

## AN/BYG-1 Combat Control System

### Executive Summary

- The Navy completed FOT&E on the AN/BYG-1 Advanced Processor Build 2007 (APB-07) Combat Control System in early FY11. Performance was similar to previous AN/BYG-1 APBs.
- Although the Navy planned to complete AN/BYG-1 APB-09 testing before the first APB-09 submarine deployed, this did not occur due to the lack of test asset availability.
- At-sea FOT&E of APB-09 began in March 2011 and is scheduled to be completed in early FY12.
- The Navy is completing development of the APB-11 version and operational testing is planned to begin in early FY13.

### System

- AN/BYG-1 is an open-architecture submarine combat control system for analyzing and tracking submarine and surface ship contacts, providing situational awareness, as well as the capability to target and employ torpedoes and missiles.
- AN/BYG-1 replaces central processors with commercial off-the-shelf (COTS) computer technology. The Navy installs improvements to the system via an incremental development program. The program includes the following:
  - A combat control system for the *Virginia* class submarine
  - A replacement combat control system back fit into *Los Angeles*, *Ohio*, and *Seawolf* class submarines
  - Biannual software upgrades (called APBs) and hardware upgrades (called Technology Insertions (TIs)). While using the same process and nomenclature, these APBs and TIs are distinct from those used in the Acoustic Rapid COTS Insertion (A-RCI) program.
- The Navy intends improvements to provide expanded capabilities for Anti-Submarine and Anti-Surface Warfare, high-density contact management, and the targeting and control of submarine weapons.

### Activity

- The Navy completed FOT&E of AN/BYG-1 APB-07 in late 2010 in accordance with a DOT&E-approved test plan. Testing was conducted on four different submarines, including two hardware variants, and was combined with the IOT&E periods of two new sonar arrays: the TB-34 and the Low Cost Conformal Array. The testing periods were also combined with the operational testing of the APB-07 variant of the A-RCI sonar system. This provided testing efficiencies and enabled an end-to-end evaluation of mission performance. DOT&E issued a classified combined A-RCI and AN/BYG-1 APB-07 test report in July 2011.
- The Navy began installing the AN/BYG-1 APB-09 system on *Virginia* class submarines in 2010, and continued to install



- The Navy is also developing AN/BYG-1 for use on the Royal Australian Navy *Collins* class diesel electric submarines.

### Mission

Submarine crews equipped with the AN/BYG-1 combat control system are able to complete the following submarine force missions:

- Analyze submarine sensor contact information to track submarine and surface vessels in open-ocean and littoral sea environments.
- Employ heavyweight torpedoes against submarine and surface ship targets.
- Receive strike warfare tasking, plan strike missions, and employ Tomahawk land attack cruise missiles.
- Receive and synthesize all organic sensor data and external tactical intelligence to produce an integrated tactical picture.

### Major Contractors

- General Dynamics Advanced Information Systems – Fairfax, Virginia
- General Dynamics Advanced Information Systems – Pittsfield, Massachusetts

the system on *Los Angeles* class submarines through 2011. Although the Navy planned to complete AN/BYG-1 APB-09 operational testing before the first submarine with the system deployed, this did not occur due to the rapid fielding cycle and the lack of available test assets when the system was ready for operational testing to occur.

- The Navy conducted an Information Assurance Vulnerability Evaluation of APB-09 in December 2010 and conducted a network penetration test of the system in January 2011.
- APB-09 FOT&E began in March 2011 on a *Virginia* class submarine and continued into early FY12. The test events were coordinated with the testing of the A-RCI APB-09 sonar upgrades and the *Virginia* class submarine.

# NAVY PROGRAMS

- The Navy began drafting an updated Test and Evaluation Master Plan for the APB-11 and APB-13 AN/BYG-1 variants and expects to issue it by mid-FY12.

## Assessment

- 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 AN/BYG-1 APB-09 system in 2011. 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-09 operational testing has not been included in the development of APB-11, which is nearing completion.
- The DOT&E classified report to Congress for the A-RCI APB-07 and AN/BYG-1 APB-07 systems concluded the following regarding AN/BYG-1 testing adequacy and system performance:
  - The Navy conducted adequate testing to assess the AN/BYG-1 APB-07 system's capability to support situational awareness in areas of high contact density, to localize enemy submarines, and to provide effective information assurance. Testing did not examine AN/BYG-1's ability to employ weapons or its performance in the Anti-Surface Warfare and Strike mission areas.
  - APB-07 is not effective in supporting operator situational awareness and contact management in areas of high contact density.

- Although AN/BYG-1's offensive targeting solutions were usually sufficient to provide the torpedo an opportunity to detect the target, APB-07 is not effective in short-range Anti-Submarine Warfare scenarios.
- APB-07 does not provide effective information assurance, because it does not provide an effective mechanism to detect unauthorized network penetrations. Although APB-07 does provide a limited, manual detection capability, the crew does not receive sufficient training to make this capability effective.
- APB-07 is operationally suitable and continues to exhibit excellent reliability and availability.

## Recommendations

- Status of Previous Recommendations. The Navy has implemented three of the four FY10 recommendations. The remaining recommendation is to consolidate the *Virginia*, A-RCI, and AN/BYG-1 Test and Evaluation Master Plans into an Undersea Enterprise Capstone document.
- FY11 Recommendations. The Navy should:
  1. Consider investing in automation that will assist the operator in areas of high contact density.
  2. Consider improving operator training such that operators understand and effectively employ new APB functionality when fielded. Many of the newly introduced features in APB-07 that were designed to improve mission performance were not used consistently during the test.