

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

Executive Summary

- The Navy conducted FOT&E on the Advanced Processing Build 2013 (APB-13) variant of the AN/BQQ-10 Acoustic Rapid Commercial Off-the-Shelf Insertion (A-RCI) sonar system in FY17. Testing included in-lab comparison testing between the APB-11 and APB-13 variants and at-sea testing of anti-submarine warfare (ASW) search capability of APB-13 against a U.S. submarine acting as a high-end threat nuclear submarine. Analysis is in progress; however, preliminary analysis shows an improvement from APB-11 in operator detection and classification times of presented submarine acoustic data.
- The Navy scheduled the remaining FOT&E event, evaluation of APB-13 capability to support situational awareness in an environment with a large number of contacts. Poor weather and submarine availability prevented the test event three times in FY17. This test is deferred to FY18 and will be conducted as part of APB-15 testing.
- DOT&E will submit a classified FOT&E report in FY18.

System

- The AN/BQQ-10 A-RCI sonar system is the undersea sensing system utilized by U.S. submarines. It uses active and passive sonar to conduct ASW and submerged operations in the execution of all assigned submarine missions. Acoustic energy is processed and displayed to enable operators to detect, classify, localize, and track threat submarines and other waterborne objects (surface ships, mines, bottom features, etc.).
- The AN/BQQ-10 A-RCI sonar system is an open-architecture system that includes biennial software upgrades (APBs) and complementary biennial hardware upgrades (Technical Insertions (TIs)). These upgrades are intended to maintain an advantage in acoustic detection of threat submarines.
- TIs normally support a preceding and subsequent APB (e.g., TI-12 would normally support both APB-11 and APB-13 software builds). Due to FY13 sequestration funding limitations, no TI-12/APB-13 systems were released. APB-13 was limited to platforms that completed an upgrade to TI-14. Furthermore, almost all TI-14 platforms will upgrade to APB-15 upon its release in FY18.



- The AN/BQQ-10 A-RCI sonar system consists of:
 - Interface to submarine acoustic sensors to include the spherical array or large aperture bow array, hull array, wide aperture array, conformal array, high-frequency array, and 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, TB-29A, or TB-29A Reduced Length)
 - Processing capability that utilizes environmental data (e.g., water depth, bottom contour, sound velocity profiles, etc.) and received acoustic energy on all acoustic sensors and displays the processed data in a way that supports operator search, detection, classification, and localization/track of contacts of concern or contacts of interest

Mission

The Operational Commander will employ submarines equipped with the AN/BQQ-10 A-RCI sonar system to:

- Search for, detect, and track submarine and surface vessels in open-ocean and littoral sea environments
- Search for, 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

Lockheed Martin Maritime Systems and Sensors – Manassas, Virginia

Activity

- In July 2016, the Navy completed two phases of cybersecurity test and evaluation of the APB-13 variant of the AN/BQQ-10 A-RCI sonar system in accordance with a DOT&E-approved test plan. Specifically, the Navy completed a Cooperative

- Vulnerability and Penetration Assessment (CVPA) and an Adversarial Assessment (AA).
- In December 2016, DOT&E approved a Test and Evaluation Master Plan (TEMP) covering the APB-13 variant of the

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AN/BQQ-10 A-RCI sonar system. The Navy has since completed the following operational testing of the system in accordance with the DOT&E-approved TEMP and DOT&E-approved test plans.

- In December 2016, the Navy completed in-lab comparison testing between variants APB-11 and APB-13 using 60 real-world sonar recordings of non-U.S. submarines. Sonar recordings were played on each variant using 20 fleet operators to assess operator detection and classification metrics. The Navy conducted this test event as combined developmental and operational testing.
- In January 2017, the Navy completed four days of open-ocean ASW search in the Southern California Operating Areas against a U.S. submarine acting as a high-end threat nuclear submarine. Data were collected to assess the capability of APB-13 to support detection through engagement of a high-end threat nuclear submarine.
- In January, July, and September 2017, the Navy scheduled a 2-day evaluation of APB-13 capability to support situational awareness in an environment with a large number of contacts, but all events were canceled due to poor weather, test submarine unplanned maintenance, or test submarine assignment to a higher fleet priority. The Navy was unsuccessful in rescheduling this test in FY17. This test is deferred to FY18 and will be conducted as part of APB-15 testing.
- In September 2017, the Navy completed its test strategy and test design development for operational test of APB-15 of the AN/BQQ-10 A-RCI sonar system. The Navy expects to submit the APB-15 TEMP for approval in early FY18. APB-15 operational testing includes at-sea evaluations focusing on ASW and situational awareness in high-density contact management situations, in-lab comparison testing between APB-13 and APB-15, and in-port evaluation of cybersecurity.
- Navy efforts to obtain high-end, diesel electric submarine target services to test APB-13 capabilities were unsuccessful in FY17. The Navy is pursuing the Rim of the Pacific Exercise (RIMPAC 2018) and Diesel Electric Submarine Initiative (DESI) exercises as opportunities to obtain high-end, diesel electric submarine target services to test APB-15 capability in FY18.

Assessment

- Cybersecurity testing identified system vulnerabilities that could negatively affect the system's operational effectiveness. DOT&E will identify specific vulnerabilities in a classified

FOT&E report in FY18. The Navy is updating the system to correct the identified vulnerabilities starting with TI-14/APB-15 system updates and continuing into future TI and APB developments.

- In-lab comparison testing between APB-11 and APB-13 showed improvement in operator detection and classification times for presented non-U.S. submarine acoustic data. The operational impact of these improvements cannot be quantified because the scenarios utilized recorded data and therefore did not allow in-situ tactical response (i.e. test and target platforms maneuvers could not be modified) during the playback periods.
- The at-sea ASW search event showed no degradation in performance from APB-11. Due to the significantly different environments in which the APB-11 and APB-13 variants were tested, DOT&E cannot make a confident determination of improvement between variants. DOT&E will provide details of observed performance and test limitations in a classified FOT&E report in FY18.
- The Navy generates and approves the requirements documents and TEMPs in parallel with APB development and installation due to the biennial software and quadrennial hardware development cycle. As a result, the fleet assumes additional risk, since most operational testing is not completed before the system is initially deployed.

Recommendations

- Status of Previous Recommendations. The Navy made progress in addressing four of five recommendations outlined in DOT&E's classified FOT&E report on APB-11, dated November 12, 2015. Six significant recommendations remain outstanding from previous DOT&E reports. The significant unclassified recommendations are:
 1. 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 characterize system effectiveness.
 2. Evaluate the covertness of the high-frequency sonar during a future submarine-on-submarine test.
 3. Determine the performance of the AN/BQQ-10 A-RCI sonar system in detecting near-surface mines.
 4. Perform an ASW event against a high-end, diesel-electric, hunter-killer submarine at a periodicity of at least every other APB variant (i.e., APB-11 and again in APB-15) of the AN/BQQ-10 A-RCI sonar system and upon introduction of new wet end sensor or software capabilities improving ASW mission capability.
- FY17 Recommendations. None.