

SSN 774 *Virginia* Class Submarine

Executive Summary

- The Milestone III Defense Acquisition Board met and awarded the program a Full-Rate Production Decision in September 2010.
- *Virginia* is an effective, suitable, and survivable replacement for the *Los Angeles* submarine, with improvements in acoustic and electromagnetic covertness.
- With the completion of IOT&E, assessment of the *Virginia* class has shifted to the following areas: modernization of the *Virginia* class submarine's Non-Propulsion Electronics Systems (NPES), verification of the correction of deficiencies discovered during IOT&E, and completion of operational testing not conducted in IOT&E. The Navy began revising the Test and Evaluation Master Plan (TEMP) to address the outstanding test requirements as well as future testing of the Block III redesign of the *Virginia* class.
- Operational and Live Fire testing demonstrated that the *Virginia* class submarine is survivable in most expected threat environments.

System

- The *Virginia* class submarine is the replacement for the aging fleet of *Los Angeles* class submarines. The *Virginia* class:
 - Is designed to be capable of targeting, controlling, and launching Mk 48 Advanced Capability torpedoes, Tomahawk cruise missiles, and future mines.
 - Is designed to have 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 components from previous submarine classes.
 - Uses a modular design and significant commercial off-the-shelf computer technologies and hardware intended to allow for rapid and cost-effective technology refresh cycles.
- The *Virginia* class submarines are being procured and incrementally upgraded in a series of blocks. Each block is procured with a multi-year contract; however, not each block will incorporate a major design change.
 - Block I (hulls 1-4) and Block II (hulls 5-10) ships incorporated the initial design of the *Virginia* class
 - Block III (hulls 11-18) ships will include the following affordability enhancements:
 - A Large Aperture Bow array will replace the spherical array in the front of the ship.
 - Two *Virginia* Payload Tubes will replace the 12 vertical launch tubes. Each *Virginia* Payload Tube is capable of storing and launching six Tomahawk Land Attack Missiles used in strike warfare.
 - The design for Block IV and beyond ships has not been finalized.



Mission

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

- Strike warfare (STW)
- Anti-Submarine Warfare (ASW)
- Intelligence, Surveillance, and Reconnaissance (ISR); Indications and Warnings (I&W); and Electronic Warfare (EW)
- Anti-Surface Ship Warfare (ASUW)
- Naval Special Warfare (NSW)
- Mine warfare (MIW)
- Battle Group Operations (BGO)

Major Contractors

- General Dynamics Electric Boat – Groton, Connecticut
- Northrop Grumman Shipbuilding Newport News – Newport News, Virginia

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Activity

- DOT&E issued a Beyond Low-Rate Initial Production (BLRIP) report in November 2009. This report was classified and included a limited distribution version to comply with the Navy's special security rules for submarine data.
 - DOT&E approved the *Virginia* TEMP Revision F in November 2009 to include FOT&E. The first FOT&E event of the *Virginia* class occurred in September 2010 and examined the submarine's susceptibility to low-frequency active sonar. Analysis of this event is expected to begin in November 2010.
 - The Under Secretary of Defense for Acquisition, Technology and Logistics (USD (AT&L)) approved full-rate production in September 2010. Per the Acquisition Decision Memorandum, the Navy must submit a revised TEMP by March 2011 that includes plans to test deferred capabilities, verify correction of major deficiencies found during IOT&E, and planned upgrades.
 - The Navy began planning the comprehensive testing to occur in FY11 required for modernization of *Virginia*'s NPES. This testing will be combined with the operational testing of the Acoustic Rapid Commercial Off-the-Shelf (COTS) Insertion (A-RCI) Sonar System, the AN/BYG-1 fire control system, and the Mk 48 Advanced Capability Torpedo. Developmental testing of these systems began in 4QFY10.
 - Because Navy security rules prohibit *Virginia* conducting exercises with foreign diesel-electric submarines (SSKs), the Navy finished IOT&E without testing the *Virginia* class submarine against this primary threat of record. The Navy began investigating alternative testing strategies against the SSK threat of record.
 - The Navy completed shock qualification of over 99 percent of the baseline *Virginia* class components. The Block III design will require a shock test series for the *Virginia* class Payload Tube hatch. The test series is scheduled for spring 2012 in support of the first Block III delivery in August 2014.
- *Virginia* was not fully evaluated for the Naval Special Warfare mission, but has the potential to use the installed Lock-Out Trunk for Special Operations Force operations once the Navy certifies *Virginia* for diver oxygen recompression and storage of Special Warfare equipment and ordinance. Further testing is required to evaluate *Virginia*'s capability with a Dry-Deck Shelter.
 - *Virginia* is operationally suitable. However, the reliability of several key engineering plant components, NPES equipment, Government Furnished Equipment, and the Photonics Mast need improvement.
 - Operational and Live Fire testing demonstrated that the *Virginia* class submarine is survivable in most expected threat environments. Details of the survivability assessment are classified and contained in the BLRIP report.
 - The Navy has achieved some testing efficiencies by combining operational testing of several programs into consolidated test events.
 - With the completion of IOT&E, assessment of the *Virginia* class has shifted to the following areas:
 - Modernization of the *Virginia* class submarine's NPES. These changes to the class require testing to assess the effects of the combat system upgrades on ASW, ASUW, STW, Mine Avoidance, and Information Assurance capabilities.
 - Verification of the correction of deficiencies discovered in IOT&E. The Navy expects to correct and retest many of the deficient areas in the upcoming modernization FOT&E period. Other efforts to retest deficient performance are under discussion and the Navy is tracking each issue identified by the Commander, Operational Test and Evaluation Force (COTF) and DOT&E from their respective IOT&E reports.
 - Operational testing not completed during IOT&E. *Virginia*'s IOT&E did not include testing of ASW capabilities in the Arctic environment (planned for 2QFY11), susceptibility to Low-Frequency Active sonar systems (completed in 4QFY10), special operations forces deployment from a Dry-Deck Shelter (planned for FY13), and ASW capabilities against diesel-electric submarines (unknown completion date).
 - *Virginia*'s mission performance is significantly dependent on supporting acquisition programs that make up the *Virginia* combat and weapons systems. The performance requirements or demonstrated performance of some NPES components do not support meeting *Virginia*'s requirements. The A-RCI Sonar AN/BQQ-10, the TB-29 series towed array, the AN/BLQ-10 Electronics Support Measures and the Mk 48 Advanced Capability torpedo are examples of systems with known performance limitations or reliability problems that affected *Virginia*'s performance during IOT&E.

Assessment

- DOT&E's classified BLRIP report on *Virginia*'s performance concluded the following:
 - *Virginia* is an effective, suitable, and survivable replacement for the *Los Angeles* submarine, with improvements in acoustic and electromagnetic covertness.
 - *Virginia*'s operational effectiveness is dependent on the mission conducted. *Virginia* is effective for conducting Strike Operations, minefield avoidance operations, Battle Group Support, and Anti-Surface Ship Warfare attack (in most scenarios).
 - *Virginia* is effective for conducting ASW against some submarines, but is not effective in some environments or against most quiet threats of record. It is not clear that any passive sonar system using existing or planned technology could be effective in all environments or against quiet threats.
 - *Virginia* is effective for conducting some limited ISR missions depending on the intelligence collection requirements; however, additional testing is required.

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Recommendations

- Status of Previous Recommendations. The Navy has made progress in addressing 12 of the 33 recommendations contained in the November 2009 classified BLRIP report. Nine of the outstanding recommendations are classified. Of the remaining 12 unclassified comments, the key recommendations are:
 1. Complete the component shock qualification program.
 2. Test against an SSK threat surrogate in order to evaluate *Virginia*'s capability, detectability, and survivability against modern diesel-electric submarines.
 3. Conduct ASW-search testing to assess *Virginia*'s capability with other towed arrays (i.e., TB-16 and TB-23).
 4. Complete ASUW testing and investigate alternatives to the Atlantic Undersea Test Evaluation Center (AUTEK) for ASW and ASUW testing.
- 5. Conduct follow-on mine avoidance training and testing in areas of mixed mine types (bottom and volume mine surrogates) using realistic tactics and realistic mine employment (near-surface).
- 6. Measure the ISR-intercept metrics with a deployment-outfitted *Virginia* class submarine and with realistic threat signals.
- FY10 Recommendation. The Navy should:
 1. Begin developing the shock test series for the *Virginia* class Payload Tube hatch.

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