

Acoustic Rapid Commercial Off-the-Shelf Insertion (A-RCI) for AN/BQQ-10(V) Sonar

Executive Summary

- DOT&E submitted a classified FOT&E report on the Advanced Processing Build 2011 (APB-11) variant of the AN/BQQ-10(V) Acoustic Rapid Commercial Off-the-Shelf Insertion (A-RCI) sonar system in November 2015.
- From May 2013 through August 2014, the Navy completed operational testing on the APB-11 variant of the A-RCI sonar system.
 - Operational test phases conducted in FY14 consisted of Anti-Submarine Warfare (ASW) against a diesel electric submarine (SSK) target, cybersecurity, and situational awareness in a High Density Contact Management (HDCM) region with a Light Weight Wide Aperture Array (LWWAA).
 - Previously conducted test phases for this software variant include ASW against a nuclear submarine (SSN) target and situational awareness in an HDCM region with an Active Low Cost Conformal Array (ALCCA).
 - DOT&E assessed that overall mission performance was unchanged from previous variants of the system; however, APB-11 demonstrated improvements in ASW and situational awareness in HDCM missions with an LWWAA over previous APB variants.
 - DOT&E assessed APB-11 demonstrated improved reliability and was suitable.
 - All test phases were adequately conducted to assess system performance. However, there were a number of test limitations, which precluded a full assessment of capabilities. More prominent test limitations were:
 - A damaged TB-29 array limited the assessment of new single leg ranging capabilities and the use the new Range Azimuth (RAZ) and Range Triage Display (RTD).
 - The RAZ/RTD suffered a material casualty that precluded assessing their mission effect on situational awareness in an HDCM region.
- The Navy began to develop its operational test strategy and associated documentation to assess the upcoming APB-13 variant of the system. The Navy intends to conduct operational testing of APB-13 in late FY16.



System

The A-RCI sonar system:

- Is intended to maintain an advantage in acoustic detecting threat submarines.
- Processes data from the submarine’s acoustic arrays (i.e., spherical array, large aperture bow array, hull array, wide aperture array, conformal array, and high-frequency array) along with the submarine’s two towed arrays (i.e., the fat line array consisting of the TB-16 or TB-34, and the thin line array consisting of the TB-23 or TB-29).

Mission

The Operational Commander will employ submarines equipped with the A-RCI system to:

- Search, detect, and track submarine and surface vessels in open-ocean and littoral sea environments without being counter-detected
- Search, detect, and avoid mines and other submerged objects
- Covertly conduct Intelligence, Surveillance, and Reconnaissance
- Covertly conduct Naval Special Warfare missions
- Perform under-ice operations

Major Contractor

A-RCI: Lockheed Martin Maritime Systems and Sensors – Washington, District of Columbia

Activity

- From May 2013 through August 2014, the Navy completed operational testing on the APB-11 variant of the A-RCI sonar system.
 - Operational test phases conducted in FY14 consisted of ASW against an SSK target, cybersecurity, and situational awareness in an HDCM region with an LWWAA.
 - Previously conducted test phases for this software variant included ASW against an SSN target and situational awareness in an HDCM region with an ALCCA.
- In July 2014, the AN/BQQ-10(V) A-RCI sonar system was removed from DOT&E oversight due to resource constraints. It was restored to oversight in October 2014 because of

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concern with the system's performance in support of both the *Virginia* and, eventually, *Ohio* Replacement submarine programs. DOT&E's resource constraint was resolved by eliminating other programs that were not as critical to *Virginia* and *Ohio* Replacement performance.

- In September 2014, DOT&E submitted an interim memorandum documenting the results of A-RCI APB-11 operational testing completed and analyzed prior to removal from oversight.
- In November 2015, DOT&E submitted a classified FOT&E report on the APB-11 variant of the A-RCI sonar system, which detailed testing phases performed and analyzed while temporarily off of DOT&E oversight.
- ASW testing and situational awareness testing with an ALCCA were conducted in accordance with a DOT&E-approved test plan. Situational awareness testing in HDCM with an LWVAA and cybersecurity testing were not conducted with a DOT&E-approved test plan due to the program being temporarily off DOT&E oversight.
- In October 2014, the Navy began test planning for the APB-13 variant of the system, which is expected to occur in late FY16. Expected test events include:
 - At-sea ASW performance assessment against an SSN or SSK target
 - In-lab ASW performance assessment against various threat targets
 - At-sea situational awareness in an HDCM region with an ALCCA and LWVAA
 - Cybersecurity

Assessment

- DOT&E determined that the APB-11 variant of the A-RCI sonar system's overall mission performance remains unchanged from previous assessments and further observed an improvement in system reliability. The recently released classified DOT&E FOT&E report, in conjunction with the classified interim assessment memorandum dated September 10, 2014, concluded the following regarding performance:
 - For ASW, APB-11 A-RCI passive sonar capability is effective against older classes of submarines in some environments, but is not effective in all environments or against modern threats. Despite an unchanged overall assessment, APB-11 demonstrated improved operator performance metrics over previous APB variants.
 - The APB-11 A-RCI sonar system is not effective in supporting operator situational awareness and contact management in areas of high-contact density; however, platforms equipped with an LWVAA demonstrated improved performance over previous APB variants.
 - APB-11 cybersecurity is not effective and remains unchanged from previous variants.
 - The APB-11 A-RCI sonar system is operationally suitable.
- Although the APB-11 assessment was able to determine system effectiveness and suitability, there were several test limitations. Some of the major limitations were:

- A damaged TB-29 array that limited the assessment of new single leg ranging capabilities and the use of the new RAZ/RTD.
- The RAZ/RTD suffered a material casualty that precluded an assessment of its impact on situational awareness in an HDCM region.
- Due to the biennial software and hardware development cycle, the Navy generates and approves the requirements documents and Test and Evaluation Master Plans (TEMPs) in parallel with APB development and installation. As a result, the fleet assumes additional risk, since most operational testing is not completed before the system is initially deployed.
- The Navy's schedule-driven process prevents operational test results from directly supporting development of the follow-on APBs. For example, the Navy completed operational testing of the A-RCI APB-09 sonar system in early FY12. Due to the combination of the late completion of testing and the Navy's practice of issuing an updated version every 2 years, data from the test could not be included in the development of APB-11.

Recommendations

- Status of Previous Recommendations. The Navy made progress in addressing 22 of the 37 previous recommendations outlined in DOT&E's classified FOT&E report on APB-09 dated November 2012. Of the 15 remaining outstanding recommendations, the significant unclassified recommendations are:
 1. Conduct additional testing in shallow water to examine the ship's ASW capabilities in those conditions.
 2. Re-evaluate the use of the current time difference between system and operator detection times as the ASW Key Performance Parameter for a more mission-oriented metric to accurately categorize system effectiveness.
 3. Evaluate the covertness of the high-frequency sonar during a future submarine-on-submarine test.
 4. Determine the performance of the A-RCI sonar system in detecting near surface mines.
 - The following recommendations from the FY12 Annual Report remain open. In the upcoming fiscal year, the Navy should:
 1. Consolidate the A-RCI and AN/BYG-1 TEMPs and test plans into an Undersea Enterprise Capstone document to permit efficiencies in testing.
 2. Evaluate A-RCI metrics to improve performance under varying environmental conditions and to focus on earlier and longer range operator detections.
- FY15 Recommendations. DOT&E's APB-11 FOT&E report dated November 2015 detailed five new recommendations. The Navy needs to address the following significant unclassified recommendations:
 1. Carry forward all APB-11 test objectives not evaluated including the ALCCA, RAZ/RTD user interface, TB-34 triangulation ranging improvements, and TB-29 ranging algorithm to the APB-13 TEMP.

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2. Perform an ASW event against a high-end SSK at least with every other APB variant and upon introduction of new wet end sensor or software capabilities improving ASW mission capability.
3. Conduct future HDCM situational awareness testing in areas that provide full radar coverage to support comparative analysis of data.

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