

SSN 774 *Virginia* Class Submarine

Executive Summary

- DOT&E submitted a classified Early Fielding Report in April 2008 when the Navy deployed the USS *Hawaii* before completing the IOT&E.
- The *Virginia* program started IOT&E in November 2007 per a DOT&E-approved test plan. IOT&E will continue through 1QFY09 to support a planned milestone and full-rate production decision in 3QFY09.
- IOT&E conduct, data distribution, and analysis has been hindered by the Navy's special security rules for *Virginia* acoustic and electro-magnetic signatures.
- Navy security rules restrict evaluation of *Virginia* operations near Anti-Submarine Warfare (ASW)-capable ships. As a result, the *Virginia* will complete IOT&E without resolving performance against a primary threat of record.
- *Virginia* class performance is dependent on the performance of separately managed sub-systems that are integrated into *Virginia*'s Non-Propulsion Electronics Systems. Versions of many of these systems are used on *Los Angeles* class submarines.

System

The *Virginia* class submarine is the replacement for the aging fleet of *Los Angeles* class submarines. The *Virginia* class:

- Is capable of targeting, controlling, and launching Mk 48 Advanced Capability torpedoes, Tomahawk cruise missiles, and future mines
- Has sonar capability similar to the *Seawolf* submarine class with improvements to the electronic support suite and combat control systems
- Has a new design propulsion plant incorporating proven components from previous submarine classes
- Utilizes a modular design and significant commercial off-the-shelf computer technologies and hardware that allow for rapid and cost-effective technology refresh cycles



Mission

The Maritime Mission Commander will employ the *Virginia* class submarine to enable open-ocean and littoral covert operations in support of the following submarine mission areas:

- Strike warfare
- Anti-submarine warfare (ASW)
- Intelligence, surveillance, and reconnaissance (ISR); indications and warnings (I&W); and Electronic Warfare (EW)
- Anti-surface ship warfare (SUW)
- Special Operations Force (SOF) warfare
- Mine warfare
- Battle Group Operations

Prime Contractors

- General Dynamics
- Northrop Grumman

Activity

- DOT&E submitted a classified Early Fielding Report on the *Virginia* class submarine in April 2008, when the Navy used USS *Hawaii* for forward-deployed operations before completing the IOT&E. USS *Hawaii* is the third ship of the *Virginia* class and has not completed her Post Shipyard Modernization availability.
- DOT&E approved the *Virginia* Test and Evaluation Master Plan (TEMP), Revision E, Change 1 on April 10, 2008, based on Navy changes to the Operational Requirements Documents.
- DOT&E approved the IOT&E test plan in October 2007 and revisions in 2008 to support changes in Navy test planning

and available test assets. The Navy started IOT&E in November 2007 to evaluate *Virginia*'s performance in each of the seven mission areas. Test events include:

- Demonstration of operations of the *Virginia* Lock-Out-Trunk by SOF in November 2007
- ASW search and attack operational testing against a nuclear submarine target in April and June 2008
- ASW attack and torpedo employment against a nuclear submarine at the Atlantic Undersea Test and Evaluation Center (AUTEK) range in June 2008

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- SUW attack and torpedo employment against surface ships at the AUTEK range in June 2008
- Covert SOF warfare using the *Virginia*'s Lock-Out-Trunk in July 2008
- Strike Warfare, including the launch of three Tomahawk cruise missiles, at the Eglin AFB, Florida, range in August 2008
- Mine avoidance and susceptibility operational testing in August 2008
- ASW search and attack testing and survivability testing in the Gulf of Maine operating areas in September 2008
- Information Assurance (IA) testing in May, July, and October 2008
- Battle Group Support Operations and ISR operational testing events in August and October 2008
- Additional operational testing is planned in October through January 2009 to make up for incomplete, cancelled (due to weather), and inadequate test events.
- The Navy conducted a ship and crew certification and a Technical Evaluation for each mission area before each phase of operational test.
- The Navy started TEMP Revision F development to support the:
 - Full-rate decision milestone
 - Future modernization of the *Virginia* submarine due to the incorporation of spiral development mission systems in the *Virginia*'s Non-Propulsion Electronics Systems (NPES)
 - Significant design changes planned for the third block of submarines
 - Operational testing not completed in IOT&E
- The Navy completed all live fire testing on the *Virginia* with the exception of component shock qualification testing. The Navy plans to complete component shock qualification testing in FY09.

Assessment

- Since the Navy does not operate diesel-electric submarines (SSK), Navy testers have relied on allied SSKs to act as surrogates for tests requiring an SSK threat of record. However, Navy security rules for the *Virginia* prevent realistic ASW testing using allied SSKs. As a result, the *Virginia* class submarine will complete IOT&E without resolving performance against a primary threat of record. The security rules also restrict *Virginia* submarine operations in the vicinity of allied ASW capable warships.
- The Navy rescheduled several IOT&E events due to test ship material problems, bad weather in the planned test area, or to obtain adequate test target surrogates and test assets. In addition, the Navy has invoked special security rules for all test data containing *Virginia* signature related information that significantly delays the transport, reconstruction, and analysis of test data. These factors have delayed IOT&E completion, will delay test analysis and reporting, and could postpone the milestone.
- *Virginia*'s mission performance is highly dependent on smaller acquisition programs that make up the *Virginia* NPES. The

- Acoustic Rapid Commercial Off-the-Shelf Insertion for Sonar (A-RCI) BQQ-10 sonar, the TB-29 series towed array, and the Mk 48 Advanced Capability (ADCAP) torpedo have been noted in previous assessments to likely result in below-threshold performance in some mission areas. For example, the TB-29 series arrays are unreliable and the Navy has instituted significant submarine operational limitations, when the array is deployed, to prevent array failure. These limitations during IOT&E could prevent evaluation of or the meeting of some performance thresholds. Other programs such as the Photonics Mast (replacement for the periscope), the Light Weight Wide Aperture Array sonar, the open loop degaussing circuit (Circuit D), and the Chin high-frequency sonar appear to have added new capabilities that could improve performance in some mission areas. These new systems and the design improvements incorporated into the *Virginia* class hull, mechanical, electrical, and electronic ship systems appear from initial test results to improve mission performance above that of the *Los Angeles* class.
- *Virginia* is the first submarine to undergo IA operational testing during the IOT&E. This testing is especially critical for the *Virginia* because the NPES integrates all mission systems on an integrated fiber optic network. IA testing has been difficult because of fleet operator concerns regarding potential damage to the systems during test and the need for recertification of the systems following test. These concerns have resulted in portions of the network being placed off-limits to testers. Navy testers are developing procedures and policies for test to ensure systems are returned to the pre-test baseline condition. Testers are evaluating the IA test practices and results.
 - Due to the multi-mission capability of the *Virginia* submarine, the Navy conducted the IOT&E during several mission focused test events. Because of the high demand on fleet assets and in order to obtain the necessary test assets and targets for the IOT&E, testers followed the Navy's proposal to conduct testing in conjunction with fleet training. *Virginia*'s initial IOT&E test plan utilized the Navy's Composite Training Unit Exercise (COMPTUEX) with the USS *Theodore Roosevelt* Carrier Strike Group as the event to support most mission area evaluations. Unfortunately, *Virginia* experienced material problems that required the ship to return to port. By the time the repairs were completed, the COMPTUEX had completed. As a result, the *Virginia* test plan was substantially rewritten to expand current test events and to take advantage of other fleet training. Although an appropriate combination of testing and training appears to be the efficient use of fleet assets, significant advance coordination and planning with the fleet trainers is necessary to ensure an adequate event is conducted that will meet the needs of both the trainers and the testers.
 - The Portable Underwater Tracking System (PUTS) developed for the *Virginia* minefield IOT&E provided an economical, reliable, and accurate method of tracking and analyzing the test ship's position in real time while submerged. PUTS was essential in convincing operators to conduct the in-stratum portions of the minefield testing and in the analysis of test data.

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Also, since PUTS is portable, the Navy conducted operational testing in a representative environment.

Recommendations

- Status of Previous Recommendations. The Navy addressed three of the four previous recommendations. The FY06 recommendation for the Navy to invest in a capability to conduct realistic shallow-water and littoral testing and training remains valid.
- FY08 Recommendations. The Navy should:
 1. Propose and resource an appropriate surrogate and adequate test strategy to resolve performance against the SSK threat of record.
 2. Establish procedures where *Virginia* submarines can operate with and train for both their peacetime and wartime missions with our allies.
 3. Define clear rules for what *Virginia* data requires special classification and handling.

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