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.

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

NUSTL

Handheld Radiation Survey Meters

Handheld Radiation Survey Meters (HHRSMs) are portable instruments used where radioactivity is suspected or known to be present in order to locate the source or to assess the radiation intensity. For example, in interdiction applications, HHRSMs might be used to screen a suspicious package or to confirm radiation detected by another type of instrument. In response missions, they can be used to determine the nature and extent of radioactive contamination, to delineate radiation protection zones, and to scan people for contamination. An HHRSM may be capable of measuring different types of radiation, such as gamma, beta, and alpha.

Overview

Examples of Handheld Radiation Survey Meters

Radiation survey meters are battery powered and may weigh several pounds. They consist of a base unit, which contains a power supply, a digital or analog display, and sometimes an integrated carrying handle. Some have an internal gamma detector, while others have an external detector probe that is attached by a cable. Some offer both an internal detector and an external probe containing another detector. The internal detector may be used to measure the overall exposure rate and the probe to measure surface contamination, which is defined as radioactive material deposited in unwanted places. The probe may be changeable to allow the detection of alpha, beta, and gamma contamination. The detector is typically held at arm's length while scanning an area of interest. Survey meters may display the exposure rate in roentgens per hour (R/h) and the contamination in counts per second (cps) or counts per minute (cpm). The conversion of count rate to activity of the source material, e.g., in units of becquerel (Bq) or curie (Ci), depends on the sensitivity of the individual detector, and a conversion factor must be applied.

Detector Technology

Most survey meters use gas-filled detectors in which voltage applied to an electrode attracts charges resulting from radiation-induced ionization of the gas, and a measure of the electric current indicates the radiation intensity. Geiger-Mueller tubes, ion chambers, and proportional counters are different types of gas-filled detectors that are used in survey meters.

Another technology is scintillation detectors, which contain materials that produce light pulses when exposed to radiation. The light pulses are counted electronically and displayed as a count rate or exposure rate. Different scintillator materials are used to measure different types of radiation, and some are designed to measure two forms, such as alpha and beta or beta and gamma.

Instrument Features

In selecting an appropriate HHRSM, practical considerations include its weight and the comfort of its handle shape. Since the meter may need to be washed if it becomes contaminated with radioactive dust, water resistance may be desirable. Other features may also be important depending on the responders' needs.

Output

Displays may be digital readouts or analog scales, and may include a user-activated backlight for use in low-light areas. Products vary in how they indicate a scale over-range: some are autoranging while others require a manual scale change. In addition to the numerical reading, some instruments have a flashing light to indicate proximity to a source. Some instruments also offer an audible output to a speaker or headphones; this feature could be used to listen for an increasing click rate in order to localize contamination hotspots. In some instruments, data is not stored within the meter, but the meter can be connected to a computer to log data while counting samples. Other instruments store data internally for later retrieval.

Controls

The control format also varies among products. Variations include knobs, toggle switches, or push buttons, which may be single function or involve scrolling though menus or pressing combinations of buttons. Control buttons may be positioned flush to the instrument body or raised and may be illuminated. Depending on the product, settings may be adjusted on the meter or through a connection to a computer.

Probes

In some products, the instrument must be powered down before changing external probes, while other products have hot-swappable probes. The probe attachment mechanism may involve alignment pins, color-coded indicators, and/or a locking mechanism. Some products offer a probe extension pole for standoff measurements.

Applications and Comparison to Other Types of Instruments

Used in incident management after a radiological event, survey meters are suitable for detecting contamination that could be taken into the body by inhalation, ingestion, or absorption into wounds. In some applications, alpha, beta, and gamma radiation can be discriminated by using different probes with and without end caps. Radiation on surface swipes can be measured to determine if surface contamination is removable. Significant training is required to use survey meters in these applications.

For interdiction, survey meters could be used to investigate alarms from screening detectors, such as personal radiation detectors (PRDs) or radiation portal monitors, and to complement information from Radioisotope Identifiers (RIIDs). PRDs are used to detect the illicit movement of radioactive material because they are capable of quickly detecting slightly elevated radiation levels. RIIDs are used to identify the radioactive source material in order to distinguish an innocent alarm from a threat such as a nuclear weapon. However, PRDs and RIIDs are not designed to operate in high radiation areas and they may overload near a strong radiation source. While HHRSMs usually have a slower response time than PRDs, they can measure higher levels of radiation and provide a good measure of the total exposure rate. Thus, HHRSMs can be helpful to determine the location and intensity of a radiation source revealed by a PRD or identified by a RIID.

Standards and Testing Programs

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 N42.33, *Performance Criteria for Portable Radiation Detection Instrumentation for Homeland Security,* was first published in 2003 and revised in 2006. It specifies radiological, environmental, electromagnetic, and mechanical performance requirements for handheld survey meters. N42.33 addresses only the photon exposure rate measurement capabilities of survey meters. It requires a measurement range from 5 μR/h to 10 mR/h or more[1], and a response time of 5 seconds or less for cesium-137, cobalt-60, and americium-241 sources. N42.33 specifies an instrument weight of less than or equal to 6.6 pounds and requires operation at temperatures from -20°C to 50°C.

In 2005 and 2007, the National Institute of Standards and Technology (NIST) published test results for commercially available radiation survey meters according to N42.33. 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 compares independent test results of commercial off-the-shelf rad/nuc detection and identification equipment with published standards. Information about the GRaDER program may be found at http://www.dhs.gov/guidance-grader-program.

Resources

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).