Dr Christina Baxter, of EmergencyResponseTIPS.com and Hazard3.com, offers helpful advice for first responders

Keeping you safe!

This column aims to provide operational guidance to the hazmat/CBRNE community on the selection and performance of equipment and tactics. In this issue we focus on emergency response to radiological threats, specifically radiological dispersal devices (RDDs).

Modern radiological warfare started when the first atomic bomb was dropped during world war two. Today's threat is mostly focused on smaller radiological devices that incorporate conventional explosives, often called dirty bombs. Since 1993, the International Atomic Energy Agency's incident and tracking database (ITDB) has recorded 4,075 cases involving nuclear materials, radioisotopes and radioactively contaminated materials. Over half involved the theft of radiological materials while 344 were linked to trafficking or malicious use. Of the 146 events recorded in 2023, only five were attributed to nefarious purposes. The number of events recorded annually over recent years is relatively static, however the proportion of attempted scams involving materials claimed to be nuclear or radioactive has increased.

Selected historical examples highlighting RDD threats include Chechen rebels planting a container of caesium in Ismailovsky Park, Moscow, while suspected Chechen rebels also placed an RDD near the railway line in Argun, Chechnya in December 1998. In June 2002 an American with ties to Al Qaeda was arrested in O'Hare Airport, Chicago, suspected of planning to build and detonate a dirty bomb in a US city.

Documents seized from Al Qaeda in Herat, Afghanistan, in January 2003 reveal that they had successfully built a dirty bomb. January 2009 saw the FBI seizing RDD materials including uranium and thorium from an American white supremacist's home following his murder. Indonesian militants with ties to Jamaah Ansharut Daulah developed a pressure cooker bomb containing thorium in August 2017. And in September 2021 a student in northern France with far right ties was arrested with four RDDs designed to use uranium oxide purchased on eBay.

While all the above focus on RDDs, the use of radiation for targeted assassinations cannot be ruled out. The November 2006 poisoning of Alexander Litvinenko using polonium-210 in the UK, is just one example.

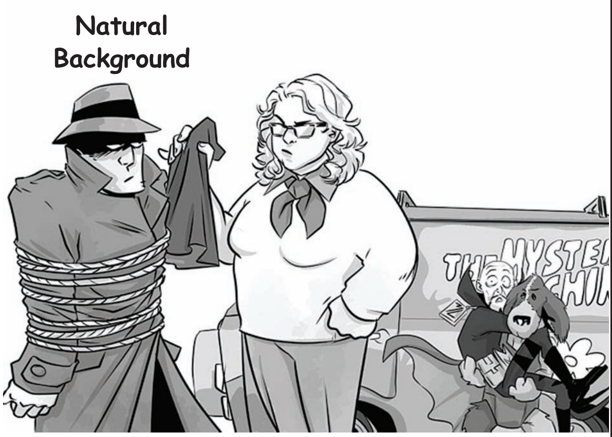
Toxicology

The effects of an RDD will be driven by the device geometry, explosive weight, amount/type of radiological material and weather conditions. People closest will suffer injuries from the explosion and also have the highest chance of radiological contamination. Moving away, radiological contamination decreases.

The toxicological effects from radiation exposure are related to the total dose. A higher dose equates to a higher risk and severity of injury. Critical factors affecting dose include type of radioactive material, source strength (alpha, beta, gamma, or x-ray); the physical and chemical form of the radioactive material (eg fine particulates, larger particulates, liquids); the means of exposure (inhalation, ingestion, dermal); the type of dispersion (eg explosive, fire, aerosolisation); distance from the source; and exposure duration. Radiological isotopes commonly discussed in the context of RDDs include alpha emitters (eg plutonium-238, uranium-238, americium-241), beta emitters (eg strontium-90), and gamma emitters (eg cobalt-60, caesium-137, and iridium-192).

Detection

Many different types of radiation detectors are used to detect and monitor radiation. They identify and establish the spread of radiological contamination and verify the decontamination of people and the environment. It is important to understand the natural background level of radiation in areas of concern, noting that the value will vary. Work with your local radiological regulatory agencies to establish criteria to describe hot, warm and cold zones, as well as acceptable decontamination levels before an incident occurs. Example levels that might be applied include 0.1 mSv/hr for hot zones, 0.0025 mSv/hr for warm zones, and natural background levels for cold zones.



First responders establish safety zones using radiation survey meters to detect gamma radiation. While alpha sources are harder to discern in operational settings, their decay products often include gamma emitters which are readily detected. Next, isotope identification is essential to establish the extent of the threat to responders and the public. In the field this is done using handheld radioisotope identification detectors (RIIDs), also called radionuclide identification detectors. The responder now knows the extent of any radiation contamination, the associated dose rate, and the radioisotope responsible. All this informs the incident response.

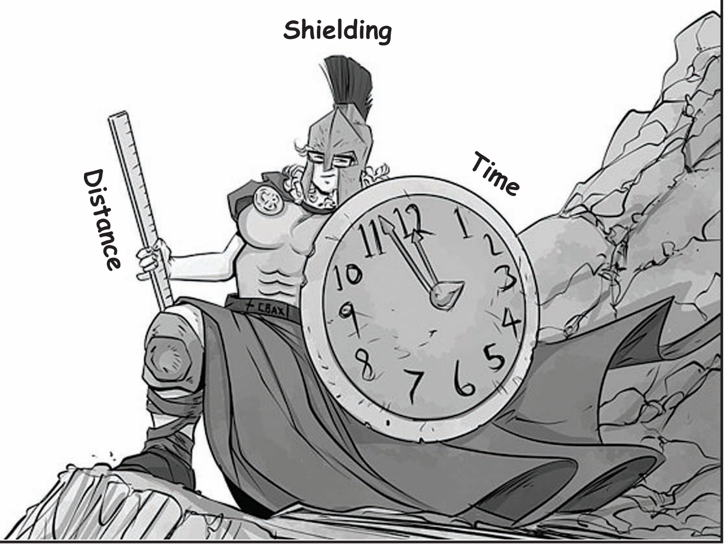
It is also essential to measure the responder's dose and compared it against established criteria. There are various commercial approaches ranging from film badges to electronic dosimeters. The latter enable real time assessment of the dose.

Assessing personnel for external contamination to distinguish those contaminated and exposed is also required. Handheld radiation detectors can be used, but this is slow and inefficient for large groups. Instead, radiation portals are an efficient and quick way of screening such groups after a RDD release. Hospitals may employ techniques for determining potential internal doses.

Detection and monitoring are also critical elements of the clean up after an RDD release and may include a mixture of on-site and laboratory measurements.

Protection

Radiation exposure from an RDD will likely be limited to a few city blocks. Exposure can be minimised using the time, distance and shielding principles, which means minimising time near the source materials and maximising distance from the source as doubling your distance from it results in one quarter the exposure. Shield yourself from both external exposure and inhalation of radioactive particulates.



Keeping you safe!

PPE can be used to limit direct contamination, but responders may still be exposed to radiation due to contamination in the local environment. Respiratory protection should be used to minimise the potential for inhalation exposure. Self-contained breathing apparatus or a full-face air purifying respirator with a P3 (or P100) particulate filter are both suitable.

Decontamination

Start the decontamination process by evaluating exposed versus contaminated people and materials. It is important to differentiate between the two. Exposure is having a substance around you; you may have received a dose, but not be contaminated. Contamination involves having a substance on or in you. For those potentially exposed, but not contaminated, moving away from the source of exposure and treating any symptoms is sufficient.

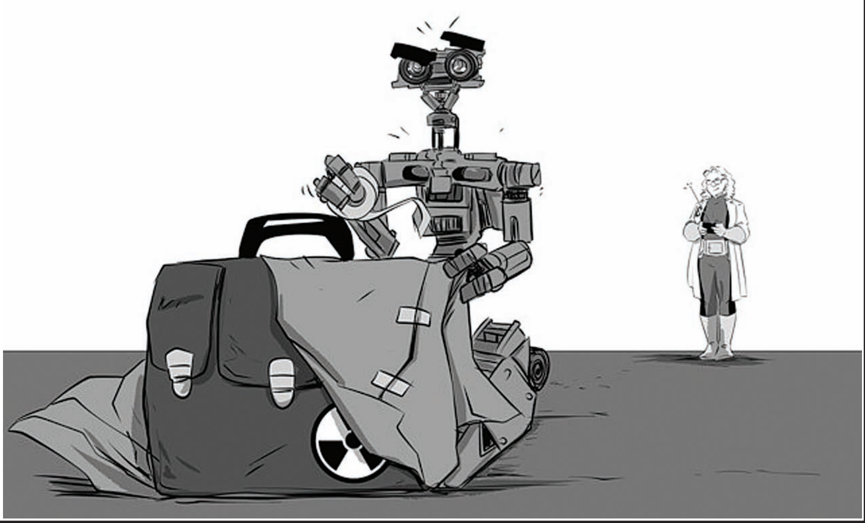
For anyone who is contaminated, a dry or hybrid decon approach is recommended. First remove any affected clothing and if fine particulates are suspected, consider dampening the garments prior to removal. Then, if there is evidence of skin deposition, whether liquid, aerosol, or solid, blot the affected area with an absorbent material being careful not to apply pressure. Whenever decontamination is deemed necessary, the person should consider taking a shower with gentle washing.

It is essential to engage with your security, public health and police agencies to identify likely threats, in enhancing your readiness to manage incidents involving radiological risks. This ensures your agency and allied responder approaches and training are contemporary and appropriate for the operational context.

Remember a safe and effective response to events involving RDDs includes:

- Securing the source using remote tools if possible, while minimising opportunities to generate aerosols.
- Wearing appropriate respiratory protection and minimising opportunities for unexpected exposures.
- Monitoring total exposure/dose.
- Ensuring appropriate field expedient decontamination is available and minimising exposure using hybrid decon.

We will discuss radiation detection in further detail in the next issue of CBRNe World.



Images are courtesy of Phil Buckenham *https://philbuckenhamart.wixsite.com/philbuckenham*