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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 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 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?"

For more information on this and other technologies, contact the SAVER Program Support Office.

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Summary

Integrated Night Vision Systems

(AEL reference number 03OE-02-TILA)

In order to provide emergency responders with information on currently available integrated night vision systems (INVSs), the Space and Naval Warfare Systems Center (SPAWARSYSCEN) Atlantic conducted a comparative assessment of INVSs for the System Assessment and Validation for Emergency Responders (SAVER) Program in July 2010. Detailed findings are provided in the Integrated Night Vision Systems Assessment Report, which is available by request at <https://www.rkb.us/saver>.

Background

INVSs are used by emergency responders for surveillance and search and rescue operations during low-light conditions. An INVS combines image output from two different types of night vision sensors into one composite (fused) image in order to take advantage of the strengths of each type of sensor. The most common form of sensor fusion for emergency responder applications is the coupling of an image intensifier (I²) sensor with a thermal imaging sensor.

Assessment Methodology

Prior to the assessment, six emergency responders were chosen from various jurisdictions to participate in a focus group. Participants possessed strong law enforcement backgrounds, including patrol, Special Weapons and Tactics (SWAT), search and rescue, marine patrol, and surveillance. The group's primary objectives were to recommend evaluation criteria, product selection criteria, and possible scenarios for the assessment.

Based on market research and equipment availability, the following INVSs were assessed:

- Irvine Sensors Corporation, Clip-On Thermal Imager (COTI); and
- ITT Night Vision & Imaging, Dual Sensor Night Vision Goggle (DSNVG).

The COTI is a clip-on thermal device that attaches to many readily available I² night vision devices (NVDs), creating an INVS. The user is presented with an integrated I² and thermal night vision image through the I² optics. The COTI was assessed attached to an AN/PVS-14 Gen 3 I² NVD. The DSNVG is a monocular device that fuses sensor images internally by overlaying an image from one sensor onto the image from another to provide the user with one integrated image.

Six emergency responders from various jurisdictions served as evaluators during the INVS assessment. They were selected based on their respective disciplines, geographic location, and professional experience. All evaluators had strong law enforcement backgrounds; specific disciplines included surveillance, patrol, SWAT, border protection, marine patrol, and narcotics.

The assessment was conducted in two phases. During the specification phase, evaluators assessed the devices using vendor-provided information. The devices were assessed based on the evaluators' hands-on experience in the operational phase, which included four scenarios: the pre-scenario, surveillance scenario, search and rescue scenario, and the post-scenario.

During the pre-scenario, evaluators referenced user manuals, swapped between available power options, rated system status indicators, and (if applicable) removed and replaced lenses, including the sacrificial window. Ergonomics and video output were also assessed.

In the surveillance scenario, the INVSs were used from an open window of a moving vehicle with the headlights turned off to perform surveillance activities. As the vehicle traveled along its route, evaluators attempted to detect three people and the objects they carried.

The search and rescue scenario was conducted in two segments involving a wooded area and a bunker. During the segment in the wooded area, evaluators standing in a cleared area attempted to detect a person hiding in the woods. During the segment in the bunker, evaluators attempted to detect three people in dark, foggy/smoky conditions. In both segments, evaluators first used the I² sensor only (thermal sensor off) to view their surroundings. Once evaluators scanned the area, they were permitted to switch to integrated night vision.

During the post-scenario, evaluators rated the systems on features that were not directly associated with the

SAVER 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 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

other operational scenarios or features that applied to all operational scenarios, such as size and weight.

Assessment Results

Evaluators rated the INVSs based on the evaluation criteria established by the focus group. Each criterion was assigned to one of the five SAVER categories, and then assigned a weight for its level of importance. Once the criteria were weighted, the five SAVER categories were assigned a percentage value to represent the level of each category's importance relative to the other categories.

Table 1. Integrated Night Vision System Assessment Results¹

Product	Composite Score	Affordability (13% Weighting)	Capability (27% Weighting)	Deployability (23% Weighting)	Maintainability (7% Weighting)	Usability (30% Weighting)
ITT Night Vision & Imaging, Dual Sensor Night Vision Goggle (DSNVG)	88	82	92	90	96	86
Irvine Sensors Corporation, Clip-On Thermal Imager (COTI)	80	78	76	88	72	78

Note:

¹ Scores contained in the assessment report are displayed differently. For the purposes of the SAVER Summary, all SAVER category scores are normalized using a 100-point scale.

Table 1 displays the composite assessment scores as well as the category scores for each product. Higher scores indicate a higher rating by evaluators. For equipment specifications, see table 2. To view how each INVS scored against each of the evaluation criteria assigned to the SAVER categories, see table 3.

The following paragraphs provide a brief summary of evaluator comments and feedback on the two INVSs used during the assessment. The complete assessment report includes a breakdown of evaluator comments by SAVER category.

ITT Night Vision & Imaging, Dual Sensor Night Vision Goggle (DSNVG)

Evaluators rated the DSNVG’s thermal sensitivity range and image quality favorably, and they agreed the device produced an “excellent” image in full thermal mode. Most evaluators agreed that the DSNVG was easy to use and commented that operation of the controls was intuitive, the controls were easily accessible, and the device was comfortable to hold with one hand. The durability of the DSNVG was also rated favorably by evaluators, who commented that the system seemed “durable enough for law enforcement use, although some of the evaluators expressed a preference for standardized components in the event replacement is required. Evaluators rated the battery life specification favorably, commenting that the battery life of 8 hours with continuous use met expectations.

Overall, evaluators agreed that the range/distance capabilities were favorable, and most of the evaluators rated image color favorably, commenting that the contrasting green and orange colors made it easier to detect thermal signatures of objects and people even from a distance; however, it was noted that the thermal overlay and outline modes produced a less favorable

	↑ Pros	<ul style="list-style-type: none"> • Contrasting colors for I² and thermal sensor images • Individual sensor control • Ergonomics • Easy-to-read indicators • Wide and rectangular field of view of the thermal sensor
	↓ Cons	<ul style="list-style-type: none"> • Thermal overlay and outline modes • No alternate power options
DSNVG	Composite Assessment Score: 88	

image than the full thermal mode. Some evaluators stated they would like to have more options to record video, and most of the evaluators noted that a hand strap was not available and would be useful.

Irvine Sensors Corporation, Clip-On Thermal Imager (COTI)

Evaluators rated the quality of the image produced by the COTI as favorable and noted throughout the assessment that the thermal outline mode produced “excellent” images. The range/distance capability was rated favorably, and evaluators commented that they could easily identify objects and persons in the surroundings throughout the scenarios. Overall, evaluators agreed that the image color met expectations and commented that during the search and rescue scenario the white-hot thermal imaging capability was optimal for target detection in the wooded area and the black-hot thermal imaging capability was optimal for the foggy/smoky conditions and close quarters of the bunker. Evaluators rated the weight, size, and covertsness of the device as well as the multiple power options favorably. The maintenance costs were also rated favorably; evaluators felt that the device would be inexpensive to maintain.

Evaluators rated the lens options criterion less favorably because the thermal image cannot be magnified with a lens, and additionally rated the video output criterion less favorably because a video output is not available. Evaluators assigned a neutral rating to the initial cost of the COTI, commenting that the device should cost less since it is only one of the two sensors required to produce an integrated image.

	↑ Pros	<ul style="list-style-type: none"> • Compact size • Integration with common I² NVDs • Thermal outline mode
	↓ Cons	<ul style="list-style-type: none"> • Initial cost • No video output
COTI	Composite Assessment Score: 80	

Conclusion

According to evaluators, both of the assessed INVSSs would assist responders in accomplishing mission objectives when conducting nighttime operations. Evaluators noted, however, that the thermal outline mode is preferred for foggy/smoky conditions and in close quarters, such as during the bunker scenario. For long-range operations, such as during the surveillance scenario, evaluators preferred a wider field of view.

Some of the DSNVG features viewed favorably by evaluators include:

- Contrasting image colors – an orange thermal image against a green I² image;
- Individual sensor control, which permits users to switch between thermal-only and I²-only imaging, as well as make adjustments to the gain for each sensor separately from the other;
- The placement and size of controls permitted operation with or without gloves on;
- Easy-to-read indicators; and

- Wide, rectangular field of view of the thermal sensor.

Some of the COTI features viewed favorably by evaluators include:

- Its compact size;
- The flexibility to integrate with existing equipment; and
- The detail in the thermal outline mode.

In addition to the anticipated operational use of the INVSSs, the condition of I² NVDs already owned by an agency could be a factor to consider when procuring INVSSs. An agency with NVDs in good, working condition may want to consider procurement of a clip-on style device. However, an agency purchasing I² NVDs may consider procurement of an all-in-one integrated device.

All reports in this series, as well as reports on other technologies, are available in the SAVER section of the Responder Knowledge Base Web site at <https://www.rkb.us/saver>.

Table 2. Integrated Night Vision System Specifications¹

Specifications	ITT Night Vision & Imaging, DSNVG	Irvine Sensors Corporation, COTI
Type	Monocular	Clip-on ²
Dimensions (Length x Width x Height)	4.0 inches x 2.3 inches x 3.5 inches	3.75 inches x 1.5 inches x 3.0 inches
Weight	2.0 pounds	0.4 pound
Anti-fog	No anti-fog optics; fog wipes included	No anti-fog optics
Battery Type	Onboard: 4 AA lithium batteries. Unit also accepts AA alkaline batteries.	Onboard: CR123A lithium battery. Auxiliary battery pack (additional cost): 3 AA lithium batteries.
Lens Options	A 3x magnification lens for the image intensifier is available for an additional \$485.	No lens options are available at this time.
Field of View	Image Intensifier: 40° Thermal Sensor: 28°	Thermal Sensor: 20.5°
Initial Cost	\$18,300	\$12,000
Warranty	2 years	1 year
Sacrificial Window	A sacrificial window for the I ² lens is included with system purchase.	The COTI does not feature a sacrificial window since it is a thermal sensor only and sacrificial window only applies to I ² NVDs.

Notes:

¹ All information based on data gathered in July 2010.

² The COTI attaches to many readily available I² NVDs.

Table 3. Integrated Night Vision System Ratings Chart¹

KEY					 ITT Night Vision & Imaging, DSNVG	 Irvine Sensors Corporation, COTI
Least Favorable				Most Favorable		
						
Assessment Criteria						
Affordability						
Initial Cost						
Life Expectancy						
Warranty						
Maintenance Costs						
Vendor-based Training						
Backwards Compatibility						
Capability						
Range/Distance						
Infrared Illuminator						
Mounting Options						
Battery Type						
Lens Options						
Indicators						
Image Color						
Video Output						
Deployability						
Size						
Weight						
Covert						
Durability						
Field of View						
Power Options						
Device Type						
Ease of Transition						
Maintainability						
Battery Life						
Sacrificial Window						
Usability						
Image Quality						
Ease of Use						
Eye Fatigue						
Ergonomics						
Thermal Sensitivity Range						
Image Adjustment						
Anti-fog						
Individual Sensor Control						
Components						
User Manuals						

Note:

¹ Averaged criteria ratings for each product that was assessed are graphically represented by colored and shaded circles. Highest ratings are represented by full green circles.