



The VIRGINIA Class

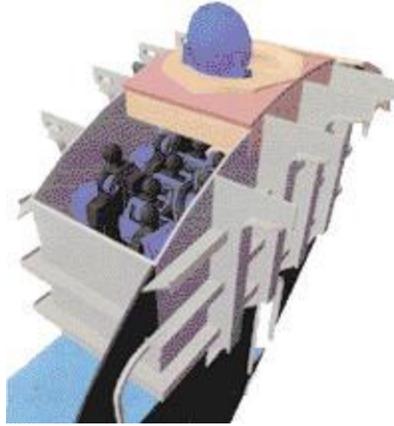
America's Next Submarine

by Barbara Graves and Edward Whitman

The New Attack Submarine – whose lead ship will be the USS Virginia (SSN-774) – charts an exciting new course for the U.S. Navy. The breadth of missions and corresponding concepts of operation envisioned for this new submarine reflect significant changes in U.S. thinking on the nature of undersea warfare. The bulk of the present attack submarine force consists of Los Angeles (SSN-688)-class ships in several variants. The Navy created this class primarily for direct support of carrier battle groups and deep-water anti-submarine warfare against the massive undersea forces fielded by the Soviet Union during the Cold War. Acoustic stealth and high speed were key factors in the 688-class design. At the height of the Cold War, the Soviets began to field SSNs nearly as stealthy acoustically as the 688 class. The U.S. Navy responded in turn with the Seawolf (SSN-21) class. Originally planned for 29 ships, Seawolf emerged as the ultimate open-ocean ASW platform: faster, quieter, more heavily armed, and equipped with better acoustic sensors than any attack submarine in the world. Fundamentally, however, Seawolf's underlying concept was little different from that of the 688s.

The New Attack Submarine: Optimized for the Littorals

In contrast, Virginia breaks new ground. Since the end of the Cold War, the Navy has shifted its focus from preparing for open-ocean conflict to dominating the littorals from the sea to influence events ashore. In response to this fundamental shift, Virginia has been designed specifically to fight in the world's littorals. While maintaining a robust capability for open-ocean ASW, Virginia nonetheless incorporates weapons, sensors, and some special new equipment and features that suit her particularly well for joint operations in shallower coastal regions, including land attack, intelligence gathering, mine reconnaissance and supporting special forces. Additionally, Virginia will be the acoustic equal of Seawolf while adding new non-acoustic stealth features for the survivability it needs to operate in future tactical environments, which will likely include greater threats from mines and non-traditional ASW methods.



Equipped with a unique nine-man lock-in / lock-out chamber.

Although Virginia's maximum speed and total weapons capacity are less than Seawolf's, it will have a wider and more flexible range of military capabilities. The ship will deploy covert, non-provocative electronic and acoustic sensors for continuous monitoring of the regional battlespace, including enemy electronic signals, communication links, and the local tactical situation. Its acoustic sensor suite will include a much-improved high frequency sonar specifically optimized for hunting diesel-electric and advanced air-independent propulsion (AIP) submarines, mines, and shallow-water hazards to navigation. Virginia will support a full range of covert special warfare missions – search and rescue, reconnaissance, sabotage and diversionary attacks, forward observation for fire direction, and direct strikes against enemy objectives. The torpedo room is re-configurable – allowing both the center weapons and their stowage structures to be removed – to accommodate greater numbers of Special Forces “troops.” Equipped with a unique nine-man lock-in/lock-out chamber, Virginia can conduct covert launch and recovery of an entire Special Forces team in a single evolution. There are also mating surfaces compatible with either the Advanced Seal Delivery System (ASDS) – essentially a 55-ton mini-submarine – or the more conventional Dry Deck Shelter.

The weapon load-out is impressive. Virginia will carry 38 full-size weapons, allocated among heavyweight torpedoes, Tomahawk Land-Attack Missiles (TLAMs), and mines. Equipped with twelve Vertical Launching System (VLS) tubes and four 21-inch torpedo tubes, Virginia can launch land-attack salvos of up to 16 missiles. This flexible firepower gives Virginia a powerful capability to engage not only hostile ships and submarines, but also to attack high-value land targets, with both precision and surprise, from well within an adversary's air defense umbrella.

The VLS and torpedo tubes add their own flexibility. The VLS will permit future installation of a navalized version of the 160-mile range Army Tactical Missile System (ATACMS) or similar weapons, when they are eventually acquired. The torpedo tubes will support launch and recovery of Unmanned Underwater Vehicles (UUVs), such as the Long-Term Mine Reconnaissance System (LMRS), currently scheduled to enter service in 2003 (one year prior to Virginia) or the deployment of Unmanned Aerial Vehicles (UAVs), if tube-launched versions are developed.

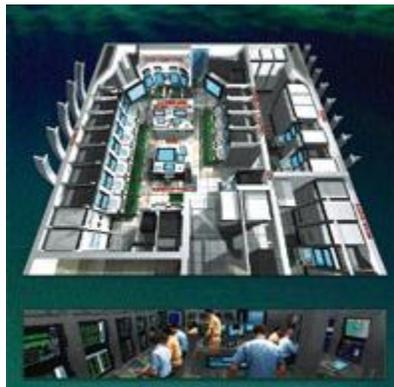
Preparation of the Battlespace – Acoustic Sensors and Processing

The Virginia will carry a mix of both “tried and true” and innovative acoustic sensors. The heart of the sonar suite will comprise a Spherical Active/Passive Array, the Lightweight Wide Aperture Array, and the TB-29(A) Thin-Line Towed Array. The new Lightweight Wide Aperture Array is optimized for locating quiet diesel-electric submarines. Additionally, the high-frequency sonar suite will consist of a sail-mounted array and a new “chin”-mounted array, located right beneath the sphere. With the addition of the chin-array and improved processing and displays, Virginia provides the Submarine Force with its best-ever hull-mounted mine detection and avoidance capability. On the processing side, the Virginia sonar system will use a variant of the Acoustic Rapid COTS Insertion (AN/BQQ-10) system that is being backfit on the 688- and

TRIDENT-class boats (Ed. Note: see pp. 26-27 of the Fall Issue of UNDERSEA WARFARE). Additionally, Virginia gets an innovative acoustic intercept system (WLY-1) that will incorporate six additional sensors and introduce a capability to estimate target range as well as bearing. In conjunction with UUVs and other off-board sensors, such as the Advanced Deployable System, the Virginia's sonar suite provides a powerful capability for Joint Task Force and Carrier Battle Group Commanders to prepare and monitor the undersea battlespace before committing follow-on forces.

A Submarine Without a Periscope!

The most radical change in the Virginia sensor suite appears in the ship's control room. The electromagnetic and electro-optics suite will include two non-hull-penetrating Photonics Masts, without a conventional periscope. This is a major break with tradition for the Submarine Force. The Officer of the Deck will no longer stand and "hang-on" the periscope, looking through a maze of mirrors, prisms, and lenses. Instead, the Photonics Mast contains several high-resolution, color cameras that send visual images to large screen displays in the ship's control room. Equipped with enhanced infrared and low-level light image enhancement features, the mast also includes an infrared laser range finder, making the art of calling periscope ranges much less challenging! Furthermore, the mast will embody an improved integrated Electronic Support Measures (ESM) array and associated signal processing for unparalleled situational awareness – all gained covertly from under the sea.

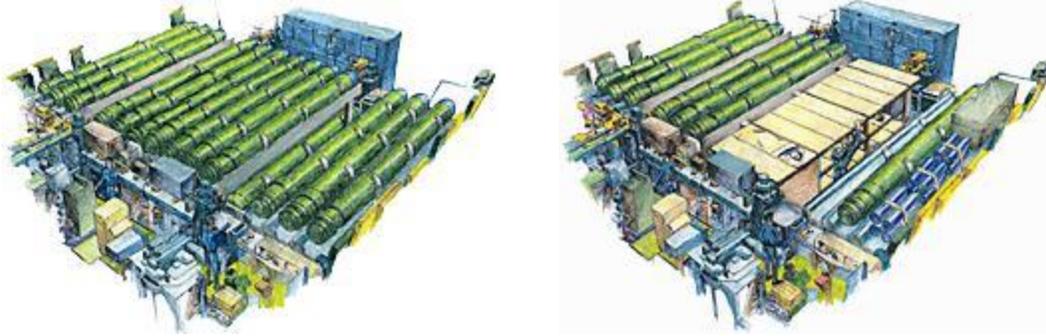


Multi-function large screen displays and a wide open layout will enable improved information flow and better decision making.

Harnessing the Revolution in Information Technology – The Combat Network

To support an unprecedented array of joint littoral warfare missions, Virginia will deploy with capabilities for Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) unknown in earlier attack submarines. Like our 688s and Seawolves with modernized capabilities, the Virginia class will be a key "node" within the emerging concept of Network-Centric Warfare and will be equipped with state-of-the-art combat systems fully linked to external targeting and intelligence grids. Virginia will maximize commonality with the Surface Navy and other joint forces by fielding the latest capabilities for building Common Tactical and Operating Pictures and supporting the coordination and launch of TLAMs. Off-board sensor information will be fused directly with own-ship data to yield a comprehensive and accurate view of the tactical situation shared mutually among U.S. and coalition forces.

Within the hull, a wideband Local Area Network built to commercial industry standards will completely link all of Virginia's combat control and communications systems. Modular, open system architecture and the use of standardized shock-isolated equipment enclosures to accommodate both COTS and government-furnished hardware are key enablers of this approach. Consequently, the cost of custom "MilSpec" developments can be avoided, and the open system approach will allow more advanced microcomputers, signal processors, and software algorithms to be incorporated as requirements change or more capability becomes available in the commercial marketplace.



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Reduced Watchstation Manning

Virginia's new capabilities have not required any additional crew. In fact, a thorough re-engineering of the ship's functionality, manpower requirements, and billet structure has enabled the reduction of 15 crew watchstanders in comparison to Seawolf. The key to this greater efficiency has been technology insertion, particularly for automating tasks and handling information, and Virginia's modular design will facilitate even further reductions as new technologies become available. Typical efficiencies are found in the following areas:

- **Ship Control Station:** Virginia's digital "fly-by-wire" advanced ship control station will be operated by a Pilot, Copilot, and a Relief Pilot. These three watchstanders replace the customary Diving Officer, Chief of the Watch, Helmsman, Planesman, and Messenger needed on previous submarine classes.
- **Navigation - Quartermaster Watch- station:** The increased use of automation, such as electronic charting, allows combining the duties of the Navigation Electronics Technician and the Quartermaster of the Watch into those of a single Navigation Watchstander.
- **Throttleman – Reactor Operator Watchstation:** Increased use of technology and automation allows the Reactor Operator also to perform the duties of the Throttleman while carrying out his current responsibilities.
- **Auxiliaryman Aft Watchstation:** The relative simplicity and innovative automation of Virginia's engineroom will allow engineroom personnel to monitor installed auxiliary equipment, thus eliminating the Auxiliaryman Aft watchstation.
- **Torpedo Room Watch:** Automated systems and tours by other watchstanders allow the elimination of the Torpedo Room watchstander.

A New Building Approach: Construction Teaming

The design and construction techniques adopted for Virginia are innovative in their own right. Of these, modularity is perhaps the most important. The teaming arrangement between General Dynamics' Electric Boat Corporation and Newport News Shipbuilding for building this new class allocates major sections of the ship to one yard or the other, so modularity by hull section is inherent from the outset. In addition, large, internal sub-assemblies are fabricated and tested separately before they are "packed" into the hull as Modular Isolated Deck Sections (MIDS). The design process itself incorporates both concurrent engineering design/build teams and an extensive infrastructure for computer-aided design, engineering, and manufacturing (CAD/CAE/CAM). Each design/build team is responsible for a specific aspect of the ship's structure or mission capability and includes Navy managers, fleet operators, technical personnel, key vendors and suppliers, and the shipyard's designers and waterfront construction supervisors.



Virginia is the first American warship designed solely by computer. The design itself is embodied in three-dimensional electronic drawings of individual components, systems, and major deck assemblies, totally replacing the paper drawings and wooden mock-ups of the past. These electronic representations can also be manipulated to simulate virtual reality “walk-throughs” and “what if?” engineering options, for validating design and engineering decisions before any metal is bent. Further, when actual construction begins, the computer-based design elements will be linked directly to the machinery that cuts steel, bends pipe, machines components, and maintains an integrated inventory control system.

The Virginia class incorporates many recent advances in submarine-related hydrodynamics, underwater explosion survivability, propulsion machinery, metallurgy, and reduction of non-acoustic signatures. These include:

- A propulsion plant with fewer pumps and valves that produces less noise
- The use of tougher structural steel for a thinner hull than that of the Los Angeles class
- A more advanced electromagnetic silencing system to reduce the ship’s magnetic signature, for reduced vulnerability to magnetic mines in littoral regions
- A platform-wide fiber optic cable system for easy “plug-in/plug-out” equipment integration, with provision for future growth
- An ultra-quiet, high-power-density main propulsion unit and weapons launch and handling system components, which will be smaller, fewer, and less expensive than those on Seawolf, while equally capable
- A “life of the ship” reactor core. The ship’s reactor plant design has been simplified and requires fewer components. It sustains Seawolf-level quieting in a 25 percent smaller volume. New concept steam generators and a solid-state electric power distribution system will both improve performance and cut costs.

The Virginia Class – Building for Tomorrow’s Attack Submarine Force

Advance procurement for the lead ship was funded in FY 1996, and construction began in 1998. The first-of-class Virginia will enter the Fleet in 2004, and a total of four NSSNs have been approved through FY 2002. Series production of an average of two NSSNs per year beginning in FY 2005 is the only way to preserve the minimum-essential 50-SSN force level confirmed by the Quadrennial Defense Review – as well as this unique aspect of the U.S. defense industrial base. Since reducing acquisition and life-cycle costs has been a major objective in the design and engineering process, the ship is affordable in sufficient numbers to satisfy America’s future force level requirements.

The Virginia class is thus well underway to becoming the core of the attack submarine force of the future – a force as much at home in the littorals of the world as her predecessors were in the deep oceans – and one which will ensure continued U.S. undersea warfare superiority.

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