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

Executive Summary

- The Acoustic Rapid Commercial Off-the-Shelf (COTS) Insertion (A-RCI) Sonar is an improvement over the legacy sonar systems it replaces. The Navy's practice of bi-annually updating the A-RCI software and hardware qualitatively appears to improve technical performance, but insufficient test data exist to measure and quantify the improved mission capability.
- The Navy completed operational testing of the A-RCI Advanced Processor Build 2007 version (APB-07) system in FY10 and is expected to issue a report in FY11.
- DOT&E's preliminary analysis of operational test results found the APB-07 system provides performance similar to previous APBs.

System

- A-RCI is an open architecture sonar system intended to maintain an advantage in acoustic detection of threat submarines.
- A-RCI uses legacy sensors and replaces central processors with COTS computer technology and software. The program includes the following:
  - A sonar system for the *Virginia* class submarine
  - A replacement sonar system retrofitted into *Los Angeles*, *Ohio*, and *Seawolf* class submarines
  - Biannual software upgrades, (APBs), and hardware upgrades, Technology Insertions (TIs). While using the same process and nomenclature, these APBs and TIs are distinct from those used in the AN/BYG-1 Combat Control System program.
- The Navy intends the A-RCI upgrades to provide expanded capabilities for anti-submarine warfare, high-density contact management, and mine warfare, particularly in littoral waters and against diesel submarines.
- A-RCI processes data from the submarine's acoustic arrays (i.e., spherical array, hull array, wide aperture array, and high frequency array) along with 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, TB-29, or TB-33).

Mission

The Navy's intent for submarine crews equipped with the A-RCI sonar is to complete the following submarine force missions:

- 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 efforts
- Covertly execute Naval Special Warfare missions
- Perform under-ice operations

Major Contractor

Lockheed Martin Maritime Systems and Sensors – Washington, District of Columbia

Activity

- The Navy completed operational testing of A-RCI APB-07 in October 2010. APB-07 testing of the passive sonar capability included Anti-Submarine Warfare (ASW) search testing against a nuclear submarine target and High-Density Surface Contact Management testing in October 2009. This testing was combined with the operational test of the newly-developed TB-34 towed array. APB-07 testing of the high-frequency mine-detection sonar occurred in June 2010. Testing was conducted in accordance with a DOT&E-approved test plan.
- DOT&E approved the A-RCI APB-07 Test and Evaluation Master Plan (TEMP) in June 2009. For the first time, the scope of the testing was expanded to combine A-RCI testing with the AN/BYG-1 Combat Control System and the new TB-34 towed array. Although the Navy planned to complete A-RCI APB-07 operational testing before the first submarine

with the system deployed, this did not occur due to a lack of available test assets.

- The Navy began installing the A-RCI APB-09 system on operational submarines (initial installation on USS *North Carolina* – a *Virginia* class submarine) in 2010. DOT&E expects to approve the A-RCI APB-09 TEMP early in FY11. Developmental testing of the APB-09 system began in 4QFY10 and is expected to continue through 2QFY11. Operational testing of the APB-09 system is scheduled to occur in FY11.

Assessment

- The Navy's practice of bi-annually updating the A-RCI software and hardware qualitatively appears to improve technical performance, but insufficient test data exists from APB to APB to measure and quantify the improved mission capability across the mission areas.
- The Navy's schedule-driven process prevents operational test results from directly supporting development of the follow-on APBs. The Navy completed operational testing of the A-RCI APB-07 system in 2010. Due to the combination of late completion of testing and the Navy's practice of issuing an updated version every two years, data from APB-07 operational testing has not been included in the development of APB-09 or APB-11, which are either already complete or nearing completion.
- Preliminary test results do not indicate that APB-07 demonstrates a measurable improvement over previous software versions. DOT&E's assessment of the A-RCI sonar system remains the following:
  - A-RCI passive sonar capability is effective against older classes of submarines in most environments, but is not effective in some environments against modern threats of record.
  - A-RCI is not effective in supporting operator situational awareness and contact management in areas of high contact density.
  - A-RCI high-frequency mine performance is not effective for transiting a minefield, and appears to meet threshold requirements in some environments, but not in others.
  - A newly introduced mine detection capability, although unable to be fully utilized, appears to provide significant potential for improving these operations.

  - Overall, A-RCI continues to be not suitable due to problems with software reliability. APB-07 appears to have poorer reliability than previous builds.
- The A-RCI program's schedule of producing bi-annual upgrades to software and hardware results in requirements documents and TEMPs being developed and approved 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 has achieved some testing efficiencies by combining operational testing of several programs into consolidated test events. Since testing is interdependent, the consolidation of A-RCI, TB-33, TB-34, and AN/BYG-1 TEMPs into an Undersea Enterprise Capstone document would increase testing efficiency and enable a full end-to-end evaluation of submarine capability in the applicable mission areas.

Recommendations

- Status of Previous Recommendations. The Navy has made progress in addressing 7 of the 15 previous recommendations. Two of the outstanding recommendations are classified and are contained in the October 2009 Beyond Low-Rate Initial Production report. The remaining recommendations are:
  1. Evaluate the covertness of the High Frequency sonar during a future submarine-on-submarine test.
  2. Investigate the software reliability problems and institute measures to improve system software and recording devices' reliability.
  3. Implement a reliability growth program.
  4. Evaluate the ability of A-RCI to detect and classify a snorkeling SSK operating in littoral waters containing several diesel-powered vessels.
  5. Consider investing in improvements to the Onboard Trainer to improve trainer reliability and target realism.
  6. Develop operationally relevant metrics to evaluate A-RCI performance to allow for comparison testing between APBs and an assessment of the system's planned improvements as well as overall performance.
- FY10 Recommendation.
  1. The Navy should consolidate the A-RCI, TB-33, TB-34, and AN/BYG-1 TEMPs into an Undersea Enterprise Capstone document.