelf products) so that it can effectively detect-to-warn passengers and authorities, and save lives.

On CONOPS
The key to implementing this is a strong Conops. Without it, authorities will have a hard time responding when detectors signal a potential chemical threat. Conops includes processes for detection, warning, mitigation and response, and will introduce clarity and efficiency by answering questions, such as:
– If a subway system has detectors, what should be done when one or more alarm goes off?
– Does the Jurisdiction Having Authority (JHA) wait for additional detectors to alarm before taking action?
– If closed circuit television (CCTV) is present, does this change the response?
– Are critical response decisions made only once the CCTV verifies that people are in distress (i.e., showing signs and symptoms of a chemical contaminant)?
– What decisions is the JHA required to make when detectors alarm after a custodial crew passes by in the course of daily cleaning?

JHA officials must consider the big picture and all manner of smaller
details before creating their Conops. They must know the strengths and weaknesses of the detection equipment, the response system, and the culture and expectations of the public they seek to protect. In laying the groundwork, officials must anticipate a full range of possible scenarios with the understanding that they must develop specific plan sets for each, thus enabling JHA operators to initiate targeted responses. All scenarios and accompanying plans must incorporate certain key elements, including the number of detectors, the agents they can detect, the presence and potential use of CCTV, and possible alerts from commuters that may arise when people see or smell something strange and notify the JHA of potential danger.

**Risk assessment, test and evaluation**

A risk assessment is a prerequisite to Conops development and may be regarded as its foundation. A proper assessment will identify local stocks of hazardous chemicals as well as others that frequently pass through the community by highway, rail or ship. Using that information as a basis, authorities can determine the requirements for any detection system they propose to implement, including detectors, response kits and operational agreements among agencies.

Once the assessment is complete, jurisdictions can purchase and install detectors in the highest-risk locations to protect the greatest number of people while making the best use of available resources. To determine optimal placements, jurisdictions should simulate dispersion of chemicals throughout the infrastructure and understand the dispersal patterns as well as the detector capabilities.

A test and evaluation plan will help the JHA to fully understand the behaviour and limits of the detection equipment and to formulate targeted responses for different chemicals in a potential release. For example, lab tests may show a detector to be sensitive to hydrogen sulphide (H2S), alarming accurately within 30 seconds, but the same detector may alarm accurately for hydrogen cyanide (HCN) only 25 percent of the time over two minutes. Given such differences in performance, the Conops might call for immediate ventilation in the case of an H2S alarm and require a second detector to alarm before the JHA takes action in the case of HCN.

Even when detectors are not present, there’s a role for Conops. Some jurisdictions may have CCTVs throughout their subway system but not the resources to purchase detectors. In such instances, the JHA should train its
personnel to use the CCTVs to monitor for passengers exhibiting signs or symptoms of exposure to dangerous levels of toxic chemicals.

**Current work to protect subway riders**

Recognising the lack of guidance on how to protect subway systems, the Chemical Defense Program at the Department of Homeland Security’s Office of Health Affairs is carrying out a demonstration project in Baltimore to model a comprehensive, risk-based approach to protecting subway riders from a chemical attack. The programme has teamed with the Maryland Transit Authority (MTA) to create a CONOPS for a metro station within the city.

As a first step, the MTA completed a risk assessment to identify which chemicals were heavily used by local industry. The results were compared to DHS’ chemical threat risk assessment to determine which chemicals the Transit Authority’s detectors should target. MTA officials are in the process of selecting a suite of detectors, which will undergo extensive lab testing to determine the accuracy and timeliness of the equipment’s signals.

In addition, the lab testing will evaluate how the detectors interact with interferent chemicals, such as cleaning products and construction materials. The MTA, with DHS support, will use the results as a basis to develop a CONOPS decision tree, relating operational procedures for different scenarios.

According to initial project discussions, it is anticipated that when a detector alarms in Baltimore, the MTA will first determine the alarm type: tamper, maintenance or chemical. Most detection equipment will send separate signals based on the alarm type, but officials must confirm the determination as the alarm type will inform the response.

For example, in the event of a tamper alarm, the MTA may investigate with CCTV and then send a technician to evaluate it. The technician would check to see whether the alarm is operational, perform corrective actions or undertake the needed maintenance, and otherwise return the detector to service. A less-
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An urgent maintenance alarm would involve a similar process. But if the alarm signals a chemical detection, the MTA will require certain key information and its response may be altogether different. The information needed may vary depending on the equipment but will include the type of chemical, its concentration and the detection location. The MTA would seek to confirm the detection with CCTV, watching for distress amongst passengers and additional alarms. If the alarm(s) and indicators are consistent, the MTA would contact emergency services and request responder support for a chemical incident.

Once the detectors and CONOPS are in place, Baltimore will be better positioned to mitigate a chemical attack on its subway system, thanks to the systematic efforts of DHS and the MTA. In addition, as part of the project, the Transit Authority will benefit from the relationships it is strengthening with the surrounding response community. The project is intended, ultimately, as a model for all subway systems in service to their passengers.

[Note: The ideas and views expressed in this article are those of the author and not necessarily those of the Department of Homeland Security.]