



**Homeland  
Security**

Science and Technology

# Summary

U.S. Department of Homeland Security



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 tests on commercial equipment and systems and provides those results along with other relevant equipment information to the emergency response community in an operationally useful form. SAVER provides information on equipment that falls within the categories listed in the DHS Authorized Equipment List (AEL).

The SAVER Program is supported by a network of technical agents who perform assessment and validation activities. Further, SAVER focuses primarily on two main questions for the emergency responder community: "What equipment is available?" and "How does it perform?"

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## Remote Chemical Detection Systems

*In order to provide emergency responders with information on currently available Remote Chemical Detection Systems (RCDS) technologies, capabilities, and limitations, the Center for Domestic Preparedness (CDP) conducted a comparative assessment of RCDS for the SAVER Program in November 2007. Detailed findings are provided in the Assessment Report on Remote Chemical Detection Systems, which is available by request at <https://www.rkb.us/saver>.*

### Background

During a hazardous material (HAZMAT) or weapons of mass destruction (WMD) chemical-related incident, responders need the ability to detect chemicals that could adversely affect the public, themselves, and their response. Response teams can rely on portable, point detection RCDS to detect chemical vapors in the air. RCDS can enhance safety by alerting responders who are at a remote location or command center of a chemical source at a disaster site, either through alarm systems or through wired or wireless data transmission. Responders can remain unharmed at a safe distance from the affected area while protecting the public and making sound decisions about their response.

### Assessment

Prior to the assessment, the CDP conducted a market survey in order to compile information on commercially available equipment. Then, a focus group consisting of nine emergency response practitioners from various regions of the country met in September 2007 to identify equipment selection criteria for the assessment, evaluation criteria, and assessment scenarios.

The RCDS focus group participants recommended that the assessment focus on portable RCDS. Based on the focus group recommendations and market survey research, the following RCDS equipment was assessed as representative of currently available portable RCDS:

- RAE Systems AreaRAE Rapid Deployment Kit (AreaRAE)
- Mine Safety Appliances (MSA) SAFESITE® Multi-Threat Detection System (SAFESITE)
- BW Technologies Rig Rat III (Rig Rat III).

Nine emergency responders with strong fire service and HAZMAT backgrounds were selected to serve as evaluators for this assessment. The assessment was conducted using HAZMAT scenarios recommended by the RCDS focus group. Each RCDS was evaluated in the same manner and operational conditions were controlled to make the evaluation of each system as similar as possible. Detailed comments were captured by the data recorders during the assessment activities and these comments have been included in the full assessment report.

## Assessment Results

Evaluators rated the RCDS based on the evaluation criteria established by the RCDS focus group. Each recommended criterion was assigned to one of the five SAVER categories and was then assigned a weighting factor based on a 100-point scale. The SAVER category and composite scores are shown in Table 1. Higher scores indicate better RCDS performance. To view how each RCDS 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 the evaluator comments and feedback on each RCDS used during the assessment. The RCDS are listed by highest to lowest composite score. The full report includes a more thorough review of evaluator comments by SAVER category and individual criterion.

### AreaRAE

The AreaRAE received the highest composite score as well as the highest scores in all five SAVER categories. The system received high capability scores largely due to its versatility and transmission range. The assessed AreaRAE remote detectors were equipped with a photoionization detector (PID) for parts per million (ppm) measurement of volatile organic compounds (VOC). The remote detectors were also equipped with lower explosive limit (LEL), oxygen (O<sub>2</sub>), carbon monoxide (CO), and hydrogen sulfide (H<sub>2</sub>S) sensors. Evaluators noted that the AreaRAE command center can control up to 32 remote detectors. The included repeater offered additional versatility. The remote detectors successfully transmitted data at distances of up to 1.5 miles without the repeater and up to 2.5 miles with the repeater.

### 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.

Evaluators rated this unit high in usability because of its easy assembly, easy-to-read buttons, large remote sensor display screen, and protective casing for the command center and sensors. The required software was preloaded on the command center and started automatically. The AreaRAE includes an in-case charger that allows for easy charging of the four remote detectors. The kit also includes four spare lithium-ion batteries and a 4-bank gang charger.

Evaluators gave a high deployability rating to this RCDS because it could be easily deployed and used while wearing Level A personal protective equipment (PPE). The size of the device allowed evaluators to easily transport it to and from the assessment sites.

**Table 1. RCDS Assessment Results**

RCDS	Composite Score	Affordability (5% Weighting)	Capability (35% Weighting)	Deployability (15% Weighting)	Maintainability (20% Weighting)	Usability (25% Weighting)
AreaRAE	82.8	73	84	92	76	84
SAFESITE®	69.8	69	66	89	67	67
Rig Rat III	64.4	64	76	42	58	67

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.

Evaluators noted disadvantages of the AreaRAE, as well. For instance, the command center laptop was not weather-resistant. Exposure to inclement weather could harm the laptop's electronic components.

 <p><b>AreaRAE</b></p>	
 <b>Pros</b>	<ul style="list-style-type: none"> <li>• User-friendly manual</li> <li>• Easy assembly by one responder</li> <li>• Easy to operate</li> <li>• Easy to deploy while wearing PPE</li> <li>• Maintenance schedule listed in literature</li> <li>• Weather-resistant remote detectors</li> <li>• Spare batteries and 4-bank gang charger included</li> <li>• Continuous sensor reading transmissions</li> <li>• User-programmable correction factors</li> <li>• Clearly labeled controls</li> <li>• Text messaging capability</li> <li>• Pre-installed command center software</li> <li>• Long transmission range</li> <li>• One-year sensor warranty from date of shipment</li> <li>• On-site training included in purchase price</li> <li>• Global positioning system (GPS) option</li> </ul>
 <b>Cons</b>	<ul style="list-style-type: none"> <li>• Command center not weather resistant</li> <li>• No internal chemical warfare agent (CWA) detection</li> </ul>
<p><b>Composite Assessment Score: 82.8</b></p>	

command center does not have a backup battery system to enable continuous operation. While the SAFESITE literature claims a 2-mile line of sight transmission range, the communication with the remote units was inconsistent when the remote detectors were moved to distances greater than 1 mile, even when using the optional high gain antennas.

The SAFESITE was easy to deploy due to its relatively small size and the large handles on the remote sensors. The large push-button design of the sensor controls made the units easy to operate while wearing PPE. Other advantages of the SAFESITE included preloaded software on the command center laptop. The command center was assembled by a single responder with minimal training in less than 10 minutes and communication between the command center and remote detectors was quickly established. Additionally, the assessed SAFESITE unit featured the optional GPS, which allowed responders to document the location of each remote sensor.

Evaluators discussed disadvantages including difficulty in accessing the remote detector display screen while wearing PPE (a screwdriver was required). One of the assessed remote detectors had a damaged display screen. Evaluators also noted that the user manual for the SAFESITE was difficult to

 <p><b>SAFESITE®</b></p>	
 <b>Pros</b>	<ul style="list-style-type: none"> <li>• Easy assembly by one responder</li> <li>• Easy to operate</li> <li>• Easy to deploy while wearing PPE</li> <li>• Weather-resistant remote detectors</li> <li>• Remote sensor controls clearly labeled</li> <li>• Pre-installed command center software</li> <li>• GPS option</li> </ul>
 <b>Cons</b>	<ul style="list-style-type: none"> <li>• Command center laptop not weather resistant</li> <li>• Remote sensor display screen cover difficult to open in PPE</li> <li>• Unclear user's manual</li> <li>• Sensors not well protected from the elements</li> <li>• Sensors difficult to calibrate</li> <li>• Command center does not have battery backup</li> </ul>
<p><b>Composite Assessment Score: 69.8</b></p>	

## SAFESITE

The SAFESITE received the second highest composite score. The assessed remote detector units were equipped with LEL, O<sub>2</sub>, and H<sub>2</sub>S sensors, a PID, and the optional GPS. Evaluators noted that the command center can manage up to 16 remote detectors. The SAFESITE received or tied for the second highest score in four of the five SAVER categories; however, the system received the lowest score in the capability category. The system received low evaluator ratings in the operating conditions, power supply, and accurate transmission range criteria. Evaluators commented that the sensors are located against the outer shell of the remote detectors and appear to have little protection from the elements. They were unable to get several of the sensors to calibrate during the assessment, and they had to disable one of the sensors in order to use the unit. Evaluators noted that the

follow and did not address several of the problems encountered during the assessment.

### Rig Rat III

The Rig Rat III received the lowest composite score. The Rig Rat III can utilize two gas-specific sensors at a time. Unlike the other assessed models, the Rig Rat III remote detector sensors are not installed inside the unit. Instead, they are attached to the outside of the unit with cables. The four assessed detector units were equipped with different combinations of CO, LEL, O<sub>2</sub>, and H<sub>2</sub>S sensors. While the system did not offer the versatility of the other assessed systems, it received the second highest score in the capability category. Advantages to the Rig Rat III included the ability to easily decontaminate the system and the continuous transmission of sensor readings. The unit had the broadest temperature operating range capability of -40° to 122°F.

Other Rat Rig III advantages included the numerous available power sources; the command center is capable of being powered by battery or 110-volt (V) alternating current (AC). The remote detectors were equipped with rechargeable batteries and could also be powered by AC power or solar panels. The remote

detector batteries were recharged by the units' solar panels.

The evaluators addressed several Rig Rat III disadvantages. The unit components were shipped in multiple boxes and had to be completely assembled. Once assembled, the detector unit with optional tripod and solar panel was bulky, difficult to transport, and presented several pinch points during assembly. Evaluators found deploying and operating the Rig Rat III while wearing PPE difficult.

### Conclusion

The assessment goal of utilizing and comparatively assessing RCDS in WMD or other HAZMAT scenarios was achieved. Analysis of the evaluators' scoring and comments revealed these conclusions:

- Simple RCDS setup and operation were highly valued by the evaluators. Evaluators expressed a strong preference for systems with user-friendly operation that required little reference to the user manual. Quick deployment and intuitive operation enables responders to quickly obtain necessary information at an incident scene.
- Evaluators preferred RCDS with GPS capability. GPS allows responders to document the location of each remote detector and to more effectively use information from the remote detectors with plume modeling software.
- Evaluators expressed a preference for weather-resistant command centers with built-in backup power sources. These features provide responders additional versatility and reliability.



**Rig Rat III**

 <b>Pros</b>	<ul style="list-style-type: none"> <li>• Weather-resistant command center and remote sensors</li> <li>• Redundant power sources for command center and remote sensors</li> <li>• Continuous sensor reading transmissions</li> <li>• Clearly labeled remote sensors</li> <li>• Easy-to-read command center display screen</li> <li>• Two-year warranty</li> </ul>
 <b>Cons</b>	<ul style="list-style-type: none"> <li>• Difficult setup</li> <li>• Difficult to follow user manual</li> <li>• No optional GPS</li> <li>• Optional tripod and solar panel configuration is difficult to deploy</li> <li>• No maintenance schedule in literature</li> <li>• No training aids provided</li> </ul>
<b>Composite Assessment Score: 64.4</b>	

## 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 Category and Criteria Scores**

KEY		  			
		AreaRAE	SAFESITE®	Rig Rat III	
Least Favorable  Most Favorable					
    					
<b>Assessment Criteria</b>	<b>Affordability</b>	Replacement parts/consumables			
		Upgradeability			
		Training			
	<b>Capability</b>	Operating conditions			
		Versatility			
		Power supply			
		Accurate transmission range			
		Real-time transmission			
		Data storage/memory recall			
		Programmable correction factors			
	<b>Deployability</b>	Weight/size			
		Simple remote sensor setup			
	<b>Maintainability</b>	Easy maintenance			
		Easy to replace parts			
		Battery replacement			
		Delivery time			
		Technical support			
		Calibration kit			
	<b>Usability</b>	Easy setup			
		Easy operation			
		Display			
Durability					
System compatibility					
User-friendly manual					
Easy to decontaminate					