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Navy Columbia (SSBN-826) Class Ballistic Missile Submarine Program: Background and Issues for Congress

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Summary

The Navy's Columbia (SSBN-826) class ballistic missile submarine (SSBN) aims to design and build a class of 12 new SSBNs to replace the Navy's current force of 14 aging Ohio-class SSBNs. Since 2013, the Navy has consistently identified the Columbia-class program as the Navy's top priority program. The Navy procured the first Columbia-class boat in FY2021 and the second in FY2024. The Navy wants to procure the third boat in FY2026.

The first and second Columbia-class boats were funded with incremental funding, a funding approach in which the procurement cost of each boat is divided into multiple annual increments, with the first increment occurring in the year in which the boat was procured. The first Columbia-class boat was funded with three-year incremental funding in FY2021-FY2023, and the second boat was funded with two-year incremental funding (also called split funding) in FY2024-FY2025. The Navy wants to use three-year incremental funding for procuring the third and subsequent boats in the program.

The procurement dates of the first, second and third Columbia-class boats were spaced years apart from one another to provide time for fixing any design issues that might be discovered in building the first boat before construction proceeds on subsequent boats, and to help ease the submarine construction industrial base into the situation of building Columbia-class submarines while continuing to build Virginia-class attack submarines. During the period FY2021-FY2025, the Columbia-class procurement rate was 0.4 boats per year (i.e., the first two boats were procured during that five-year period).

Starting with the third boat in FY2026, the Navy wants to shift Columbia-class procurement to a higher rate of one boat per year, so that the final 10 ships in the program (i.e., boats 3 through 12) would be procured over the 10-year period FY2026-FY2035. To reduce Columbia-class procurement costs and mitigate risks from shifting Columbia-class procurement to the higher rate of one boat per year, the Navy wants to use a block buy contract to procure the five Columbia-class boats that are scheduled to be procured in FY2026-FY2030 (i.e., boats 3 through 7).

The Navy's FY2026 budget submission requests

- the procurement of the third boat in the class;
- authority to use three-year incremental funding for procuring each of the remaining 10 boats in the program (i.e., boats 3 through 12); and
- authority for using a block buy contract to procure the five Columbia-class boats that are scheduled to be procured in FY2026-FY2030 (i.e., boats 3 through 7).

Issues for Congress for the Columbia-class program include

- the impact of an estimated 17-month delay in the delivery of the first Columbia-class boat on the Navy's plans for replacing Ohio-class SSBNs on a timely basis, and
- the potential impact of the Columbia-class construction workload on the ability of the submarine construction industrial base to build Virginia-class submarines in desired numbers in coming years.

Decisions that Congress makes on these issues could substantially affect U.S. military capabilities and funding requirements, and the U.S. shipbuilding industrial base.

Contents

Figures

Tables

Appendixes

Contacts

Introduction

This report provides background information and potential oversight issues for Congress on the Navy's Columbia (SSBN-826) class program, which aims to design and build a class of 12 new ballistic missile submarines (SSBNs) to replace the Navy's current force of 14 aging Ohio-class SSBNs. Since 2013, the Navy has consistently identified the Columbia-class program as the Navy's top priority program. The Navy procured the first Columbia-class boat in FY2021 and the second in FY2024. Navy plans call for procuring the remaining 10 boats in the class at a rate of one boat per year in FY2026-FY2035.

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Decisions that Congress makes on these issues could substantially affect U.S. military capabilities and funding requirements, and the U.S. shipbuilding industrial base.

This report focuses on the Columbia-class program as a Navy shipbuilding program. Another CRS product—CRS In Focus IF10519, *Defense Primer: Strategic Nuclear Forces*, by Anya L. Fink—discusses the Columbia class as an element of future U.S. strategic nuclear forces in the context of strategic nuclear arms modernization efforts.[1] Another CRS report—CRS Report RL32418, *Navy Virginia-Class Submarine Program and AUKUS Submarine (Pillar 1) Project: Background and Issues for Congress*, by Ronald O'Rourke—discusses the Navy's Virginia-class attack submarine program.

Background

U.S. Navy SSBNs in General

Mission of SSBNs

The U.S. Navy operates three kinds of submarines—nuclear-powered attack submarines (SSNs), nuclear-powered cruise missile submarines (SSGNs), and nuclear-powered ballistic missile

[1] For additional discussion, see CRS Report RL33640, *U.S. Strategic Nuclear Forces: Background, Developments, and Issues*, by Amy F. Woolf.

submarines (SSBNs).[2] The SSNs and SSGNs are multi-mission ships that perform a variety of peacetime and wartime missions.[3] Since the early 1990s, they have not carried nuclear weapons, but the United States has reserved a right to rearm SSNs with nuclear-armed cruise missiles at some point in the future should conditions warrant, and the Navy is currently developing a new nuclear weapon called the nuclear-armed sea-launched cruise missile (SLCM-N) that could be placed on Navy SSNs at some point in the future.[4]

In contrast to the multi-mission SSNs and SSGNs, the SSBNs perform a single mission of strategic nuclear deterrence. To perform this mission, SSBNs are armed with submarine-launched ballistic missiles (SLBMs), which are large, long-range missiles that can be armed with multiple nuclear warheads. SSBNs launch their SLBMs from large-diameter vertical launch tubes located in the middle section of the boat.[5] The SSBNs' basic mission is to remain hidden at sea with their SLBMs, so as to deter a nuclear attack on the United States by another country by demonstrating to other countries that the United States has an assured second-strike capability, meaning a survivable system for carrying out a retaliatory nuclear attack.

Navy SSBNs, which are sometimes referred to informally as "boomers,"[6] form one of three legs of the U.S. strategic nuclear deterrent force, or "triad," which also includes land-based intercontinental ballistic missiles (ICBMs) and land-based long-range bombers. At any given moment, some of the Navy's SSBNs are conducting nuclear deterrent patrols. The Department of Defense's (DOD's) report on the 2018 Nuclear Posture Review (NPR), released on February 2, 2018, states the following:

> Ballistic missile submarines are the most survivable leg of the triad. When on patrol, SSBNs are, at present, virtually undetectable, and there are no known, near-term credible threats to the survivability of the SSBN force. Nevertheless, we will continue to hedge against the possibility that advances in anti-submarine warfare could make the SSBN force less survivable in the future.[7]

[2] In the designations SSN, SSGN, and SSBN, the SS stands for submarine, N stands for nuclear-powered (meaning the ship is powered by a nuclear reactor), G stands for guided missile (such as a cruise missile), B stands for ballistic missile. As shown by the "Ns" in SSN, SSGN, and SSBN, all U.S. Navy submarines are nuclear-powered. Other navies operate nonnuclear powered submarines, which are powered by energy sources such as diesel engines. A submarine's use of nuclear or nonnuclear power as its energy source is not an indication of whether it is armed with nuclear weapons—a nuclear-powered submarine can lack nuclear weapons, and a nonnuclear-powered submarine can be armed with nuclear weapons.

[3] For more on the Navy's SSNs and SSGNs, see CRS Report RL32418, *Navy Virginia-Class Submarine Program and AUKUS Submarine (Pillar 1) Project: Background and Issues for Congress*, by Ronald O'Rourke; and CRS Report RS21007, *Navy Trident Submarine Conversion (SSGN) Program: Background and Issues for Congress*, by Ronald O'Rourke.

[4] The Navy's nonstrategic nuclear weapons—meaning all of the service's nuclear weapons other than submarine-launched ballistic missiles (SLBMs)—were removed from Navy surface ships and submarines under a unilateral U.S. nuclear initiative announced by President George H. W. Bush in September 1991. The initiative reserved a right to rearm SSNs with nuclear-armed cruise missiles at some point in the future should conditions warrant. The Navy is currently developing a new nonstrategic nuclear weapon—the nuclear-armed sea-launched cruise missile (SLCM-N). For more on the SLCM-N program, see CRS In Focus IF12084, *Nuclear-Armed Sea-Launched Cruise Missile (SLCM-N)*, by Anya L. Fink.

[5] SSBNs, like other Navy submarines, are also equipped with horizontal torpedo tubes in the bow for firing torpedoes or other torpedo-sized weapons.

[6] This informal name is a reference to the large boom that would be made by the detonation of an SLBM nuclear warhead.

[7] Department of Defense, *Nuclear Posture Review 2018*, released February 2, 2018, pp. 44-45.

Current Ohio-Class SSBNs

The Navy currently operates 14 Ohio (SSBN-726) class SSBNs (see **Figure 1**). The boats are commonly called Trident SSBNs or simply Tridents because they carry Trident D-5 SLBMs. They were procured in FY1977-FY1991 and entered service in 1984-1997. They were designed and built by General Dynamics' Electric Boat Division (GD/EB) of Groton, CT, and Quonset Point, RI. They were originally designed for 30-year service lives but were later certified for 42-year service lives, consisting of two approximately 19-year periods of operation separated by an approximately four-year midlife nuclear refueling overhaul, called an engineered refueling overhaul (ERO). The nuclear refueling overhaul includes a nuclear refueling and additional overhaul work that is not related to the nuclear refueling.[8]

Figure 1. Ohio (SSBN-726) Class SSBN

With the hatches to some of its SLBM launch tubes open

Source: Cropped version of U.S. Navy photograph.

The Ohio-class boats were originally designed to each carry 24 SLBMs. As part of the U.S. plan for complying with U.S.-Russia strategic nuclear arms control limits, four SLBM launch tubes on each boat were deactivated, reducing to 20 the number of SLBMs they can each carry. Section 20008(a)(8) of the FY2025 reconciliation act (aka One Big Beautiful Bill Act, or OBBBA) (H.R. 1/P.L. 119-21 of July 4, 2025) provides $62.0 million in FY2025 funding "to convert Ohio-class submarine tubes to accept additional missiles, not to be obligated before March 1, 2026."

Eight of the 14 Ohio-class SSBNs are homeported at Bangor, WA, in Puget Sound; the other six are homeported at Kings Bay, GA, close to the Florida border. Unlike most Navy ships, which are operated by single crews, Navy SSBNs are operated by alternating crews (called the Blue and Gold crews) so as to maximize the percentage of time that they spend at sea in deployed status.

[8] A total of 18 Ohio-class SSBNs were procured in FY1974-FY1991. The ships entered service in 1981-1997. The first 8 boats in the class were originally armed with Trident I C-4 SLBMs; the final 10 were armed with larger and more-capable Trident II D-5 SLBMs. The Clinton Administration's 1994 Nuclear Posture Review (NPR) recommended a strategic nuclear force for the START II strategic nuclear arms reduction treaty that included 14 Ohio-class SSBNs, all armed with D-5s. This recommendation prompted interest in the idea of converting the first four Ohio-class boats (SSBNs 726-729) into SSGNs, so as to make good use of the 20 years of potential operational life remaining in these four boats, and to bolster the U.S. SSN fleet. The first 4 Ohio-class boats were converted into SSGNs in 2002-2008, and the next 4 (SSBNs 730-733) were backfitted with D-5 SLBMs in 2000-2005, producing the current force of 14 Ohio-class SSBNs, all of which are armed with D-5 SLBMs. For more on the SSGN conversion program, see CRS Report RS21007, *Navy Trident Submarine Conversion (SSGN) Program: Background and Issues for Congress*, by Ronald O'Rourke.

The first of the 14 Ohio-class SSBNs (SSBN-730) will reach the end of its 42-year service life in 2027. The remaining 13 will reach the ends of their service lives at a rate of roughly one ship per year thereafter, with the 14th reaching the end of its service life in 2040.

The Navy has initiated a program to refurbish and extend the service lives of D-5 SLBMs to about 2040. As Columbia-class SSBNs begin to replace Ohio-class boats, refurbished D-5s carried by retiring Ohio-class boats will be transferred to new Columbia-class boats. Columbia-class boats will continue to be armed with these refurbished D-5s until about 2040, at which time the D-5s are to be replaced by a successor SLBM.

Including the Ohio class, the Navy has operated four classes of SSBNs since 1959. For a table summarizing these four classes, see **Appendix A**.

U.S.-UK Cooperation on SLBMs and the New UK SSBN

As one expression of U.S.-UK cooperation on nuclear weapon matters that dates back to World War II, the UK's four Vanguard-class SSBNs, which entered service in 1993-1999, each carry 16 Trident II D-5 SLBMs, and previous classes of UK SSBNs similarly carried earlier-generation U.S. SLBMs.[9] The UK plans to replace the four Vanguard-class boats with three or four Dreadnought-class next-generation SSBNs. Dreadnought-class boats are to be equipped with 12 SLBM missile launch tubes, but current UK plans call for each boat to carry eight D-5 SLBMs, with the other four tubes not being used for SLBMs. The United States is providing technical assistance to the United Kingdom for the Dreadnought-class program, as it has over the years for some other UK submarine programs; for additional discussion, see **Appendix B**.

Submarine Construction Industrial Base

U.S. Navy submarines are built at two shipyards—General Dynamics' Electric Boat Division (GD/EB) of Groton, CT, and Quonset Point, RI, and Huntington Ingalls Industries' Newport News Shipbuilding (HII/NNS), of Newport News, VA. GD/EB and HII/NNS are the only two shipyards in the country capable of building nuclear-powered ships, and the only two capable of performing final assembly of submarines. GD/EB builds submarines only, while HII/NNS also builds nuclear-powered aircraft carriers and is capable of building other types of surface ships. The two yards currently are jointly building Virginia-class attack submarines.[10]

In addition to GD/EB and HII/NNS, the submarine construction industrial base includes 20 or more strategic outsources (facilities for building submarine structures), hundreds of material and component supplier firms, and laboratories and research facilities. These additional elements of the submarine construction industrial base are located in numerous U.S. states. About 70% of the critical suppliers for the construction of submarines are sole-source suppliers.[11] For nuclear-propulsion component suppliers, an additional source of stabilizing work is the Navy's nuclear-powered aircraft carrier construction program.[12]

[9] Although the SLBMs on UK SSBNs are U.S.-made, the nuclear warheads on the missiles are of UK design and manufacture.

[10] For more on the arrangement for jointly building Virginia-class boats, see CRS Report RL32418, *Navy Virginia-Class Submarine Program and AUKUS Submarine (Pillar 1) Project: Background and Issues for Congress*, by Ronald O'Rourke.

[11] Source for figure of about 70%: Email to CRS and CBO from navy Office of Legislative Affairs, July 31, 2024.

[12] For more on this program, see CRS Report RS20643, *Navy Ford (CVN-78) Class Aircraft Carrier Program: Background and Issues for Congress*, by Ronald O'Rourke. In terms of work provided to nuclear-propulsion component suppliers, a carrier nuclear propulsion plant is roughly equivalent to five submarine propulsion plants.

Much of the design and engineering portion of the submarine construction industrial base is resident at GD/EB. Additional portions are resident at HII/NNS and some of the component makers.

Columbia-Class Program

Navy's Top Priority Program

Navy officials have stated consistently since September 2013 that the Columbia-class program is the Navy's top priority program, and that this means, among other things, that from the Navy's perspective, the Columbia-class program *will* be funded, even if that comes at the expense of funding for other Navy programs, and that in a situation of industrial base constraints, the Columbia-class program will have first call on resources to minimize the chances of schedule delays in building the boats.[13] The status of the Columbia-class program as the Navy's top priority program reflects the importance of the SSBNs' strategic nuclear deterrence mission.

Program Name, Origin, and Milestones

Until 2016, the Columbia-class program was known as the Ohio replacement program (ORP) or SSBN(X) program,[14] and boats in the class were referred to as Ohio replacement boats or SSBNXs.

As discussed in the CRS report on Navy ship names, on December 14, 2016, the Navy announced that SSBN-826, the first boat (aka lead boat) in the class, would be named *Columbia*, in honor of the District of Columbia. Consequently, since December 2016, the 12 or more planned boats have been referred to as Columbia (SSBN-826) class boats. On June 3, 2022, the Navy announced that it was modifying SSBN-826's name from *Columbia* to *District of Columbia*, so as to avoid an overlap in names with USS *Columbia* (SSN-771), a Los Angeles (SSN-688) class attack submarine that was named for Columbia, SC; Columbia, IL; and Columbia, MO. The Navy states that notwithstanding the modification to SSBN-826's name, the 12 or more planned new SSBNs will continue to be referred to as Columbia (SSBN-826) class boats.[15]

For information on the Columbia-class program's origin and milestones, see **Appendix C**.

[13] On September 18, 2013, Admiral Jonathan Greenert, then-Chief of Naval Operations, testified that the Columbia-class program "is the top priority program for the Navy." (Statement of Admiral Jonathan Greenert, U.S. Navy, Chief of Naval Operations, Before the House Armed Services Committee on Planning for Sequestration in FY2014 and Perspectives of the Military Services on the Strategic Choices and Management Review, September 18, 2013, p. 10.) Navy officials since then have reiterated this statement on numerous occasions. At a September 12, 2013, hearing before the Seapower and Projection Forces subcommittee of the House Armed Services Committee on undersea warfare, a Navy official stated the following:

> The CNO has stated, his number one priority as the chief of Naval operations, is our—our strategic deterrent—our nuclear strategic deterrent. That will trump all other vitally important requirements within our Navy, but if there's only one thing that we do with our ship building account, we—we are committed to sustaining a two ocean national strategic deterrent that protects our homeland from nuclear attack, from other major war aggression and also access and extended deterrent for our allies.
>
> (Transcript of hearing. (Spoken remarks of Rear Admiral Richard Breckenridge. The other witness at the hearing was Rear Admiral David Johnson.)

[14] In the designation SSBN(X), the (X) meant that the design of the boat had not yet been determined.

[15] See CRS Report RS22478, *Navy Ship Names: Background for Congress*, by Ronald O'Rourke.

Design and Production

Design

The Columbia-class design (see **Figure 2** and **Figure 3**) includes 16 SLBM tubes, as opposed to 24 SLBM tubes (of which 20 are currently used for SLBMs) on Ohio-class SSBNs. Although the Columbia-class design has fewer SLBM tubes than the Ohio-class design, it is larger than the Ohio-class design in terms of submerged displacement. The Columbia-class design, like the Ohio-class design before it, will be the largest submarine ever built by the United States.

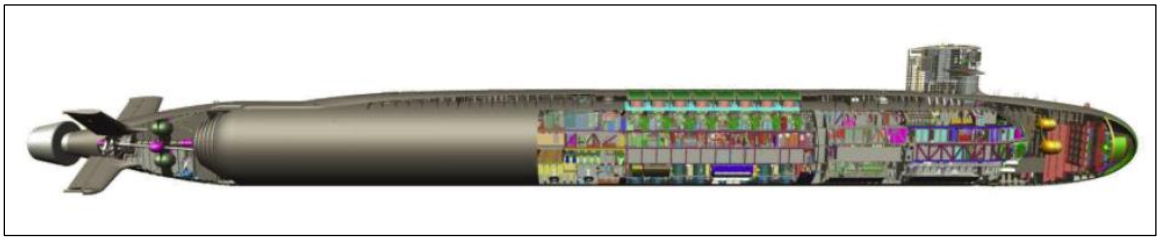
Figure 2. Columbia (SSBN-826) Class SSBN

Artist's rendering

Source: Cropped version of illustration accompanying David B. Larter, "US Navy Inks $9.4B Contract for two Columbia-class Nuclear Missile Submarines," Defense News, November 5, 2020. A caption to the image credits it to the U.S. Navy.

Figure 3. Columbia (SSBN-826) Class SSBN

Notional cutaway illustration



Source: Detail of slide 2, entitled "OHIO Replacement Program System Description," in Navy briefing on Columbia-class program presented by Captain William J. Brougham, Program Manager of PMS 397 (i.e., Project Manager Shipbuilding, Office Code 397, the office for the Columbia-class program), at the Sea, Air, and Space Symposium, April 8, 2014, posted at InsideDefense.com (subscription required), April 9, 2014.

Current U.S. and UK plans call for the Columbia-class and the UK's Dreadnought-class SSBN to use a missile compartment—the middle section of the boat with the SLBM launch tubes—of the

same general design called the Common Missile Compartment (CMC).[16] As Dreadnought-class boats are to be equipped with 12 SLBM missile launch tubes, but current UK plans call for each boat to carry eight D-5 SLBMs, with the other four tubes not being used for SLBMs. The modular design of the CMC will accommodate the difference in the number of SLBM missile launch tubes between the Columbia-class design and the Dreadnaught-class design. The UK provided some of the funding for the design of the CMC, including a large portion of the initial funding.[17]

For additional background information on the Columbia-class design, see **Appendix D**.

Production: Integrated Enterprise Plan (IEP)

The Navy, under a plan it calls the Integrated Enterprise Plan (IEP), plans to build Columbia-class boats jointly at GD/EB and HII/NNS, with most of the work going to GD/EB. (The IEP was previously called the Submarine Unified Build Strategy, or SUBS.) As part of this plan, the Navy is adjusting the division of work on the Virginia-class attack submarine program (in which boats are jointly built at GD/EB and HII/NNS),[18] so that HII/NNS will receive a larger share of the final-assembly work for that program than it has received in the past.[19]

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[16] Statement of Rear Admiral Stephen Johnson, USN, Director, Strategic Systems Programs, Before the Subcommittee on Strategic Forces of the Senate Armed Services Committee [on] FY2011 Strategic Systems, March 17, 2010, p. 6, which states the following: "The OHIO Replacement programs includes the development of a common missile compartment that will support both the OHIO Class Replacement and the successor to the UK Vanguard Class."

[17] See Government Accountability Office, *Defense Acquisitions[:] Assessments of Selected Weapon Programs*, GAO-10-388SP, March 2010, p. 152; Government Accountability Office, *Defense Acquisitions[:] Assessments of Selected Weapon Programs*, GAO-11-233SP, March 2011, p. 147; Sam LaGrone and Richard Scott, "Deterrent Decisions: US and UK Wait on Next Steps for SSBN Replacements," *Jane's Navy International*, May 2010, pp. 10-11.

[18] For more on the arrangement for jointly building Virginia-class boats, see CRS Report RL32418, *Navy Virginia-Class Submarine Program and AUKUS Submarine Proposal: Background and Issues for Congress*, by Ronald O'Rourke.

[19] Key elements of the Navy's IEP plan include the following:

- GD/EB is to be the prime contractor for designing and building Columbia-class boats;
- HII/NNS is to be a subcontractor for designing and building Columbia-class boats;
- GD/EB is to build certain parts of each Columbia-class boat—parts that are more or less analogous to the parts that GD/EB builds for each Virginia-class attack submarine;
- HII/NNS is to build certain other parts of each Columbia-class boat—parts that are more or less analogous to the parts that HII/NNS builds for each Virginia-class attack submarine;
- GD/EB is to perform the final assembly on all 12 Columbia-class boats;
- as a result of the three previous points, the Navy estimates that GD/EB would receive an estimated 77%-78% of the shipyard work building Columbia-class boats, and HII/NNS would receive 22%-23%;
- GD/EB is to continue as prime contractor for the Virginia-class program, but to help balance out projected submarine-construction workloads at GD/EB and HII/NNS, the division of work between the two yards for building Virginia-class boats is to be adjusted so that HII/NNS would perform the final assembly on a greater number of Virginia-class boats than it would have under a continuation of the current Virginia-class division of work (in which final assemblies are divided more or less evenly between the two shipyards); as a consequence, HII/NNS would receive a greater share of the total work in building Virginia-class boats than it would have under a continuation of the current division of work.

See Julia Bergman, "Congressmen Visit EB A Day After It Is Named Prime Contractor for Ohio Replacement Program," *The Day (New London)*, March 29, 2016; Sydney J. Freedberg Jr., "Ohio Replacement Plan Is Good News For Electric Boat," *Breaking Defense*, March 29, 2016; Robert McCabe, "Newport News Shipbuilding's Share of Virginia-Class Submarine Deliveries to Grow," *Virginian-Pilot (Newport News)*, March 29, 2016; Valerie Insinna, "GD Electric Boat Chosen To Take Lead Role for Ohio Replacement Sub," *Defense Daily*, March 30, 2016: 1-3; Hugh Lessig, "Navy: More Submarine Work Coming to Newport News Shipyard," *Military.com*, March 30, 2016; Lee (continued...)

Procurement Quantity

Planned Quantity of 12

Current Navy plans call for procuring 12 Columbia-class boats to replace the current force of 14 Ohio-class SSBNs. In explaining the planned procurement quantity of 12 boats, the Navy states the following:

- Ten operational SSBNs—meaning boats not encumbered by lengthy maintenance actions such as a midlife overhaul—are needed to meet strategic nuclear deterrence requirements for having a certain number of SSBNs at sea at any given moment.
- Fourteen Ohio-class boats were needed to meet the requirement for 10 operational boats because, during the middle years of the Ohio class life cycle, three and sometimes four of the boats were nonoperational at any given moment on account of being in the midst of lengthy midlife nuclear refueling overhauls or other extended maintenance actions.
- Twelve (rather than 14) Columbia-class boats will be needed to meet the requirement for 10 operational boats because the midlife overhauls of Columbia-class boats, which will not include a nuclear refueling, will require less time (about two years) than the midlife refueling overhauls of Ohio-class boats (which require about four years from contract award to delivery), the result being that only two Columbia-class boats (rather than three or sometimes four) will be in the midst of midlife overhauls or other extended maintenance actions at any given moment during the middle years of the Columbia-class life cycle.[20]

Potential for Increase to Something More than 12

The Trump Administration's Nuclear Posture Review (NPR), released in February 2018, states the following: "The COLUMBIA-class program will deliver a minimum of 12 SSBNs to replace the current OHIO fleet and is designed to provide required capabilities for decades."[21] The use of the word "minimum" in that sentence can be viewed as signaling a possibility that the required number of Columbia-class boats might at some point be increased to something more than 12 boats.[22] An October 2023 report by a congressional commission on U.S. strategic posture

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Hudson, "Work on Ohio-Class Replacement Will Be 80-20 Split Between GDEB, HII-NNS," *Inside the Navy*, April 4, 2016. See also Richard R. Burgess, "Submarine Admirals: 'Unified Build Strategy' Seeks Affordability for Future Sub Fleet," *Seapower*, July 8, 2016. See also Statement of the Honorable Sean J. Stackley, Assistant Secretary of the Navy (Research, Development and Acquisition), and Vice Admiral Joseph P. Mulloy, Deputy Chief of Naval Operations for Integration of Capabilities and Resources, and Lieutenant General Robert S. Walsh, Deputy Commandant, Combat Development and Integration & Commanding General, Marine Corps Combat Development Command, before the Subcommittee on Seapower and Projection Forces of the House Armed Services Committee on Department of the Navy Seapower and Projection Forces Capabilities, February 25, 2016, p. 12.

[20] For additional discussion, see "Navy Responds to Debate Over the Size of the SSBN Force," Navy Live, May 16, 2013, accessed July 26, 2013, at http://navylive.dodlive.mil/2013/05/16/navy-responds-to-debate-over-the-size-of-the-ssbn-force/, and Richard Breckenridge, "SSBN Force Level Requirements: It's Simply a Matter of Geography," Navy Live, July 19, 2013, accessed July 26, 2013, at http://navylive.dodlive.mil/2013/07/19/ssbn-force-level-requirements-its-simply-a-matter-of-geography/.

[21] Department of Defense, *Nuclear Posture Review 2018*, released February 2, 2018, p. 49. A similar statement (which differs only in saying "COLUMBIA program" rather than "COLUMBIA-class program") appears on p. x.

[22] See, for example, Marc Selinger, "Navy Might Someday Consider Buying More Than 12 Columbia-Class

(continued...)

recommended increasing the total planned number of Columbia-class boats to something more than 12.[23]

Procurement Schedule, Lead Boat Schedule, Lead Boat Delivery Delay

Procurement Schedule

As noted earlier, the Navy procured the first Columbia-class boat in FY2021 and the second Columbia-class boat in FY2024. The Navy wants to procure the remaining 10 boats in the program—boats 3 through 12—at a rate of one per year in FY2026-FY2035. After being delivered to the Navy, the lead boat is to undergo substantial testing prior to serving on its first deterrent patrol.

Taking into account both projected delivery dates for Columbia-class boats and projected retirement dates for Ohio-class boats, the Navy's FY2025 30-year (FY2025-FY2054) shipbuilding plan projects that the SSBN force will include 14 boats in FY2025-FY2026, 13 boats in FY2027-FY2029, and 12 boats for the remainder of the 30-year period (except for FY2040-FY2041, when it is projected to include 13 boats). (The Navy did not submit an FY2026 30-year shipbuilding plan.) The Navy is planning to extend the service lives of up to five Ohio-class SSBNs to hedge against potential delays in the deliveries of Columbia-class boats.[24]

Lead Boat Schedule

The schedule for designing and building the lead Columbia-class boat and having it ready for an intended scheduled first deterrent patrol in late 2030 or 2031 includes little margin for absorbing design or construction delays. The tightness in the lead boat's design and construction schedule has been a principal feature of the program (along with the program's high priority) for several years. Much of the management time and attention that the Navy devotes to the program is

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Submarines," *Defense Daily*, April 12, 2018: 2-3; Jason Sherman, "Navy Keeping Options Open to 'Tack On' Additional Submarines to 12-Boat Columbia Buy," *Inside Defense*, November 18, 2020. See also Richard R. Burgess, "Navy SSBN PEO: Data Clearly Supports Building More than 12 Columbia Subs," *Seapower*, June 9, 2022.

[23] Madelyn R. Creedon, chair, et al., *America's Strategic Posture, The Final Report of the Congressional Commission on the Strategic Posture of the United States*, October 2023, pp. 48, 99.

[24] Source: Navy information paper on the FY2022 Fiscal Planning Framework and submarine service life extensions, February 5, 2021, provided by Navy Office of Legislative Affairs to Congressional Budget Office (CBO) and CRS on February 5, 2021. See also Rich Abott, "Navy Confirms Extending Five SSBNs Starting In 2029," *Defense Daily*, November 8, 2023; Sam LaGrone and Mallory Shelbourne, "Navy Mulling Large Diameter Sub Hulls After 12 Columbias, SSN(X) Requirements Due Next Year," *USNI News*, November 8 (updated November 9), 2023; Nick Wilson, "Navy Planning Ohio Service Life Extension to Mitigate Risk as Columbia Construction Continues," *Inside Defense*, November 8, 2023; Justin Katz, "Navy Planning to Execute 3-Year Ohio-Class Sub Life Extensions," *Breaking Defense*, November 7, 2023; Megan Eckstein, "US Navy May Accelerate Investments to Extend Some Ohio Subs' Lives," *Defense News*, May 19, 2023; Rich Abott, "Navy Eyes 2026 Decision On First Ohio-Class SSBN Extension," *Defense Daily*, November 2, 2022; Megan Eckstein, "US Navy Wants to Avoid Shortfall of Nuke-Armed Subs in 2030s," *Defense News*, November 2, 2022; Justin Katz, "Navy 'Scoping Study' to Examine Shipyard Capacity, Potential for a New Yard," Breaking Defense, November 2, 2022; Caitlin M. Kenney, "A Handful of Ohio Subs Could Get Yet Another Service Life Extension," *Defense One*, November 1, 2022; Sam LaGrone, "Navy Could Extend Life of Five Ohio-class Ballistic Missile Boats to Hedge Against Columbia Program Delays," *USNI News*, November 1, 2022; Nick Wilson, "Navy to Consider Service Extensions for Select Ohio-Class Subs," *Inside Defense*, November 1, 2022; Emma Helfrich, "Navy Eyeing Life Extension Of Nine Ohio Class [SSBN and SSGN] Submarines," *The Drive*, May 18, 2022; Megan Eckstein, "Navy May Extend Life of Ohio SSBNs to Provide Cushion for Introduction of Columbia-class," *USNI News*, November 16 (updated December 24), 2020; Aidan Quigley, "Navy Considering Expanding Life Cycles of Some Ohio-class Submarines to Ease Columbia Transition," *Inside Defense*, July 7, 2021; Megan Eckstein, "US Navy Reorganizes Submarine Enterprise to Address Challenges in Construction, Maintenance," *Defense News*, September 27, 2021.

focused on anticipating, monitoring, and mitigating risks to the lead boat's design and construction schedule.

Lead Boat Delivery Delay

On April 2, 2024, the Navy announced that several of its shipbuilding programs were experiencing significant delays due to shipyard workforce challenges, supply chain challenges, and other issues. As part of this announcement, the Navy announced an estimated 12- to 16-month delay in the delivery of the first Columbia-class boat. An April 2, 2024, press report stated,

> The vessel's new projected delay can't be attributed to one factor or a new technical issue, Navy officials told reporters Tuesday [April 2]. Instead, the delays are "related to the whole of the ship," in terms of assembling its modules correctly, "getting them all buttoned up," said Navy assistant secretary for acquisition Nickolas Guertin.
>
> And although some components are late, the projected delays don't appear related to technology performance issue, said Naval Sea Systems Command head Vice Admiral Jim Downey.[25]

An April 10, 2024, press report states,

> Late delivery of steam turbines for the under-construction District of Columbia (SSBN-826) is one of the main obstacles the Navy faces in delivering the nuclear ballistic missile submarine on time, Secretary of the Navy Carlos Del Toro told a House panel on Wednesday [April 10].
>
> "One of the most significant challenges that we have with Columbia … is actually the late delivery of the turbine generator to Columbia by subcontractor Northrop Grumman," Del Toro the House Appropriations subcommittee on defense.
>
> "That has had a major impact on the Columbia."…
>
> In addition to the turbines, sources familiar with the slip in schedule have also pointed to the delay in completing the bow dome of District of Columbia. The dome, the same design as the Ohio-class, is getting cast at forge at HII's Newport News Shipbuilding in Virginia.[26]

An April 17, 2024, press report states,

> A delay of as much as 16 months in delivering the first of the US's first Columbia-class nuclear-missile submarines—the Navy's top weapons priority—stems from contractor delays in delivering the vessel's bow section and power generators, according to an internal assessment by the service….
>
> … HII was to ship the bow in May 2025 from its Newport News, Virginia, yard to the General Dynamics facility in Groton, Connecticut. That's now estimated for June 2026, or 13 months late, according to internal service figures….
>
> In addition, Northrop Grumman Corp. was contracted by the Navy to deliver the first ship's turbine generators by November 2021, which would have provided months of margin before they'd be needed.

[25] Anthony Capaccio, "US Navy Sees Delays of a Year or More for New ICBM Submarine," *Bloomberg*, April 2, 2024. See also Mallory Shelbourne and Sam LaGrone, "First Columbia Nuclear Missile Sub At Risk of 1-Year Delay Due to Supplier Problems," *USNI News*, March 11, 2024; "Absent General Dynamics Improvements, Pentagon Forecasts Year-Long Delay to Columbia-class Nuclear Submarine Program," *Capitol Forum*, March 11, 2024.

[26] Sam LaGrone, "Late Turbines Have 'Major Impact' on Columbia Sub Delivery Schedule, Says SECNAV," *USNI News*, April 10, 2024. See also Rich Abott, "Del Toro Says Turbine Generator A Major Issue In Columbia Delay," *Defense Daily*, April 10, 2024.

Instead, the turbine generators are projected to be delivered in early 2025, according to a Navy statement.[27]

The Navy's FY2026 budget submission updated the estimated delay in the delivery of the first Columbia-class boat to 17 months.

Program Cost and Funding

Program Acquisition Cost

Estimates of the procurement cost and acquisition cost (i.e., the research and development cost plus procurement cost) of the Columbia-class program include the following:

- The Navy's FY2025 budget submission estimates the total procurement cost of the 12-ship class at $126.4 billion in then-year dollars, an increase of 15.2% over the figure in the FY2021 budget submission of $109.8 billion in then-year dollars. (The Navy's FY2026 budget submission does not include an updated estimate of the total procurement cost of the 12-ship class.)
- A December 31, 2023, DOD Modernized Selected Acquisition Report (MSAR) for the Columbia-class program estimates the program's total acquisition cost at $139,716.8 million (about $139.7 billion) in then-year dollars, including $13,938.2 million (about $13.9 billion) in research and development costs, $125,320.2 million (about $125.3 billion) in procurement costs, and $458.4 million in military construction costs.[28]
- A June 2025 Government Accountability Office (GAO) report assessing selected major weapon acquisition programs being pursued by the Department of Defense (DOD), which is "using a secondary Department of War designation," under Executive Order 14347, dated September 5, 2025, stated that the estimated total acquisition cost of the Columbia-class program as of August 2024 was $126,495 million (about $126.5 billion) in constant FY2025 dollars, an increase of about 6% from the cost as estimated in August 2023, including $16,651 million (about $16.7 billion) in research and development costs, $109,408 million (about $109.4 billion) in procurement costs, and $436 million for military construction and acquisition-related operation and maintenance costs.[29]

The above estimates do not include estimated costs for refurbishing D-5 SLBMs so as to extend their service lives to about 2040.

Unit Procurement Cost

Table 1 shows the estimated procurement costs of the first three boats in the program, as shown in the Navy's FY2026 budget submission. The lead boat's procurement cost is much higher than that of subsequent boats in the class because the lead boat includes most of the detail design/nonrecurring engineering (DD/NRE) costs for the class. (It is a long-standing Navy budgetary practice to incorporate the much or all of the DD/NRE costs for a new class of ship

[27] Anthony Capaccio, "US Nuclear-Missile Sub Delayed Up to 16 Months Over Bow, Generators," *Bloomberg*, April 17, 2024.

[28] Department of Defense, *Modernized Selected Acquisition Report (MSAR), SSBN 826 COLUMBIA Class Submarine (SSBN 826)*, FY 2025 President's Budget, December 31, 2023, p. 16.

[29] Government Accountability Office, *Weapon Systems Annual Assessment[:] DOD Leaders Should Ensure That Newer Programs Are Structured for Speed and Innovation*, GAO-25-107569, June 2025, p. 147.

into the total procurement cost of the first ship in the class.) In the table, the category shown as "Plans" is similar to DD/NRE, while the category shown as "Other," which includes all other procurement costs, can be viewed as the hands-on construction cost of the boat. As can be seen in the table, the first three boats in the program have estimated hands-on construction costs of more than $9 billion each.

Table 1. Estimated Procurement Costs for First Three Boats

In millions of dollars, rounded to nearest tenth

	First boat (SSBN-826)	Second boat (SSBN-827)	Third boat (SSBN-828)
Plans	6,946.3	1,443.3	969.6
Other	9,175.0	9,245.2	9,574.2
Total	**16,121.3**	**10,688.5**	**10,543.7**

Source: Table prepared by CRS using data from Navy's FY2026 budget submission. Totals may not add due to rounding.

Notes: "Other" category includes basic construction/conversion; change orders; electronics; propulsion equipment; hull, mechanical, and electrical (HM&E) equipment; ordnance-related equipment (but not the weapons themselves, which are procured separately); and other costs.

CBO and GAO Perspectives on Risk of Cost Growth

Regarding the risk of cost growth in the Columbia-class program, a January 2025 CBO report on the cost of the Navy's shipbuilding programs states,

> The cost of the 10 Columbia class submarines included in the [Navy's FY]2025 shipbuilding plan is one of the most significant uncertainties in the Navy's and CBO's analyses of future shipbuilding costs….
>
> The Navy currently estimates that construction of the first Columbia class ship, the District of Columbia, will be complete in 2029 at a cost of $16.1 billion (in 2024 dollars). As of November 2024, the ship was 51 percent complete (measured in terms of the number of labor hours the Navy estimates it will need to build the ship). The second ship, authorized in 2024, would cost about $9.0 billion. Subsequent ships in the class would cost $7.9 billion, on average, according to the Navy. The total procurement cost for the 12 submarines would be $106 billion (which includes appropriations totaling $27.4 billion from 2017 to 2024), or $8.8 billion per ship, on average.
>
> According to the Navy's estimate, the cost per thousand tons of displacement for the first Columbia class ship would be 13 percent less than that of the first Virginia class attack submarine. But the costs of lead ships of new classes of submarines built in the 1970s and 1980s provide little evidence that ballistic missile submarines are cheaper to build, per ton, than attack submarines. In a February 2024 report to the Congress on the Columbia program, the Navy stated that there was a 68 percent chance that the cost of the first Columbia class submarine would exceed its estimates and a 32 percent chance that it would cost less than estimated. The likelihood that subsequent ships in the class would cost more or less than estimated was similar—67 percent and 33 percent, respectively. Those estimates of the probability of cost growth were substantially higher than the estimates that the service provided the year before. When CBO analyzed the 2024 shipbuilding plan, the Navy had stated that the likelihood that cost growth would affect the lead ship was 54 percent; the probability of subsequent ships' being affected was 49 percent.
>
> CBO's estimate for a program of 12 ships is 16 percent higher than the Navy's. CBO estimates that the first Columbia class submarine will cost $18.1 billion—$2.0 billion more

> than the Navy estimates it will cost. The second submarine would cost $11.4 billion. Including appropriations from 2017 to 2024, CBO estimates that, all told, 12 Columbia class submarines would cost $123 billion ($95 billion of which would be appropriated from 2025 to 2036). The 10 submarines set to follow the first two ships would cost an average of $9.4 billion each—$1.5 billion more per submarine than the Navy estimates they would cost.
>
> Costs for the Columbia class submarines could, however, exceed both the Navy's and CBO's estimates. The new SSBN will be the largest, most technologically complex submarine that the United States has ever built. It is expected to reuse some technology and components from the Virginia class submarine, but it would also include many new elements, such as an all-electric drive system, an X-stern ship control system (in which the rear rudders and dive planes are shaped like an "x" rather than a "+" as they are on the Ohio class submarines), a new missile compartment, and a nuclear reactor designed to last the entire 42-year service life of the submarine. Furthermore, the Navy has repeatedly stated that the Columbia is its first acquisition priority and that the program must stay on schedule to meet its strategic deterrence mission. Thus, if the program encounters problems in construction, the Navy and the shipbuilders are likely to invest more resources and assign more people to the program to meet the schedule, all of which would increase costs.
>
> Conversely, costs for the Columbia class ships could be less than CBO estimates if the Navy and the shipbuilders are successful in their ongoing efforts to increase the speed and efficiency of construction and to improve the performance of the supplier base.[30]

A September 2024 GAO report on the Columbia-class program states,

> According to GAO's analysis of program data from January 2022 through May 2023, cost and schedule performance for lead submarine construction has consistently fallen short of targets. Through early 2024, those trends had not improved, and future risks will likely add to current cost and schedule growth. The program has reported that the shipbuilder needs to take swift and significant actions to address the causes of poor construction performance. However, as GAO has previously reported, the program has tried to mitigate some of these causes—such as late materials and detailed design products—for years….
>
> Based on data through May 2023, GAO estimated that lead submarine construction costs at completion could be hundreds of millions of dollars more than the Navy's planned costs. Although the shipbuilder is also expecting cost increases, its estimated overrun is smaller and assumes significant future improvement that GAO's past work suggests is unrealistic. Further, program reporting on submarine construction progress did not always include a thorough analysis of why the program missed cost and schedule goals. Without realistic cost estimates and adequate analysis, the program will struggle to address continuing and future risks that could further degrade construction performance.
>
> The Navy has not consistently defined information needed to determine whether investments made in the supplier base have increased supplier production or generated cost savings and how those results support the program's goals. Since 2018, the Navy reported receiving more than $2.6 billion to invest in the submarine supplier base and help achieve Columbia class construction goals. Without identifying consistent information, the Navy is not well positioned to ensure that these investments will effectively spur their intended benefits for the program.[31]

[30] CBO, *An Analysis of the Navy's Fiscal Year 2025 Shipbuilding Plan*, January 2025, pp. 28-29.

[31] Government Accountability Office, *Columbia Class Submarine[:] Overcoming Persistent Challenges Requires Yet Undemonstrated Performance and Better-Informed Supplier Investments*, GAO-24-107732, September 2024, highlights page.

Use of Incremental Funding

The first and second Columbia-class boats were funded with incremental funding, a funding approach in which the procurement cost of each boat is divided into multiple annual increments, with the first increment occurring in the year in which the boat was procured.[32] The first Columbia-class boat was funded with three-year incremental funding in FY2021-FY2023, and the second boat was funded with two-year incremental funding (also called split funding) in FY2024-FY2025. The Navy wants to use three-year incremental funding for procuring the third and subsequent boats in the program.

National Sea-Based Deterrence Fund (NSBDF)

The National Sea-Based Deterrence Fund (NSBDF) is a fund in DOD's budget separate from the Navy's shipbuilding account for holding and executing procurement funding for the construction of new SSBNs. It was created by Congress in 2014 with an original the aim of helping to financially insulate other Navy shipbuilding programs from the potential cost impact of the Columbia-class program, and to encourage U.S. policymakers to finance the procurement of Columbia-class boats from across DOD's budget rather than solely from the Navy's budget.

In subsequent years, the statute establishing and governing the fund (10 U.S.C. 2218a) has been amended to give the NSBDF an additional function of acting as a vehicle or repository for certain special acquisition authorities that have the potential for reducing at the margin procurement costs of Columbia-class boats and other Navy nuclear-powered ships (i.e., aircraft carriers and attack submarines). The Navy has stated that it is using the special acquisition authorities in 10 U.S.C. 2218a, and that doing so has marginally reduced the estimated combined procurement cost of the 12 Columbia-class boats.[33] For additional background information on the NSBDF, see **Appendix E**.

Procurement Funding Profiles for First Three Boats

Table 2 shows the funding profiles for the first three boats in the Navy's FY2026 budget submission. Note that this table does not show procurement or advance procurement (AP) funding for the fourth and subsequent boats in the class.

[32] For background information on the use of incremental funding in procuring Navy ships, see CRS Report RL32776, *Navy Ship Procurement: Alternative Funding Approaches—Background and Options for Congress*, by Ronald O'Rourke.

[33] Navy briefing, "COLUMBIA Class National Sea Based Deterrence Fund Procurement Authorities & Initiatives," March 2022, provided to CRS and CBO by Navy Office of Legislative Affairs, July 1, 2022.

Table 2. Procurement Funding Profiles for First Three Boats in FY2026 Budget

Millions of dollars, rounded to nearest tenth; does not include funding for fourth and subsequent boats

Fiscal year	First boat (SSBN-826)	Second boat (SSBN-827)	Third boast (SSBN-828)
FY17	773.1 (AP)		
FY18	802.3 (AP)	59.5 (AP)	
FY19	3,016.0 (AP)	139.1 (AP)	0.8 (AP)
FY20	1,636.4 (AP)	148.5 (AP)	20.0 (AP)
FY21	2,869.0 (FF)	1,110.7 (AP)	93.0 (AP)
FY22	3,003.0 (FF)	1,271.4 (AP)	149.9 (AP)
FY23	3,079.2 (FF)	769.1 (AP)	1,090.1 (AP)
FY24		2,443.6 (FF)	949.7 (AP)
FY25		3,364.8 (FF)	1,183.1 (AP)
FY26 requested			*3,928.8 (FF)*
FY27 programmed	566.6 (CC)	19.4 (CC)	995.8 (FF)
FY28 programmed	375.6 (CC)	716.4 (CC)	2,132.7 (FF)
FY29 programmed		377.0 (CC)	
FY30 programmed		269.08 (CC)	
Total	**16,121.3**	**10.688.5**	**10,543.7**

Source: CRS table based on Navy's FY2026 budget submission.

Notes: Totals may not add due to rounding. Table does not show funding for fourth and subsequent boats in the class. **AP** is advance procurement funding, which is funding provided prior to the boat's year of procurement, to be used for procuring long leadtime components that need to be procured ahead of the rest of the boat to ensure that the components will be ready for incorporation into the boat at the right point during the boat's construction sequence. **FF** is full funding, meaning procurement funding increments provided in the boat's year of procurement and in one or more subsequent years, so as to fully fund (i.e., complete the procurement cost of) the boat. **CC**, also abbreviated CTC, is cost-to-complete funding, also known as completion of prior year shipbuilding funding (i.e., PY completion funding), which is funding that is added in years after the nominal completion of a ship's full funding to cover cost growth beyond the ship's originally estimated total procurement cost.

FY2026 Procurement Funding Request

The Navy's proposed FY2026 budget requests $3,928.8 million (i.e., about $3.9 billion) in procurement funding for the third Columbia-class boat, and $6,991.7 million (i.e., about $7.0 billion) in advance procurement (AP) funding for the fourth and subsequent boats in the program, for a total FY2026 request of $10,920.5 million (i.e., about $10.9 billion) for the program.

Issues for Congress

Impact of 17-Month Delay in Delivery of Lead Boat

Overview

One oversight issue for Congress concerns the impact of the estimated 17-month delay in the delivery of the first Columbia-class boat on the Navy's plans for replacing Ohio-class SSBNs on a timely basis. As mentioned earlier, this estimated delay is part of a larger situation of delivery delays on multiple Navy shipbuilding programs due to shipyard workforce challenges, supply chain challenges, and other issues.

As mentioned earlier, much of the management time and attention that the Navy devotes to the Columbia-class program is focused on anticipating, monitoring, and mitigating risks to the lead boat's design and construction schedule. The emergence of an estimated 17-month delivery delay in spite of these efforts is a reflection of the depth of the challenges the Navy and industry currently face in executing Navy shipbuilding programs. The situation of delays in Navy shipbuilding programs discussed more generally in another CRS report.[34]

Potential oversight questions for Congress regarding the estimated 17-month delivery delay on the first Columbia-class boat include the following:

- At this stage in the lead boat's construction process, how much potential is there for reducing the lead boat's estimated delivery delay to something less than 17 months? Conversely, how likely is it that the estimated delivery delay will grow to something greater than 17 months as construction of the boat continues? What steps is the Navy taking to reduce the estimated delivery delay to something less than 17 months or, failing that, prevent the estimated delivery delay from growing to something greater than 17 months?
- What impact might a 17-month delay in delivering the lead boat have on the delivery dates of subsequent boats in the class?
- To what degree can the delay in delivering the lead boat (and possibly some of the subsequent boats) be offset by extending the service lives of up to five of the Ohio-class SSBNs? What will be the net impact on the size of the SSBN force? What are the estimated costs of extending the service lives of these five boats?

Navy Perspective

At an April 8, 2025, hearing before the Senate Armed Services Committee on the Navy's programs for building nuclear-powered ships, Rear Admiral Todd Weeks, the Navy's program executive officer (PEO) for strategic submarines (i.e., SSBNs) stated that "right now, we are projecting it [the lead boat] to be 12 to 18 months late to contract. However, we are—we're taking action, right now, to—to accelerate and recover as much schedule as we possibly can. The second ship [in the class], Wisconsin, is currently on schedule, so we are on—on schedule to deliver that ship at the 80-month contract."[35]

[34] See CRS Report RL32665, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, by Ronald O'Rourke.

[35] Source: CQ transcript of hearing. For a press report about the hearing, see, for example, Hope Hodge Seck, "First (continued...)

A November 15, 2024, press report stated,

> The lead ship in the Navy's new class of nuclear ballistic missile submarines will deploy in 2030, a service official said Thursday [November 14].
>
> Speaking at the annual Naval Submarine Symposium, Matt Sermon emphasized the Navy's commitment to delivering the future USS District of Columbia (SSBN-826) on time.
>
> "Shipbuilders out there, supply chain, major mechanical equipment out there, stakeholders out there, we're going to have District of Columbia on patrol in 2030," Sermon, the executive director of the strategic submarines program executive office at Naval Sea Systems Command, told the audience.
>
> Sermon acknowledged the ongoing trouble with the lead ship's schedule, which is currently tracking to a 96-month build instead of the 84-month contract timeline.
>
> "We are clawing back every single day, those earnings, and how we pave that critical path," Sermon said. "We will not give up."[36]

GAO Perspective

A June 2025 GAO report assessing selected major DOD weapon acquisition programs stated the following regarding the Columbia-class program:

> **Program Performance**
>
> In November 2024, the Navy declared a schedule breach for SSBN 826. As a result, the Navy is planning to update the acquisition program baseline by September 2025. The Navy is also developing plans to meet a delivery date of October 2028 for SSBN 826—a 12-month delay from the program's contract delivery date. However, the Navy estimated that delivery may be delayed to as late as March 2029 if planned construction improvements do not materialize. Moreover, we previously reported that the Navy lacked schedule insight that would better position the program to mitigate risks to achieving key dates, including independent analysis and data to easily validate the schedule's quality.
>
> Program officials stated that, while construction performance was stable during much of 2024, it was not good enough to recover from existing delays. The program attributed particularly slow periods of construction to out-of-sequence work that significantly disrupted planned construction events and led to large amounts of rework. According to program officials, the out-of-sequence work resulted from missing instructions in some design products that detail how to build the submarine. For example, some areas of the submarine were missing electrical work and holes for pipe installation. Officials added that while the shipbuilders are taking steps to correct these design products, there remains a backlog of design changes that the shipbuilders need to address. This could further affect the program's schedule.
>
> In an attempt to improve schedule performance, the program resequenced some work to optimize the order of construction events. For example, delivery of the turbine generators—a major propulsion system component—is delayed over 2 years due to design challenges. According to program officials, these delays forced modifications to the order of work on the engine room, one of the submarine's six large hull modules. Other resequencing involved moving selected work among shipyards to ensure the shipbuilders deliver modules as planned. However, we previously reported that resequencing can introduce additional schedule risks. Moreover, program officials stated that the volume of

Columbia-class Sub, Two Aircraft Carriers Face Delivery Delays, Navy Officials Tell Senate," *USNI News*, April 9 (updated April 10), 2025.

[36] Mallory Shelbourne, "Navy Promises First Columbia-class Boat Will 'Be on Patrol in 2030,'" *USNI News*, November 15, 2024.

work yet to be completed is substantial, and their ability to further optimize the schedule by resequencing it is limited.

According to program officials, costs for SSBN 826 and the second submarine, SSBN 827, each significantly exceed their respective cost to complete due to poor construction performance, inflation, and higher material costs. Program officials stated that increases in the total acquisition cost estimate from last year reflect inflation and higher labor and material costs. Increases do not yet reflect recent construction trends. Officials stated that a future estimate will reflect higher costs due to further inflation and poor construction performance through July 2024.

Leading Product Development Practices

The program reported implementing some elements of leading product development practices. For example, it provided high-level operational needs to stakeholders that were subsequently refined prior to beginning detail design, and officials said that they incorporated end user feedback throughout the design process. The program also reported implementing a modular approach for certain architecture and software components. However, it reported no plans for a digital twin of key subsystems or a digital thread. Our prior work found that these tools are key to anticipating potential design flaws and incorporating changes. Program officials stated that a 3D model was developed for some of the submarine for use by the shipbuilders and maintainers.

Other Program Issues

The program continues to face challenges across the submarine industrial base such as a lack of workers trained in the necessary trades like welding and metal fabrication. There is also limited workforce and industrial capacity at suppliers that manufacture Columbia class components. According to program officials, while the Navy is working to identify additional suppliers to help increase capacity, it can take years for potential suppliers to complete the qualification process.

After more than a year of formal construction, SSBN 827 is about 12 percent behind schedule. According to program officials, material availability issues, among others, hindered construction progress. SSBN 827's planned construction schedule is 4 months shorter than the lead submarine's now-unachievable contract schedule, and the program will need to significantly accelerate construction to meet planned delivery.

Program Office Comments

We provided a draft of this assessment to the program office for review and comment. It provided technical comments, which we incorporated where appropriate. According to the program, the Columbia class remains positioned to provide the capability needed to meet national strategic deterrence requirements. The program stated that to reduce risk, it ensured stable requirements, executed manufacturing readiness and supplier base efforts, and continued cost reduction efforts.

According to the program, the Navy continues to address industrial base challenges with oversight, workforce development pipelines, and supplier development funding. The program added that the Navy is pursuing additive manufacturing, robotics, automation, and digital technologies to increase efficiency, capacity, and quality. It also stated that the Navy is working to minimize SSBN 826 delays, mitigate the effect of late delivery on planned initial capability, and incorporate lessons learned for SSBN 827 and future submarine construction.[37]

[37] Government Accountability Office, *Weapon Systems Annual Assessment[:] DOD Leaders Should Ensure That Newer Programs Are Structured for Speed and Innovation*, GAO-25-107569, June 2025, p. 148.

Potential Impact on Virginia-Class Construction

Another oversight issue for Congress concerns the potential impact of the Columbia-class construction workload on the ability of the submarine construction industrial base to build Virginia-class submarines in desired numbers in coming years. As mentioned earlier, the Columbia-class program is the Navy's top program priority, and that this means, among other things, that in a situation of industrial base constraints, the Columbia-class program will have first call on resources to minimize the chances of schedule delays in building Columbia-class boats. In light of constraints on the capacity of the submarine construction industrial base, some observers are concerned that giving priority to the Columbia-class program could add to challenges currently faced by the Navy and industry in increasing the Virginia-class attack submarine construction rate to a desired rate of at least 2.0 Virginia-class boats per year. The increase in the planned Columbia-class procurement to a rate of one boat per year starting in FY2026 could reinforce these concerns. The situation is discussed in further detail in the CRS report on the Virginia-class program.[38]

FY2026 Legislative Request

As mentioned earlier, the Navy's FY2026 budget submission requests

- $3,928.8 million (i.e., about $3.9 billion) in procurement funding for the third Columbia-class boat, and $6,991.7 million (i.e., about $7.0 billion) in advance procurement (AP) funding for the fourth and subsequent boats in the program, for a total FY2026 request of $10,920.5 million (i.e., about $10.9 billion) for the program;
- authority to use three-year incremental funding for procuring each of the remaining 10 boats in the program (i.e., boats 3 through 12); and
- authority for using a block buy contract to procure the five Columbia-class boats that are scheduled to be procured in FY2026-FY2030 (i.e., boats 3 through 7).[39]

[38] CRS Report RL32665, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, by Ronald O'Rourke.

[39] For a press report about the request for the block buy contract, see, for example, Abby Shepherd, "DOD Submits Proposal to Allow Contract for up to Five Columbia Subs, Mirroring House and Senate Provisions," *Inside Defense*, August 4, 2025.

Appendix A. Summary of Past U.S. SSBN Designs

This appendix provides background information on the four SSBN classes that the United States has operated since 1959. The four classes are summarized in **Table A-1**. As shown in the table, the size of U.S. SSBNs has grown over time, reflecting in part a growth in the size and number of SLBMs carried on each boat. The Ohio class carries an SLBM (the D-5) that is much larger than the SLBMs carried by earlier U.S. SSBNs, and it carries 24 SLBMs, compared to the 16 on earlier U.S. SSBNs.[40] In part for these reasons, the Ohio-class design, with a submerged displacement of 18,750 tons, is more than twice the size of earlier U.S. SSBNs.

Table A-1. U.S. SSBN Classes

	George Washington (SSBN-598) class	Ethan Allen (SSBN-608) class	Lafayette/Benjamin Franklin (SSBN-616/640) class	Ohio (SSBN-726) class
Number in class	5	5	31	18/14
Fiscal years procured	FY1958-FY1959	FY1959 and FY1961	FY1961-FY1964	FY1974/FY1977-FY1991
Years in commission	1959-1985	1961-1992	1963-2002	1981/1984-present
Length	381.7 feet	410.5 feet	425 feet	560 feet
Beam	33 feet	33 feet	33 feet	42 feet
Submerged displacement	6,700 tons	7,900 tons	8,250 tons	18,750 tons
Number of SLBM launch tubes	16	16	16	24 (to be reduced to 20 by 2018)
Final type(s) of SLBM carried	Polaris A-3	Polaris A-3	Poseidon C-3/ Trident I C-4	Trident II D-5
Diameter of those SLBMs	54 inches	54 inches	74 inches	83 inches
Length of those SLBMs	32.3 feet	32.3 feet	34 feet	44 feet
Weight of each SLBM (pounds)	36,000 pounds	36,000 pounds	65,000/73,000 pounds	~130,000 pounds
Range of SLBMs	~2,500 nm	~2,500 nm	~2,500 nm/~4,000 nm	~4,000 nm

Sources: Prepared by CRS based on data in Norman Polmar, *The Ships and Aircraft of the U.S. Fleet*, Annapolis, Naval Institute Press, various editions, and (for SSBN decommissioning dates) U.S. Naval Vessel Register.

Notes: Beam is the maximum width of a ship. For the submarines here, which have cylindrical hulls, beam is the diameter of the hull.

The range of an SLBM can vary, depending on the number and weight of nuclear warheads it carries; actual ranges can be lesser or greater than those shown.

The George Washington-class boats were procured as modifications of SSNs that were already under construction. Three of the boats were converted into SSNs toward the ends of their lives and were

[40] The larger size of the Ohio-class design also reflects a growth in size over time in U.S. submarine designs due to other reasons, such as providing increased interior volume for measures to quiet the submarine acoustically, so as to make it harder to detect.

decommissioned in 1983-1985. The two boats that remained SSBNs throughout their lives were decommissioned in 1981.

All five Ethan Allen-class boats were converted into SSNs toward the ends of their lives. The boats were decommissioned in 1983 (two boats), 1985, 1991, and 1992.

Two of the Lafayette/Benjamin Franklin-class boats were converted into SSNs toward the ends of their lives and were decommissioned in 1999 and 2002. The 29 that remained SSBNs throughout their lives were decommissioned in 1986-1995. For 19 of the boats, the Poseidon C-3 was the final type of SLBM carried; for the other 12, the Trident I C-4 SLBM was the final type of SLBM carried.

A total of 18 Ohio-class SSBNs were built. The first four, which entered service in 1981-1984, were converted into SSGNs in 2002-2008. The remaining 14 boats entered service in 1984-1997. Although Ohio-class SSBNs are designed to each carry 24 SLBMs, by 2018, four SLBM launch tubes on each boat are to be deactivated, and the number of SLBMs that can be carried by each boat consequently is to be reduced to 20, so that the number of operational launchers and warheads in the U.S. force will comply with strategic nuclear arms control limits.

Appendix B. U.S.-UK Cooperation on SLBMs and the New UK SSBN

This appendix provides background information on U.S.-UK cooperation on SLBMs and the UK's next-generation SSBN, previously called the Successor-class SSBN and now called the Dreadnought-class SSBN.

The UK's four Vanguard-class SSBNs, which entered service in 1993-1999, each carry 16 Trident II D-5 SLBMs. Previous classes of UK SSBNs similarly carried earlier-generation U.S. SLBMs.[41] The UK's use of U.S.-made SLBMs on its SSBNs is one element of a long-standing close cooperation between the two countries on nuclear-related issues that is carried out under the 1958 Agreement for Cooperation on the Uses of Atomic Energy for Mutual Defense Purposes (also known as the Mutual Defense Agreement).[42] Within the framework established by the 1958 agreement, cooperation on SLBMs in particular is carried out under the 1963 Polaris Sales Agreement and a 1982 Exchange of Letters between the two governments.[43] The Navy testified in

[41] Although the SLBMs on UK SSBNs are U.S.-made, the nuclear warheads on the missiles are of UK design and manufacture.

[42] For additional discussion of U.S.-UK cooperation on nuclear-related issues since 1958, see CRS In Focus IF11999, *AUKUS Nuclear Cooperation*, by Paul K. Kerr and Mary Beth D. Nikitin.

[43] A March 18, 2010, report by the UK Parliament's House of Commons Foreign Affairs Committee stated the following:

> During the Cold War, the UK's nuclear co-operation with the United States was considered to be at the heart of the [UK-U.S.] 'special relationship'. This included the 1958 Mutual Defence Agreement, the 1963 Polaris Sales Agreement (PSA) (subsequently amended for Trident), and the UK's use of the US nuclear test site in Nevada from 1962 to 1992. The co-operation also encompassed agreements for the United States to use bases in Britain, with the right to store nuclear weapons, and agreements for two bases in Yorkshire (Fylingdales and Menwith Hill) to be upgraded to support US missile defence plans.
>
> In 1958, the UK and US signed the Mutual Defence Agreement (MDA). Although some of the appendices, amendments and Memoranda of Understanding remain classified, it is known that the agreement provides for extensive co-operation on nuclear warhead and reactor technologies, in particular the exchange of classified information concerning nuclear weapons to improve design, development and fabrication capability. The agreement also provides for the transfer of nuclear warhead-related materials. The agreement was renewed in 2004 for another ten years.
>
> The other major UK-US agreement in this field is the 1963 Polaris Sales Agreement (PSA) which allows the UK to acquire, support and operate the US Trident missile system. Originally signed to allow the UK to acquire the Polaris Submarine Launched Ballistic Missile (SLBM) system in the 1960s, it was amended in 1980 to facilitate purchase of the Trident I (C4) missile and again in 1982 to authorise purchase of the more advanced Trident II (D5) in place of the C4. In return, the UK agreed to formally assign its nuclear forces to the defence of NATO, except in an extreme national emergency, under the terms of the 1962 Nassau Agreement reached between President John F. Kennedy and Prime Minister Harold Macmillan to facilitate negotiation of the PSA.
>
> Current nuclear co-operation takes the form of leasing arrangements of around 60 Trident II D5 missiles from the US for the UK's independent deterrent, and long-standing collaboration on the design of the W76 nuclear warhead carried on UK missiles. In 2006 it was revealed that the US and the UK had been working jointly on a new 'Reliable Replacement Warhead' (RRW) that would modernise existing W76-style designs. In 2009 it emerged that simulation testing at Aldermaston on dual axis hydrodynamics experiments had provided the US with scientific data it did not otherwise possess on this RRW programme.
>
> The level of co-operation between the two countries on highly sensitive military technology is, according to the written submission from Ian Kearns, "well above the norm, even for a close alliance relationship". He quoted Admiral William Crowe, the former US Ambassador to London,

(continued...)

March 2010 that "the United States and the United Kingdom have maintained a shared commitment to nuclear deterrence through the Polaris Sales Agreement since April 1963. The U.S. will continue to maintain its strong strategic relationship with the UK for our respective follow-on platforms, based upon the Polaris Sales Agreement."[44]

The first Vanguard-class SSBN was originally projected to reach the end of its service life in 2024, but an October 2010 UK defense and security review report states that the lives of the Vanguard class ships will now be extended by a few years, so that the four boats will remain in service into the late 2020s and early 2030s.[45]

The UK plans to replace the four Vanguard-class boats with three or four next-generation Dreadnought-class boats are to be equipped with 12 missile launch tubes, but current UK plans call for each boat to carry eight D-5 SLBMs, with the other four tubes not being used for SLBMs. The report states that "'Main Gate'—the decision to start building the submarines—is required around 2016."[46] The first new boat is to be delivered by 2028, or about four years later than previously planned.[47]

The United States is assisting the UK with certain aspects of the Dreadnought SSBN program. In addition to the modular Common Missile Compartment (CMC), the United States is assisting the UK with the new PWR-3 reactor plant[48] to be used by the Dreadnought SSBN. A December 2011 press report states that "there has been strong [UK] collaboration with the US [on the Dreadnought program], particularly with regard to the CMC, the PWR, and other propulsion technology," and that the design concept selected for the Dreadnought class employs "a new propulsion plant based on a US design, but using next-generation UK reactor technology (PWR-3) and modern secondary propulsion systems."[49] The U.S. Navy states that

> Naval Reactors, a joint Department of Energy/Department of Navy organization responsible for all aspects of naval nuclear propulsion, has an ongoing technical exchange

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> who likened the UK-US nuclear relationship to that of an iceberg, "with a small tip of it sticking out, but beneath the water there is quite a bit of everyday business that goes on between our two governments in a fashion that's unprecedented in the world." Dr Kearns also commented that the personal bonds between the US/UK scientific and technical establishments were deeply rooted.
>
> (House of Commons, Foreign Affairs Committee, *Sixth Report Global Security: UK-US Relations*, March 18, 2010, paragraphs 131-135; http://www.publications.parliament.uk/pa/cm200910/cmselect/cmfaff/114/11402.htm; paragraphs 131-135 are included in the section of the report available at http://www.publications.parliament.uk/pa/cm200910/cmselect/cmfaff/114/11406.htm.)

See also "U.K. Stays Silent on Nuclear-Arms Pact Extension with United States," *Global Security Newswire*, July 30, 2014.

[44] Statement of Rear Admiral Stephen Johnson, USN, Director, Strategic Systems Programs, Before the Subcommittee on Strategic Forces of the Senate Armed Services Committee [on] FY2011 Strategic Systems, March 17, 2010, p. 6.

[45] *Securing Britain in an Age of Uncertainty: The Strategic Defence and Security Review*, Presented to Parliament by the Prime Minister by Command of Her Majesty, October 2010, p. 39.

[46] *Securing Britain in an Age of Uncertainty: The Strategic Defence and Security Review*, Presented to Parliament by the Prime Minister by Command of Her Majesty, October 2010, pp. 5, 38-39. For more on the UK's Dreadnought SSBN program as it existed prior to the October 2010 UK defense and security review report, see Richard Scott, "Deterrence At A Discount?" *Jane's Defence Weekly*, December 23, 2009: 26-31.

[47] *Securing Britain in an Age of Uncertainty: The Strategic Defence and Security Review*, Presented to Parliament by the Prime Minister by Command of Her Majesty, October 2010, p. 39.

[48] PWR3 means pressurized water reactor, design number 3. U.S. and UK nuclear-powered submarines employ pressurized water reactors. Earlier UK nuclear-powered submarines are powered by reactor designs that the UK designated PWR-2 and PWR-1. For an article discussing the PWR3 plant, see Richard Scott, "Critical Mass: Re-Energising the UK's Naval Nuclear Programme," *Jane's International Defence Review*, July 2014: 42-45, 47.

[49] Sam LaGrone and Richard Scott, "Strategic Assets: Deterrent Plans Confront Cost Challenges," *Jane's Navy International*, December 2011: 17 and 18.

> with the UK Ministry of Defence under the US/UK 1958 Mutual Defence Agreement. The US/UK 1958 Mutual Defence Agreement is a Government to Government Atomic Energy Act agreement that allows the exchange of naval nuclear propulsion technology between the US and UK.
>
> Under this agreement, Naval Reactors is providing the UK Ministry of Defence with US naval nuclear propulsion technology to facilitate development of the naval nuclear propulsion plant for the UK's next generation SUCCESSOR ballistic missile submarine. The technology exchange is managed and led by the US and UK Governments, with participation from Naval Reactors prime contractors, private nuclear capable shipbuilders, and several suppliers. A UK based office comprised of about 40 US personnel provide full-time engineering support for the exchange, with additional support from key US suppliers and other US based program personnel as needed.
>
> The relationship between the US and UK under the 1958 mutual defence agreement is an ongoing relationship and the level of support varies depending on the nature of the support being provided. Naval Reactors work supporting the SUCCESSOR submarine is reimbursed by the UK Ministry of Defence.[50]

U.S. assistance to the UK on naval nuclear propulsion technology first occurred many years ago: To help jumpstart the UK's nuclear-powered submarine program, the United States transferred to the UK a complete nuclear propulsion plant (plus technical data, spares, and training) of the kind installed on the U.S. Navy's six Skipjack (SSN-585) class nuclear-powered attack submarines (SSNs), which entered service between 1959 and 1961. The plant was installed on the UK Navy's first nuclear-powered ship, the attack submarine *Dreadnought*, which entered service in 1963.

The December 2011 press report states that "the UK is also looking at other areas of cooperation between Dreadnought and the Ohio Replacement Programme. For example, a collaboration agreement has been signed off regarding the platform integration of sonar arrays with the respective combat systems."[51]

A June 24, 2016, press report states the following:

> The [U.S. Navy] admiral responsible for the nuclear weapons component of ballistic missile submarines today praised the "truly unique" relationship with the British naval officers who have similar responsibilities, and said that historic cooperation would not be affected by Thursday's vote to have the United Kingdom leave the European Union.
>
> Vice Adm. Terry Benedict, director of the Navy's Strategic Systems Programs, said that based on a telephone exchange Thursday morning with his Royal Navy counterpart, "I have no concern." The so-called Brexit vote—for British exit—"was a decision based on its relationship with Europe, not with us. I see yesterday's vote having no effect."[52]

[50] Source: Email to CRS from Navy Office of Legislative Affairs, June 25, 2012. See also Jon Rosamond, "Next Generation U.K. Boomers Benefit from U.S. Relationship," *USNI News* (http://news.usni.org), December 17, 2014.

[51] Sam LaGrone and Richard Scott, "Strategic Assets: Deterrent Plans Confront Cost Challenges," *Jane's Navy International*, December 2011: 19. See also Jake Wallis Simons, "Brits Keep Mum on US Involvement in Trident Nuclear Program," *Politico*, April 30, 2015.

[52] Otto Kreisher, "Benedict: UK Exit From European Union Won't Hinder Nuclear Sub Collaboration," *USNI News*, June 24, 2016.

Appendix C. Columbia-Class Program Origin and Milestones

This appendix provides background information on the Columbia-class program's origin and milestones.

Program Origin and Early Milestones

Although the eventual need to replace the Ohio-class SSBNs has been known for many years, the Columbia-class program can be traced more specifically to an exchange of letters in December 2006 between President George W. Bush and UK Prime Minister Tony Blair concerning the UK's desire to participate in a program to extend the service life of the Trident II D-5 SLBM into the 2040s, and to have its next-generation SSBNs carry D-5s. Following this exchange of letters, and with an awareness of the projected retirement dates of the Ohio-class SSBNs and the time that would likely be needed to develop and field a replacement for them, DOD in 2007 began studies on a next-generation sea-based strategic deterrent (SBSD).[53] The studies used the term sea-based strategic deterrent (SBSD) to signal the possibility that the new system would not necessarily be a submarine.

An Initial Capabilities Document (ICD) for a new SBSD was developed in early 2008[54] and approved by DOD's Joint Requirements Oversight Committee (JROC) on June 20, 2008.[55] In July 2008, DOD issued a Concept Decision providing guidance for an analysis of alternatives (AOA) for the program; an acquisition decision memorandum from John Young, DOD's acquisition executive, stated the new system would, barring some discovery, be a submarine.[56] The Navy established an Columbia-class program office at about this same time.[57]

The AOA reportedly began in the summer or fall of 2008.[58] The AOA was completed, with final brief to the Office of the Secretary of Defense (OSD), on May 20, 2009. The final AOA report was completed in September 2009. An AOA Sufficiency Review Letter was signed by OSD's Director, Cost Assessment & Program Evaluation (CAPE) on December 8, 2009.[59] The AOA concluded that a new-design SSBN was the best option for replacing the Ohio-class SSBNs. (For

[53] In February 2007, the commander of U.S. Strategic Command (STRATCOM) commissioned a task force to support an anticipated Underwater Launched Missile Study (ULMS). On June 8, 2007, the Secretary of the Navy initiated the ULMS. Six days later, the commander of STRATCOM directed that a Sea Based Strategic Deterrent (SBSD) capability-based assessment (CBA) be performed. In July 2007, the task force established by the commander of STRATCOM provided its recommendations regarding capabilities and characteristics for a new SBSD. (Source: Navy list of key events relating to the ULMS and SBSD provided to CRS and the CBO on July 7, 2008.)

[54] On February 14, 2008, the SBSD ICD was approved for joint staffing by the Navy's Resources and Requirements Review Board (R3B). On April 29, 2008, the SBSD was approved by DOD's Functional Capabilities Board (FCB) to proceed to DOD's Joint Capabilities Board (JCB). (Source: Navy list of key events relating to the ULMS and SBSD provided to CRS and CBO on July 7, 2008.)

[55] Navy briefing to CRS and CBO on the SBSD program, July 6, 2009.

[56] Navy briefing to CRS and CBO on the SBSD program, July 6, 2009.

[57] An August 2008 press report states that the program office, called PMS-397, "was established within the last two months." (Dan Taylor, "Navy Stands Up Program Office To Manage Next-Generation SSBN," *Inside the Navy*, August 17, 2008.

[58] "Going Ballistic," *Defense Daily*, September 22, 2008, p. 1.

[59] *Department of Defense Fiscal Year (FY) 2012 Budget Estimates, Navy, Justification Book Volume 2, Research, Development, Test & Evaluation, Navy Budget Activity 4*, entry for PE0603561N, Project 3220 (PDF page 345 of 888).

a June 26, 2013, Navy blog post discussing options that were examined for replacing the Ohio-class SSBNs, see **Appendix D**.)

The program's Milestone A review meeting was held on December 9, 2010. On February 3, 2011, the Navy provided the following statement to CRS concerning the outcome of the December 9 meeting:

> The OHIO Replacement Program achieved Milestone A and has been approved to enter the Technology Development Phase of the Dept. of Defense Life Cycle Management System as of Jan. 10, 2011.
>
> This milestone comes following the endorsement of the Defense Acquisition Board (DAB), chaired by Dr. Carter (USD for Acquisition, Technology, and Logistics) who has signed the program's Milestone A Acquisition Decision Memorandum (ADM).
>
> The DAB endorsed replacing the current 14 Ohio-class Ballistic Missile Submarines (SSBNs) as they reach the end of their service life with 12 Ohio Replacement Submarines, each comprising 16, 87-inch diameter missile tubes utilizing TRIDENT II D5 Life Extended missiles (initial loadout). The decision came after the program was presented to the Defense Acquisition Board (DAB) on Dec. 9, 2010.

The ADM validates the program's Technology Development Strategy and allows entry into the Technology Development Phase during which warfighting requirements will be refined to meet operational and affordability goals. Design, prototyping, and technology development efforts will continue to ensure sufficient technological maturity for lead ship procurement in 2019.[60]

January 2017 Milestone B Approval

On January 4, 2017, DOD gave Milestone B approval to the Columbia-class program. Milestone B approval, which permits a program to enter the engineering and manufacturing development (EMD) phase, is generally considered a major milestone for a defense acquisition program, permitting the program to transition, in effect, from a research and development effort into a procurement program of record. A January 6, 2017, Navy notification to Congress on the Milestone B approval for the Columbia-class program states the following:

> On 4 November 2016, Under Secretary of Defense for Acquisition, Technology and Logistics Frank Kendall chaired the Milestone B Defense Acquisition Board, and on 4 January, 2017 signed the acquisition decision memorandum approving COLUMBIA Class program's Milestone B and designating the program as an Acquisition Category ID major defense acquisition program. Milestone B also establishes the Acquisition Program Baseline against which the program's performance will be assessed. Additionally, this decision formally authorizes entry into the Engineering and Manufacturing Development Phase of an acquisition program, permitting the transition from preliminary design to detail design, using Shipbuilding and Conversion, Navy (SCN) funds. Cost estimates for this program have been rebaselined from CY2010 dollars to CY2017 dollars in accordance with DoDI 5000.02, Rev p, dated 7 January 2015.
>
> The MS B Navy Cost Estimate for Average Follow Ship End Cost (hulls 2-12) in 2010$ using specific shipbuilding indices is $5.0 billion, a $600 million reduction from the MS A estimate, which nearly achieves the affordability target of $4.9 billion set at MS A. To continue cost control, the Navy will focus on
>
> • Stable operational and technical requirements
>
> • High design maturity at construction start

[60] Source: Email from Navy Office of Legislative Affairs to CRS, February 3, 2011.

• Detailed plans to ensure manufacturing readiness including robust prototyping efforts and synergies with other nuclear shipbuilding programs

• Aggressive cost reduction actions

Affordability caps have been assigned that are consistent with current cost estimates and reasonable margins for cost growth. Relative to Milestone A, these estimates have been updated to adjust Base Year from 2010 to 2017, a standard practice to match Base Year with the year of Milestone B approval. The MS A unit cost affordability target ($4.9 billion in CY2010$ using Navy indices) used a unique metric, "Average Follow-on Ship End Cost," which accounted for hulls 2-12. From Milestone B forward, the affordability cap for the unit cost will be measured by using the Average Procurement Unit Cost (APUC), which includes all 12 hulls. The Affordability Cap of $8.0 billion in CY2017$ is based upon the approved APUC estimate of $7.3 billion plus 10%....

The Navy and industry are currently negotiating the detail design and construction (DD&C) contract, which is expected to award in early 2017. With negotiations continuing on the DD&C contract, the Navy has ensured the COLUMBIA Program design effort will continue without interruption. The Navy issued a contract modification to allow execution of SCN for detail design on the existing R&D contract. With this modification in place, detail design efforts that had initially planned to transition to the DD&C contract, will continue on the current R&D contract to ensure continued design progress. With the Milestone B approval and the appropriation of $773M in FY17 SCN under the second Continuing Resolution, funding is now available to execute detail design. In accordance with 10 U.S.C. §2218a and the FY17 National Defense Authorization Act, the Navy deposited the FY17 SCN into the National Sea-Based Deterrence Fund (NSBDF). The first installment of funding will be executed on the existing R&D contract, which allows transition into detail design and continued design progress until the award of the DD&C contract.[61]

[61] *Columbia Class MS [Milestone] B, Congressional Notification*, January 6, 2017, pp. 1-2. See also Megan Eckstein, "Columbia-class Submarine Program Passess Milestone B Decision, Can Begin Detail Design," *USNI News*, January 4, 2017.

Appendix D. Design of Columbia-Class Boats

This appendix provides additional background information on the design for the Columbia-class boats.

Some Key Design Features

The Columbia-class design will reflect the following:

- The Columbia class is being designed for a 42-year expected service life.[62]
- Unlike the Ohio-class design, which requires a midlife nuclear refueling,[63] the Columbia class is to be equipped with a life-of-the-ship nuclear fuel core (a nuclear fuel core that is sufficient to power the ship for its entire expected service life).[64] Although the Columbia class will not need a midlife nuclear refueling, it will still need a midlife nonrefueling overhaul (i.e., an overhaul that does not include a nuclear refueling) to operate over its full 42-year life.
- The Columbia class is to be equipped with an electric-drive propulsion train, as opposed to the mechanical-drive propulsion train used on other Navy submarines. The electric-drive system is expected to be quieter (i.e., stealthier) than a mechanical-drive system.[65]
- The Columbia class is to have SLBM launch tubes that are the same size as those on the Ohio class (i.e., tubes with a diameter of 87 inches and a length sufficient to accommodate a D-5 SLBM).
- The Columbia class will have a beam (i.e., diameter)[66] of 43 feet, compared to 42 feet on the Ohio-class design,[67] and a length of 560 feet, the same as that of the Ohio-class design.[68]

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[62] Rear Admiral David Johnson, briefing to Naval Submarine League Annual Symposium [on] Expanding Undersea Dominance, October 23, 2014, briefing slide 19. See also William Baker et al., "Design for Sustainment: The Ohio Replacement Submarine," *Naval Engineers Journal*, September 2015: 89-96.

[63] As mentioned earlier (see "Current Ohio-Class SSBNs"), the Ohio-class boats receive a midlife nuclear refueling overhaul, called an Engineered Refueling Overhaul (ERO), which includes both a nuclear refueling and overhaul work on the ship that is not related to the nuclear refueling.

[64] U.S. Navy, *Report to Congress on Annual Long-Range Plan for Construction of Naval Vessels for FY 2011*, February 2010, p. 5.

[65] Source: Rear Admiral David Johnson, briefing to Naval Submarine League Annual Symposium [on] Expanding Undersea Dominance, October 23, 2014, briefing slide 19. See also the spoken testimony of Admiral Kirkland Donald, Deputy Administrator for Naval Reactors, and Director, Naval Nuclear Propulsion, National Nuclear Security Administration, at a March 30, 2011, hearing before the Strategic Forces Subcommittee of the Senate Armed Services Committee, as shown in the transcript of the hearing, and Dave Bishop, "What Will Follow the Ohio Class?" *U.S. Naval Institute Proceedings*, June 2012: 31; and Sam LaGrone and Richard Scott, "Strategic Assets: Deterrent Plans Confront Cost Challenges," *Jane's Navy International*, December 2011: 16. For more on electric drive propulsion, see CRS Report RL30622, *Electric-Drive Propulsion for U.S. Navy Ships: Background and Issues for Congress*, by Ronald O'Rourke.

[66] Beam is the maximum width of a ship. For Navy submarines, which have cylindrical hulls, beam is the diameter of the hull.

[67] Dave Bishop, "What Will Follow the Ohio Class?" *U.S. Naval Institute Proceedings*, June 2012: 31. (Bishop was program manager for the Columbia-class program.) See also Sam LaGrone and Richard Scott, "Strategic Assets: Deterrent Plans Confront Cost Challenges," *Jane's Navy International*, December 2011: 15 and 16.

[68] Sydney J. Freedberg, "Navy Seeks Sub Replacement Savings: From NASA Rocket Boosters To Reused Access Doors," *Breaking Defense* (http://breakingdefense.com), April 7, 2014.

- Instead of 24 SLBM launch tubes, as on the Ohio-class design, the Columbia class is to have 16 SLBM launch tubes.
- As noted earlier, although the Columbia-class design has fewer SLBM tubes than the Ohio-class design, it is larger than the Ohio-class design in terms of submerged displacement. The Columbia-class design has a reported submerged displacement of 20,815 tons (as of August 2014), compared to 18,750 tons for the Ohio-class design.[69] The Columbia-class design, like the Ohio-class design before it, will be the largest submarine ever built by the United States.
- The Navy states that "owing to the unique demands of strategic relevance, [Columbia-class boats] must be fitted with the most up-to-date capabilities and stealth to ensure they are survivable throughout their full 40-year life span."[70]

June 2013 Navy Blog Post Regarding Ohio Replacement Options

A June 26, 2013, blog post by Rear Admiral Richard Breckenridge, the Navy's Director for Undersea Warfare (N97), discussing options that were examined for replacing the Ohio-class SSBNs, stated the following:

> Over the last five years, the Navy–working with U.S. Strategic Command, the Joint Staff and the Office of the Secretary of Defense–has formally examined various options to replace the Ohio ballistic missile submarines as they retire beginning in 2027. This analysis included a variety of replacement platform options, including designs based on the highly successful Virginia-class attack submarine program and the current Ohio-class ballistic missile submarine. In the end, the Navy elected to pursue a new design that leverages the lessons from the Ohio, the Virginia advances in shipbuilding and improvements in cost-efficiency.
>
> Recently, a variety of writers have speculated that the required survivable deterrence could be achieved more cost effectively with the Virginia-based option or by restarting the Ohio-class SSBN production line. Both of these ideas make sense at face value–which is why they were included among the alternatives assessed–but the devil is in the details. When we examined the particulars, each of these options came up short in both military effectiveness and cost efficiency.
>
> **Virginia-based SSBN design with a Trident II D5 missile.** An SSBN design based on a Virginia-class attack submarine with a large-diameter missile compartment was rejected due to a wide range of shortfalls. It would

[69] Navy information paper on Columbia-class program dated August 11, 2014, provided to CBO and CRS on August 11, 2014.

[70] U.S. Navy, *Report to Congress on Annual Long-Range Plan for Construction of Naval Vessels for FY 2011*, February 2010, p. 24. See also Mike McCarthy, "Navy Striving To Reduce Detectability Of Next Boomers," *Defense Daily*, February 6, 2015: 1. In an article published in June 2012, the program manager for the Columbia-class program stated that "the current configuration of the Ohio replacement is an SSBN with 16 87-inch-diameter missile tubes, a 43-foot-diamater hull, electric-drive propulsion, [an] X-stern, accommodations for 155 personnel, and a common submarine radio room tailored to the SSBN mission." (Dave Bishop, "What Will Follow the Ohio Class?" *U.S. Naval Institute Proceedings*, June 2012: 31. See also Sam LaGrone and Richard Scott, "Strategic Assets: Deterrent Plans Confront Cost Challenges," *Jane's Navy International*, December 2011: 15 and 16. The X-stern is also shown in Rear Admiral David Johnson, briefing to Naval Submarine League Annual Symposium [on] Expanding Undersea Dominance, October 23, 2014, briefing slide 19.) The term X-stern means that the steering and diving fins at the stern of the ship are, when viewed from the rear, in the diagonal pattern of the letter X, rather than the vertical-and horizontal pattern of a plus sign (which is referred to as a cruciform stern). The common submarine radio room is a standardized (i.e., common) suite of submarine radio room equipment that is being installed on other U.S. Navy submarines.

• Not meet survivability (stealth) requirements due to poor hull streamlining and lack of a drive train able to quietly propel a much larger ship

• Not meet at-sea availability requirements due to longer refit times (since equipment is packed more tightly within the hull, it requires more time to replace, repair and retest)

• Not meet availability requirements due to a longer mid-life overhaul (refueling needed)

• Require a larger number of submarines to meet the same operational requirement

• Reduce the deterrent value needed to protect the country (fewer missiles, warheads at-sea)

• Be more expensive than other alternatives due to extensive redesign of Virginia systems to work with the large missile compartment (for example, a taller sail, larger control surfaces and more robust support systems)

We would be spending more money (on more ships) to deliver less deterrence (reduced at-sea warhead presence) with less survivability (platforms that are less stealthy).

Virginia-based SSBN design with a smaller missile. Some have encouraged the development of a new, smaller missile to go with a Virginia-based SSBN. This would carry forward many of the shortfalls of a Virginia-based SSBN we just discussed, and add to it a long list of new issues. Developing a new nuclear missile from scratch with an industrial base that last produced a new design more than 20 years ago would be challenging, costly and require extensive testing. We deliberately decided to extend the life of the current missile to decouple and de-risk the complex (and costly) missile development program from the new replacement submarine program. Additionally, a smaller missile means a shorter employment range requiring longer SSBN patrol transits. This would compromise survivability, require more submarines at sea and ultimately weaken our deterrence effectiveness. With significant cost, technical and schedule risks, there is little about this option that is attractive.

Ohio-based SSBN design. Some have argued that we should re-open the Ohio production line and resume building the Ohio design SSBNs. This simply cannot be done because there is no Ohio production line. It has long since been re-tooled and modernized to build state-of-the-art Virginia-class SSNs using computerized designs and modular, automated construction techniques. Is it desirable to redesign the Ohio so that a ship with its legacy performance could be built using the new production facilities? No, since an Ohio-based SSBN would

• Not provide the required quieting due to Ohio design constraints and use of a propeller instead of a propulsor (which is the standard for virtually all new submarines)

• Require 14 instead of 12 SSBNs by reverting to Ohio class operational availability standards (incidentally creating other issues with the New START treaty limits)

• Suffer from reduced reliability and costs associated with the obsolescence of legacy Ohio system components

Once again, the end result would necessitate procuring more submarines (14) to provide the required at-sea presence and each of them would be less stealthy and less survivable against foreseeable 21st century threats.

The Right Answer: A new design SSBN that improves on Ohio: What has emerged from the Navy's exhaustive analysis is an Ohio replacement submarine that starts with the foundation of the proven performance of the Ohio SSBN, its Trident II D5 strategic weapons system and its operating cycle. To this it adds:

• Enhanced stealth as necessary to pace emerging threats expected over its service life

> • Systems commonality with Virginia (pumps, valves, sonars, etc.) wherever possible, enabling cost savings in design, procurement, maintenance and logistics
>
> • Modular construction and use of COTS equipment consistent with those used in today's submarines to reduce the cost of fabrication, maintenance and modernization. Total ownership cost reduction (for example, investing in a life-of-the-ship reactor core enables providing the same at-sea presence with fewer platforms).
>
> Although the Ohio replacement is a "new design," it is in effect an SSBN that takes the best lessons from 50 years of undersea deterrence, from the Ohio, from the Virginia, from advances in shipbuilding efficiency and maintenance, and from the stern realities of needing to provide survivable nuclear deterrence. The result is a low-risk, cost-effective platform capable of smoothly transitioning from the Ohio and delivering effective 21st century undersea strategic deterrence.[71]

16 vs. 20 SLBM Tubes

Overview

The Navy's decision to design Columbia-class boats with 16 SLBM tubes rather than 20 was one of several decisions the Navy made to reduce the estimated average procurement cost of boats 2 through 12 in the program toward a Navy target cost of $4.9 billion in FY2010 dollars.[72] Some observers were concerned that designing the Columbia class with 16 tubes rather than 20 would create a risk that U.S. strategic nuclear forces might not have enough capability in the 2030s and beyond to fully perform their deterrent role. These observers noted that to comply with the New Start Treaty limiting strategic nuclear weapons, DOD plans to operate in coming years a force of 14 Trident SSBNs, each with 20 operable SLBM tubes (4 of the 24 tubes on each boat are to be rendered inoperable), for a total of 280 tubes, whereas the Navy in the Columbia-class program is planning a force of 12 SSBNs each with 16 tubes, for a total of 192 tubes, or about 31% less than

[71] "Facts We Can Agree Upon About Design of Ohio Replacement SSBN," Navy Live, accessed July 3, 2013, at http://navylive.dodlive.mil/2013/06/26/facts-we-can-agree-upon-about-design-of-ohio-replacement-ssbn/.

[72] At a March 30, 2011, hearing before the Strategic Forces subcommittee of the Senate Armed Services Committee, Admiral Kirkland Donald, Deputy Administrator for Naval Reactors and Director, Naval Nuclear Propulsion, National Nuclear Security Administration, when asked for examples cost efficiencies that are being pursued in his programs, stated the following:

> The—the Ohio replacement [program] has been one that we've obviously been focused on here for—for several years now. But in the name of the efficiencies, and one of the issues as we work through the Defense Department's acquisition process, we were the first program through that new process that Dr. [Aston] Carter [the DOD acquisition executive] headed up.
>
> But we were challenged to—to drive the cost of that ship down, and as far as our part was concerned, one of the key decisions that was made that—that helped us in that regard was a decision to go from 20 missile tubes to 16 missile tubes, because what that allowed us to do was to down rate the—the propulsion power that was needed, so obviously, it's a–it's a small[er] the reactor that you would need.
>
> But what it also allowed us to do was to go back [to the use of existing components]. The size [of the ship] fell into the envelope where we could go back and use components that we had already designed for the Virginia class [attack submarines] and bring those into this design, not have to do it over again, but several of the mechanical components, to use those over again.
>
> And it enabled us to drive the cost of that propulsion plant down and rely on proven technology that's—pumps and valves and things like that don't change like electronics do.
>
> So we're pretty comfortable putting that in ship that'll be around 'til 2080. But we were allowed to do that.
>
> (Source: Transcript of hearing.)

280. These observers also cited the uncertainties associated with projecting needs for strategic deterrent forces out to the year 2080, when the final Columbia-class boat is scheduled to leave service. These observers asked whether the plan to design the Columbia class with 16 tubes rather than 20 was fully supported within all parts of DOD, including U.S. Strategic Command (STRATCOM).

In response, Navy and other DOD officials stated that the decision to design the Columbia class with 16 tubes rather than 20 was carefully considered within DOD, and that they believe a boat with 16 tubes will give U.S. strategic nuclear forces enough capability to fully perform their deterrent role in the 2030s and beyond.

Testimony in 2011

At a March 1, 2011, hearing before the House Armed Services Committee, Admiral Gary Roughead, then-Chief of Naval Operations, stated the following:

> I'm very comfortable with where we're going with SSBN-X. The decision and the recommendation that I made with regard to the number of tubes—launch tubes are consistent with the new START treaty. They're consistent with the missions that I see that ship having to perform. And even though it may be characterized as a cost cutting measure, I believe it sizes the ship for the missions it will perform.[73]

At a March 2, 2011, hearing before the Strategic Forces subcommittee of the House Armed Services Committee, the following exchange occurred:

> REPRESENTATIVE TURNER:
>
> General Kehler, thank you so much for your continued thoughts and of course your leadership. One item that we had a discussion on was the triad, of looking to—of the Navy and the tube reductions of 20 to 16, as contained in other hearings on the Hill today. I would like your thoughts on the reduction of the tubes and what you see driving that, how you see it affecting our strategic posture and any other thoughts you have on that?
>
> AIR FORCE GENERAL C. ROBERT KEHLER, COMMANDER, U.S. STRATEGIC COMMAND
>
> Thank you, Mr. Chairman. Well, first of all, sir, let me say that the—in my mind anyway, the discussion of Trident and Ohio-class replacement is really a discussion in the context of the need to modernize the entire triad. And so, first of all, I think that it's important for us to recognize that that is one piece, an important piece, but a piece of the decision process that we need to go through.
>
> Second, the issue of the number of tubes is not a simple black-and-white answer. So let me just comment here for a minute.
>
> First of all, the issue in my mind is the overall number of tubes we wind up with at the end, not so much as the number of tubes per submarine.
>
> Second, the issue is, of course, we have flexibility and options with how many warheads per missile per tube, so that's another consideration that enters into this mixture.
>
> Another consideration that is important to me is the overall number of boats and the operational flexibility that we have with the overall number of boats, given that some number will need to be in maintenance, some number will need to be in training, et cetera.
>
> And so those and many other factors—to include a little bit of foresight here, in looking ahead to 20 years from now in antisubmarine warfare environment that the Navy will have

[73] Source: Transcript of hearing.

> to operate in, all of those bear on the ultimate sideways shape configuration of a follow-on to the Ohio.
>
> At this point, Mr. Chairman, I am not overly troubled by going to 16 tubes. As I look at this, given that we have that kind of flexibility that I just laid out; given that this is an element of the triad and given that we have some decision space here as we go forward to decide on the ultimate number of submarines, nothing troubles me operationally here to the extent that I would oppose a submarine with 16 tubes.
>
> I understand the reasons for wanting to have 20. I understand the arguments that were made ahead of me. But as I sit here today, given the totality of the discussion, I am—as I said, I am not overly troubled by 16. Now, I don't know that the gavel has been pounded on the other side of the river yet with a final decision, but at this point, I am not overly troubled by 16.[74]

At an April 5, 2011, hearing before the Strategic Forces subcommittee of the House Armed Services Committee, the following exchange occurred:

> REPRESENTATIVE LARSEN:
>
> General Benedict, we have had this discussion, not you and I, I am sorry. But the subcommittee has had a discussion in the past with regards to the Ohio-class replacement program.
>
> The new START, though, when it was negotiated, assumed a reduction from 24 missile tubes per hole to, I think, a maximum a maximum of 20.
>
> The current configuration [for the Columbia class], as I understand it, would move from 24 to 16.
>
> Can you discuss, for the subcommittee here, the Navy's rationale for that? For moving from 24 to 16 as opposed to the max of 20?
>
> NAVY REAR ADMIRAL TERRY BENEDICT, DIRECTOR, STRATEGIC SYSTEMS PROGRAMS (SSP):
>
> Sir, as part—excuse me, as part of the work-up for the milestone A [review for the Columbia class program] with Dr. Carter in OSD, SSP supported the extensive analysis at both the OSD level as well as STRATCOM's analysis.
>
> Throughout that process, we provided, from the SWS [strategic weapon system] capability, our perspective. Ultimately that was rolled up into both STRATCOM and OSD and senior Navy leadership and in previous testimony, the secretary of the Navy, the CNO, and General Chilton have all expressed their confidence that the mission of the future, given their perspectives, is they see the environment today can be met with 16.
>
> And so, as the acquisition and the SWS provider, we are prepared to support that decision by leadership, sir.
>
> REPRESENTATIVE LARSEN:
>
> Yes.
>
> And your analysis supports—did your analysis that fed into this, did you look at specific numbers then?
>
> REARD ADMIRAL BENEDICT:
>
> Sir, we looked at the ability of the system, again, SSP does not look at specific targets with...

[74] Source: Transcript of hearing.

> REPRESENTATIVE LARSEN:
>
> Right. Yes, yes, yes.
>
> REAR ADMIRAL BENEDICT:
>
> Our input was the capability of the missile, the number of re-entry bodies and the throw weight that we can provide against those targets and based on that analysis, the leadership decision was 16, sir.[75]

At an April 6, 2011, hearing before the Strategic Forces subcommittee of the Senate Armed Services Committee, the following exchange occurred:

> SENATOR SESSIONS:
>
> Admiral Benedict, according to recent press reports, the Navy rejected the recommendations of Strategic Command to design the next generation of ballistic missile submarines with 20 missile tubes instead of opting for only 16 per boat.
>
> What is the basis for the Navy's decision of 16? And I'm sure cost is a factor. In what ways will that decision impact the overall nuclear force structure associated with the command?
>
> NAVY REAR ADMIRAL TERRY BENEDICT, DIRECTOR, STRATEGIC SYSTEMS PROGRAMS (SSP):
>
> Yes, sir. SSP supported the Navy analysis, STRATCOM's analysis, as well as the OSD analysis, as we proceeded forward and towards the Milestone A decision [on the Columbia class program] that Dr. Carter conducted.
>
> Based on our input, which was the technical input as the—as the director of SSP, other factors were considered, as you stated. Cost was one of them. But as the secretary, as the CNO, and I think as General Kehler submitted in their testimony, that given the threats that we see today, given the mission that we see today, given the upload capability of the D-5, and given the environment as they saw today, all three of those leaders were comfortable with the decision to proceed forward with 16 tubes, sir.
>
> SENATOR SESSIONS:
>
> And is that represent your judgment? To what extent were you involved—were you involved in that?
>
> REAR ADMIRAL BENEDICT:
>
> Sir, we were involved from technical aspects in terms of the capability of the missile itself, what we can throw, our range, our capability. And based on what we understand the capability of the D-5 today, which will be the baseline missile for the Ohio Replacement Program, as the director of SSP I'm comfortable with that decision.[76]

Section 242 Report

Section 242 of the FY2012 National Defense Authorization Act (H.R. 1540/P.L. 112-81 of December 31, 2011) required DOD to submit a report on the Columbia-class program that includes, among other things, an assessment of various combinations of boat quantities and numbers of SLBM launch tubes per boat. The text of the section is as follows:

> SEC. 242. REPORT AND COST ASSESSMENT OF OPTIONS FOR OHIO-CLASS REPLACEMENT BALLISTIC MISSILE SUBMARINE.

[75] Source: Transcript of hearing.

[76] Source: Transcript of hearing.

> (a) Report Required- Not later than 180 days after the date of the enactment of this Act, the Secretary of the Navy and the Commander of the United States Strategic Command shall jointly submit to the congressional defense committees a report on each of the options described in subsection (b) to replace the Ohio-class ballistic submarine program. The report shall include the following:
>
> (1) An assessment of the procurement cost and total life-cycle costs associated with each option.
>
> (2) An assessment of the ability for each option to meet—
>
> (A) the at-sea requirements of the Commander that are in place as of the date of the enactment of this Act; and
>
> (B) any expected changes in such requirements.
>
> (3) An assessment of the ability for each option to meet—
>
> (A) the nuclear employment and planning guidance in place as of the date of the enactment of this Act; and
>
> (B) any expected changes in such guidance.
>
> (4) A description of the postulated threat and strategic environment used to inform the selection of a final option and how each option provides flexibility for responding to changes in the threat and strategic environment.
>
> (b) Options Considered- The options described in this subsection to replace the Ohio-class ballistic submarine program are as follows:
>
> (1) A fleet of 12 submarines with 16 missile tubes each.
>
> (2) A fleet of 10 submarines with 20 missile tubes each.
>
> (3) A fleet of 10 submarines with 16 missile tubes each.
>
> (4) A fleet of eight submarines with 20 missile tubes each.
>
> (5) Any other options the Secretary and the Commander consider appropriate.
>
> (c) Form- The report required under subsection (a) shall be submitted in unclassified form, but may include a classified annex.

Subsection (c) above states the report "shall be submitted in unclassified form, but may include a classified annex."

The report as submitted was primarily the classified annex, with a one-page unclassified summary, the text of which is as follows (underlining as in the original):

> The National Defense Authorization Act (NDAA) for Fiscal Year 2012 (FY12) directed the Secretary of the Navy and the Commander of U.S. Strategic Command (USSTRATCOM) to jointly submit a report to the congressional defense committees comparing four different options for the OHIO Replacement (OR) fleet ballistic missile submarine (SSBN) program. Our assessment considered the current operational requirements and guidance. The four SSBN options analyzed were
>
> 1. 12 SSBNs with 16 missile tubes each
>
> 2. 10 SSBNs with 20 missile tubes each
>
> 3. 10 SSBNs with 16 missile tubes each
>
> 4. 8 SSBNs with 20 missile tubes each
>
> The SSBN force continues to be an integral part of our nuclear Triad and contributes to deterrence through an assured second strike capability that is survivable, reliable, and

credible. The number of SSBNs and their combined missile tube capacity are important factors in our flexibility to respond to changes in the threat and uncertainty in the strategic environment.

We assessed each option against the ability to meet nuclear employment and planning guidance, ability to satisfy at-sea requirements, flexibility to respond to future changes in the postulated threat and strategic environment, and cost. In general, options with more SSBNs can be adjusted downward in response to a diminished threat; however, options with less SSBNs are more difficult to adjust upward in response to a growing threat.

Clearly, a smaller SSBN force would be less expensive than a larger force, but for the reduced force options we assessed, they fail to meet current at-sea and nuclear employment requirements, increase risk in force survivability, and limit flexibility in response to an uncertain strategic future. Our assessment is the program of record, 12 SSBNs with 16 missile tubes each, provides the best balance of performance, flexibility, and cost meeting commander's requirements while supporting the Nation's strategic deterrence mission goals and objectives.

The classified annex contains detailed analysis that is not releasable to the public.[77]

[77] Report and Cost Assessment of Options for OHIO-Class Replacement Ballistic Missile Submarine, Unclassified Summary, received from Navy Legislative Affairs Office, August 24, 2012. See also Christopher J. Castelli, "Classified Navy Assessment On SSBN(X) Endorses Program Of Record," *Inside the Navy*, September 10, 2012.

For more recent discussions of this issue, see Patty-Jane Geller and Brent D. Sadler, "Faulty Assumptions About the Global Nuclear Threat May Require Changes in U.S. SeaBased Nuclear Force," Heritage Foundation, February 22, 2022, 11 pp.; Frank Miller, "Don't Even Think About Redesigning the Columbia SSBN," *RealClearDefense*, March 31, 2022.

Appendix E. National Sea-Based Deterrence Fund (NSBDF)

This appendix provides additional background information on the National Sea-Based Deterrence Fund (NSBDF).

Created by P.L. 113-291

Section 1022 of the Carl Levin and Howard P. "Buck" McKeon National Defense Authorization Act for Fiscal Year 2015 (H.R. 3979/P.L. 113-291 of December 19, 2014) created the National Sea-Based Deterrence Fund (NSBDF), a fund in the DOD budget, codified at 10 U.S.C. 2218a, that is separate from the Navy's regular shipbuilding account (which is formally known as the Shipbuilding and Conversion, Navy, or SCN, appropriation account).

Amended by Subsequent Legislation

Section 1022 of the FY2016 National Defense Authorization Act (S. 1356/P.L. 114-92 of November 25, 2015), Section 1023 of the FY2017 National Defense Authorization Act (S. 2943/P.L. 114-328 of December 23, 2016), Section 1022 of the FY2018 National Defense Authorization Act (H.R. 2810/P.L. 115-91 of December 12, 2017), and Section 1023 of the FY2021 National Defense Authorization Act (H.R. 6395/P.L. 116-283 of January 1, 2021) amended 10 U.S.C. 2218a to provide additional acquisition authorities for the NSBDF.

Text as Amended

The text of 10 U.S.C. 2218a, as of September 24, 2025, is as follows:

> **§2218a. National Sea-Based Deterrence Fund**
>
> (a) Establishment.-There is established in the Treasury of the United States a fund to be known as the "National Sea-Based Deterrence Fund".
>
> (b) Administration of Fund.-The Secretary of Defense shall administer the Fund consistent with the provisions of this section.
>
> (c) Fund Purposes.-(1) Funds in the Fund shall be available for obligation and expenditure only for construction (including design of vessels), purchase, alteration, and conversion of national sea-based deterrence vessels.
>
> (2) Funds in the Fund may not be used for a purpose or program unless the purpose or program is authorized by law.
>
> (d) Deposits.-There shall be deposited in the Fund all funds appropriated to the Department of Defense for construction (including design of vessels), purchase, alteration, and conversion of national sea-based deterrence vessels.
>
> (e) Expiration of Funds After 5 Years.-No part of an appropriation that is deposited in the Fund pursuant to subsection (d) shall remain available for obligation more than five years after the end of fiscal year for which appropriated except to the extent specifically provided by law.
>
> (f) Authority to Enter Into Economic Order Quantity Contracts.-(1) The Secretary of the Navy may use funds deposited in the Fund to enter into contracts known as "economic order quantity contracts" with private shipyards and other commercial or government entities to achieve economic efficiencies based on production economies for major

components or subsystems. The authority under this subsection extends to the procurement of parts, components, and systems (including weapon systems) common with and required for other nuclear powered vessels under joint economic order quantity contracts.

(2) A contract entered into under paragraph (1) shall provide that any obligation of the United States to make a payment under the contract is subject to the availability of appropriations for that purpose, and that total liability to the Government for termination of any contract entered into shall be limited to the total amount of funding obligated at time of termination.

(g) Authority to Begin Manufacturing and Fabrication Efforts Prior to Ship Authorization.-(1) The Secretary of the Navy may use funds deposited into the Fund to enter into contracts for advance construction of national sea-based deterrence vessels to support achieving cost savings through workload management, manufacturing efficiencies, or workforce stability, or to phase fabrication activities within shipyard and manage sub-tier manufacturer capacity.

(2) A contract entered into under paragraph (1) shall provide that any obligation of the United States to make a payment under the contract is subject to the availability of appropriations for that purpose, and that total liability to the Government for termination of any contract entered into shall be limited to the total amount of funding obligated at time of termination.

(h) Authority to Use Incremental Funding to Enter Into Contracts for Certain Items.-(1) The Secretary of the Navy may use funds deposited into the Fund to enter into incrementally funded contracts for-

(A) advance procurement of high value, long lead time items for nuclear powered vessels to better support construction schedules and achieve cost savings through schedule reductions and properly phased installment payments; and

(B) construction of the first two Columbia class submarines.

(2) A contract entered into under paragraph (1) shall provide that any obligation of the United States to make a payment under the contract is subject to the availability of appropriations for that purpose, and that total liability to the Government for termination of any contract entered into shall be limited to the total amount of funding obligated at time of termination.

(i) Authority for Multiyear Procurement of Critical Components to Support Continuous Production.-(1) To implement the continuous production of critical components, the Secretary of the Navy may use funds deposited in the Fund, in conjunction with funds appropriated for the procurement of other nuclear-powered vessels, to enter into one or more multiyear contracts (including economic ordering quantity contracts), for the procurement of critical contractor-furnished and Government-furnished components for critical components of national sea-based deterrence vessels. The authority under this subsection extends to the procurement of equivalent critical components common with and required for other nuclear-powered vessels.

(2) In each annual budget request submitted to Congress, the Secretary shall clearly identify funds requested for critical components and the individual ships and programs for which such funds are requested.

(3) Any contract entered into pursuant to paragraph (1) shall provide that any obligation of the United States to make a payment under the contract is subject to the availability of appropriations for that purpose and that the total liability to the Government for the termination of the contract shall be limited to the total amount of funding obligated for the contract as of the date of the termination.

(j) Budget Requests.-Budget requests submitted to Congress for the Fund shall separately identify the amount requested for programs, projects, and activities for construction (including design of vessels), purchase, alteration, and conversion of national sea-based deterrence vessels.

(k) Definitions.-In this section:

(1) The term "Fund" means the National Sea-Based Deterrence Fund established by subsection (a).

(2) The term "national sea-based deterrence vessel" means any submersible vessel constructed or purchased after fiscal year 2016 that is owned, operated, or controlled by the Department of Defense and that carries operational intercontinental ballistic missiles.

(3) The term "critical component" means any of the following:

(A) A common missile compartment component.

(B) A spherical air flask.

(C) An air induction diesel exhaust valve.

(D) An auxiliary seawater valve.

(E) A hovering valve.

(F) A missile compensation valve.

(G) A main seawater valve.

(H) A launch tube.

(I) A trash disposal unit.

(J) A logistics escape trunk.

(K) A torpedo tube.

(L) A weapons shipping cradle weldment.

(M) A control surface.

(N) A launcher component.

(O) A propulsor.

(P) Major bulkheads and tanks.

(Q) All major pumps and motors.

(R) Large vertical array.

(S) Atmosphere control equipment.

(T) Diesel systems and components.

(U) Hydraulic valves and components.

(V) Bearings.

(W) Major air and blow valves and components.

(X) Decks and superstructure.

(Y) Castings, forgings, and tank structure.

(Z) Hatches and hull penetrators.

Precedents for Funding Navy Acquisition Programs Outside Navy Appropriation Accounts

Prior to the establishment of the NSBDF, some observers had suggested funding the procurement of Columbia-class boats outside the Navy's shipbuilding budget so as to preserve Navy shipbuilding funds for other Navy shipbuilding programs. There was some precedent for such an arrangement.

- Construction of certain DOD sealift ships and Navy auxiliary ships was funded in past years in the National Defense Sealift Fund (NDSF), a part of DOD's budget that is outside the Shipbuilding and Conversion, Navy (SCN) appropriation account, and also outside the procurement title of the DOD appropriations act.
- Most spending for ballistic missile defense (BMD) programs (including procurement-like activities) is funded through the Defense-Wide research and development and procurement accounts rather than through the research and development and procurement accounts of the individual military services.

A rationale for funding DOD sealift ships in the NDSF had been that DOD sealift ships perform a transportation mission that primarily benefits services other than the Navy, and therefore should not be forced to compete for funding in a Navy budget account that funds the procurement of ships central to the Navy's own missions. A rationale for funding BMD programs together in the Defense-Wide research and development account is that this makes potential trade-offs in spending among various BMD programs more visible and thereby helps to optimize the use of BMD funding.

Potential Implications of NSBDF on Funding Available for Other Programs

The NSBDF has at least two potential implications for the impact that the Columbia-class program may have on funding available in coming years for other DOD acquisition programs:

- A principal apparent intent in creating the NSBDF is to help preserve funding in coming years for other Navy programs, and particularly Navy shipbuilding programs other than the Columbia-class program, by placing funding for the Columbia-class program in a location within the DOD budget that is separate from the Navy's shipbuilding account and the Navy's budget in general. Referring to the fund as a national fund and locating it outside the Navy's budget appears intended to encourage a view (consistent with an argument made by supporters of the Columbia-class program that the program is intended to meet a national military need rather than a Navy-specific need) that funding for the Columbia-class program should be resourced from DOD's budget as a whole, rather than from the Navy's budget in particular.
- The acquisition authorities in subsections (f), (g), (h), and (i) of 10 U.S.C. 2218a, which were added by P.L. 114-92 and P.L. 114-328, could marginally reduce the procurement costs of not only Columbia-class boats, but also other nuclear-powered ships, such as Virginia-class attack submarines and Gerald R. Ford (CVN-78) class aircraft carriers, by increasing economies of scale in the production of ship components and better optimizing ship construction schedules.

The joint explanatory statement for the FY2016 National Defense Authorization Act (S. 1356/P.L. 114-92 of November 25, 2015) directed DOD to submit a report on the "acquisition strategy to build Ohio-class replacement submarines that will leverage the enhanced procurement authorities provided in the [NSBDF] ... ." Among other things, the report was to identify "any additional authorities the Secretary [of Defense] may need to make management of the Ohio-class replacement more efficient...."[78] The Navy submitted the report on April 18, 2016. The report states in part that

> the high cost for this unique, next generation strategic deterrent requires extraordinary measures to ensure its affordability. Further, procuring the OHO Replacement (OR), the next generation SSBN, within the current shipbuilding plan presents an extreme challenge to the Navy's shipbuilding budget. To minimize this challenge and reduce OR schedule risk, the Navy proposes to leverage those authorities provided by the National Sea-Based Deterrence Fund (NSBDF) in conjunction with the employment of best acquisition practices on this critical program....
>
> ... the Navy is continuing to identify opportunities to further acquisition efficiency, reduce schedule risk, and improve program affordability. Most notably in this regard, the Navy is currently assessing [the concept of] Continuous Production [for producing components of Columbia-class boats more efficiently than currently scheduled] and will keep Congress informed as we quantify the benefits of this and other initiatives that promise substantial savings....
>
> ... the Navy's initial assessment is that the authorities and further initiatives described [in this report] will be essential to achieving the reductions to acquisition cost and schedule risk that are so critical to success on the OR program....
>
> Section 1022 of the FY2016 NDAA authorized the use of funds in the NSBDF to enter into contracts for EOQ [Economic Order Quantity purchases of materials and equipment] and AC [advance construction activities in shipyards], and to incrementally fund contracts for AP [advance procurement] of specific components. These authorities are essential to successfully executing the OR acquisition strategy. The Navy is able to take advantage of these authorities largely due to how its submarine shipbuilding plan is phased....
>
> Economic Order Quantity contracts provide substantial cost savings to the Navy from procuring materials and equipment in bulk quantities. In addition to the cost savings typically associated with EOQ authority, the Navy has identified an opportunity to implement EOQ procurements to achieve OR schedule efficiencies and commonality contract actions with VCS [Virginia-class submarine] Block V [boats] and CVN [nuclear-powered aircraft carriers]....
>
> Advance Construction is the authority to begin [shipyard] construction [work] in fiscal years of AP [advance procurement] budget requests prior to the full funding/authorization year of a hull. Early manufacturing activities help retire construction risk for first-of-a-kind efforts, ease transition from design to production, and provide efficiencies in shipyard construction workload. Advance Construction would allow the shipbuilders to begin critical path construction activities earlier, thus reducing risk to the OR delivery schedule....
>
> The FY2016 NDAA allows the Navy and shipbuilders to enter into incrementally funded procurements for long lead components that employ both AP and Full Funding (FF) SCN increments. This funding approach will provide significant schedule improvements and cost savings by maximizing the utilization of limited funding....

[78] Joint explanatory statement for H.R. 1735, p. 165 (PDF page 166 of 542). Following the veto of H.R. 1735, a modified bill, S. 1356, was passed and enacted into law. Except for the parts of S. 1356 that differ from H.R. 1735, the joint explanatory statement for H.R. 1735 in effect serves as the joint explanatory statement for S. 1356.

Maximum economic advantage can be obtained through Continuous Production. Procuring components and systems necessary for Continuous Production lines [as opposed to production lines that experience periods during which they are without work] would provide opportunities for savings through manufacturing efficiencies, increased [production-line] learning and the retention of critical production skills. In addition to lowering costs, Continuous Production would reduce schedule risk for both the U.S. and UK SSBN construction programs and minimize year-to-year funding spikes. To execute Continuous Production, the Navy requires authority to enter into contracts to procure contractor furnished and government furnished components and systems for OR SSBNs.

OR Missile Tube and Missile Tube Module component procurement through Continuous Production lines have been identified as the most efficient and affordable procurement strategy.... Missile Tube Continuous Production could achieve an average reduction of 25 percent in Missile Tube procurement costs across the [Columbia] Class. These savings are compared to [the] single shipset procurement costs [that are] included in the PB17 PoR [the program of record reflected in the President's (proposed) Budget for FY2017]....

The Navy estimates that procuring Missile Tube Modules in Continuous Production lines would result in a cumulative one year schedule reduction in Missile Tube Module manufacturing for the OR Class. This schedule reduction, on a potential critical path assembly, would reduce ship delivery risk and increase schedule margin for follow ship deliveries. In addition to improving schedule, Missile Tube Module Continuous Production (including Strategic Weapon System (SWS) Government Furnished Equipment (GFE)) would produce savings as high as 20 percent compared to single shipset procurement costs included in the PB17 PoR. Executing Continuous Production of Missile Tubes or Missile Tube Modules requires re-phasing of funding from outside the PB17 Future Year's Defense Program (FYDP) [to years that are within the FYDP] but results in significant overall program reductions. The Navy is evaluating additional Continuous Production opportunities for nuclear and nonnuclear components with common vendors required for VIRGINIA Class submarines and FORD Class aircraft carriers. Some examples include spherical air flasks, hull valves, pressure hull hemi heads, bow domes, castings, and torpedo tubes. The prerequisite to Continuous Production in each of these cases would be an affirmation of design stability consistent with completion of first article testing, or its equivalent....

The Navy's position on the cost benefits of these authorities is not fully developed. However, the Congressional Budget Office stated in its *Analysis of the Navy's FY2016 Shipbuilding Plan*, " ... the Navy could potentially save several hundred million dollars per submarine by purchasing components and materials for several submarines at the same time."... The Navy's initial cost analysis aligns with CBO's projections, and the cost reductions from employing these acquisition authorities will be further evaluated to support the Navy's updated OR Milestone B cost estimate in August 2016....

The Under Secretary of Defense for Acquisition, Technology and Logistics (USD AT&L) approved the OR Program Acquisition Strategy on January 4, 2016. This strategy emphasizes using alternative acquisition tools and cross-platform contracting to reduce schedule risk and lower costs in support of the Navy's shipbuilding programs....

To reduce costs and help alleviate fiscal pressures, the Navy will work with Congress to implement granted authorities and explore the additional initiatives identified in this report.... The cost reductions from employing the granted and proposed acquisition authorities will be further evaluated to support the Navy's updated OR Milestone B cost estimate in August 2016.... These authorities are needed with the National Sea-Based Deterrence Fund, RDTEN [research, development, test, and evaluation, Navy], and SCN appropriations accounts. Together, these acquisition tools will allow the Navy, and the

shipbuilders, to implement the procurement strategy which will reduce total OR acquisition costs and shorten construction schedules for a program with no margin for delay.[79]

Navy Use of Acquisition Authorities

The Navy states that it is using the acquisition authorities in subsections (f), (g), (h), and (i) of 10 U.S.C. 2218a, and that doing so has marginally reduced the estimated combined procurement cost of the 12 Columbia-class boats.[80]

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Disclaimer

[79] U.S. Navy, *Report to Congress on Ohio Replacement Acquisition Strategy and National Sea-Based Deterrence Fund Accountability*, April 2016, with cover letters dated April 18, 2016, pp. 1-8.

[80] Navy briefing, "COLUMBIA Class National Sea Based Deterrence Fund Procurement Authorities & Initiatives," March 2022, provided to CRS and CBO by Navy Office of Legislative Affairs, July 1, 2022.