Homeland Security
Science and Technology

Summary

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 operational 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 mission includes:

- Conducting impartial, practitioner-relevant, and operationally oriented assessments and validations of emergency responder equipment;
- Providing information that enables decision makers and responders to better select, procure, use, and maintain emergency responder equipment.

Information provided by the SAVER Program will be shared nationally with the responder community, providing a life-saving 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?"

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Radioisotope Identifiers

(AEL reference number 07RD-01-RIID)

In order to provide emergency responders with information on currently available radioisotope identifiers (RIIDs) capabilities and limitations, National Security Technologies, LLC (NSTec), conducted a comparative assessment of RIIDs for the SAVER Program in August 2007. Detailed findings are provided in the Radioisotope Identifiers Assessment Report, *which is available by request at https://www.rkb.us/saver.*

Background

Distinguishing between legitimate radioactive sources and potential terrorist weapons is an important step in determining the appropriate response action. In the past, radioactive material identification through gamma spectroscopic analysis was only achievable at highly specialized universities and national or commercial laboratories. However, new technologies have resulted in availability of portable gamma spectroscopy systems known as RIIDs that can be used by emergency responders in the field. Spectroscopic analysis relies on measuring characteristic gamma ray energies emitted by radioactive elements. Collected spectra provide a unique "signature" for identifying the original isotopes.

Assessment

Prior to the assessment, NSTec conducted a market survey in order to compile information on commercially available equipment. Then, a focus group consisting of 11 emergency responders met to identify equipment selection criteria, determine evaluation criteria, and recommend assessment scenarios. Initially, the focus group felt that all currently available RIIDs should be evaluated due to the limited number of commercially available devices. However, the focus group determined that not all of the devices were useful for the mission of an emergency responder. Therefore, the focus group decided to establish product selection criteria that identified specifications, attributes, or characteristics a product should possess to be considered for the assessment. The focus group determined that assessed RIIDs should allow one-handed operation with no external cables or probes, and should not impede respiratory protection by requiring the user to wear a strap around the head and shoulder areas. Based on the selection criteria, four devices were chosen for the assessment. The following RIIDs were assessed:

- ORTEC Detective EX™
- SAIC Exploranium GR-135, The Identifier™
- Thermo Fisher Scientific identiFINDER NGH+™ Digital Spectrometer
- Thermo Fisher Scientific Interceptor GNid™

Eleven emergency responders from various backgrounds and jurisdictions were selected to serve as assessment evaluators. Evaluators were selected

based on their experience and knowledge of radiation instrumentation and radiological emergencies. Two basic scenarios proposed by the focus group were performed. One scenario focused on law enforcement response activities and the second on HAZMAT operations.

Each RIID was evaluated in the same manner, and operational conditions were controlled to make the evaluation of each RIID as similar as possible. An Evaluator Debriefing Questionnaire was developed to record evaluator ratings and comments on the RIIDs. These comments have been included in the full assessment report.

Assessment Results

Evaluators rated the RIIDs based on 18 assessment criteria categorized by the focus group within four of the five SAVER Program categories (capability, deployability, maintainability, and usability). The fifth SAVER Program category, affordability, was not included in the assessment because future maintenance and life cycle costs cannot be adequately measured. The focus group also assigned a weighting factor based on a total score of 100 percent to each category, and evaluators rated the devices on a scale of 1 to 5. The SAVER category and composite scores are shown in Table 1 (out of 100). Higher scores indicate better performance. To view how each RIID scored within the specific evaluation criteria assigned to the SAVER Program categories, see Table 2 on page 6.

The following paragraphs provide a brief summary of evaluator comments and feedback on each RIID used during the assessment. The sections present the RIIDs from the highest to the lowest composite scores.

SAVER Program Category Definitions

Affordability: This category groups criteria related to life cycle costs of a piece of equipment or system.

Capability: This category groups criteria related to the power, capacity, or features available for a piece of equipment or system to perform or assist the responder in performing one or more responder-relevant tasks.

Deployability: This category groups criteria related to the movement, installation, or implementation of a piece of equipment or system by responders at the site of its intended use.

Maintainability: This category groups criteria related to the maintenance and restoration of a piece of equipment or system to operational conditions by responders.

Usability: This category groups criteria related to the quality of the responders' experience with the operational employment of a piece of equipment or system. This includes the relative ease of use, efficiency, and overall satisfaction of the responders with the equipment or system.

identiFINDER NGH+™

The identiFINDER received the highest composite score and the highest scores in the deployability, maintainability, and usability categories, and tied with the GR-135 for capability. The identiFINDER uses a gamma detector capable of identifying multiple isotopes accurately and quickly. The manufacturer-provided reference library of 74 radioisotopes was considered adequate for most applications. The three large membrane-type buttons, labeled L (left), M (middle), and R (right), can be thumb-operated wearing gloves. The function of these

Table 1. Radioisotope Identifiers Assessment Results

System	Composite Score	Capability (40% Weighting)	Deployability (20% Weighting)	Maintainability (10% Weighting)	Usability (30% Weighting)
identiFINDER NGH+™	86	82	94	86	86
GR-135 Plus The Identifier™	82	82	86	82	78
Interceptor GNid™	78	74	90	72	82
Detective-EX-100™	66	76	68	56	56

Note:

Scores contained in the complete assessment report may be listed in a different numerical scale. For the purposes of the SAVER Summary, SAVER category scores are normalized and rounded to the nearest whole number.

	Pros	• Easy to use • Rugged design • One-hand operation • Large gamma detector for hand-held unit • Built-in source for self-check and calibration • Good identification speed and accuracy
	Cons	• LCD screen is hard to see in the sun • Serial port communication • Requires user to select radioisotope library
identiFINDER NGH+	Composite Assessment Score: 86	

buttons changes with each screen, with the current function displayed on the screen above the buttons. The device is well balanced, with the battery pack in the handle. The RIID can also be carried in the provided holster and it is very simple and easy to use. Up to 100 spectra of 1024 channels can be stored in the identiFINDER and directly transferred to any PC for further analysis. The transfer is accomplished via a proprietary cable from the device to a serial port using manufacturer-provided software.

The setup time for the device is minimal, and the device can be operated and carried easily by one person. Calibration is easy to execute and requires no external radiation source. The evaluators considered the identiFINDER easy to maintain; the smooth and sealed surfaces combined with very few open ports make this device ideal for decontamination. Power is supplied by either the rechargeable battery pack or four AA batteries.

Evaluators did note, however, that while the RIID was easy to use, the LCD screen was difficult to see in sunlight. The evaluators felt the proprietary cable and serial port were also a disadvantage to field work. Also, the radioisotopes are distributed into six separate libraries that are user selectable but they require previous knowledge of the hazards.

GR-135 Plus

The GR-135 received the second highest composite score and tied with the identiFINDER for the highest score in the capability category. The evaluators appreciated the large gamma detector's capability of identifying multiple isotopes accurately and quickly. The GR-135 has four pre-defined nuclide libraries,

	Pros	• Easy to use • Rugged design • One-hand operation • Large gamma detector for hand-held unit • Good identification speed and accuracy
	Cons	• Requires a base station for self-check and calibration • LCD screen is hard to see in the sun • Joystick is prone to breaking • Serial port communication
GR-135	Composite Assessment Score: 82	

with a total of 200 radionuclides. Most evaluators liked the GR-135 controls and that the device can be easily carried and operated with one hand. The Identiview software has a user-friendly interface.

Overall, evaluators felt that the GR-135 met their deployability needs. The evaluators liked the charging base for storage purposes, and they noted that the device was easily accessed from the base. The GR-135 was considered easy to maintain and decontaminate if necessary because it is completely sealed with few open areas. The power source for this system is a set of rechargeable AA batteries.

Disadvantages include that the joystick was considered prone to breaking by some evaluators, especially when pushed down. The LCD screen was also difficult to see in the sunlight. The greatest drawback of this device is the requirement of a base station for self-checks, and for data download to a PC. The GR-135 can internally store 185 spectra of
1024 channels each. The data transfer to a PC is accomplished via a proprietary base station and serial RS-232 cable, using manufacturer-provided software. The evaluators found the software installation difficult because the source was built into the charging base, and not the device itself.

Interceptor GNid

The Interceptor, which received the third highest composite score, worked very well in most environments. Evaluators reported that the Interceptor is operated with just three buttons and has a user-friendly display, optional built-in digital camera, and a voice recorder for event documentation. It has the appearance of a large personal radiation device (PRD) and can be worn in a belt holster. The

	Pros	• Easy to use • Rugged design • One-hand operation • Built-in camera and voice recorder • USB communication • Can be used within minutes of startup
	Cons	• Color LCD screen is hard to see in the sun • Based on a PDA, stylus required for advanced operation • Limited capability due to small detector • Batteries inaccessible by field responders
Interceptor GNid	Composite Assessment Score: 78	

Interceptor scored higher than all the other RIIDs in the ergonomics criterion.

This device uses the Microsoft® Windows® CE operating system, and its operational software is one of the applications. For data transfer, the device is shipped with a Universal Serial Bus (USB) cable and Interceptor Sync software, based on the Microsoft ActiveSync 4.1 software package.

Manufacturer-provided software resulted in quick synchronization. An alternative data transfer method was to configure the Interceptor to save the spectra directly to a Secure Digital (SD) memory card. At the end of deployment, the spectra from the SD card can be inserted into, and read directly by, most laptop computers.

Evaluators agreed that this RIID met their deployability needs. The preparation time for use was minimal, and one person can easily carry and operate the device. The Interceptor is ready for use within a few moments of turning it on, requiring only a quick boot-up to load all of the spectral and library files. The Interceptor's case is small, weatherproof, and capable of holding all of the Interceptor's accessories. Decontamination of the device would be fairly simple because it is a well sealed system with rubber casing.

The Interceptor is capable of identifying multiple isotopes, but it can only do so if they are included in the device's library. The major drawback affecting the Interceptor's capability is a small cadmium zinc telluride (CZT) detector that was considered inadequate for fast and accurate radioisotope identification under some circumstances. Although identification results for weak radioactive sources may take up to 30 minutes, a larger source (a few microcuries) can be identified within 1 minute. Additionally, the battery was not a standard type, such as AA, AAA, or D-cell. Instead, it is a rechargeable battery built into the Interceptor, which is inconvenient for field use because it is only accessible with an Allen wrench-type tool. Lastly, although the bright backlight made the color LCD screen very easy to see inside a dark building, the screen was difficult to read in bright sunlight.

Detective-EX-100

The Detective-EX-100 received the lowest composite score. The device can store up to 40 spectra containing 8096 channels of spectra internally, or many more if data storage is done on removable media, such as an SD card. Its internal, fixed library includes 24 radioisotopes from industrial, medical, nuclear, and natural categories. The data (spectra) transfer is accomplished via a USB connection to a laptop with Microsoft ActiveSync® software installed. The evaluators found the data transfer to be simple and the software interface user-friendly. Evaluators felt that the Detective-EX-100 would be easy to clean due to its smooth casing and sealed ports.

Although the Detective-EX-100 could identify isotopes almost immediately (within 1 to 2 seconds of searching), it had a harder time identifying multiple isotopes at the same time, specifically americium-241 in the presence of cesium-137. Evaluators agreed that the Detective-EX-100 was not well suited to meet their usability needs. The most prominent disadvantage is the device's sheer size, as it is much larger and heavier than any of the other products assessed. The device put a strain on the evaluators' arms and hands, was difficult to operate with one hand, and proved difficult to hold for an extended amount of time. Although a large wheeled transport case can be purchased as part of a package, such a solution was considered impractical for emergency response.

The Detective-EX-100 also did not fully meet the evaluator's deployability needs; the storage case is durable, but the size detracted from its ease of deployment. The preparation time and running time were important drawbacks to this system. Typical cooling time for this detector is about 4 hours, and the high purity germanium crystal inside the detector will not perform unless it has been cooled thoroughly.

The device's power source requires the use of the included docking station, which serves as a power supply to cool the detector and charge the internal battery. The docking station also contains the

	Pros	• Potentially highest identification speed and accuracy • User-friendly software interface • Common spectra storage format • Data easily retrieved and displayed on standard spectroscopy software
	Cons	• Price • Size and weight • Color LCD screen is hard to see in the sun • Based on a PDA, stylus required for operation • Cooling time required
Detective-EX-100	Composite Assessment Score: 66	

1.25 µCi cesium-137 check source used for routine calibration of the detector. The Detective-EX-100 can operate on internal batteries only for a limited time (up to 3 hours) before it must be recharged at the docking station. Because of this, evaluators felt that this device was more suitable for a fixed location, such as at a cargo screening checkpoint, rather than for use in an emergency team vehicle.

Conclusion

A comparative assessment of RIIDs was performed by a diverse group of law enforcement officers, firefighters, and U.S. Department of Energy professional radiological emergency responders. The Thermo Fisher Scientific identiFINDER received the highest composite score; however, none of the devices were considered to fully meet the needs of the emergency response community. The following recommendations were made by the evaluators for improvements to RIIDs designed for use by emergency responders:

- Simplify the user interface in the automatic (simplified) mode of operation.
- Provide displays that are easy to interpret and see under all illumination conditions.
- Clearly state the confidence level of automatic analysis.
- Simplify data transfer from the device to a PC—eliminate serial RS-232 communication protocol.
- Avoid proprietary cables, such as those with a mini-USB at one end and an RS-232 9-pin at the other end.
- Change the design philosophy from laboratory-based gamma spectroscopy to field-based operation under extreme conditions.
- Involve the emergency response community during the design phase of each new device.
- Design rugged, ergonomic devices.
- For emergency response groups equipped with RIIDs, establish working relationships with local radiation professionals (universities or national laboratories) for training.

QuickLook Snapshot

Note:

The SAVER QuickLook, available on the SAVER Web site, allows users to select the SAVER categories that are most important to their department and view results according to their specific needs.

All reports in this series as well as reports on other technologies are available by request at https://www.rkb.us/saver.

Table 2. SAVER Evaluation Criteria Scores

KEY Least Favorable → Most Favorable				
○ ◔ ◑ ◕ ●	identiFINDER	GR-135	Interceptor GNid	Detective-EX-100
Affordability				
N/A	N/A	N/A	N/A	N/A
Capability				
Ability to identify multiple radioisotopes	●	●	◑	◕
Use in wide range of environments	◕	◕	◕	◕
Ease of calibration	◕	◕	◕	◕
Identification speed	◕	◕	◕	◕
Use in hazardous environments	◕	◕	◕	◑
Deployability				
Ease of deployment	●	◕	◕	◑
Manpower requirement	●	●	●	◕
Preparation time	●	◕	◕	◑
Case/Storage	●	●	◕	◕
Maintainability				
Power source	◕	◕	◑	◔
Ease of maintenance and cleaning/decontamination	●	◕	◕	◕
Usability				
Display/Readout	◕	◕	◕	◑
Button/Switches	◕	◕	◑	◑
Simplicity/User-friendliness	●	◕	◕	◕
Ergonomics	◕	◕	●	◔
Information transmittal	◕	◕	●	◕
Size of device	◕	◕	◕	○
Training time	◕	◕	◕	◑
Specification				
Cost per unit	$13,980	$9,345	$10,995	$70,695
Size (inches)	9.8 x 3.7 x 3.0	6.8 x 9.0 x 4.0	4.4 x 2.4 x 1.0	15.5 x 7.2 x 13.8
Weight (pounds)	2.8	4.5	0.6	26.3
Gamma detector size and type	1.4" x 2.0" Sodium iodide (NaI)	1.5" x 2.2" Sodium iodide (NaI)	0.3" x 0.3" Cadmium zinc telluride (CZT)	2.5" x 2.0" P-type coaxial high-purity germanium
Battery type	8 hours NiMH rechargeable	8 hours 2 D size rechargeable	10 hours Internal Li-Ion rechargeable	3 hours Internal Li-Ion rechargeable