

Tomahawk Missile and Weapon System

Executive Summary

- As demonstrated during FY13 test flights, the Tomahawk Weapon System (TWS) continues to meet Navy standards for reliability and performance.
- The FOT&E Operational Test Launch (OTL) program concluded in 2013. This phase of operational testing ran from 2004 to 2013. Flight testing of Tomahawk All-Up Round changes, stockpile monitoring, emerging deficiencies requiring immediate correction, and hardware obsolescence will be conducted in future developmental tests.
- In 2013, DOT&E removed the TWS from operational testing oversight. This decision was based upon TWS history of consistent satisfactory performance over the past nine years in test planning, test execution, and the TWS in meeting reliability and performance requirements.

System

- The Tomahawk Land Attack Missile is a long-range, land attack cruise missile designed for launch from submarines and surface ships.
- There are three fielded variants: a Block III with a conventional unitary warhead, a Block III with a conventional submunitions warhead, and a Block IV with a conventional unitary warhead. Production of Tomahawk Block II and III missiles is complete.
- Block IV Tomahawk is in production as the follow-on to the Block III conventional unitary warhead variant. These missiles are produced at lower cost and provide added capability, including the ability to communicate and be redirected to an alternate target during flight.
- The TWS also includes the Tomahawk Command and Control System (TC2S) and the shipboard Tactical Tomahawk Weapon Control Systems (TTWCS). The TC2S and TTWCS provide



for command and control, targeting, mission planning, distribution of Tomahawk tactical and strike data, and post-launch control of Block IV missiles.

Mission

The Joint Force Commander employs the TWS for long-range, precision strikes against land targets.

Major Contractors

- Missile element: Raytheon Missile Systems – Tucson, Arizona
- Weapon Control System element: Lockheed Martin – Valley Forge, Pennsylvania
- Command and Control element:
 - QinetiQ North America LLC – San Jose, California
 - Boeing Inc. – St. Louis, Missouri

Activity

- In accordance with the DOT&E-approved Test and Evaluation Master Plan and operational test plan, the Navy continued to conduct FOT&E OTLs to verify reliability and performance of Block IV Tomahawk missiles, their associated weapon control systems, and the TC2S. The Navy conducted a total of four Tomahawk missile test launches in FY13. These constitute the final launches in the nine year test series, which completed in FY13.
- In 2013, DOT&E removed the TWS from operational testing oversight. This decision was based upon TWS history of consistent satisfactory performance over the past nine years in test planning, test execution, and the TWS in meeting reliability and performance requirements. Flight testing

to evaluate All-Up Round changes, stockpile monitoring, emerging deficiencies requiring immediate correction, and hardware obsolescence will be conducted in future developmental tests.

Assessment

- The final OTL (OTL-423) of FY12 resulted in a failure when the missile self-terminated. As this test was late in the year, no final failure analysis was available for the FY12 DOT&E Annual Report.
 - The cause of the flight termination was a missile electrical bus under-voltage initiated by an engine flame out.

NAVY PROGRAMS

- Range safety procedures required a chase aircraft to maintain visual contact with the missile at all times. To avoid clouds, the chase pilot directed the missile to climb to a higher altitude resulting in an unplanned departure from the flight plan. As a result, the test missile was 4,000 feet higher than expected when it began its descent towards the target.
- The missile engine's fuel control algorithm was unable to compensate for the pace of descent, resulting in unstable combustion and engine flame out. As the engine flamed out and engine speed decreased, missile electrical bus voltage fell below the minimum, causing the missile to self-terminate.
- Pending a flight software update, OES 0056, the Navy has developed and implemented procedures to ensure future tests and operational flight plans avoid the conditions that led to the OTL-423 failure. The OES 0056 software update is in development and planned for end-to-end testing in May 2014.
- As demonstrated during FY13 test flights, the TWS continues to meet Navy standards for reliability and performance.
- The OTL program (OT-IIIB/IT-CB) concluded in 2013.
 - This phase of operational testing ran from 2004 through 2013, consisting of 67 flight tests of Tomahawk Block II/III/IV missiles.
 - In later years, only Block III and IV missiles were tested, with the last Block III test being in 2012.
 - Using cruise reliability data from 45 Block IV tests, the 80 percent confidence interval for cruise reliability spans 11 percent and indicates a true cruise reliability value consistent with operational requirements.

Recommendations

- Status of Previous Recommendations. All previous recommendations have been addressed.
- FY13 Recommendations. None.