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NATIONAL URBAN SECURITY TECHNOLOGY LABORATORY

SAVER TechNote

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MOBILE RADIATION DETECTION SYSTEMS

Highly sensitive radiation detection systems mounted in mobile platforms such as automobiles, boats, or small aircraft can detect, assess and characterize radiation for multiple first responder missions. Such mobile detection systems can cover a large area quickly to perform routine mapping of a city's normal background radiation levels, monitor entry points, search for illicit radioactive materials, or determine where radioactivity has spread after an accident. This equipment falls under the AEL reference numbers 07RD-04-SGND titled "Detector, Radiation, Standoff" and 07RD-03-DRHS titled "Detector, Radionuclide, High Sensitivity."

Overview

Mobile radiation (RAD) detection systems make geo-referenced radiation measurements while in motion. Large RAD detectors installed in mobile platforms are more sensitive and can detect radiation at greater distances than those portable detectors that are hand-held or wearable. Further, mobile RAD detection systems can be easily deployed to a site of interest and can cover large areas relatively quickly. Most systems consist of modular components that can be customized to meet users' needs. Some configurations are designed to be integrated semi-permanently into a mobile platform; others may be easily removed from or transferred between platforms.

Figure 1: An example of detector boxes in the back of an SUV.
Image credit: Berkely Nucleonics

Applications

For radioactive material discovery and interdiction missions (e.g., monitoring land or maritime entry points), a mobile RAD detection system must be able to quickly detect small changes (i.e., < 10 microroentgen/h (µR/h)) above background radiation levels; show the location of "hot spots" detected by surveying an area; and, ideally, analyze the radiation to determine if the source is benign (from natural, medical and industrial sources) or a threat (such as materials for a radioactive dispersal device or nuclear weapon). Many mobile RAD detection systems include mapping software that overlays radiation level measurements on a map.

Mobile RAD detection systems may have a combination of detectors for different missions. Large sensitive gamma scintillation detectors may be used for interdiction and isotope identification. For response missions after a release of radioactive material, mobile systems would need to be able to measure radiation well above background levels. To locate a "hot zone" in order to establish control perimeters, for example, a system must measure radiation fields > 10 mR/h. [1] Helium-, lithium-, or boron-based neutron detectors and others may be used for measuring high radiation fields. Adding a neutron detector to a system also furthers its capacity to assess potential nuclear threats.

The U.S. Department of Homeland Security (DHS) established the System Assessment and Validation for Emergency Responders (SAVER) program to inform emergency responder equipment selection and procurement decisions.

Under the Science and Technology Directorate, the National Urban Security Technology Laboratory (NUSTL) manages the SAVER program , which – with the participation of emergency responders – performs objective operational assessments of commercially available equipment.

SAVER knowledge products provide information about equipment that falls under the DHS Authorized Equipment List (AEL) categories and focus on two questions for the responder community: "What equipment is available?" and "How does it perform?"

To explore the full library, visit SAVER online at www.dhs.gov/science-and-technology/saver-documents-library.

For additional information on the SAVER program, email NUSTL at NUSTL@hq.dhs.gov.

Science and Technology

System Capabilities and Features

All mobile RAD detection systems should be able to detect, identify, and map gamma-emitting radionuclides, but some may have additional capabilities including sensing non-radiological threats or integrating radiation readings with visual images to assist source attribution. Some systems can also determine a source's direction and location. Mobile RAD detection systems often have data transfer capabilities so that system operators and those overseeing several systems can see what has been surveyed, if there are any hot spots, and what radionuclides have been identified.

Users control and monitor a system through software, typically via a laptop, tablet, or other mobile device. That software may offer different types of displays to help operators better understand the data as it comes in. A "breadcrumb" display (Figure 2, left) uses color-coded dots of count or exposure rates to indicate radiation levels that might warrant a closer look. A "waterfall" display (upper right) shows the gamma-ray energy "fingerprint" of even weak or distant radioactive sources by showing several minutes' worth of data in a single display. Notice how the brighter lines in the waterfall display – where the red arrows were added – line up with the peaks of the green line in the accumulated "spectrum" display (bottom right).

Systems may be integrated into the mechanical and power systems of the vehicles carrying them or be transportable from one vehicle or type of vehicle to another. Some are meant for use in a specific environment (e.g., land, water, air); others, for use in multiple environments. Most vendors offer flexible customization options based on users' needs, budget and (if applicable) vehicle fleet requirements.

Relevant Standards

A variety of standards from the Institute of Electrical and Electronics Engineers and the U.S. Domestic Nuclear Detection Office specify minimum performance criteria for mobile rad detection systems to be deployed for homeland security applications.

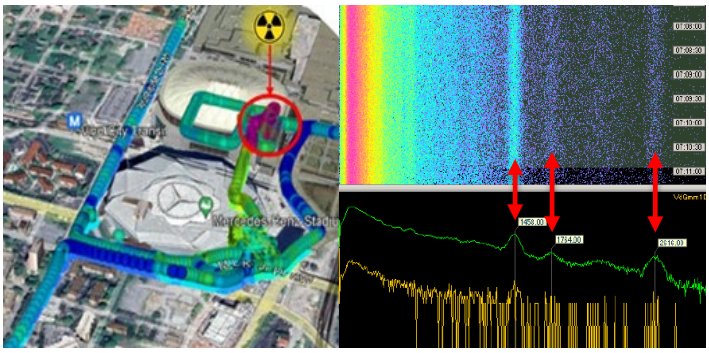

Figure 2: Examples of data displays: breadcrumbs (left), waterfall (top right), and spectrum (bottom right).
Image credit: Radiation Solutions Inc.

The standards describe tests to detect specific radioactive sources at distances similar to those in typical applications, as well as other parameters. [2] [3] [4] One addresses false alarms when the detector is exposed only to background radiation (i.e., more than one per hour is unacceptable), while another tests a detector's accuracy in identifying single radionuclides. The standards also include performance criteria for resistance to environmental conditions such as temperature, humidity, moisture and dust, vibration, electromagnetic interference, impact and more.

Cybersecurity Considerations

Installing any software or using any network-connected computer carries potential cybersecurity risks. In the case of RAD detection software, communication channels used to share information with a command center should be encrypted to ensure information is not accidentally disclosed to unauthorized entities.

References

[1] NCRP, "Report No. 165: Responding to a Radiological or Nuclear Terrorism Incident: A Guide for Decision-Makers," NCRP, Bethesda MD, 2010.

[2] Institute of Electrical and Electronics Engineers, "IEEE Standard for Mobile Radiation Monitors Used for Homeland Security," 2021.

[3] Domestic Nuclear Detection Office, "Technical Capability Standard for Vehicle Mounted Mobile Systems,500-DNDO-119420v0.00," 2013.

[4] Domestic Nuclear Detection Office, "Technical Capability Standard for Aerial Mounted Radiation Detection Systems, 500-DNDO-119430v0.00," 2017.