Homeland Security

TechNote

The U.S. Department of Homeland Security, Preparedness Directorate, Office of Grants and Training (G&T) established the System Assessment and Validation for Emergency Responders (SAVER) Program to assist emergency responders in performing their duties. The mission of the SAVER Program is to

- Provide impartial, practitioner relevant, and operationally oriented assessments and validations of emergency responder equipment.
- Provide information that enables decision-makers and responders to better select, procure, use, and maintain emergency responder equipment.
- Assess and validate the performance of products within a system, as well as systems within systems.
- Provide information and feedback to the user community through a well-maintained, Web-based database.

The SAVER Program established and is supported by a network of technical agents who perform the actual 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?"

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Radiation Portal Monitors

Background

Radiation portal monitors are detection devices that allow for passive or non-intrusive means to screen people, vehicles, or other objects for presence of nuclear and radiological materials.

Large portal monitors are usually deployed and set permanently at road checkpoints, cargo inspection stations, and ports. Such portals are equipped with radionuclide identification capabilities and can distinguish between legitimate commercial radioactive sources (e.g., medical, industrial); naturally-occurring radioactive materials (NORM) present in shipments of kitty litter, ceramic tiles, or fertilizer; and potential terrorist weapons (i.e., radiological dispersion devices [RDD] or improvised nuclear devices [IND]).

Small, portable portal monitors, typically without spectral identification capabilities, may be used by emergency responders as a means to monitor a large number of people, in a reasonable amount of time, for radioactive contamination after a radiological accident or terrorist attack using an RDD or IND. Small portal monitors can be deployed as temporary security measures to screen people entering political conventions, concerts, sporting events, or trade shows for illicit radioactive sources that could be potential components of an RDD. The use of portal monitors in such situations eliminates the need for individual hand searching using hand-held survey meters.

Fundamentals

Ionizing radiation produces charged particles (i.e., ionization), or produces micro flashes of light (i.e., scintillations) that can be detected by measuring these charges or scintillations with specialized instrumentation.

Different types of radiation carry different amounts of energy and penetrating powers. Alpha radiation can travel 2 inches in air and can be stopped by a piece of paper, but can cause the most damage to human organs if alpha-emitting radioactive substances enter the human body. Beta radiation can travel several hundred feet in air and can be stopped by most protective clothing. Skin contamination and inhalation are the primary paths of exposure from beta radiation. Gamma is the most penetrating radiation and can be stopped only by several inches of lead or several feet of concrete and other high-density materials.

More information on radiation and radiation protection basics can be found on the Health Physics Society (HPS) or Environmental Protection Agency (EPA) home pages listed at the end of this note.

There is no detection system that can detect all forms of ionizing radiation. As gamma is the most penetrating form of radiation, most early detection devices are optimized to detect gammas first. Radiation detection is based on measuring the electric signal produced by radiation in gases using Geiger-Muller (G-M) tubes; semiconductors, such as Cadmium-Zinc-Telluride (CdZnTe) and high purity germanium (HPGe); or scintillating crystals, such as Sodium Iodide (NaI) and Cesium Iodide (CsI).

Stationary portal monitors may use multiple semiconductors (HPGe) or scintillators (NaI) as radiation detectors.

Using such detectors, portals can have gamma radionuclide identification capabilities and will allow for positive identification of radioactive isotopes for resolution of alarms. Stationary portal monitors are heavy and more expensive than portable portal monitors, but their increased shielding, relative to portable portals, lowers the amount of background radiation detected by the portal, and therefore increases the instrument's sensitivity.

The small, portable portal monitors most likely to be used by emergency responders weigh less than 100 lb, fit into one to two carrying cases, can be powered from multiple sources including batteries, and can be configured for scanning or screening of people or vehicles. They utilize lightweight gas-filled radiation detectors, G-M pancake detectors, or plastic scintillators. The readout/alarming unit is included with the system and most of the time will have data recording capability.

NaI detector array inside spectroscopic portal monitor.

Portal monitor in its transport case

Portal monitors operate in two modes: the background mode when the monitor control area is unoccupied and the detection mode when the monitor control area is occupied. During the background mode, the monitor records and displays the count rate of gamma radiation. When the monitor enters detection mode, it compares the current count rate with the one collected during background mode and generates an alarm if the alarm threshold is exceeded. If the threshold is not exceeded and the object leaves the control area, the monitor re-enters the background mode.

Performance Factors

Performance factors for portal monitors were defined originally by the Federal Emergency Management Agency (FEMA) in 1995, and recently by American National Standards Institute (ANSI) Standard N42.35-2004, "American National Standard for Evaluation and Performance of Radiation Detection Portal Monitors for Use in Homeland Security." According to ANSI N42.35-2004, at natural background levels, a portal monitor alarm shall be triggered by e.g., 4 μCi of Cobalt-60 (Co-60) or 16 μCi of Cesium-137 (Cs-137). The probability

of detecting this alarm condition should be greater than, or equal to, 0.90 with 95 percent confidence, (i.e., 59 alarms in 60 passages).

Applications

The portal monitors designed for emergency responders are intended to be used:

- In emergency situations to evaluate potentially contaminated people, animals, or vehicles from an airborne radioactive plume resulting from a release of gamma emitting radioactive material from a nuclear power plant accident, or from short-term exposure to widespread contamination deposited from airborne radioactive material (FEMA-REP-21), (e.g., exploded RDD).
- As search tools to detect the presence of illicit radioactive materials in trucks and other conveyances, as well as for screening people to prevent terrorist attacks using RDD or IND.

For additional applications, see the EPA's Radiation Protection Basics or the HPS's Radiation Basics.

Limitations

- Portal monitors do not provide data to assess contamination or exposure levels to an individual or worker, as defined in 10 CFR 19.3(c), that could be exposed to contamination under controlled conditions such as in a work-place environment.
- Portable portal monitors are relatively expensive (in the range of $10,000–$20,000) and require special training for setup and operation.

Resources

Background Information on FEMA-REP-21: "Contamination Monitoring Standard for Portal Monitor Used for Radiological Emergency Response. Federal Emergency Management Agency," March 1995.

Statements of Consideration for FEMA-REP-21: "Contamination Monitoring Standard for a Portal Monitor Used For Radiological Emergency Response. Federal Emergency Management Agency," March 1995.

IEEE ANSI N42.35-2004: American National Standard for Evaluation and Performance of Radiation Detection Portal Monitors for Use in Homeland Security.

10 CFR 19.3(c): Title 10 Energy, Chapter I—Nuclear Regulatory Commission, Part 19-Notices, Instructions and Reports to Workers: Inspection and Investigations, 19.3 Definitions.

Radiation Basics (http://hps.org/publicinformation/ate/faqs/radiation.html).

Radiation Protection Basics (http://www.epa.gov/radiation/understand/protection_basics.htm).

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