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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 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

Side-Scan Sonar Systems

(AEL reference number 03WA-02-SONR)

In order to provide emergency responders with information on currently available side-scan sonar system capabilities, limitations, and usability, the Space and Naval Warfare Systems Center (SPAWARSYSCEN) Atlantic conducted a comparative assessment of side-scan sonar systems for the System Assessment and Validation for Emergency Responders (SAVER) Program in February 2009. Detailed findings are provided in the complete Side-Scan Sonar Systems Assessment Report, which is available by request at <https://www.rkb.us/saver>.

Background

Law enforcement and search and rescue personnel often conduct difficult underwater searches for weapons, submerged vehicles, drowning victims, and other objects of interest. To conduct underwater searches, emergency responders typically deploy underwater cameras and search and rescue divers. However, these search methods can be time-consuming and cover a limited area. In addition, search and rescue divers may have to contend with hazardous conditions, low or no visibility, and getting caught in underwater debris. To overcome these operational challenges, emergency responders can use side-scan sonar systems.

Side-scan sonar systems use sonar technology to develop an image of underwater objects. The systems are deployed from a boat and typically consist of a towfish, tow cable, sonar software, interface processing unit, and a computer. Side-scan sonar systems enable emergency responders to cover a wide search area in a short amount of time, look for hazards before divers enter the water, and safely deploy divers after an object of interest is located.

Assessment

A focus group met on July 30, 2008, in Charleston, South Carolina. The focus group participants consisted of six emergency responders from across the United States representing law enforcement agencies that have marine patrol units. The purpose of the focus group was to identify equipment selection criteria, evaluation criteria, and assessment scenarios. Based on focus group recommendations and market survey research, five side-scan sonar systems were ordered from different vendors for the assessment. The following side-scan sonar systems were included in the evaluation:

- System 3900 (445/900 kHz) by L-3 Klein Associates, Inc.
- 4125-P (400/1250 kHz) by EdgeTech
- Centurion Sea Scan (900/1800 kHz) by Marine Sonic
- Model 872 Yellowfin (260/330/770 kHz) by Imagenex
- SSS 100K/600K (100/600 kHz) by J.W. Fishers.

The assessment was conducted on the Cooper River in Charleston, South Carolina, in shallow water, where depths ranged between 10 and 20 feet

depending on the tide. The river bottom consisted of mud and silt and was generally smooth in appearance. The tow speeds ranged from 1 to 5 knots depending on each system's capabilities, and target objects were used to create scenarios that simulated real-world law enforcement applications.

Five side-scan sonar practitioners served as assessment evaluators, and they assessed one system per day. Before beginning the assessment each day, a vendor representative provided familiarization training and an overview of their side-scan sonar system to the evaluators, allowing them an opportunity to become familiar with the system's capabilities and features. J.W. Fishers did not send a representative to provide product familiarization training to the evaluators. However, the evaluators stated that they were able to adequately learn and operate the J.W. Fishers side-scan sonar system without the vendor-provided familiarization training.

There were two portions to the assessment. The scenario segment allowed evaluators to assess the side-scan sonar systems based on their hands-on experience using the systems in four operational scenarios. The specification segment allowed evaluators to assess the systems based on vendor-provided specifications.

Assessment Results

Evaluators rated the side-scan sonar systems based on the evaluation criteria established by the focus group. Each original criterion was assigned to one of the five SAVER categories, and each SAVER category was assigned a weighting factor to indicate its impact on the total composite score. The SAVER category and

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.

composite scores are shown in table 1. Higher scores indicate better performance. To view how each system scored against the individual evaluation criteria assigned to the SAVER Program categories, see table 2. For product specifications, see table 3.

The following paragraphs provide a brief summary of the evaluator comments and feedback on each side-scan sonar system and present the systems from the highest to lowest composite score. For the purposes of this SAVER Summary, the category scores are normalized and rounded to the nearest

Table 1. Side-Scan Sonar Systems Assessment Results¹

Side-Scan Sonar System	Composite Score	Affordability (23% Weighting)	Capability (30% Weighting)	Deployability (15% Weighting)	Maintainability (10% Weighting)	Usability (22% Weighting)
System 3900	82	78	88	76	88	82
4125-P	76	72	78	86	72	76
Centurion Sea Scan	76	74	78	76	76	80
Model 872 Yellowfin	64	70	58	74	52	62
SSS 100K/600K	50	36	48	62	72	50

Note:




¹ Scores contained in the assessment report may be displayed differently. For the purposes of the SAVER Summary, all SAVER category scores are normalized using a 100-point scale and rounded to the nearest whole number.

whole number. The complete assessment report includes a breakdown of evaluator comments by individual criterion.

System 3900




The System 3900 received the highest overall score. Evaluators stated that the images are clear and easily identifiable and the system produces viable images even when traveling at speeds above 5 knots. Evaluators noted the operating frequencies are sufficient for both long-range searches and target identification, and the user interface offers many useful features and functions. They also stated that the stainless steel towfish and ruggedized workstation would be able to withstand harsh marine environments. Although the System 3900 was the most expensive side-scan sonar system assessed, evaluators agreed that the cost is justified by the system's performance, construction, and software.

There were noted disadvantages to the System 3900. Evaluators reported that the cable is not very flexible and its 50-meter length is too long. They stated the user interface is too complex for the occasional user and would require ongoing training, and the 1-year warranty was considered insufficient in comparison to the cost of the system.

	 Pros	<ul style="list-style-type: none"> Detailed sonar images Tow speed over 5 knots Rugged towfish and workstation Operating frequencies Multiple power supply options User interface features/functions System cost/value
	 Cons	<ul style="list-style-type: none"> 1-year warranty Complex user interface Long, stiff tow cable
System 3900	Composite Assessment Score: 82	

4125-P

The 4125-P tied in receiving the second highest overall score. Evaluators highlighted the system's ability to consistently produce usable sonar images throughout the assessment scenarios, and they favored the rugged construction and light weight of the towfish. Evaluators noted the user interface is easy to use, offers flexible monitor configurations, and provides intuitive icons and control functions. They stated the system cost is appropriate for the performance and technology used.




	 Pros	<ul style="list-style-type: none"> Towfish weight Rugged towfish Multiple power supply options System cost/value Detailed sonar images
	 Cons	<ul style="list-style-type: none"> 1-year warranty Workstation ruggedness Long tow cable
4125-P	Composite Assessment Score: 76	

Evaluators expressed concern that the workstation is not ruggedized and would not be able to withstand the harshness of the marine environment. They noted the 50-meter tow cable is too long, and the 1-year warranty should be longer to align with the cost of the system.

Centurion Sea Scan

The Centurion Sea Scan also tied for the second highest overall score. Evaluators described the compact, rugged, all-in-one workstation as a desirable feature. They stated the user interface is easy to use, and the screen images can be seen in direct sunlight. Evaluators stated the system is very portable and setup is straightforward and simple. In addition, the Centurion Sea Scan includes a 3-year warranty.




Evaluators noted a few disadvantages with the system. They reported that the graphics on the display appear small and crowded, and the image presentation lacks some features found in the other systems that were assessed. They also stated that an AC power option would be useful in addition to the 12-volt DC power requirement.

	 Pros	<ul style="list-style-type: none"> Ease of use Portable system Easy system setup Rugged towfish and workstation 3-year warranty Readable day/night display screen
	 Cons	<ul style="list-style-type: none"> Limited power supply options Small and crowded screen graphics
Centurion Sea Scan	Composite Assessment Score: 76	

Model 872 Yellowfin

The Model 872 Yellowfin scored fourth overall. Evaluators stated the system is lightweight, includes a small towfish, and can be easily transported. They noted the system is easy to set up and operate and the 23-meter tow cable is easy to handle during search operations.




Evaluators stated several disadvantages with using the Model 872 Yellowfin. They noted the user interface is almost too basic and lacks features needed by emergency responders (e.g., an effective chart plotter, geo-referencing tool, image enhancements, and speed correction). Evaluators believed the system would produce better images if higher operating frequencies were incorporated into the towfish. They explained that in order to produce usable images, the tow speed had to remain at 2 knots or less, which was considered too slow and difficult to maintain in high winds and strong currents. Although the cost of the system was described as reasonable, evaluators noted the standard package does not include a computer or display and carrying cases for the system must be purchased separately.

	 Pros	<ul style="list-style-type: none"> • Portable system • Easy system setup • Low cost • Light towfish • Short tow cable length
	 Cons	<ul style="list-style-type: none"> • Slow tow speed • Poor image quality at lower frequencies • Limited user interface • Product support not 24/7 • Limited geo-referencing capabilities
Model 872 Yellowfin	Composite Assessment Score: 64	

SSS 100K/600K

The SSS 100K/600K scored fifth overall and was considered by the evaluators to be the least effective side-scan sonar system that was assessed. Evaluators stated the system is easy to set up, and the manufacturer offers sufficient product support.

They stated the 600 kHz frequency produced adequate target images; however, the 100 kHz frequency did not produce distinguishable target images in any of the assessment scenarios. The system offers limited user

	 Pros	<ul style="list-style-type: none"> • Easy system setup • Product support
	 Cons	<ul style="list-style-type: none"> • System cost/value • Cumbersome, permanently attached tow cable • System portability • Limited user interface features
SSS 100K/600K	Composite Assessment Score: 50	

interface features and is incapable of performing multiple functions simultaneously. The SSS 100K/600K includes a permanently attached tow cable, which adds to the overall weight of the towfish, making it cumbersome to handle and transport. Evaluators stated the system is overpriced, its technology needs to be updated, and its 2-year warranty period is insufficient to meet the needs of emergency responders.

Conclusion

Evaluators stated that, most importantly, a side-scan sonar system should provide clear, identifiable sonar images and have a user interface that is capable of enhancing, tagging, and storing images while conducting an active search. They also felt that a side-scan sonar system should have a durable, well-built towfish and a ruggedized laptop computer that is able to withstand the harsh operating conditions of the marine environment.

Evaluator feedback highlighted the following recommendations for law enforcement agencies interested in procuring a side-scan sonar system:

- Compare various systems on the market
- Contact law enforcement agencies currently using side-scan sonar systems to draw on their experiences with the system and with the manufacturer
- Determine the vendor's ability and willingness to support the purchased systems
- Identify what is and is not included in the standard package price.

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 Scores¹

KEY						
Least Favorable	➔	Most Favorable				
						
		System 3900	4125-P	Centurion Sea Scan	Model 872 Yellowfin	SSS 100K/600K
Assessment Criteria						
Affordability						
System Cost						
Warranty						
Capability						
Operating Frequency						
Work Station Ruggedness						
Image Presentation						
Towfish Depth Rating						
Tow Cable Attributes						
Towfish Composition						
Available Options						
Tow Speed						
Deployability						
Portability						
Setup						
Power Requirements						
Towfish Weight						
Maintainability						
Product Support						
Usability						
Ease of Use						
User Interface						
Image Quality						
Screen Display					2	

Notes:

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.

² A computer/screen display is not supplied with the Model 872 Yellowfin's standard package. This criterion was not included in the Model 872 Yellowfin's scoring calculations.

Table 3. Side-Scan Sonar System Specifications

Specifications					
	System 3900	4125-P	Centurion Sea Scan	Model 872 Yellowfin	SSS 100K/600K
Cost of Standard Package (as of June 2008)	\$39,998	\$35,000	\$37,080	\$10,580	\$24,995
Operating Frequencies	445/900 kHz	400/1250 kHz	900/1800 kHz	260/330/770 kHz	100/600 kHz
Towfish Weight in Air	64 lbs	26 lbs	65 lbs	23 lbs	60 lbs
Towfish Length	48 in	42 in	35.5 in	32.8 in	55 in
Towfish Depth Rating	200 m	100 m	300 m	300 m	152 m
Warranty Coverage (Included in Cost)	One year for parts, labor, repair, and diagnostics	One year for parts, labor, repair, and diagnostics	Three years for parts, labor, repair, and diagnostics	One year for parts, labor, repair, and diagnostics	Two years for parts, labor, repair, and diagnostics
Laptop Computer Included	Yes	Yes	Yes	No	Yes
Available Options	Pressure sensor, ruggedized laptop computer	Cable clamp, line weight, GPS, and a computer upgrade to a drop/shock/ water-resistant laptop computer	Extra lengths of cable, DDW-1 deep dive wing; PVC towfish can be upgraded to an aluminum or stainless steel towfish	61 additional meters of tow cable	Up to 500 feet of tow cable, DDW-1 deep dive wing, splash-proof computer, sonar coverage map software, GPS, 220 VAC European transformer, 120 VAC adaptor