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

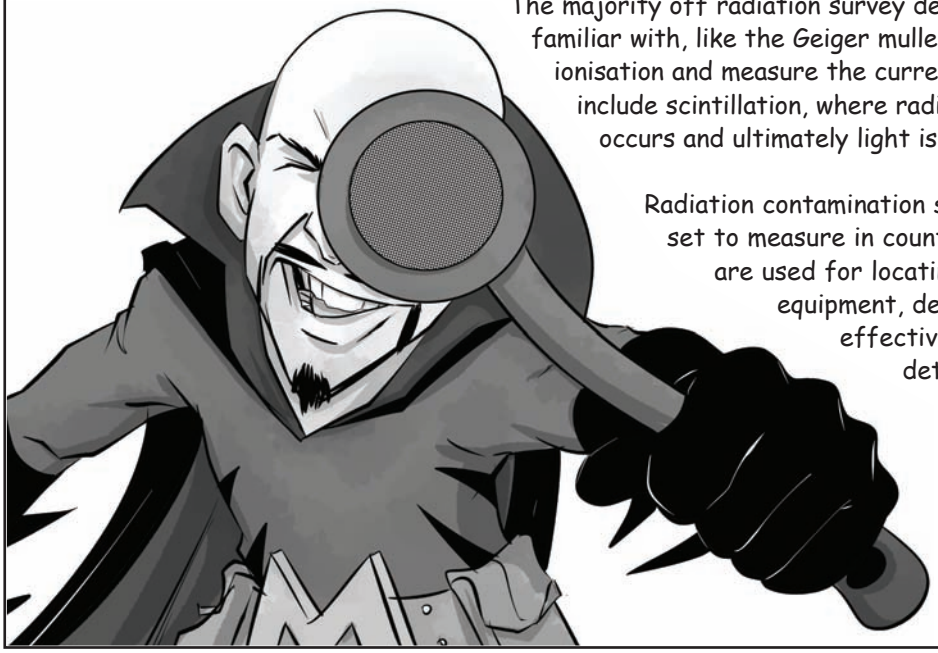
Keeping you safe!

This column sets out to provide operational guidance to the hazmat/CBRNE community regarding the selection and performance of equipment and tactics. In this issue we focus on the use of radiation detection equipment in hazmat/CBRNE response. The various systems are intended for use in establishing site safety and the extent of contamination through determining dose rates, dose, isotope identification and more.

International consensus standards specifying the recommended performance characteristics for portable radiation detection equipment can be used to assist in determining which instruments best suit your operational requirements. Examples include the International Electrotechnical Commission (IEC) standard IEC 60846-1 and the American National Standards Institute (ANSI) standard ANSI N42.34-2021. Key considerations include the type of radiation to be measured, exposure rate range, type of detector, weight, battery life, operating conditions and cost.

Radiation survey meters

Radiation survey meters are used by first responders to detect the presence and intensity of radiation so they can establish safety zones. In addition, the instruments are used to manage personnel exposure, assess package integrity and locate sources of radiation. Many of these detectors have different probes for measuring alpha, beta and gamma radiation; however, the gamma survey mode is most used operationally as gamma rays are the most penetrating.



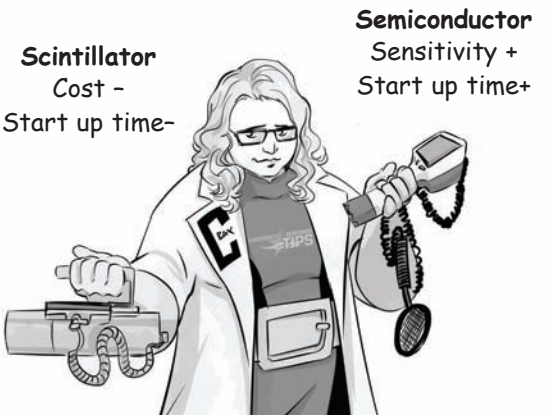
The majority off radiation survey detectors that first responders are familiar with, like the Geiger muller tube, utilise radiation induced gas ionisation and measure the current generated. Other approaches include scintillation, where radiation induced molecular excitation occurs and ultimately light is emitted and measured.

Radiation contamination survey instruments are generally set to measure in counts per minute. These instruments are used for locating contamination on personnel and equipment, determining decontamination effectiveness, verifying control zones, and determining the extent of a contaminated area.

While survey meters can often determine the type of radiation present (alpha, beta, or gamma), they are unable to identify the isotopes involved.

Radioisotope identification detectors

It is essential to identify the radioisotope, or radionuclide, to establish the extent of the threat to responders and the public. This is achieved in the field using handheld radioisotope identification detectors (RIIDs), also referred to as radionuclide identification detectors. RIIDS may use different detection approaches. The most common scintillator detectors used for the purpose employ thallium doped sodium iodide or cerium doped lanthanum bromide crystals. When the crystals are struck by gamma rays, pulses of light are produced which correspond to the incident gamma ray energies. These pulses are then converted to an electronic signal. An energy spectrum is produced by plotting the number gamma rays measured at each energy. This information is used to uniquely identify the isotope responsible for the energy emitted.



The most common semiconductor detectors used in RIIDs include high purity germanium or cadmium zinc telluride crystals. When gamma rays strike these crystals, an electric current is detected which is proportional to the energy of the incident radiation.

Important operational parameters to consider when evaluating RIIDs include resolution, sensitivity, start-up time and cost. RIIDs using scintillator detectors tend to cost less and have short start-up times (minutes), but they are generally hampered by lower resolution. Semiconductor-based RIIDs have excellent sensitivity but require cooling to operate resulting in much longer start-up times (hours).

The responder now knows the extent of any radiation contamination, the associated dose rate, and the radioisotope responsible; this information informs the incident response.

Personal radiation dosimeters and detectors

It is essential to measure the responder's dose and compared it with established criteria. The commercial options range from film badges to electronic personal dosimeters (EPD). They use a variety of detection approaches such as Geiger muller and scintillation. EPDs enable real time assessment of the dose the responder receives. While some personal radiation detector (PRD) features overlap with those of survey meters, they are generally smaller and lighter weight, while only focusing on low exposure rate levels of gamma radiation in fast response times (seconds). Most PRDs use scintillation detectors.

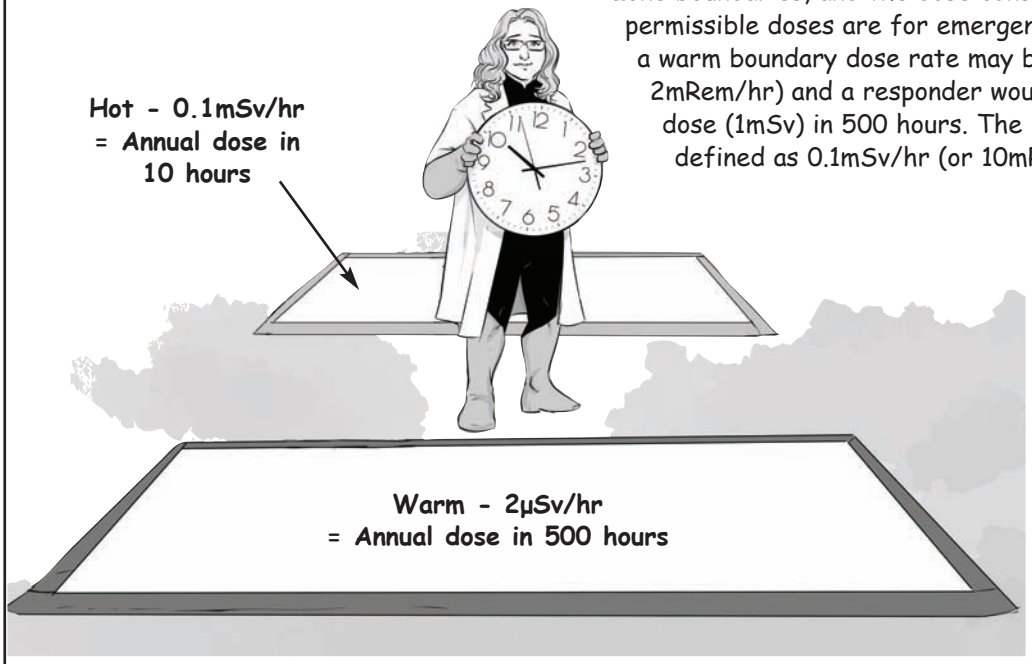
Radiation portals

Assessing personnel for external contamination to determine who has been contaminated and exposed is also necessary. Handheld radiation detectors can be used, but this is slow and inefficient for large groups. Instead, radiation portals are an efficient and quick method for screening large groups after a RDD release or other incident.

Keeping you safe!

Operational applications

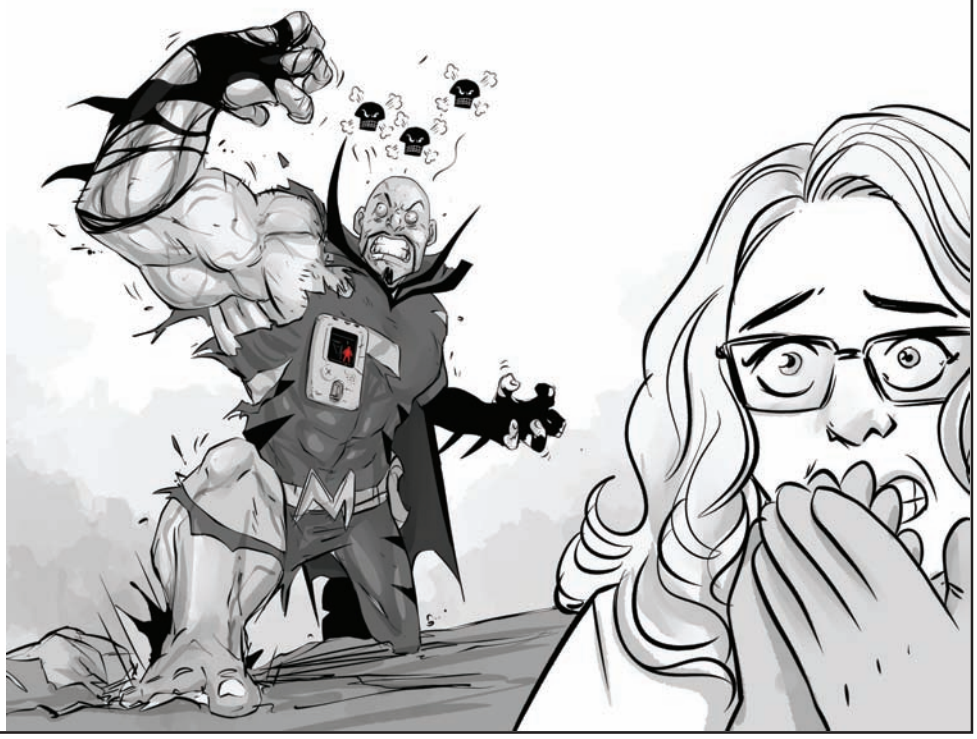
There is always a natural background that varies from 0.05 to 0.2µSv/hr or 0.005 to 0.02mRem/hr. All responders should be familiar with the dose rates applied in your response area for the warm zone and hot zone boundaries, and the dose constraints or what your permissible doses are for emergency responses. For example, a warm boundary dose rate may be 2µSv/hr (or 0.2mRem/hr) and a responder would receive the public annual dose (1mSv) in 500 hours. The hot zone boundary may be defined as 0.1mSv/hr (or 10mRem/hr), so a responder would receive the public annual dose in 10 hours.



First responders use radiation pagers and survey meters to determine the presence of radioactive sources and their activity (strength). Measuring the responder's dose is also integral to the response and this is carried out by using dosimeters like the EPD. The RIID is then used to identify the radioisotope to inform the response. Finally, contamination assessment and decontamination are carried out using survey meters and radiation portals.

For further guidance on radiation events, consider using the Emergency Response Decision Support System (ERDSS), also known as the Chemical Companion. ERDSS has a suite of tools for determining radiation exposures and shielding as well as decontamination and protection.

Remember! Preplan in conjunction with your response partners to identify suitable detectors, respiratory and skin protection approaches, and mitigation strategies that will protect the crime scene, as well as your decontamination and medical strategies. Most importantly, practice together!



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