

Note: This report features LIMIS, the predecessor to DIDSON-DH. LIMIS is no longer made.

CSS diver display technology locates space shuttle debris

CSS Public Affairs and Diving and Life Support, Staff Report

Panama City, Fla., — Supervisor of Salvage and Diving, CAPT Jim Wilkins, contacted Dahlgren Division's Coastal Systems Station Feb. 25 to request the deployment of two prototype Limpet Mine Imaging Sonar (LIMIS) systems to assist in finding the STS-107 Columbia space shuttle's debris.

LIMIS systems are hand-held sonar prototypes used in combination with the Miniature Diver Display System (MDDS) to conduct underwater search and identification operations. Limpet mines are small-explosive attack mines that are magnetically attached to ships' hulls, usually near the rudder and propeller systems.

Wilkins, Operational Commander of the mission, also requested that CSS send supporting technical expertise to aid in the deployment of the LIMIS systems. CSS's Human Factors Engineer Ron Honaker and Senior Electronic Systems Engineer Bill Olstad were on site at the search area for two weeks with the systems and supporting materials. The call to assist provided a unique opportunity to test the systems in an extremely challenging environment.

The search and recovery mission required nine dive teams deployed each day in the Toledo Bend Reservoir area located in eastern Texas. Because there are only two LIMIS prototypes currently in existence, their use was prioritized for areas where careful and detailed scrutiny was required – mainly the zero-visibility regions of the deeper reservoir and the shallow-ponds.

According to Wilkins, the LIMIS proved its worth. "I'm convinced that in the future the LIMIS will be the replacement system for the PQS-2A, which is now the standard diver hand-held sonar search tool in the U.S. Navy inventory," Wilkins said. "The high resolution heads-up display makes this tool the best technological choice for zero-visibility, close-range underwater searches."

According to Olstad, the LIMIS can be used to quickly scan an object from many different angles to help the diver define its characteristics and exploit it as required. The Limpet Mine Imaging Sonar unit was developed by Dr. Edward O. Belcher at the Applied Physics Laboratory, University of Washington (Seattle) through funding from the Explosive Ordnance Disposal-Low Intensity Conflict Program Office managed by Larry Tierney.

Olstad said the LIMIS was able to find objects that most of the other sensors could not detect at ranges up to 40 feet. He added that visibility conditions would have seriously inhibited recovery efforts if not for the LIMIS-MDDS systems. "I believe the LIMIS system provided one of the highest levels of resolution of any other sensor used during this recovery operation."

CWO Jeffrey Barone, one of Mayport, Florida's Shore Intermediate Maintenance Activity's most experienced divers, has used the LIMIS on numerous jobs. Barone said that the technology has proved itself many times over. "There is no other tool in my arsenal that can accomplish the tasking I receive with this high percentage of validity and in as minimal time as the LIMIS can."

CSS's Olstad said the MDDS display is the key-enabling technology that makes the LIMIS system operationally effective "It was essentially the diver's eyes in the dark," said Olstad, who added there were zero visibility conditions that existed in most of the underwater operations areas.

The Miniature Diver Display System was developed by CSS's Diving and Life Support Division - also sponsored by the EOD-LIC Program Office. The LIMIS-MDDS system provides a marked operational improvement over current search techniques and equipment. The MDDS provides the diver with an SVGA-quality (800 x 600 pixel resolution) display of the dynamic LIMIS sonar images and enables the diver to clearly see these images in zero visibility conditions underwater.

Visibility is exactly what made this search and recovery so challenging, according to Ron Honaker – a Human Factors Engineer with CSS's Human Systems Integration and Engineering Team. "The Toledo Bend Reservoir is the search site where we used our equipment," Honaker said, "which is a site that was actually flooded before residential houses and trees could be removed." "It was like exploring in an underwater forest," Honaker said.

The MDDS is available as both a monocular and a binocular display and is easily integrated with a number of diver mask platforms and a range of low-volume SCUBA masks. The MDDS has become "the" underwater information display for the LIMIS.

Despite the tragic reason for the Columbia's debris-recovery, CSS's technical experts and MDDS developers were appreciative for the opportunity to evaluate their technology in such a challenging environment. "I have personally been working on the development of the Diver Head-Mounted Display technology since 1992," said Senior Project Engineer Dennis Gallagher, who works for CSS's Diving and Life Support Division. It's been very rewarding to see this technology come to maturity and become the key 'enabling' technology for many diver-based underwater sensors such as the LIMIS," Gallagher said.

During evaluations at the search site, the LIMIS systems were tested against a variety of search conditions and targets, including actual shuttle pieces placed in the water. After careful review of the LIMIS capabilities, CAPT Wilkins designated the LIMIS as the primary visual display sonar asset for searching small areas where larger side-scan sonar units could not be utilized – i.e., in ponds, rivers, and shallow-water areas around piers and seawalls.

CSS participated in a number of actual search operations while at Toledo Bend, including “splash report” areas reported by several eye-witnesses. During these operations, CSS representatives were directly involved in the recovery of five land-based pieces of Columbia debris and their transfer back to NASA representatives.

Honaker pointed out that even though crewmembers were pleased by the efficiency of their CSS-developed equipment, everyone involved felt the tragedy that brought about the mission. “Supporting the Columbia in-water recovery operations was a unique and very rewarding opportunity, despite the underlying reason for the search,” Honaker said. “But it was an honor and distinct privilege to support the recovery of the Columbia and her crew.”



Figure 1: Mobile Diving and Salvage Unit Two’s DC1 Don Coley (left) helps Navy diver EM3 Dan Colletti (center) - also of MDSU-2 Detachment Cleveland, OH - with LIMIS. CWO Jeffrey Barone (right) assists Colletti with workings of the MDDS head mounted display.

Officer LCDR Dave Ince scans a shallow pond area where there was a credible report of fallen *Columbia* debris. Ince holds the LIMIS sonar underwater with the Miniature Diver Display System worn as a visual mask. This type of surface scanning was not initially intended to be the primary operating mode of the LIMIS, but it is effective and can also be done from a boat or a dock.

