System Assessment and Validation for Emergency Responders (SAVER)

Handheld Radiation Survey Meters Focus Group Recommendations

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System Assessment and Validation for Emergency Responders

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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 (S&T) Directorate 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 mission includes:

- Conducting impartial, practitioner-relevant, 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- 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 (NUSTL) has been tasked to provide expertise in hazard detection, response, and remediation instruments and techniques. In support of this tasking, NUSTL will conduct a comparative assessment of Handheld Radiation Survey Meters (HHRSMs) to provide emergency responders with reference information on currently available technologies. HHRSMs fall under AEL equipment category Handheld Survey Meter, reference number 07RD-01-HHSM. As part of the project, assessment recommendations were gathered from a focus group and are highlighted in this report.

Visit the SAVER website at www.dhs.gov/science-and-technology/SAVER.

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1. INTRODUCTION

The System Assessment and Validation for Emergency Responders (SAVER) Program will conduct a comparative assessment of Handheld Radiation Survey Meters (HHRSMs) to provide emergency responders with useful information for operational and procurement decisions. HHRSMs are portable instruments that measure the activity (e.g. counts per minute) or the exposure rate from radioactive material. HHRSMs are used where radioactivity is suspected to be present in order to locate or to assess the intensity of the radioactivity. For example, an HHRSM might be used to screen packages, delineate the extent to which an area is contaminated, or to confirm radiation detected by another type of instrument. The HHRSM assessment will be conducted by emergency response professionals who will address the five SAVER categories: affordability, capability, deployability, maintainability, and usability.

In support of the comparative assessment, a focus group convened June 8, 2010 with the primary objectives of recommending evaluation criteria, product selection criteria, individual products, and possible scenarios for the assessment.

1.1 Focus Group Participants

Seven emergency responders from various jurisdictions in multiple states participated in the focus group. The diversity of the organizations they represented, coupled with their relevant experience and areas of expertise, resulted in stimulating and productive discussions throughout the day. Participants possess strong backgrounds in law enforcement, hazardous materials (HAZMAT), search and rescue, radiation protection regulation, firefighting service, and emergency medicine. The group's professional expertise and experience provided substantial credibility to the assessment recommendations. Table 1-1 lists the demographics of the focus group participants.

Each of the participants signed a statement certifying that they had no employment or financial relationship with the instrument manufacturers or vendors that may create a potential conflict of interest with the work to be performed for the SAVER Program.

Table 1-1. Focus Group Participant Demographics

Participant Demographics and Backgrounds		
Practitioner Discipline	**Years of Experience**	**Home State**
City Police Department Counter Terrorism Research	8	NY
State Police Emergency Preparedness Bureau	21	NJ
State Department of Environmental Protection	24	CT
Transit Police Special Operation Emergency Services	25	NJ
City Bureau of Environmental Emergency Preparedness and Response	29	NY
State Police Hazardous Material Unit	30	NY
City Fire Department Hazardous Material Operations	22	NY

1.2 Future Actions

The focus group recommendations will be used to guide the development of the HHRSM assessment plan and the selection of products to evaluate in the assessment. Once the assessment is completed, a *Handheld Radiation Survey Meter Assessment Report*, which will highlight the results of the assessment, will be available through on the SAVER at www.dhs.gov/science-and-technology/SAVER.

2. FOCUS GROUP METHODOLOGY

The focus group opened with an overview of the SAVER Program, the HHRSM project, and the focus group goals and objectives. Once the background material was covered, four sets of recommendations were solicited from the focus group participants:

- Evaluation criteria recommendations – General criteria that are important to consider when making acquisition or operational decisions.
- Product selection criteria – specifications, attributes, or characteristics a product should possess.
- Product recommendations – Products that are relevant to the emergency responder community and should be candidates for inclusion in the comparative assessment;
- Assessment scenario recommendations – Operational scenarios in which the products should be assessed to evaluate their performance.

Figure 2-1 highlights the process followed to gather these recommendations.

Focus group participants first described the typical applications in which their respective organizations use HHRSMs. Next, they discussed key features that they require in HHRSMs through a brainstorming style group discussion. National Urban Security Technology Laboratory (NUSTL) staff captured the discussions in real time using electronic worksheets projected on a presentation screen. Participants read the text and provided immediate feedback to clarify points made during the brainstorming discussion. The features identified during this process were grouped into evaluation criteria and sorted into the SAVER assessment categories of affordability, capability, deployability, maintainability, and usability.

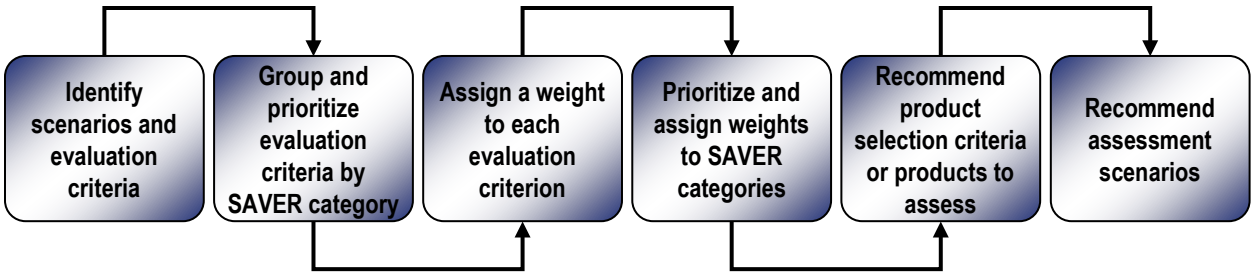

Figure 2-1. Focus Group Process

The SAVER categories are defined as:

Affordability – Groups criteria related to life-cycle costs of a piece of equipment or system.

Capability – 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 relevant tasks.

Deployability – 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 – Groups criteria related to the maintenance and restoration of a piece of equipment or system to operational conditions by responders.

Usability – 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.

A ranking system was used as a guide to assign weight factors to the evaluation criteria. Reaching consensus on the ranking and weighting factors within the categories involved an in depth exchange of ideas and further clarification of the evaluation criteria recommendations. After reviewing the criteria recommendations and weighting factors, the participants were asked to weigh the categories.

The focus group participants also discussed product selection and identified seven specific products that should be considered for the assessment. Lastly, the focus group participants recommended scenarios and operational environments for the HHRSM assessment.

3. EVALUATION CRITERIA RECOMMENDATIONS

The focus group identified 25 evaluation criteria in the five SAVER categories (i.e., affordability, capability, deployability, maintainability and usability). They concluded that all of the categories were of equal importance. Table 3-1 presents the category weights, the evaluation criteria, and the evaluation criteria weights. The evaluation criteria are further explained in sections 3.1-3.5.

Table 3-1. Evaluation Criteria

Evaluation Criteria				
SAVER CATEGORIES				
Affordability	**Capability**	**Deployability**	**Maintainability**	**Usability**
Overall Weighting 20%	**Overall Weighting 20%**	**Overall Weighting 20%**	**Overall Weighting 20%**	**Overall Weighting 20%**
Criterion: Operational Costs **Weight Factor: 35%**	**Criterion:** Radiological Performance **Weight Factor: 50%**	**Criterion:** System Durability **Weight Factor: 25%**	**Criterion:** Serviceability **Weight Factor: 60%**	**Criterion:** Display Interface **Weight Factor: 50%**
Criterion: Initial Cost **Weight Factor: 25%**	**Criterion:** Non-radiological Capabilities **Weight Factor: 20%**	**Criterion:** Environmental **Weight Factor: 25%**	**Criterion:** Calibration **Weight Factor: 20%**	**Criterion:** Probe Use **Weight Factor: 25%**
Criterion: Repair Costs **Weight Factor: 15%**	**Criterion:** Data **Weight Factor: 20%**	**Criterion:** Probe Features **Weight Factor: 15%**	**Criterion:** Power **Weight Factor: 20%**	**Criterion:** Alarm / Audible Options **Weight Factor: 10%**
Criterion: Warranty **Weight Factor: 15%**	**Criterion:** Standards Conformance **Weight Factor: 5%**	**Criterion:** Battery Replacement **Weight Factor: 15%**		**Criterion:** Form Factor **Weight Factor: 10%**
Criterion: Shipping Costs **Weight Factor: 5%**	**Criterion:** Intrinsically Safe **Weight Factor: 5%**	**Criterion:** Weight **Weight Factor: 10%**		**Criterion:** Software/Controls/ Data Handling **Weight Factor: 5%**
Criterion: Customer Service **Weight Factor: 5%**		**Criterion:** Equipment Storage/Transport **Weight Factor: 10%**		

3.1 Affordability

Six affordability criteria were identified by focus group members. Operational costs and initial costs were considered the most important criteria in this category.

The affordability criteria were defined by the focus group as follows:

Operational Costs: Ongoing costs associated with using and maintaining the survey meters. This includes the routine maintenance costs, calibration costs, required frequency of calibration, software and other upgrade costs, and meter life expectancy. Participants also discussed battery life and type, noting a preference for generic off-the-shelf batteries over specialized batteries. Turn-around time in sending the HHRSMs to the manufacturer for calibration, maintenance, or

repair was also a concern. Some participants have established in-house facilities for maintenance and calibration to deal with that issue. Participants discussed training costs to maintain skilled personnel for using and calibrating the equipment or backfilling those positions.

Initial Cost: Initial purchase cost including the cost of necessary accessories.

Repair Costs: Costs to repair the equipment including the cost of replacement parts.

Warranty: Availability of standard or extended warranties, especially on electronic instruments.

Shipping Costs: Costs to ship the equipment back to the manufacturer for calibrations or repair. It was noted that it would be an advantage to have the capability to just ship the probe for calibrations rather than the whole unit. Other participants suggested that availability of a shipping container that meets Department of Transportation regulations is an important feature.

Customer Service: Responsiveness of the manufacturer to requests for price quotes, repair issues, or technical questions. Participants noted that any delays in response, or the need for repeated inquiries to the manufacturer, impact affordability.

3.2 Capability

Five capability criteria were identified by focus group members. Radiological performance was considered the most important criteria in this category. For HAZMAT response, the capability to measure high radiation (exposure rates of 100 Roentgen per hour [R/h]) is desired in order to carry out rescue missions, and the ability to measure alpha, beta, and gamma radiation was also cited. It was also noted that the capability to store data is significant since it may be needed for evidence.

The capability criteria were defined by the focus group as follows:

Radiological Performance: Radiological measurement capabilities of the instrument. Participants prefer that the instrument measure alpha, beta, and gamma radiation. For HAZMAT and rescue operations (i.e., not interdiction applications), participants commented that an instrument with an upper range of 100 R/h is needed. Responders prefer instrument readout in units of Roentgen (R) and that the detector response times meet American National Standards Institute (ANSI) / Institute of Electrical and Electronics Engineers (IEEE) standard 42.33, section 6.4.

Non-radiological Capabilities: Other features of the instrument including meter self-checks and a functionality check that would indicate that the unit is working properly. Other important capabilities are an accurate battery test circuit that would indicate remaining battery life, the ability to set alarms and thresholds, and the ability to silence alarms.

Data: How the device stores, handles, or transmits data. Participants prefer that the meter store data, preferably in a format that complies with Institute of Electrical and Electronic Engineers

standards. In some applications, data could be needed for legal reasons or as evidence. Participants commented that data storage could be scalable to use, and a desirable feature would be easily added memory, especially in a generic off-the-shelf-configuration. The ability to share real-time data is a desired feature, especially in a standard wireless format such as Infrared, Bluetooth®, or wireless Ethernet. The ability to encrypt data and a global positioning capability are also desired features.

Standards Conformance: The instrument meets third party certification, ANSI / IEEE standards, or military specifications.

Intrinsically Safe: Certified for use in explosive environments.

3.3 Deployability

Six deployability criteria were identified by focus group members. System durability and environmental ruggedness were considered the most important criteria in this category.

The deployability criteria were defined by the focus group as follows:

System Durability: The instrument's useful life without breaking or deteriorating under a wide range of operating conditions. Responders prefer a rugged, durable, shock- and drop-resistant meter with a rugged counting window, cabling, and cable attachments and that the internal contacts for the cable are durable, with the probe cables easy to attach and lock without coming loose during operation. An optional rubber jacket for shock resistance is also a desired feature.

Environmental: Ability to function in a wide range of operating conditions. Responders prefer instruments to be water-resistant or waterproof, immune to external interference from radio frequency (RF) or magnetic fields, and able to operate over a wide temperature range. Responders also prefer that instrument work properly during sudden changes in temperature for numerous cyclical exposures to temperature extremes, and that the user has the ability to turn off wireless RF signals from the instrument.

Probe Features: Durability and optional extendable probe.

Battery Replacement: The ease of replacing batteries in different operating conditions or while wearing personal protective equipment (PPE). This includes the type of battery access and the number of batteries required.

Weight: The carrying weight of the instrument, and the availability of a shoulder or other support strap.

Equipment Storage/Transport: Ability to be stored and transported without damage under different use scenarios. Responders prefer that the instrument have a water-resistant, durable, and non-slippery protective case.

3.4 Maintainability

Three maintainability criteria were identified by focus group members. Serviceability is considered the most important criteria in this category. Participants agreed that a product with modular construction that a user can service by swapping components would be the most maintainable.

The maintainability criteria were defined by the focus group as follows:

Serviceability: Degree to which the servicing of the instrument can be accomplished with minimal time and resources. Participants suggested that easily serviceable instruments with modular construction and easily accessible components were most desirable. Some wanted features such as an easily swapped out Geiger-Müller-tube that allows servicing in-house without shipping back to the manufacturer. For this, a wide availability of spare parts is also needed. Participants prefer that the instrument construction allow for it to be decontaminated.

Calibration: The frequency and complexity of the instrument's calibration requirements. Some participants expressed a preference for instruments that could be calibrated in-house without shipping the unit to the manufacturer. The availability of training for maintenance and calibration of the unit is a desirable feature.

Power: The battery type of the instrument. Responders prefer generic, off-the-shelf or rechargeable batteries.

3.5 Usability

Five usability criteria were identified by focus group members. The display interface is considered the most important criteria in this category, followed by probe use. To meet their mission needs, participants prefer an auto-ranging digital display with large size numbers that can be clearly read in both daylight and no light conditions and while wearing respiratory protection, and that probes are easy to change.

The usability criteria were defined by the focus group as follows:

Display Interface: The interface that displays radiological measurements or other important instrument information to the user. Responders prefer the display to be in English, digital with large size numbers, clearly displayed units, backlight, and glare protection. They also prefer auto-ranging displays and indicators for increasing or decreasing radiation fields, as well as overload indicators if readings are off scale.

Probe Use: The features and ease of use of probes. Some of the features considered significant include hot-swappable probes, ability to interchange probes with multiple meters, simple identification system for connecting probes, and a clip to store the probe on the instrument. Responders prefer that instruments have an internal detector, but also probes with long cables for different measurement positioning applications, with a simple procedure to adjust the voltage

associated with each probe. For pancake probes, participants would like disposable standoffs to be available.

Alarm/Audible Options: Clicks or other audible tones for measurement and alarm. Participants prefer instruments with audible and/or vibrate capabilities which are easy to set. For surveying, clicks are useful, particularly if an earphone is available. A wireless earphone (e.g. Bluetooth headset) is desirable.

Form Factor: The shape, size, and material construction of the instrument. Responders prefer instruments that can be easily held and operated both with and without gloves. Single-handed operation is preferable, with large and few control buttons or simple dial controls.

Software/Controls/Data Handling: Electronic features of the instrument. Participants noted that intuitive menus, the ability to lock out certain controls or features, and simplicity of data transfer are important criteria.

4. PRODUCT SELECTION CRITERIA

The focus group participants noted that instruments should be able to detect radiation levels of 100 R/h, and to measure alpha, beta, and gamma radiation. Based on their experience, the focus group participants recommended the following seven products as candidates for the HHRSM assessment:

- Thermo Scientific FH 40 G Multi-Purpose Survey Meter
- Canberra Radiagem™ 4000 Personal Portable Dose Rate and Survey Meter
- SE International Radiation Alert Inspector
- Ludlum 2241-3K
- Ludlum 2360 contamination meter
- Ludlum Model 9 Ion Chamber
- Thermo/Bicron MicroRem survey meter.

5. SCENARIO RECOMMENDATIONS

The focus group identified many applications in which they use HHRSMs. These included: threat assessment for HAZMAT teams, alarm resolution, establishing hot zones and boundaries, random vehicle inspections, HAZMAT inspections, background mapping, contamination assessment, evaluation of personnel for decontamination post event, and searching for suspect

sources. Based on these applications, the focus group recommended several assessment scenarios and operational environments which will be incorporated into the assessment.

The participants also suggested specific methods to test some of the key features of the instrument. For example, they want to determine how removing and inserting cables, replacing the battery, changing scales, and changing probes would be affected with the use of gloves. Another suggestion they made is to test the display interface of the equipment in different scenarios such as in darkness and in direct sunlight and while wearing PPE especially when their mask is fogged up. These suggestions will be incorporated in the assessment scenarios by planning for them to include outdoor and indoor environments and the use of PPE.

5.1 Operational Environment: Fire Response/HAZMAT/Rescue

The instrument is carried in a case within a vehicle storage compartment and driven to an incident scene; rough driving conditions and extreme temperature changes are possible. The instrument is then used for frisking by an operator wearing bulky PPE, including such things as firefighter gloves and respiratory protection. The instrument may be subjected to water spray.

5.2 Operational Environment: Police Response

The instrument is carried in the back of vehicle and subjected to vibration and temperature cycles. The instrument is then used for frisking or searching by an operator wearing police gloves; one-handed operation may be required.

5.3 Operational Environment: Post Event

The instrument is used for a post-event radiological survey among rubble, over difficult terrain. The user will listen for audible clicks and swap probes.

6. ACKNOWLEDGEMENTS

NUSTL thanks the focus group participants for their valuable time and expertise. Their insights and recommendations will guide the planning and execution of the HHRSM assessment as well as future assessments. Appreciation is also extended to the home jurisdictions of the participants for allowing them to participate.