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 commenced a cybersecurity assessment of the *Virginia* class Block III submarine in September 2016. The Navy intends to complete a comprehensive operational test of the *Virginia* class Block III submarine in FY17 that covers anti-submarine warfare, anti-surface ship warfare, strike warfare, and intelligence collection mission areas.

System
- The *Virginia* class submarine is the Navy's latest fast attack submarine and 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 Block III 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

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, but has since redesigned a subcomponent of the hatch. Electric Boat has requested hatch shock qualification with a noted exception of the modified component and is investigating methods to resolve this exception. The Navy is evaluating, but has not yet approved, the request.
- In September 2015, DOT&E submitted a classified Early Fielding Report on the first *Virginia* class Block III submarine due to submarine deployment prior to the completion of operational testing.
- The Navy continued its analysis, but delayed validation of the Transient Shock Analysis modeling method used for the design of *Virginia* class Block III items until FY17.
- The Navy delayed the update of the *Virginia* class Vulnerability Assessment report that addresses Block III modifications until FY17.
- In September 2016, the Navy commenced a cybersecurity assessment of the *Virginia* class Block III submarine in accordance with a DOT&E-approved test plan. The assessment will complete in FY17.
- The Navy intends to complete a comprehensive operational test of the *Virginia* class Block III submarine in FY17 that covers anti-submarine warfare, anti-surface ship warfare, strike warfare, and covert intelligence collection mission areas.

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 presented a series of display artifacts, which could affect performance. The Navy issued software fixes to mitigate the effects; however, the software remains to be operationally tested.
  - The sonar LWWAA experienced a hardware fault which limited the ability to assess effectiveness of the system.
  - 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.
- The cybersecurity assessment of the *Virginia* class Block III submarine remains ongoing and will be reported in FY17.

Recommendations

- Status of Previous Recommendations. The following are recommendations that remain from FY15. The Navy should:
  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 anti-submarine warfare threats such as Maritime Patrol Aircraft and helicopters.
  3. Coordinate the *Virginia*, Acoustic Rapid Commercial Off-the-Shelf Insertion (A-RCI), and AN/BYG-1 Test and Evaluation Master Plans to facilitate testing efficiencies.
  4. Complete the verification, validation, and accreditation of the Transient Shock Analysis method used for *Virginia* class Block III items.
  5. Repeat the FOT&E event to determine *Virginia's* susceptibility to low-frequency active sonar and the submarine's ability to conduct anti-surface ship warfare in a low-frequency active environment. This testing should include a *Los Angeles* class submarine operating in the same environment to enable comparison with the *Virginia* class submarine.
  6. Investigate and implement methods to aid the Special Operation Forces in identifying the submarine during operations in conditions of low visibility.
  7. Address the three classified recommendations listed in the September 2015 Block III *Virginia* class Early Fielding Report.
- FY16 Recommendations. None.