System Assessment and Validation for Emergency Responders (SAVER)

Portable Radiation Portal Monitors Market Survey Report

March 2015

Homeland Security

Science and Technology

U.S. Department of Homeland Security

SAVER

System Assessment and Validation for Emergency Responders

Prepared by the National Urban Security Technology Laboratory

The *Portable Radiation Portal Monitors Market Survey Report* was prepared by the National Urban Security Technology Laboratory for the U.S. Department of Homeland Security, Science and Technology Directorate.

The views and opinions of authors expressed herein do not necessarily reflect those of the U.S. Government.

Reference herein to any specific commercial products, processes, or services by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the U.S. Government.

The information and statements contained herein shall not be used for the purposes of advertising, nor to imply the endorsement or recommendation of the U.S. Government.

With respect to documentation contained herein, neither the U.S. Government nor any of its employees make any warranty, express or implied, including but not limited to the warranties of merchantability and fitness for a particular purpose. Further, neither the U.S. Government nor any of its employees assume any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed; nor do they represent that its use would not infringe privately owned rights.

Cover photos courtesy of US Nuclear Corporation, Canberra Industries, Inc., and Thermo Scientific, Inc.

FOREWORD

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 assessments and validations on commercial equipment and systems, and provides those results along with other relevant equipment information to the emergency responder 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 mission includes:

- Conducting impartial, practitioner-relevant, operationally oriented assessments and validations of emergency response equipment
- Providing information, in the form of knowledge products, that enables decision-makers and responders to better select, procure, use, and maintain emergency response equipment.

Information provided by the SAVER Program will be shared nationally with the responder community, providing a life- and cost-saving asset to DHS, as well as to Federal, state, and local responders.

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?"

As a SAVER Program Technical Agent, the National Urban Security Technology Laboratory has been tasked to provide expertise and analysis on key subject areas, including chemical, biological, radiological, nuclear, and explosive weapons detection; emergency response and recovery; and related equipment, instrumentation, and technologies. In support of this tasking, NUSTL conducted a market survey of commercially available portable radiation portal monitors (PRPMs). PRPMs fall under AEL reference number 15SC-00-PMON titled Monitors, Portal.

Visit the SAVER website at www.firstresponder.gov/SAVER for more information on the SAVER Program or to view additional reports on PRPMs and other technologies.

POINTS OF CONTACT

SAVER Program
U.S. Department of Homeland Security
Science and Technology Directorate
FRG Stop 0203
245 Murray Lane
Washington, DC 20528-0203

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

National Urban Security Technology Laboratory
U.S. Department of Homeland Security
Science and Technology Directorate
201 Varick Street
New York, NY 10014-7447

E-mail: nustl.saver1@hq.dhs.gov

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

Portable radiation portal monitors (PRPMs) are used by police, security, and emergency response personnel to screen people for the presence of radioactive materials. The main application for these devices is monitoring large populations for contamination after a radiological or nuclear incident. They may also be used to screen people entering or leaving a sensitive area. To provide emergency responder and law enforcement organizations with information on PRPMs, the System Assessment and Validation for Emergency Responders (SAVER) Program conducted a market survey on commercially available PRPMs.

This market survey report is based on information gathered between September 2014 and November 2014 from a search of vendor websites, industry publications, and a government-issued Request for Information posted on the Federal Business Opportunities (FedBizOpps) website (https://www.fbo.gov).

For inclusion in this report, PRPMs had to meet the following criteria:

- Commercially available
- Contain vertically oriented detector panels at least 48 inches in height
- Able to detect gamma and beta radiation and alarm on significant increases in the radiation level
- Able to be assembled and disassembled into a transportable storage case.

Due diligence was performed to develop a report that is representative of products in the marketplace.

2. PORTABLE RADIATION PORTAL MONITORS OVERVIEW

PRPMs are detection systems that are designed to be easily assembled, disassembled, and transported to locations where they are used to screen individuals for the presence of radioactive materials. They are deemed to be "portable" if they can be disassembled into a case designed for ease of transport. PRPMs typically weigh about 100 pounds, come in transportable cases with wheels, and can be set up and operational within approximately 10 minutes. Conventional PRPMs detect gamma and beta radiation with plastic scintillation detectors. PRPM systems that are designed for security applications may provide options for including spectroscopic gamma detectors and/or neutron detectors.

The main components of a typical PRPM system are two vertical panels containing detectors and a top panel that connects them and provides stability. The width and height of the portal may be adjustable, but many systems have fixed dimensions that are typically about 32 inches wide by 80 inches high. PRPMs operate on alternating current (AC) power with battery backup. Other common components and features of PRPMs include a control/display panel, audible and visible alarms, and an infrared beam-breaking occupancy sensor.

PRPMs typically collect data for a short occupancy period as a person passes through the portal. If there is a significant increase in the radiation level compared to background radiation, the system will generate an alarm. In normal operation, hundreds of people can be screened per hour.

2.1 Current Technologies

This section describes the key technologies used by PRPMs—their detectors, operational modes, and alarm algorithms.

2.1.1 Detectors

All PRPMs in this report contain plastic scintillation detectors on each vertical panel, thus providing head-to-toe coverage for persons passing through the portal. Plastic scintillators are organic materials that emit visible light pulses when struck by ionizing radiation, such as gamma rays or beta particles. The light pulses are measured and converted into electronic pulses by a photomultiplier tube and associated electronics. The pulse count rate is proportional to the radiation dose rate, which is measured in units of rem per hour (rem/h), millirem per hour (mrem/h), or microrem per hour (μrem/h). A typical reading for background radiation is 10 μrem/h.

PRPMs with plastic scintillation detectors reliably measure radiation dose rate and alarm when there is a significant increase in dose rate as compared to background radiation. They provide a yes-or-no answer to whether or not radioactive material is present on the person passing through the portal. They do not have sufficient energy resolution to measure the spectrum of gamma-ray energies emitted by radioactive materials; thus, they cannot determine the radionuclide that causes an alarm. Other equipment, such as radionuclide identification devices (RIDs), can be used to investigate the cause of the alarm once it occurs.

Spectroscopic gamma detectors, such as thallium-doped sodium iodide (NaI(Tl)), may be added to PRPM systems in order to provide for radionuclide identification. Spectroscopic detectors are generally more expensive, less rugged, and more difficult to manufacture in large sizes as compared with nonspectroscopic plastic scintillators. Furthermore, count times as high as 30 seconds may be needed in order to produce a gamma spectrum that can reliably identify radionuclides, which could be incompatible with applications that screen large numbers of people quickly. For these reasons, spectroscopic detectors are infrequently used in PRPMs. In the PRPMs featured in this report, only one unit provides spectroscopic detectors as an option.

PRPMs that are used in security screening applications may use neutron detectors in order to find threatening radioactive materials such as plutonium. Plutonium is one of several special nuclear materials (SNMs) that can be used to make a nuclear weapon. In the PRPMs featured in this report, one unit provides neutron detectors as an option; it is the same product that is offered with spectroscopic detection.

2.1.2 Operational Modes

PRPMs generally have two modes of operation, the most common of which is known as *walk-through mode*. The objective of walk-through mode is to quickly scan large numbers of people in a short amount of time. When a person enters the portal and trips the occupancy sensor, the system measures the radiation level for a short duration roughly corresponding to the occupancy period. The exact time of the measurement depends on system software and user-settable parameters. It may include a fraction of a second before and after the occupancy and will usually be limited to a maximum walk-through time of approximately 2 seconds. In walk-though mode, hundreds of individuals can be screened per hour.

PRPMs generally provide a secondary mode of operation that allows for a longer measurement of the person of interest. This is most often called *stop-and-count mode*. In this mode, the person remains in the portal for a certain pre-set count time, usually about 5 to 20 seconds. The setting is usually pre-programmed into memory but may be overridden at the control panel, depending on the vendor's software design. A longer measurement time provides extra sensitivity at the cost of decreased throughput.

2.1.3 Alarm Algorithms

PRPMs continually measure and update the radiation background level when the portal is unoccupied. When the occupancy sensor indicates the presence of a person within the portal, system software will compare the measured radiation level with the background radiation level to determine whether or not to alarm.

The most common method of determining the alarm level is a statistical method known as *sigma-level alarming*. With this method, the system software computes the average background value over a certain period of time. Typically it will measure the background value every second over a period of several minutes. It also computes the *standard deviation*, which is a measure of the amount of variation of individual data points about the average. A low standard deviation indicates that each background reading is close to the average value, while a high standard deviation indicates that readings tend to vary widely about the average. Standard deviation is represented mathematically by the Greek letter sigma (σ). A common alarm level for PRPMs and other radiation detection instruments is five standard deviations (5-sigma) above background. Thus, if the average background value is 10 µrem/h, and the standard deviation is calculated as 1.0 µrem/h, an alarm would occur if the occupancy radiation value is above 15.0 µrem/h. System software on most PRPMs allows the user to set the sigma value. A higher sigma value (e.g., 7-sigma) will generally decrease the number of alarms, while a lower sigma value (e.g., 3-sigma) will generally increase the number of alarms. An optimum setting is obtained when false alarms are minimized, but the system still has the sensitivity to alarm on radiation measurements that are distinguishable from background.

All but one of the PRPMs included in this report employ sigma-level alarming and give the operator the ability to set the sigma level. One PRPM allows the user to either set a percentage above background as the alarm level, or a rate of increase from background, such as 7 µrem/h per second.

2.2 Applications

Applications for PRPMs fall into two broad categories—contamination monitoring and security screening.

2.2.1 Contamination Monitoring

An essential element of emergency response planning for radiological and nuclear events is monitoring the population for radiological contamination that may be deposited on the skin and

clothing. Population monitoring can identify individuals in need of decontamination and/or medical treatment, and can prevent cross-contamination among individuals[i].

PRPMs work well for population monitoring because of their portability, ease of use, and ability to monitor many individuals in a short amount of time. They are designed to make quick yes-or-no decisions about whether or not decontamination is needed based upon the amount of radiation emitted from individuals. PRPMs can be brought near the site of a radiological event to screen affected individuals or be set up at community reception centers (CRCs), where citizens who believe they may have been affected can go for screening. At CRCs, PRPMs can be used to determine if decontamination or further treatment is warranted. Individuals who cause the portal monitor to alarm can wash with soap and warm water and change clothes to remove surface contamination. Those that cause the portal to alarm after these decontamination procedures would then undergo further screening to check for internal contamination and may be registered for long-term health monitoring. Citizens concerned about health effects should be encouraged to go to their local CRC first to avoid overwhelming hospitals and medical facilities, ensuring those facilities will be available to those who need them.

2.2.2 Security Screening

A less common potential use of PRPMs is for security screening to detect the illicit transport of radioactive material by an individual. For example, a PRPM could be used to screen passengers entering a railway station or public sporting event. The plastic scintillators on conventional PRPMs will detect individuals who have an elevated radiation level, but will not be able to determine the type of radiation. An investigation using secondary screening tools, such as RIDs, will then be needed to determine the type of radioactive material that is present and its threat potential. Alternatively, the PRPM can be fitted with spectroscopic gamma radiation detectors in addition to the conventional plastic scintillators. This would allow a single system to perform alarm screening and radionuclide identification.

Many of the PRPMs included in this report sell vehicle monitoring kits that allow the system to also screen vehicles (Figure 2-1). Thus, PRPMs can be configured to screen the flow of traffic at chokepoints. A vehicle monitoring kit allows the top panel to be removed and the vertical detector panels to be separated. The resulting portal has an adjustable width that will depend upon the placement of the detector panels. In this configuration, the ability to distinguish a radioactive source from background will depend upon the portal width, the vehicle speed, and the sensitivity of the detector. Emergency response organizations should test their

Figure 2-1. PRPM in use as a vehicle monitor
Courtesy of Thermo Scientific, Inc.

[i] For more information, see the U.S. Centers for Disease Control and Prevention publication, *Population Monitoring in Radiation Emergencies*, April 2014.

configurations with a vehicle containing a test source to determine the maximum vehicle speed that will allow detection.

2.3 Standards/Regulations

PRPMs used for population monitoring in emergency response situations should meet Federal Emergency Management Agency (FEMA) standard REP-21, *Contamination Monitoring Standard for a Portal Monitor Used for Radiological Emergency Response*, issued in March 1995. This standard specifies that a portal monitor must be capable of detecting a 1-microcurie (μCi) cesium-137 source positioned at several points along a vertical line centered between the two side columns and between 0.5 and 5.5 feet above the instrument base. Individuals cleared by a portal meeting this standard will have no significant risk of detrimental health effects due to contamination on the skin and clothing. According to the standard, cesium-137 was selected for determining compliance because of its widespread availability, long half-life, and common use as a standard reference source of beta and gamma radiation. The standard also notes that beta radiation is the major contributor to skin dose from contamination on the skin, and the average beta radiation energy from cesium-137 is near the average beta radiation energy for radionuclides typically assumed to be present in a release from a commercial nuclear power plant accident.

Several standards may apply to the application of PRPMs for security screening of persons or vehicles to detect illicit radioactive material transport:

- American National Standards Institute (ANSI) N42.35, *American National Standard for Evaluation and Performance of Radiation Detection Portal Monitors for Use in Homeland Security*, addresses performance requirements for conventional (nonspectroscopic) portal monitors
- ANSI N42.38, *American National Standard Performance Criteria for Spectroscopy-based Portal Monitors Used for Homeland Security*, addresses performance requirements for spectroscopic portal monitors
- ASTM International Standard C-1169, *Standard Guide for Laboratory Evaluation of Automatic Pedestrian SNM Monitor Performance*, provides a method for evaluating the performance of SNM monitors for use in a security plan.

Most of the PRPMs described in this report are marketed primarily as contamination monitors, and the manufacturers therefore cite compliance with the FEMA REP-21 standard. One PRPM manufacturer reports that it meets the ANSI N42.35 and ASTM International C-1169 standards.

3. PRODUCT DATA

The PRPMs featured in this market survey report have many common features. For instance, all systems contain plastic scintillation beta/gamma detectors and infrared beam-breaking occupancy sensors. In addition, all systems operate from AC power and provide a battery backup option. Features such as price, size, weight, number of detectors, size of detectors, battery type, and battery life vary from system to system. Prices range from $11,486 to $17,700.

Product data for these systems is presented in Table 3-1, and the products are described in sections 3.1 through 3.6. Products are listed in alphabetical order by vendor. Product data was obtained directly from vendors and supplemented with information from the vendor website

except where otherwise noted. The information obtained has not been independently validated by the SAVER program.

Features in Table 3-1 are defined as follows:

Company indicates the manufacturer or distributor of the product. Some of the products may be available from multiple vendors.

Product indicates the product name.

Cost indicates the price of the PRPM as quoted by the vendor in U.S. dollars. Optional features may incur an extra cost and are not included in the table value.

Warranty Period indicates the number of years covered under the product's standard warranty.

GSA Schedule indicates whether or not the product is listed on the General Services Administration schedule of products that are available at negotiated rates for government agencies.

Weight indicates the total weight in pounds of the PRPM including battery and carrying case.

Carrying Case Dimensions indicates the length, width, and height, in inches, of the carrying case that the PRPM is stored in when disassembled.

Wheeled Case indicates whether or not the carrying case contains wheels for enhanced transportability.

Portal Inside Dimensions indicates the inner width and inner height, in inches, of the portal through which people who are scanned by the PRPM must pass.

Battery Type, Life indicates the type of battery used by the PRPM and amount of time, in hours, that one fully charged set of batteries can power the PRPM under ordinary conditions.

Detector Quantity and Type indicates the number and type of detectors contained in the PRPM.

Detector Dimensions indicates the height, width, and length, in inches, of each detector contained in the PRPM.

Total Detection Volume indicates the combined volume, in liters, of all detectors contained in the PRPM.

Meets FEMA REP-21 indicates whether or not the PRPM meets the FEMA REP-21 standard for contamination monitoring.

Spectroscopic Detectors indicates whether or not the PRPM includes spectroscopic gamma detectors.

Neutron Detectors indicates whether or not the PRPM includes neutron detectors.

Vehicle Monitor Kit indicates whether or not the vendor provides a vehicle monitor kit that allows the PRPM to scan moving vehicles for radiation.

Table 3-1. Product Comparison Matrix for PRPMs

Company	Product	Cost ($)	Warranty Period (years)	GSA Schedule	Weight (pounds)	Carrying Case Dimensions (inches)	Wheeled Case	Portal Inside Dimensions (inches)	Battery Type, Life	Detector Quantity and Type	Detector Dimensions (inches)	Total Detection Volume (liters)	Meets FEMA REP-21	Spectroscopic Detectors	Neutron Detectors	Vehicle Monitor Kit
Canberra Industries, Inc.	MiniSentry	NA	NA	NA	108	NA	Opt	30 x 80	Sealed lead acid, 40 hours	2 plastic scintillators	72 x 3 x 1.5	10.6	Yes	NA	NA	Opt
Laurus Systems, Inc.	TPM-903B	13,920	1	Yes GS-07F-0147T	110	80 x 18 x 18	Opt	NA	6 D cells, 40 hours	2 plastic scintillators	72 x 3 x 1.5	10.6	Yes	No	No	Opt
Ludlum Measurements, Inc.	Model 52-1-1 Personnel Portal Monitor	12,041	1	No	100	48 x 24 x 12	Yes	32 x 81	3 D cells, 24 hours	4 plastic scintillators	NA	11.0	Yes	No	No	No
Rapiscan Systems	TSA PM704	12,240	1	No	190	15 x 30 x 83	Yes	NA	8 D cells, 14 hours	2 plastic scintillators	72 x 3 x 1.5	10.6	No *	No	No	No
WB Johnson Instruments	AM-801	11,486	2	Yes GS-07F-0147T	110	50 x 27 x 13	Yes	36 x 84	6 D cells, 18 hours	4 plastic scintillators †	36 x 3 x 1.5	10.6	Yes	No	No	Opt
US Nuclear Corporation	Portable Personnel and Vehicle Monitor	17,700	1	No	128	54 x 16 x 7 per detector, 20 x 16 x 10 control case	Yes	No portal ‡	Recharge able, 10 hours	2 plastic scintillators	44 x 12 x 1.5	12.8	Yes	Opt	Opt	Yes

* This system meets security screening standards ANSI N42.35 and ASTM C-1169.
† Additional plastic scintillators on the top panel and bottom panel are available as an option.
‡ This system contains two detector panels that are 54 inches in height and can be separated between 24 and 240 inches.

Abbreviations:
NA = information not available
Opt = optional feature available at additional cost

3.1 Canberra Industries, Inc., MiniSentry

The MiniSentry is a PRPM that was designed to quickly scan pedestrians for gamma and beta radiation. System setup time including assembly is less than 10 minutes. With automatic startup and operation, it can be used by operators who may have little training or experience with radiation measurements. The MiniSentry meets the FEMA REP-21 standard for contamination monitoring as part of an emergency response.

MiniSentry
Courtesy of Canberra Industries, Inc.

Each of the two vertical panels on the MiniSentry contains a plastic scintillation detector having dimensions of 72 x 3 x 1.5 inches. Total detection volume is 10.6 liters. The pedestrian opening is 30 inches wide by 80 inches high; if needed, the opening can be modified to meet customers' specifications. An optional vehicle monitoring kit can be purchased to allow the MiniSentry to be used as a vehicle portal monitor. The kit contains all items needed to separate the two detector panels.

The control panel on the MiniSentry contains a liquid-crystal display (LCD) that shows the battery status, background radiation reading, and occupancy radiation reading. A "clean" or "contamination" status indicator is used to alert operators to alarms. There is also an optional audible alarm that can be heard up to 6 feet away. The firmware provides a menu-driven user interface that allows operators to set the system parameters and the mode of operation. A Windows-based software program is provided so that users can set up the MiniSentry to their specifications from a personal computer (PC). Once setup is complete, the user can download information to nonvolatile memory via an RS-232 serial port. Values can also be uploaded from the MiniSentry and stored on a PC for downloading to other units. All parameters are stored in nonvolatile memory, but can be overridden by operators at the control panel.

The MiniSentry weighs 108 pounds including the battery. When disassembled, it is packaged in a canvas carrying case that can be carried by two or more persons. An optional hard case with wheels can be purchased for increased ease of storage and transport. The MiniSentry operates from AC power or from its 20-amp-hour sealed lead-acid battery that provides 40 hours of continuous monitoring. An uninterruptible power supply with surge suppression and automatic battery charging is included. The MiniSentry is weather-resistant for use in outdoor weather conditions.

The MiniSentry uses an infrared beam-breaking sensor to determine occupancy within the portal. System software continually measures and updates the radiation background when there is no occupancy. The MiniSentry can operate in walk-through mode or stop-and-count mode and uses a sigma-level parameter to determine the alarm threshold. The occupancy time and alarm sigma level are parameters that can be set by the user.

The preceding information was compiled from publicly available vendor information.

3.2 Laurus Systems, Inc., TPM-903B

The TPM-903B is a PRPM that is suitable for permanent or temporary installation. The portal accommodates pedestrians, wheelchairs, walkers, ambulance gurneys, and strollers. An optional kit allows it to be adapted as a vehicle monitor as well. Emergency response teams, security forces, hazardous material (HAZMAT) teams, and evacuation teams can make use of the TPM-903B. With an assembly and setup time of approximately 10 minutes, the TPM-903B can quickly provide personnel radiation screening in an emergency response scenario or temporary security event. Minimal instruction is required for installation and operation.

TPM-903B
Courtesy of Laurus Systems, Inc.

The TPM-903B contains a plastic scintillation detector with dimensions of 72 x 3 x 1.5 inches on each of the two vertical panels. There is 1.6 millimeters of lead shielding on the three sides of each detector that face away from the portal. The system meets or exceeds FEMA REP-21, the standard for contamination monitoring in emergency response scenarios.

The TPM-903B weighs 90 pounds and comes with a canvas ski-style carrying bag as its standard packaging. A soft-sided or hard-sided carrying case with wheels can be purchased separately. The system operates from AC power or from six backup alkaline D-cell batteries that can provide approximately 40 hours of operation. The control panel has a 4-line by 20-character alphanumeric backlit LCD and a password-protected keypad. Its self-test procedure is complete in 2 seconds, and background acquisition takes 20 seconds. Alarms sound audibly and are displayed visibly on a status indicator with a green light for “ready/clear” and a red light for “alarm/fault.” The TPM-903B supports both walk-through mode (with a walk-through time of 2 seconds) and stop-and-count mode. The radiation alarm threshold setting is a number of standard deviations (sigma) above background. If the operator needs to change parameters such as alarm setting, time, or date, a menu interface on the display will prompt for the setup values, which are then entered through the keypad. The TPM-903B stores data internally and can be remotely operated and networked through its Ethernet port.

The TPM-903B is manufactured by Thermo Scientific, Inc., and distributed by Laurus Systems, Inc., and other vendors. It is only available on the GSA schedule (GS-07F-0147T) through Laurus, who also provide onsite training at GSA-scheduled rates. The vehicle monitoring kit is available for purchase for $765.

3.3 Ludlum Measurements, Inc., Model 52-1-1 Personnel Portal Monitor

The Model 52-1-1 Personnel Portal Monitor is a beta/gamma radiation personnel contamination monitor that meets FEMA REP-21, the standard for emergency response contamination portal monitoring. It is designed to be disassembled for ease of transportation and storage, and can be set up and operating in 5 minutes or less without tools. The unit contains four plastic scintillation detectors, with two on each vertical panel. The total detection volume is 11 liters. The inside dimensions of the portal are 24 inches wide by 81 inches high.

Model 52-1-1 Personnel Portal Monitor
Courtesy of Ludlum Measurements, Inc.

The control panel contains a 2-line by 20-character LCD that shows background rates from all detectors and sigma values above background. Alarms occur when a scan count rate exceeds the current background by a user-settable parameter—the number of sigma above background. All parameters are stored in nonvolatile memory and may be displayed and set with the keypad. The Model 52-1-1 supports both walk-through mode and stop-and-count mode. In walk-through mode, counts are collected every 0.2 seconds when the portal is occupied and for a period of 0.6 seconds before and after occupation. In stop-and-count mode, counts are collected for a fixed count time that may be set from 1 second to 20 seconds. During setup, the user can specify individual alarms (in which case a high reading from any detector will cause an alarm), sum alarms (in which case a high summed reading from all detectors will cause an alarm), or both. Alarms display in red on an LED status indicator; an additional audible alarm can also be used.

The Model 52-1-1 comes with a carrying case made of high-density plastic containing wheels and padded handles. The Portal monitor weighs 70 pounds, and the total weight of the system, including the carrying case, is 100 pounds. It operates from AC power or from three D-cell alkaline backup batteries that provide approximately 24 hours run time under nonalarm conditions. A clear polypropylene weather sleeve is provided to cover the control panel and protect it from wet weather conditions. Data is stored internally and can be transferred to a computer through an RS-232 serial port.

The Model 52-1-1 comes with a 1-year warranty, and an extended warranty for an additional year can be purchased for $1,354. Customers can receive free training on the Model 52-1-1 and other instruments at Ludlum's facility in Sweetwater, Texas.

3.4 Rapiscan Systems, TSA PM704

The TSA PM704 is a personnel-monitoring PRPM suitable for security applications and use at locations where radioactive materials need to be monitored. It is intended for use by hospitals, laboratories, and emergency response organizations. Its portability allows it to screen for radioactive materials at special events and at a wide variety of indoor and outdoor locations. The TSA PM704 meets the ANSI N42.35 standard for radiation detection portal monitors used for homeland security applications. Although it contains only nonspectroscopic detectors, its gamma sensitivity allows it to detect small amounts of highly enriched uranium (HEU) and other SNM. The TSA PM704 exceeds the criteria for the ASTM C-1169 standard for a Category II SNM monitor that can detect 10 grams of HEU on a walk-through basis. An optional mode is provided for optimal SNM monitoring.

TSA PM704
Courtesy of Rapiscan Systems

The main components of the system are two vertical pillars, each containing an organic plastic scintillation detector, with dimensions of 72 x 3 x 1.5 inches, and a crossover pillar. An alarm and control box with a numeric keypad and LCD is located on the crossover pillar and provides both audible and visible alarm indicators. The alarm level setting, a number of sigma above background, can be entered through the keypad interface.

The TSA PM704 weighs 190 pounds and comes in a wheeled tri-laminate polypropylene carrying case with spring-loaded handles and a custom foam insert. It operates from AC power or from eight alkaline D-cell batteries that provide approximately 14 hours of operation. Battery-backed random access memory (RAM) is used to store average hourly background data and alarm data. Under normal conditions, the memory is adequate for storing data for at least three months of operation. The TSA PM704 is dust-tight and is resistant to water splashes and jets. All detectors are shock mounted for increased ruggedness. The system complies with the Americans with Disabilities Act (ADA) requirements for wheelchair accessibility.

The TSA PM704 is compatible with TSA Radiation Alarm and Video Event Notification (RAVEN™) communications software that is designed to capture and view data related to a radiological detection incident at a remote computer. RAVEN can monitor multiple detectors, aid in managing individual detector activity, and can assist response personnel in pinpointing radioactive sources. RAVEN must be purchased separately. Extended warranties, service contracts, and training for the TSA PM704 and RAVEN software are also available. The vendor can be contacted for a quote.

3.5 WB Johnson Instruments, AM-801

The AM-801 is a transportable PRPM that can be assembled in less than 10 minutes without tools. It meets FEMA REP-21, the standard for contamination monitoring as part of an emergency response. The AM-801 comes with voice operational commands for ease of operation. The vendor claims that it is the only PRPM to come with a 36-inch interior pass-through width. The AM-801 contains four plastic scintillation detectors with dimensions of 36 x 3 x 1.5 inches, with two detectors on each vertical panel. Optionally, an extra detector can be purchased for the top panel (AM-801-5T), bottom panel (AM-801-5B), or both panels (AM-801-6). The inside dimensions of the portal are 36 inches wide by 84 inches high.

AM-801
Courtesy of Laurus Systems, Inc.

The AM-801 system is pre-programmed with voice operational commands that coincide with portal monitor operations. Commands can also be custom configured. The AM-801 comes with a full-color touch-sensitive Video Graphics Array (VGA) control panel that provides audible and visible alarms. All data entry is through the touch-sensitive screen. The AM-801 automatically and continuously measures the radiation background until an occupancy occurs. The AM-801 can operate in walk-through mode or stop-and-count mode using timed counts. In walk-through mode, throughput is approximately 500 persons per hour.

The AM-801 comes with a polyethylene hard-sided transport and storage case and weighs 75 pounds without the case and 110 pounds with the case. It operates from AC power or from six alkaline D-cell batteries that provide approximately 14 hours of operation. Data is stored internally and can be downloaded to a computer through an RS-232 serial port or Ethernet port. The AM-801 can also be configured in a wireless mesh network that allows automatic connections with other AM-801 units within 1,000 meters. In addition, software is available that allows for data-logging and remote monitoring of the AM-801 from a PC (DX-View) or through the Internet from a PC, Apple smartphone, or Android smartphone (DX-Dashboard). An optional vehicle monitoring kit is available that includes a shipping case and all materials needed to separate the vertical panels a maximum distance of 10 feet. The kit costs between $600 and $1,300, depending on the model.

The AM-801 is manufactured by WB Johnson Instruments, and distributed by Laurus Systems, Inc., and other companies. It is available through the GSA schedule from Laurus Systems, Inc. The AM-801 comes with a 2-year warranty and includes a National Institute of Standards and Technology (NIST)-traceable calibration certificate. A free interactive training compact disk (CD) is included with purchase of the system. On-site training is also available at GSA-scheduled rates from Laurus Systems, Inc.

3.6 US Nuclear Corporation, Portable Personnel and Vehicle Monitor (PPVM)

PPVM-TA
Courtesy of US Nuclear Corporation

The Portable Personnel and Vehicle Monitor (PPVM) is a portable beta and gamma radiation detection system that can be set up as a portal monitor for people or vehicles. The system consists of two vertical detector panels and a control/alarm panel. Unlike other PRPMs, there is no upper horizontal panel that creates a fixed portal width. The self-contained vertical panels are 54 inches in height and can be set up from between 2 feet and 20 feet apart, so that they can scan either people or vehicles. Each of the three panels that constitute the system is packaged in a weather-tight container that contains a tongue-in-groove continuous O-ring system for water, moisture, and dust protection. The detectors do not have to be unpacked and assembled. The detector panels can be attached to a fence, walls, doorways, or operate free-standing using wheeled deployment stands that are included with the system. This allows a setup time of between 2 and 4 minutes by a single person.

Each of the two detector panels weighs 55 pounds, and the control panel weighs 18 pounds, giving the system a total weight of 128 pounds. Each detector panel contains a single plastic scintillator with dimensions of 44 x 12 x 1.5 inches. Total detection volume is 12.8 liters. The PPVM is designed to meet the need for a large-scale evacuation of a contaminated area and meets the FEMA REP-21 standard for contamination monitoring during an emergency response. A wide range of alternate detectors, including neutron detectors, spectroscopic NaI(Tl) detectors, specialized beta detectors, and alternate-sized plastic scintillators, can be ordered as an option. The system operates from AC power or from a built-in rechargeable battery that provides approximately 10 hours of operation.

Two models of the PPVM are available based upon the operational approach. The PPVM-TA operates on a non-pause basis, providing quick scans of people, containers, or vehicles passing through the portal. Alarms are based on the rate of change of radiation. The alarm threshold is factory set at 7 µR/h per second, but can be changed by the user. The PPVM-TB achieves greater sensitivity by relying on a stop-and-count approach. Measurement times can be set from 1 to 20 seconds, and the alarm threshold is factory set at 10 percent above background radiation, but can be changed by the user.

The control/alarm panel provides both a visible alarm (through a flashing red-light status indicator) and a volume-adjustable 90 decibel (db) audible alarm. The system automatically self-tests for low battery, loss of signal, and high-background conditions. The system can store data for up to 1 year when continually operated. Data can be downloaded through a serial port or Ethernet connection.

Optional accessories include a license-exempt uranium check source, a flasher/siren remote alarm, wireless operation, and 7-day battery backup. The vendor can be contacted for pricing on these accessories and alternate detector options.

4. VENDOR CONTACT INFORMATION

Additional information on the products included in this market survey report can be obtained from the vendors of PRPMs.

Table 4-1. Vendor Contact Information

Company	Product	Address/Phone Number	E-Mail/Website
Canberra Industries, Inc.	MiniSentry	800 Research Parkway Meriden, CT 06450 (800) 243-3955	customersupport@canberra.com www.canberra.com
Laurus Systems, Inc.	TPM-903B AM-801*	3460 Ellicott Center Drive Suite 101 Ellicott City, MD 21043 (410) 465-5558	rad.info@LaurusSystems.com www.LaurusSystems.com
Ludlum Measurements, Inc.	Model 52-1-1 Personnel Portal Monitor	501 Oak Street Sweetwater, TX 79556 (325) 235-5494	sales@ludlums.com www.ludlums.com
Rapiscan Systems	TSA PM704	2900 Crystal Drive Suite 910 Arlington, VA 22202 (970) 535-9949 x18	RapiscanTSASales@osi-systems.com www.rapiscansystems.com
WB Johnson Instruments	AM-801	3998 Commerce Circle Idaho Falls, ID 83401 (208) 557-6945	bschaper@jradmeters.com www.jradmeters.com
US Nuclear Corporation	Portable Personnel and Vehicle Monitor	7051 Eton Avenue Canoga Park, CA 91303 (818) 883-7043	info@usnuclearcorp.com www.usnuclearcorp.com

*The AM-801 is manufactured by WB Johnson Instruments and is also available from Laurus Systems, Inc.

5. SUMMARY

PPRMs are radiation portal monitors that can be easily assembled, disassembled, and transported. The primary application for PRPMs is to screen for radioactive contamination on individuals after a radiological or nuclear event in which radioactive material is dispersed into the environment. Many state and local agencies have emergency response plans that call for using PRPMs at CRCs. A secondary application for PRPMs is security screening to interdict the illicit movement of radioactive material at strategic locations where the devices can be configured to screen persons or vehicles entering or leaving an area.

This market survey includes six commercially available PRPMs ranging in price from $11,486 to $17,700. Each system contains plastic scintillation detectors on its vertical panels, with detector volume ranging from between 10.6 and 12.8 liters. Product weights vary from between 70 and 190 pounds. Each product can be stored in a wheeled carrying case when disassembled, but the case is not included in the price for all systems. Each system operates from AC power with the option for battery backup. Battery configurations vary, and battery run times range from between 10 and 40 hours. Three systems featured in this report provide vehicle monitoring kits as an option, and another system can monitor vehicles in its standard configuration. One system provides the option for adding gamma spectroscopic detectors and/or neutron detectors.

Five systems are designed primarily for contamination monitoring and meet the FEMA REP-21 standard for contamination monitoring during an emergency response scenario. One system is designed primarily for security screening applications and meets the ANSI N42.35 standard for radiation detection portal monitors used in homeland security applications and the ASTM International C-1169 standard for SNM monitoring as part of a homeland security application.

Emergency response agencies that may be considering purchasing PRPMs should carefully consider the overall capabilities and limitations of each product in relation to the agency's operational needs. Different applications will have different requirements for detection sensitivity, portal size, weight, battery life, alarm types, amount of weatherproofing, and other specifications and features.