

SSN 774 Virginia Class Submarine

Executive Summary

- The Navy deployed the first *Virginia* class Block III submarine, USS *North Dakota* (SSN 784), in May 2015 with only limited developmental testing of the platform's major subsystem upgrades. Major testing phases included developmental testing of the new Large Aperture Bow (LAB) sonar array, testing of the system to support weapon system accuracy (this included sonar performance assessments), testing of the weapon system interfaces, and a limited operational assessment phase to support deployment certification.
- DOT&E submitted a classified Early Fielding Report in September 2015 detailing the results of the testing to date. DOT&E concluded that:
 - The *Virginia* class Block III submarine with the LAB array has the potential to perform as an adequate replacement for the spherical array used on previous *Virginia* class variants.
 - System reliability meets the Navy's thresholds.
 - The new LAB array and the Light Weight Wide Aperture Array (LWWAA) sonar processing systems suffer from some deficiencies. Although the Navy has implemented corrective action in each case, a full operational evaluation has not yet been conducted.
- The Navy intends to conduct a comprehensive operational test of the Block III system starting in 1QFY17 covering the Anti-Submarine Warfare (ASW), Anti-Surface Warfare (ASUW), Strike Warfare, and Intelligence collection mission areas in addition to suitability and cybersecurity assessments.
- The Navy has conducted four major test periods to assess the *Virginia* class Block I and Block II submarines. The overall results of these combined testing periods were:
 - *Virginia* class submarines are capable of hosting the Dry Deck Shelter system and can remain covert during Naval Special Warfare missions in some environments against some threat forces.
 - *Virginia* class submarines are effective at supporting general arctic operations.
 - *Virginia* class submarines are effective at conducting ASW missions in some environments against some threats.
 - Although the *Virginia* class submarine was not effective for some missions tested, it remains an effective replacement for the *Los Angeles* class submarine, providing similar mission performance and improved covertness.

System

- The *Virginia* class submarine is the Navy's latest fast attack submarine that is capable of targeting, controlling, and launching MK 48 Advanced Capability torpedoes and Tomahawk cruise missiles.



- The Navy is procuring *Virginia* class submarines incrementally in a series of blocks; the block strategy is for contracting purposes, not necessarily to support upgrading capabilities.
 - Block I (hulls 1-4) and Block II (hulls 5-10) ships were built to the initial design of the *Virginia* class.
 - Block III (hulls 11-18) and Block IV (hulls 19-28) ships include the following affordability enhancements starting with SSN 784, USS *North Dakota*:
 - A LAB array in place of the spherical array in the front of the ship.
 - Two *Virginia* payload tubes replace the 12 vertical launch tubes; each payload tube is capable of storing and launching six Tomahawk land attack missiles used in Strike Warfare missions.
 - Block V and beyond will increase strike payload capacity from 12 to 40 Tomahawk land attack missiles by adding a set of four additional payload tubes in an amidships payload module, capable of storing and launching seven Tomahawk missiles each, as well as providing the potential to host future weapons and unmanned systems.

Mission

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

- Strike Warfare
- Anti-Submarine Warfare
- Intelligence, Surveillance, and Reconnaissance
- Mine Warfare
- Anti-Surface Ship Warfare
- Naval Special Warfare
- Battle Group Operations

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Major Contractors

- General Dynamics Electric Boat – Groton, Connecticut
- Huntington Ingalls Industries, Newport News Shipbuilding – Newport News, Virginia

Activity

- The Navy completed the shock qualification testing for the *Virginia* Common Weapons Launcher and the *Virginia* Payload Tube hatch in late 2014. The analysis of the test results and redesign of a sub component has resulted in the hatch qualification being delayed until late 2015.
- The Navy has delayed the validation of the Transient Shock Analysis modeling method used for the design of *Virginia* class Block III items until mid to late 2016 to allow more time to complete their analysis.
- The update of the *Virginia* Class Vulnerability Assessment report, which will include the Block III modifications, will be delayed to late 2016.
- The following developmental testing events were completed prior to deploying the first *Virginia* class Block III platform with data from each event provided to DOT&E for analysis:
 - In September 2010, the Navy completed a full scale LAB array acoustic and vibration developmental test.
 - In October 2014, the Navy completed the first Block III *Virginia* class submarine Weapon System Accuracy Test, which assessed the overall systems ability to employ weapons.
 - In December 2014, the Navy conducted a limited free play test event to support an early system follow-on assessment to re-evaluate the LAB array sonar.
- In May 2015, the Navy conducted a limited free play developmental test event observed by DOT&E to evaluate the LAB array in support of an early deployment. In September 2015, DOT&E submitted a classified Early Fielding Report on the first *Virginia* class Block III submarine in response to an early deployment prior to the completion of developmental or operational testing.
- The Navy is planning to conduct a comprehensive operational test of the Block III system in early FY17 covering ASW, ASUW, Strike Warfare, and Intelligence collection mission areas, in addition to suitability and cybersecurity assessments.
- Due to material issues associated with Electric Boat sub-vendor work, all *Virginia* class Block III operational testing previously scheduled for completion in 3QFY16 has been delayed until 2QFY17.

Assessment

- The September 2015 DOT&E classified Early Fielding Report details the impact of the new major components of the system with respect to the intended mission during the early deployment. The report concluded the following:
 - The changes to the *Virginia* class Block III submarine do not appear to improve or degrade the system's ability to conduct submarine missions.

- The LAB array demonstrates the potential to perform as an adequate replacement for the legacy spherical array.
- Although the technical parameters are similar, the system initially presented a series of display artifacts, which could affect performance. The Navy has investigated these artifacts and has issued software fixes to mitigate the effects. This software has not been operationally tested.
- The sonar LWWAA experienced a hardware fault, which limited the effectiveness of the system. The Navy investigated the issue, determined the root cause, and implemented a software update to help mitigate the issue.
- Developmental testing of the system indicates that system software reliability meets the Navy's thresholds. Hardware reliability was not able to be evaluated because of the limited time available to testers for the evaluation. The LAB array outboard signal processing equipment has exhibited some early failures. The Navy issued fleet guidance for monitoring system performance and continues to investigate potential causes.

Recommendations

- Status of Previous Recommendations.
 - The Navy has made progress in addressing 25 of the 44 recommendations contained in the November 2009 and 2012 classified FOT&E reports. However, there are several that remain outstanding. The significant unclassified recommendations are:
 1. Test against a diesel submarine threat surrogate in order to evaluate *Virginia*'s capability, detectability, and survivability against modern diesel-electric submarines.
 2. Conduct an FOT&E to examine *Virginia*'s susceptibility to airborne ASW threats such as Maritime Patrol Aircraft and helicopters.
 - The following recommendations from the FY12 Annual Report remain open and the Navy should work to address them in the upcoming fiscal year:
 1. Coordinate the *Virginia*, A-RCI, and AN/BYG-1 Test and Evaluation Master Plans and utilize Undersea Enterprise Capstone documents to facilitate testing efficiencies.
 2. Complete the verification, validation, and accreditation of the Transient Shock Analysis method used for *Virginia* class Block III items.
 3. Repeat the FOT&E event to determine *Virginia*'s susceptibility to low-frequency active sonar and the submarine's ability to conduct ASUW in a low-frequency active environment. This testing should include a *Los Angeles* class submarine operating in the same

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environment to enable comparison with the *Virginia* class submarine.

- The following recommendations from the FY13 Annual Report remain open and the Navy should work to address them in the upcoming fiscal year:
 1. Reconsider the metrics used to assess the *Virginia* class submarine's ability to covertly conduct mass swimmer lockout operations using the Dry Deck Shelter.
 2. Investigate and implement methods to aid the Special Operation Forces in identifying the submarine during operations in conditions of low visibility.
 3. Investigate modifying the reducer in the air charging system to allow higher air pressure for the Seal Delivery Vehicle (SDV) Auxiliary Life Support System in order to provide

increased flexibility for SDV missions that can be hosted from *Virginia* class submarines.

- 4. Continue to collect data on the susceptibility of the *Virginia* class to low-frequency passive systems and conduct a more quantitative assessment (e.g., determine detection ranges for different ship postures).
- FY15 Recommendations. The Navy should:
 1. Address the three classified recommendations listed in the September 2015 Block III *Virginia* class Early Fielding Report.
 2. Complete operational testing of the Block III *Virginia* class submarine as soon as practical.

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