

## Surface Mine Countermeasures (SMCM) Unmanned Undersea Vehicle (UUV) (also called Knifefish UUV)

### Executive Summary

- The Navy conducted a Surface Mine Countermeasure (SMCM) Unmanned Undersea Vehicle (UUV) (hereafter referred to a Knifefish) operational assessment to evaluate the system's capability to detect, classify, and identify naval mines that are moored in the ocean volume and that lay on, or are buried in, the ocean bottom.
- The test results show that Knifefish requires further development to provide an operationally effective and suitable capability for its intended use.
- The Navy plans to incrementally upgrade and test Knifefish capability to meet operational needs prior to IOT&E and fleet introduction.

### System

- Knifefish is an element of the family of systems needed for naval mine countermeasure (MCM) capability.
- Each Knifefish system includes two UUVs, an operator console, a planning and post mission analysis (PMA) station, and an Iridium modem with an antenna for communication with the UUV when it is surfaced.
- The UUV is a self-propelled, untethered, unmanned, autonomous undersea vehicle with sensor capability to perform MCM missions in user-designated shallow-water regions.
- The PMA subsystem employs machine-learning algorithms to process sensor data acquired by the UUV after recovery aboard the host platform.
- A Knifefish system will be configured for deployment, operation, and maintenance on a Littoral Combat Ship (LCS)



or vessels of opportunity, which are ships capable of launching the UUV and supporting Knifefish operations.

### Mission

The MCM Commander (MCMC) will employ units equipped with Knifefish to conduct mine reconnaissance operations, such as area or route surveys, in littoral regions throughout the world in support of Combatant Commander operations.

### Major Contractor

General Dynamics Mission Systems – Quincy, Massachusetts

### Activity

- The Navy began this program in FY10, and DOT&E put it on oversight in FY10 as a subsystem in the LCS MCM mission package. This is the first time DOT&E has included this program in its annual report.
  - DOT&E approved the Milestone B SMCM UUV Knifefish Test and Evaluation Master Plan on August 13, 2012.
  - DOT&E approved the SMCM UUV Knifefish Operational Assessment (OT-BI) Test Plan, Revision 2 on March 29, 2019.
  - The Navy completed the operational assessment of Knifefish performance to detect, classify, and identify moored mines, unburied mines, and mines buried in the ocean bottom near the entrance of Boston harbor in May 2019 in accordance with the DOT&E-approved test plan.
- The operational assessment included a total of 12 missions in 2 designated UUV operating areas that contained moored and bottom mine targets accredited by the Navy Operational Test and Evaluation Force as foreign mine surrogates.
  - Navy operators trained in Knifefish operations and maintenance completed six missions in each UUV operating area to test Knifefish capability to detect, classify, and identify mines in two different operational environments.
  - To assess Knifefish capability to conduct simultaneous UUV missions without mutual interference, missions 6 and 12 launched an additional UUV, which operated in areas

without mine targets adjacent to the 2 designated UUV operating areas.

- DOT&E completed a classified SMCM UUV Knifefish OT-B1 report in January 2020.

## Assessment

- The testing was adequate within the scope of the test objectives; however, the testing occurred in areas and environments similar to those in which the system developers trained and tuned Knifefish's PMA classification algorithm. Therefore, DOT&E is unable to assess how well the system will perform in operational environments that are new to the system.
- The test targets included a limited number of mine variants that were also used for system development. Testing did not provide data on the system's capability to detect other mine variants or its capability to distinguish mines from non-mine, mine-like bottom objects, and clutter.
- Due to test limitations, DOT&E is unable to fully assess the system's ability to detect, classify, and identify buried mines as a function of burial depth.
- While exceeding the operational availability threshold, the system did not meet the Navy's reliability threshold due to operational mission failures. During two sorties, UUV

hardware failures terminated the sorties. During PMA, hardware and software faults delayed completion of sensor data analysis.

- The operational assessment did not include an evaluation of cybersecurity since the system, software, and interfaces are still in development.
- A complete DOT&E analysis of Knifefish operational assessment test results is available in the classified SMCM UUV Knifefish OT-B1 report.
- Based on the operational assessment, the Navy plans to incrementally upgrade and test Knifefish capability to meet operational needs prior to IOT&E and fleet introduction.

## Recommendations

The Navy should implement the following recommendations to improve operational performance prior to IOT&E and subsequent fleet introduction:

1. Complete system upgrades and conduct additional testing to more fully characterize Knifefish performance in operational environments in which the system capability has not previously been assessed.
2. Specific recommendations are available in the classified SMCM UUV Knifefish OT-B1 report.