Homeland Security
Science and Technology

TechNote

U.S. Department of Homeland Security
SAVER
System Assessment and Validation for Emergency Responders

The U.S. Department of Homeland Security (DHS) established the System Assessment and Validation for Emergency Responders (SAVER) Program to assist emergency responders making procurement decisions.

Located within the Science and Technology Directorate (S&T) of DHS, the SAVER Program conducts objective assessments and validations on commercial equipment and systems and provides those results along with other relevant equipment information to the emergency response community in an operationally useful form. SAVER provides information on equipment that falls within the categories listed in the DHS Authorized Equipment List (AEL).

The SAVER Program is supported by a network of technical agents who perform assessment and validation activities. Further, SAVER focuses primarily on two main questions for the emergency responder community: "What equipment is available?" and "How does it perform?"

For more information on this and other technologies, contact the SAVER Program by e-mail or visit the SAVER website.

E-mail: saver@hq.dhs.gov
Website: http://www.firstresponder.gov/saver

This SAVER TechNote was prepared by the National Urban Security Technology Laboratory for the SAVER Program.

NUSTL

Personal Radiation Detectors (PRDs)

Personal radiation detectors (PRDs) are small electronic devices used to detect the illicit transport of radioactive materials. They are designed to be worn by law enforcement personnel or customs inspectors to provide an indication of elevated radiation levels. Also known as radiation pagers, they may be used for screening during patrols or at events.

Overview

Personal radiation detectors are very sensitive, designed to detect changes in the gamma radiation level slightly above background with a fast response time. Most PRDs provide a digital display of the exposure rate and a visual, auditory, or vibratory alarm at preset thresholds. The threshold may be a multiple of the measured background rate or a numerical exposure rate. Alternatively, some products use a unitless display, such as a 1-10 scale or a color-coded indicator (red, green, and yellow), rather than a numerical exposure rate reading.

A Personal Radiation Detector

PRDs are typically designed to be clipped to the wearer's belt, weigh less than a pound, and use battery power. They generally employ scintillation technology to detect gamma radiation. Some PRDs incorporate additional detectors to add capability. For example, some units also include small Geiger-Mueller (GM) or silicon semiconductor detectors to measure high exposure rates. Other units add small helium-3 gas-filled proportional counters or scintillators containing lithium to indicate the presence of neutron radiation. Typically, these devices have separate indicators to show if neutrons are detected.

PRDs alert the wearer of the presence of radioactive material and can be used to interdict the illicit movement of radioactive material because they can be deployed in large numbers and are capable of quickly detecting slightly elevated radiation levels. Innocent or false alarms can occur during screening of people or objects. These can be caused by naturally occurring radioactive material in products such as granite, ceramics, or fertilizers, or by medical patients given radioactive material internally for diagnosis or treatment. If PRDs detect radiation, additional equipment may be used for secondary screenings to confirm an alarm and to determine the location, intensity, or type of a radiation source. Thus, PRDs are one of several complementary radiation measurement devices used in interdiction missions.

Comparison with Other Instruments

PRDs are sometimes confused with Electronic Personal Dosimeters (EPDs). While PRDs look very similar to EPDs, they are not used for responder safety because they do not measure the high dose rates required. Instead, PRDs are designed to alarm at exposure rates that are well below the levels that would be of health concern in radiation protection. Also, the PRDs' response to gamma radiation of various energies may differ from that of EPDs, especially at lower energies.

Some PRD product features may overlap with handheld radiation survey meters. However, a PRD generally differs from a survey meter in several ways. PRDs weigh less than survey meters because PRDs are designed to be worn by the user, while a survey meter is held in the hand. Typically, law enforcement personnel would wear a PRD when performing other duties, while a survey meter is likely to be stored in an emergency vehicle until needed by hazardous material response teams. A PRD is sensitive to lower exposure rate levels, but may overload at higher levels; survey meters can then be used to measure the higher exposure rates. Also, PRDs are not designed to measure alpha or beta radiation, while some survey meters have thin windows or special probes for alpha or beta measurements.

Other small devices, typically classified as Spectroscopic Personal Radiation Detectors (SPRDs), use a scintillator or solid-state detector to measure the energy of the gamma radiation and identify the isotope present. They may use algorithms to indicate suspicious sources. Larger spectroscopic detectors, i.e., radioisotope identifiers (RIIDs), are used to identify the radioisotope responsible for the radiation in order to distinguish an innocent alarm from a high level threat, such as a nuclear weapon.

Considerations

Many features of PRDs differ among products and may influence selection. The size, shape, and weight of a PRD are important so that the PRD does not interfere with other equipment worn. Some products offer a rubber jacket for increased ruggedness. Battery life, battery type, and replacement procedures are important factors for routine field use of PRDs.

Various PRD settings may be established though a computer connection or by using control buttons on the device. Some settings may require multiple button presses or using combinations of buttons. The location of the display varies: in some products it is viewable from the top when the device is clipped to a belt, and in others the display is on the side. For use in low-light environments, some products have a backlight on the display, which may operate automatically or be turned on and off manually. Some instruments store information about the alarms that have occurred. Some may also to transmit data through radio or Bluetooth.

Standards and Testing Program

The American National Standards Institute (ANSI) and the Institute of Electrical and Electronics Engineers (IEEE) jointly publish standards that are available for download at no charge at http://standards.ieee.org/about/get/.

The standard ANSI/IEEE N42.32, *Performance Criteria for Alarming Personal Radiation Detectors for Homeland Security,* was first published in 2003, revised in 2006, and is currently undergoing another revision. N42.32 specifies radiological, environmental, electromagnetic, and mechanical performance requirements for PRDs. For example, using the unit of roentgen (R) for radiation exposure, N42.32 requires that alarming PRDs be capable of measuring a range of exposure rates from 5 μR/h to at least 2 mR/h or greater[1]. This standard also requires response times of less than or equal to 2 seconds for cesium-137, cobalt-60, and americium-241 sources. It specifies that PRDs weigh less than 0.9 lbs and be functional at temperatures between -20°C and 50°C.

Starting in 2004, the National Institute of Standards and Technology (NIST) began testing PRDs according to N42.32. The Graduated Rad/Nuc Detector Evaluation and Reporting (GRaDER®) program is a conformity assessment program that is managed by the U.S. Department of Homeland Security Domestic Nuclear Detection Office (DNDO). It evaluates the independent test results of commercial off-the-shelf rad/nuc detection and identification equipment and compares them to published standards. Information about the GRaDER program may be found at the website http://www.dhs.gov/guidance-grader-program.

The GRaDER program has different levels of certification. For Level 2 certification, an instrument must meet all N42.32 requirements. For Level 1, some N42.32 requirements are modified or removed. For example, the limit for the time to alarm is modified from 2 seconds to 4 seconds for cesium-137 and cobalt-60, and is not specified for americium-241. The temperature performance range is relaxed to between 0°C and 40°C.

Resources

Combating Illicit Trafficking in Nuclear and other Radioactive Material, International Atomic Energy Agency (2007).

Portable Radiological Equipment -Technical Guide, SAVER (July 2012).

Planning Guidance for Response to a Nuclear Detonation, Second Edition, National Security Staff Interagency Policy Coordination Subcommittee for Preparedness and Response to Radiological and Nuclear Threats (June 2010).

[1] The prefix μ stands for micro, meaning 10^{-6} (one millionth), and the prefix m means milli, or 10^{-3} (one thousandth).