

A rapid response to radiological incidents

Dirty bombs: are they the elephant in the room where terrorism is concerned? **Dr Andy Oppenheimer** discusses the challenges the authorities face when dealing with this overlooked threat, and what constitutes a 'gold standard' response.

A radiological dispersal device is, in essence, an IED that has had a radioisotope incorporated into it so that it emits radiation on detonation. Immediate injuries will first resemble those caused by a conventional IED. If an improvised chemical device is set off, it would likely cause characteristic burns and respiratory distress, and possibly paralysis if a nerve agent or organophosphate has been used, marking it out from an IED.

Such added elements would present substantial and instant challenges to authorities in the wake of a terrorist attack. If radiological detection tests are not performed at the scene of an

explosion, and the people in the vicinity do not quickly start to exhibit the classic symptoms of radiation poisoning, officials may assume that they are dealing with an 'ordinary' IED.

The debate over effects and mitigation of radiological dispersal device is controversial; the same is true for non-explosive radiological incidents, the most notable of which was the

radiotoxic poisoning of Alexander Litvinenko in London in November 2006. It is difficult to assess both the threat and likely effects of radiological dispersal device attacks as their incidence is low or unknown.

The overlooked threat

A small-scale radiological attack would be costly, and not only in terms of lives lost in the initial explosion: it may necessitate the evacuation of homes and workplaces, the cordoning off of areas for long periods, and could lead to long-term health effects. Radiological threats are therefore worth serious consideration in any first-response policy. Hundreds of sources are classified as high risk because of their activity (Figure 1, opposite).

Countries with nuclear power facilities and civilian-use radioactive sources have differing levels of security. An attack on a civilian facility or shipment of spent nuclear fuel using penetrative anti-tank weapons is a considered scenario in unstable countries with a nuclear power programme, ongoing insurgency or terrorism, or a record of infiltration into the police, army, universities and other organisations.

Effects – the jury's still out

Research into the effects of all forms of radioactivity – alpha, beta, and gamma

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– is based on the atomic bombings of Hiroshima and Nagasaki, the Chernobyl disaster, and now, Fukushima. There are also debates about the manufacture of radiological dispersal devices themselves: some argue that it would be too dangerous for bombers to incorporate unshielded radioactive materials into IEDs, as they run the risk of frying themselves before even a suicide attack. Ways around this include using personal protective equipment to ‘buy time’ so the bomb maker can launch his attack before succumbing to the effects of radiation. Another possibility is that the shielding is removed with insider technical help.

Transporting significant quantities of radioactive materials for a viable device is also problematic, as substantial sources are heavy and, if they emit gamma radiation, detectable. Much depends on whether nuclear states acknowledge that radioactive material is missing from any of their military or civilian facilities.

Response to a radiological dispersal device

As with any IED attack, the police, fire and health services would have to immediately secure and isolate the blast area. Bomb squads would need to search for unexploded secondary devices. Military support for civil response would be necessary in a major incident, with interagency cooperation within the country, and possibly across borders.

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Once the release is identified as radioactive, which would depend on the quality of detection devices and training, contamination can be managed on-scene. Triage and then decontamination on the spot, including of lightly injured and uninjured persons, would be vital to prevent the radioisotope spreading onto transit systems and beyond. An assessment of contaminated areas would define the remediation – whether

Figure 1: Radioisotopes

	Alpha emitters	Beta emitters	Gamma emitters
Americium-241	x		
Carbon-14		x	
Caesium-137		x	x
Cobalt-60		x	x
Hydrogen-3 (tritium)		x	
Iodine-129		x	
Iodine-131		x	x
Plutonium-239	x		
Polonium-210	x		
Radium-226		x	x
Strontium-90		x	
Sulphur-35		x	
Techneium-99		x	x
Uranium (depleted)	x		
Uranium primer	x		

to close up the premises or, if the half-life of the radioisotope is long, decontamination to save premises and assure reoccupation at a later date. Medical follow-up and counselling for those exposed should be mandatory.

When dealing with a radiological dispersal device that has not detonated, the prime aim – if there is time – should be to identify the isotope enclosed within. As the device may be sealed, this presents significant additional challenges; the first of which is detection. Remotely controlled vehicles would need to

incorporate a ruggedised, microprocessor-controlled radiation detector with integrated sensors for all types of radiation. Disruptive techniques used in current explosive ordnance disposal missions may risk releasing toxic contents; likewise, if the device has been booby-trapped moving it could cause detonation.

In some instances, the radiological dispersal device can be encased in

foam, and possibly allowed to explode within it. Wind direction is vital in selecting the incident control point: warm, still days produce concentrated fallout, but windy weather would disperse particles further.

Litvinenko – the gold standard response

Litvinenko’s murder was unprecedented, but so was the response. More akin to a bioterrorist attack, the dispersal of Po-210 – determined to be the causative agent through cross-contamination – required services from specialists in detection, protection and health physics. The radioisotope was spread within the Millennium Hotel (the site of the poisoning), in part due to the amount of time that elapsed between the actual poisoning and the initial phase of the police investigation, in part by cleaning staff.

As a true interagency effort, London’s first radiological dispersal event comprised a ‘dry run’ for a possible future attack. The overseeing body, Westminster City Council, assumed control over the recovery stage of the Litvinenko incident for the worst contaminated sites. The Health Protection Agency had to suddenly

learn everything about Po-210, trace contacts of the victim, and arrange for radiation scanning to be carried out at the affected premises. Urine samples were taken from hundreds of potential contacts, with 17 eventually deemed at risk of developing illness from exposure.

Meanwhile, the Government Decontamination Service had to organise the clean-up, hiring specialist contractors. Of importance for future radiological response was the Millennium Hotel's requirement that there be zero radioactivity left behind. Among revised policies which emerged was specific CBRN guidance for local authorities as part of the UK's Strategy for Countering International Terrorism (CONTEST), which includes guidance on business continuity.

Detecting radiation

Most current handheld and stand-off detectors can locate sources of gamma radiation (which penetrates human

tissue) and beta radiation (which causes burns, lethal or injurious) in military and civilian use. Heavily shielded, small sources may be harder to spot, especially in large shipments. But a prime challenge is finding pure alpha particle-emitting radionuclides, which cause significant biological damage if ingested or inhaled – as in the Litvinenko incident.

In that case, only a few micrograms of Po-210 was used to assassinate one individual, but small amounts spread to several noted premises, two seats in a football stadium and three aircraft. The handheld scanners used to assess these locations had to be used at short range.

Larger-scale incidents dispersing plutonium – such as a major terrorist attack on a spent fuel rod cooling pond or shipment – would also involve alpha radiation. Where alpha particles get inside objects, they are unable to escape and therefore cannot be detected, and research continues apace to produce less expensive handheld

detectors that can detect them.

Portal scanners must be able to rapidly identify any radioactive source present in a vehicle or cargo container. To do this, they must have adequate energy resolution, or 'selectivity', to quickly identify and differentiate innocent sources from illicit nuclear material, including those that are intentionally shielded or those masked by legal sources.

High-resolution spectroscopic portal monitors have been installed at several ports and border checkpoints for secondary inspections to ascertain if alarms are innocent or real.

A terrorist attack may involve the infiltration of a nuclear plant to set off major system failures, rather than try to attack guarded plants from outside or from the air.

Our response plans and how we regard the risk from radiation in all its forms, based on what little precedent we have and lessons learned, will define how we deal with the unthinkable. ■

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