

Remote Minehunting System (RMS)

Executive Summary

- In the wake of the Navy's 2015 Technical Evaluation (TECHEVAL) of the Increment 1 mine countermeasures (MCM) mission package, and following the Navy's independent review of the program, the Navy cancelled the Remote Minehunting System (RMS) program and announced its intention to evaluate alternatives to the RMS. Those alternatives included use of an unmanned surface vessel (USV) to tow improved minehunting sensors and the Knifefish unmanned undersea vehicle (UUV). The Navy's decision came after approximately two decades of RMS development and repeated claims by Navy officials that the system had achieved remarkable reliability growth in recent years. As illustrated clearly in the FY15 edition of this report, the Navy's claims regarding reliability improvement were demonstrably incorrect.
- The Navy has reportedly funded refurbishment of a small number of the existing Remote Multi-Mission Vehicles (RMMVs) and may still employ these vehicles in some capacity. However, planning for developmental and operational testing of the mission package is proceeding under the assumption that the future minehunting capability will be provided by one or two USVs towing an AN/AQS-20C or AN/AQS-24C minehunting sensor and a pair of Knifefish UUVs.
- The Navy continued to develop pre-planned product improvements for the AN/AQS-20 sonar in FY16. Its plans to commence realistic AN/AQS-20C developmental and operational testing are uncertain because of limited availability of two potential tow platforms; existing RMMVs are not reliable but the Navy does not expect to begin upgrades necessary to make the initial, limited-quantity USVs compatible with the improved sonar until at least FY18.

System

- The RMS is designed to provide off-board mine reconnaissance capability to detect, classify, and localize non-buried bottom and moored mines, and to identify bottom mines in shallow water.
- RMS uses the RMMV, which is an unmanned, diesel-powered, semi-submersible vehicle, to tow the AN/AQS-20 variable depth sensor.
 - The AN/AQS-20 is a multi-mode sensor in a modular towed body that can house as many as five sonars. The AN/AQS-20 can also be fitted with an electro-optical identification device to identify mine-like objects. The Navy is developing a new variant of the sensor, designated AN/AQS-20C, which includes an improved forward-looking sonar and new synthetic aperture side-looking sonars. The Navy expects to field the AN/AQS-20C by FY18 or FY19, pending availability of a tow vehicle.



- Although the Navy cancelled the RMS program and suspended further RMMV procurement, it plans to overhaul some of the existing RMMVs for possible deployment with early variants of the Littoral Combat Ship (LCS) MCM mission package. The Navy is also developing the capability to tow a minehunting sensor (AN/AQS-20C or AN/AQS-24) with an USV (based on the vessel used in the Unmanned Influence Sweep System being developed for LCS) to replace the RMS.
- A datalink subsystem provides real-time communications between the host ship and the RMMV for command and control and transmission of some sensor data. The RMS datalink subsystem, which includes ultra-high frequency line-of-sight (LOS) and low-band very-high frequency over-the-horizon (OTH) radios, interfaces with the multi-vehicle communications system installed in the LCS seaframes.
- Shipboard operators control the RMMV using a remote minehunting functional segment integrated into the LCS mission package computing environment.
- The RMS records sensor data to a removable hard drive during minehunting operations. Following vehicle recovery, operators transfer data to an organic post mission analysis station and review sonar data to mark contacts as suspected mine-like objects. The RMS does not determine the absence or presence of mines or complete mine clearance operations in a single pass. Following an initial search by the RMS, sailors plan additional RMS sorties in the same area to assess persistence of in-volume contacts marked as mine-like and to identify bottom contacts marked as mine-like as either mines or non-mines. When operators conclude that RMS in-volume contacts are persistent, those contacts are passed to another system for identification and neutralization.

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Mission

If the system is fielded, MCM Commanders would likely employ the RMS from an MCM mission package-equipped LCS, to detect, classify, and localize non-buried bottom and moored mines, and to identify shallow-water bottom mines in support of theater minehunting operations.

Major Contractors

- RMMV: Lockheed Martin – West Palm Beach, Florida
- AN/AQS-20 (all variants): Raytheon Corporation – Portsmouth, Rhode Island

Activity

- The Navy initiated RMS cybersecurity testing and conducted additional ship-based RMS testing to assess readiness for operational testing that it expected to complete in FY15
- In October 2015, the Navy delayed IOT&E of the *Independence*-variant LCS equipped with the first increment of the MCM mission package pending the outcome of an independent program review, including an evaluation of potential alternatives to the RMS. The Navy chartered the review in response to an August 21, 2015, letter from Senators John McCain and Jack Reed, Chairman and Ranking Member of the Senate Committee on Armed Forces expressing concerns about the readiness to enter operational testing given the significant reliability problems observed during a TECHEVAL in 2015.
- In early 2016, following the completion of the independent review, the Navy:
 - Concluded that reliance on shore-based test metrics provided a false sense of RMMV maturity and contributed to the RMS progressing to sea-based test events prematurely.
 - Cancelled the RMS program and halted further RMMV procurement.
 - Announced its intention to field existing RMMVs following overhauls to mitigate high impact failure modes.
 - Revealed initial plans (subsequently dashed by lack of funding for Knifefish improvements) to evaluate alternatives to the RMS, including an USV towing either the AN/AQS-20C or AN/AQS-24C minehunting sensor and an improved version of the Knifefish UUV already in development.
 - Abandoned plans to conduct operational testing of individual MCM mission package increments and delayed the start of LCS MCM mission package IOT&E until at least FY20.
- In June 2016, DOT&E submitted an early fielding report to the Congress in response to the Navy's plan to deploy the *Independence*-variant LCS equipped with the MCM mission package, including the existing v6.0 RMMVs and AN/AQS-20As, prior to the conduct of operational testing. The classified report, which does not support the Full-Rate Production decision, provided DOT&E's interim assessments of operational effectiveness and operational suitability of the *Independence*-variant LCS employing the MCM mission package and its components, including the RMS.
- The Navy continued to develop pre-planned product improvements for the AN/AQS-20 sonar in FY16. It's plans

to commence realistic AN/AQS-20C developmental and operational testing are unsettled because of limited availability of two potential tow platforms; existing RMMVs are not reliable but the Navy does not expect to make the initial, limited-quantity USVs compatible with the AN/AQS-20C until late FY18. In testimony to the Senate Armed Services Committee in December, the Navy announced that two RMMVs will be groomed and one will be overhauled. These RMMVs will then be used to continue AN/AQS-20 sonar testing, conduct data collection, and support user evaluation until the first USV is available.

Assessment

- The RMS would not be operationally effective or operationally suitable if called upon to conduct MCM missions in combat. The primary reasons for these conclusions are:
 - The system is not reliable.
 - The system's minehunting capabilities are limited in other-than-benign environmental conditions.
 - The fleet is not equipped to maintain the system.
- Since the Navy has not implemented corrective actions to mitigate the problems observed in earlier testing, the substantive unclassified details of DOT&E's assessment are unchanged from the FY15 edition of this report. DOT&E's classified June 2016 early fielding report provides additional detail.

Recommendations

- Status of Previous Recommendations.
 - The Navy made progress on all four FY13 recommendations. Shore-based testing completed in 1QFY14 and shipboard testing completed in 1QFY15 provided additional information regarding RMS, RMMV, and AN/AQS-20A reliability; RMS operational availability; and RMMV launch, handling, and recovery system performance. Although the Navy continues to develop and test AN/AQS-20 upgrades, it has not demonstrated in developmental or operational testing that it has corrected problems with false classifications and contact localization errors that will otherwise limit performance in operational testing. The Navy has not determined the test program for the AN/AQS-20 sonar yet, but will include that as an annex to the LCS TEMP rather than having a separate document.
 - The Navy has made progress on two of the nine FY14 recommendations. The Navy did not act on the following FY14 recommendations:

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- Conduct testing of the RMS consisting of the v6.0 RMMV and AN/AQS-20B/C in operationally realistic end-to-end minehunting missions to characterize minehunting performance and accurately assess availability of the RMS and reliability of the RMMV and sonar.
- Investigate the use of communications relays and other solutions that might improve the standoff distance between an RMMV and its host ship to improve the efficiency of LCS MCM operations.
- Reassess RMMV v6.0 radiated noise following vehicle upgrades.
- Reexamine minimum vehicle and sensor reliability and LCS organizational-level maintenance support needed to complete timely and realistic operational scenarios without excessive reliance on intermediate- and depot-level support.
- Reconsider RMS minehunting requirements in the context of expected LCS tactics and operations.
- By reviewing alternatives to the RMMV, the Navy has made progress on one of the six FY15 recommendations. The Navy did not act on the following FY15 recommendations, which are applicable to RMS and potential replacement systems:
 - Complete a comprehensive review of RMMV and mission package communications interfaces and, if necessary, re-engineer the Multi-Vehicle Communication System (MVCS), RMMV, and/or other essential system-of-systems components to improve interoperability and enable reliable line-of-sight and over-the-horizon communications between LCS and RMMVs.
 - Develop tactics to mitigate system vulnerabilities to mines and other hazards.
 - Assess improvements to post mission analysis and contact management software and training to resolve problems observed during TECHEVAL when multiple RMS contacts on the same mine were passed to AMNS for identification and neutralization.
 - Continue to develop and implement improvements for launch, handling, and recovery equipment and procedures.
 - Provide LCS sailors better training, technical documentation, test equipment, and tools, along with additional spares to improve the crews' self-sufficiency and enhance RMS maintainability.
- FY16 Recommendations. The Navy should address the prior applicable recommendations and consider the following actions:
 1. Suspend further use of RMMV v6.0 until completing a comprehensive reliability-centered analysis, correcting high impact failure modes, and testing repairs in an operationally realistic environment.
 2. Complete a comprehensive LCS-based cybersecurity assessment of the RMMV before deploying any existing units for operational use.
 3. Limit procurement of AN/AQS-20 sonars and upgrade kits, which are not yet meeting the Navy's original requirements and negatively affect LCS MCM capability, until much needed performance improvements are developed, tested, and proven effective in testing representative of realistic LCS mine-clearance operations.
 4. Given the cancellation of the RMS program, fully fund and accelerate the development of the most promising minehunting alternatives, including the USV with a towed AN/AQS-20C or AN/AQS-24C sensor and the Knifefish UUV with pre-planned product improvements.

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