FLYING HIGH,

Steve Wolff discusses CBRNe threats to aviation and ways of countering them

The long history of aviation-related terrorism involving the use of smuggled explosives and hijacking, both before and after the attacks of 11 September 2001, and the ongoing threat of terrorists migrating to CBRN weapons continue to make aviation a prime area for prevention strategies. This article will discuss the challenges and possible countermeasures that aviation security professionals will need to implement.

With limited budgets and a broad range of threats, prioritising each vector and threat combination for likely attack and factoring in the likelihood of successful discovery and mitigation is critical to maximise the return on security investment. Threat vectors relevant to aviation targets include land-based attacks against airports or airline passengers, and the use of aircraft as 'guided delivery systems' to reach and destroy ground targets and their occupants. Along with emerging CBRN threats, new trends in homemade explosives (HME) pose urgent challenges.

Unhindered vehicle access demonstrates the potential for damage to the airport, staff and travellers

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Explosive trends

Explosives still represent the greatest threat against aviation. The multiple attempts that have occurred since 9/11 (including the foiled UK plot last August) have borne this out, as well as indicating a move away from conventional high explosives towards easy-to-make-and-conceal HME, which require new detection technologies and procedures. Recent events in Iraq have shown terrorists' willingness to combine conventional explosives with poisonous chemicals, and this strategy could migrate to aviation security. The UK plot revealed a great effort on the part of the plotters to disguise the components and liquids they smuggled on board in innocuous packaging.

CBRN weapons represent different challenges for aviation security professionals who have over the decades grown used to hijacking and conventional explosives. Airports make ideal targets. A lack of access control and entryway security allows terrorists easy access. Passengers congregate in increasingly large numbers at security, departure gates and baggage claim so even small quantities of non-conventional substances could be more devastating than conventional bombs. Current security checkpoints do not effectively screen for chemicals, or bio-weapons, so terrorists can gain ready access to aircraft. The high concentration of people would allow rapid dissemination of pathogens nationally and internationally.

Given the difficulty in obtaining nuclear devices and the extent of damage, an airport would likely be a secondary target compared to a political or financial centre. However, airports could provide terrorists with aerial access to better reach these more attractive targets. More likely is the detonation of a radiological dispersal device (RDD) in an airport. This would cause fatalities and a damage radius comparable to a conventional explosive device, along with variable radiation effects. However, an alternative strategy is the kind of clandestine poisoning used in the London Litvinenko case - but on a larger scale. Airports of course provide a smuggling route

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for lethal substances, including those such as alpha emitters that are the hardest to detect - requiring close proximity to specialised radiation detection equipment. Given the difficulty in obtaining nuclear devices and the extent of damage, an airport would likely be a secondary target compared to a political or financial centre. However, airports could provide terrorists with aerial access to better reach these more attractive targets.

Delivery methods

Several delivery methods could be used, each with its own detection/ prevention challenges. Though limited to carrying relatively small quantities, humans can manoeuvre and reach an airport or aircraft target unless good detection methods are in place. A terrorist will likely set the device off if alerted to discovery; this needs to be factored in to screening methods, facilities and countermeasures used by security personnel. For bio-weapons, the terrorist may be deliberately infected, transmitting the contagion by interacting with others until caught, killed or dying of the disease. This poses the ultimate challenge.

Ground vehicles carry larger quantities, thereby maximising the damage radius and dispersal, but they provide more limited access to an airport. However, access prevention without detection and disarming may just lead to terrorists selecting another softer target either at – or off – airport. The 9/11 attacks proved the value to suicide bombers of using aircraft as ‘poor man’s guided missiles’. While improved cockpit security reduces the likelihood of commercial aircraft hijackings, remaining risks include cabin contamination or smuggling a device via unscreened cargo, possibly with a terrorist on board to remotely detonate it.

However, general aviation may well be a larger threat vector for more compact CBRN devices due to better targeting opportunities and less likelihood of detection and interdiction. Such aircraft have sufficient carrying capacity and an aerial detonation is likely to expand the damage and contamination radius over that achieved by ground-based detonation.

Trace detectors

To face such challenges, detection systems form an increasingly vital part of the overall countermeasures strategy. Available CB detection technology is largely based on trace detectors based on mass spectrometry, IMS, Raman spectrometry and Fourier transform IR spectroscopy, which are best suited to chemical rather than bioweapons detection. Microsensors using recombinant DNA or antibodies, which detect certain materials by absorbing specific molecules or pathogens on a microscopic sensor surface, are being developed and show promise, but all these techniques require good sampling and their application to routine, wide-area monitoring at airports remains unproven.

Manually collecting samples using swabs (similar to explosives detection at checkpoints) is likely to be the best sampling approach. ‘Puffer’ systems shoot out jets of air to dislodge particles of explosives that might be present on a passenger. They are drawn up using the convection plume around a passenger’s warm body into the overhead sensor, where trace detection analyses them for the presence of explosives. But these systems are still being tested. A recent deployment at US airports for explosives detection was halted due to efficacy and reliability concerns. However, they should be re-evaluated for CB weapons, as the material properties are different from low-vapour-pressure explosives. Regardless of a particular technology, detection must be rapidly linked to an isolation/ detoxification response and planners must ensure that the detection procedure does not cause involuntary or intended release of toxins.

Bulk detectors

Homemade explosives are highly variable, placing new burdens on existing detection systems. In some cases, software inspection algorithms or hardware modifications to existing systems may be sufficient. In others, new technology (especially for passenger inspection) is needed and is being investigated. While some bulk detectors – such as dielectric constant, magnetic resonance or X-ray systems - may be suitable for scanning bottles or aerosol cans for CBW, bulk detectors are most suited to explosives and nuclear materials detection.

Whole-body imaging systems based on X-ray or millimetre waves are in late-stage trials around the world and, while incapable of identifying specific threats, can assess whether passengers are smuggling non-metallic objects through the

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checkpoint. Nuclear weapons and alpha emitters are difficult to detect: alpha particle radiation from plutonium-239, uranium-235, polonium 210 and others is easily shielded and difficult to detect in air even within a few inches of the material. For nuclear devices, muon radiography and nuclear resonance fluorescence are being investigated, but fast-neutron activation followed by detection and characterisation of the resulting small-scale nuclear fission process represents the most mature detection method. However, neutron-based systems are large and slow, making deployment challenging for airport operations.

Preventing and containing

Other countermeasures may offer the best short-term approach for prevention and containment. Passenger and container profiling and verification can help identify suspicious individuals or items that can then be searched by slower detectors. The 'Mark One Eyeball' can be used to observe unusual behaviour (personnel or suspicious vehicles), and should be coupled with careful access control and interdiction measures aimed at rapidly disabling suspected terrorists, especially in publicly accessible locations.

The high cost of security needs to be carefully balanced against risk and operational challenges

Travellers concentrate at certain locations, which would result in greater casualties from a targeted CBRN terrorist attack

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Similarly, rapid symptom recognition training for security personnel will allow early identification and containment, possibly aided by infrared cameras to assess whether individuals are sick. This approach was used extensively and effectively at Asian airports during the SARS epidemic. Detection methods are being investigated that involve measuring variation in output of sweat and other physiological changes that indicate a passenger may be incubating a serious or rare infectious disease.

Careful building, airflow and air-conditioning design and management – including air removal or negative/ positive pressurisation – can isolate certain areas following an incident. This might include high-efficiency particulate air filter (HEPA) filtration and possibly chemical conversion to innocuous materials using, for example, ozone or radicalised hydrogen peroxide, which are highly reactive, short-lived and form benign by-products (oxygen and water respectively).

The potential for CBRN attacks provides a broad and substantial challenge to aviation security professionals. Although highly unpredictable in their effects, tools such as those presented here are needed for prioritising threats and responses to assure that our limited resources are focused on the most critical threats. Strengthening intelligence gathering, focused detection technology deployment, and improved training coupled with rapid response and containment following an incident will form the best short-term strategies for countering a long-established and worrying threat that may increase in its potential to do harm on a mass scale. ■

To prioritise and counter the new threat, it is important to consider which are true WMD versus 'weapons of mass disruption'. This will vary by weapon type and delivery method. The following approach takes into account a broad range of issues and can help prioritise among alternative responses

threat (T) = intent (I) x ability (A)
The intelligence community provides an estimate of both I and A, in the short and long term for each threat and aviation target

risk (R) = threat (T) x vulnerability (V)
V depends on ease of access, detection and mitigation effectiveness

effect (E) = risk (R) x damage (D)
D includes number of potential casualties, economic impacts and the potential for destroyed infrastructure

benefit (B) = prevention (P)/cost (C)
B estimates the value of a proposed security measure based on P - which includes detection effectiveness as well as mitigation effects - and its capital and operating cost, C

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