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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) program is a program 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. The Navy's proposed FY2024 budget requests the procurement of the second boat in the class.

The Navy's FY2024 budget submission estimates the procurement costs of the first and second boats at $15,179.1 million and $9,285.3 million (i.e., about $15.2 billion and $9.3 billion), respectively. The first boat's procurement cost is much higher than that of subsequent boats in the class because the first 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 DD/NRE costs for a new class of ship into the total procurement cost of the first ship in the class.) The first boat's estimated procurement cost includes $6,557.6 million for plans, meaning, meaning (essentially) the DD/NRE costs for the class. Excluding costs for plans, the estimated hands-on construction cost of the first ship is $8,621.5 million.

The third, fourth, and fifth boats in the class, which are programmed for procurement in FY2026, FY2027, and FY2028, have estimated procurement costs of about $8.2 billion or $8.3 billion each. The Navy's FY2024 budget submission estimates the total procurement cost of a 12-ship class at $112.7 billion in then-year dollars, or an average of $9,387.6 million each in then-year dollars.

The first two boats in the class are being funded with incremental funding, meaning that the procurement cost of each boat has been divided into multiple annual increments. The procurement of the first boat was funded with three increments in FY2021-FY2023, and the procurement of the second boat is programmed to be funded with two increments in FY2024 and FY2025.

The Navy's proposed FY2024 budget requests $2,443.6 million (i.e., about $2.4 billion) in procurement funding for the second boat and $3,390.7 million (i.e., about $3.4 billion) in advance procurement (AP) funding for Columbia-class boats to be procured in FY2026 and subsequent years.

In addition to the above requested funds, on October 20, 2023, the Administration submitted a request for FY2024 emergency supplemental funding for national security priorities that includes, among other things, a total of $3,393.2 million in funding for the submarine industrial base to support construction of new submarines and maintenance of existing submarines.

Issues for Congress for the Columbia-class program include the following:

- the risk—due to technical challenges and/or funding-related issues—of a delay in designing and building the lead Columbia-class boat, which could put at risk the Navy's ability to have the boat ready for its first scheduled deterrent patrol in 2031, when it is to deploy in the place of the first retiring Ohio-class SSBN;
- the risk of cost growth in the program;
- the potential impact of the Columbia-class program on funding that will be available for other Navy programs, including other shipbuilding programs; and
- potential industrial-base challenges of building both Columbia-class boats and Virginia-class attack submarines (SSNs) at the same time.

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Introduction

This report provides background information and potential oversight issues for Congress on the Navy's Columbia (SSBN-826) class program, a program 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. The Navy's proposed FY2024 budget requests the procurement of the second boat in the class. The Navy's proposed FY2024 budget requests $2,443.6 million (i.e., about $2.4 billion) in procurement funding for the second boat and $3,390.7 million (i.e., about $3.4 billion) in advance procurement (AP) funding for Columbia-class boats to be procured in FY2026 and subsequent years.

The program poses a number of funding and oversight issues for Congress. Decisions that Congress makes on the Columbia-class program 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 report—CRS Report RL33640, *U.S. Strategic Nuclear Forces: Background, Developments, and Issues*, by Amy F. Woolf—discusses the Columbia class as an element of future U.S. strategic nuclear forces in the context of strategic nuclear arms modernization efforts and arms control agreements.

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 submarines (SSBNs).[1] The SSNs and SSGNs are multi-mission ships that perform a variety of peacetime and wartime missions.[2] They do not carry nuclear weapons.[3]

The SSBNs, in contrast, perform a singular mission of strategic nuclear deterrence. To perform this mission, SSBNs are armed with submarine-launched ballistic missiles (SLBMs), which are large, long-range missiles armed with multiple nuclear warheads. SSBNs launch their SLBMs

[1] 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.

[2] For more on the Navy's SSNs and SSGNs, see CRS Report RL32418, *Navy Virginia-Class Submarine Program and AUKUS Submarine Proposal: 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.

[3] 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.

from large-diameter vertical launch tubes located in the middle section of the boat.[4] 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,"[5] 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.[6]

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 both a nuclear refueling and overhaul work on the ship that is not related to the nuclear refueling.[7]

The boats were originally designed to each carry 24 SLBMs. As part of DOD's plan for complying with U.S.-Russia strategic nuclear arms control limits, four SLBM launch tubes on each boat have been deactivated, reducing to 20 the number of SLBMs they can each carry.

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

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

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

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

[7] 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.

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.

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 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 in 2031, 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.[8] 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 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. GD/EB builds submarines

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

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.[9]

In addition to GD/EB and HII/NNS, the submarine construction industrial base includes hundreds of supplier firms, as well as laboratories and research facilities, in numerous states. Much of the total material procured from supplier firms for the construction of submarines comes from sole-source suppliers. For nuclear-propulsion component suppliers, an additional source of stabilizing work is the Navy's nuclear-powered aircraft carrier construction program.[10]

Much of the design and engineering portion of the submarine construction industrial base is resident at GD/EB. Smaller 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.[11]

Program Name, Origin, and Milestones

Until 2016, the Columbia-class program was known as the Ohio replacement program (ORP) or SSBN(X) program,[12] 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 in the class, would be named *Columbia*, in honor of the District of

[9] 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.

[10] 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.

[11] 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.)

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

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.[13]

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

Planned Procurement Quantity and Schedule

Planned Procurement Quantity of 12

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—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.[14]

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."[15] 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.[16] An October 2023 report by a congressional commission on U.S. strategic posture

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

[14] 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/.

[15] 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.

[16] 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.[17]

Relationship of Planned Procurement Quantity to Navy's Current 355-Ship Force-Level Goal

The Navy's existing force-level goal, which the Navy released on December 15, 2016, calls for achieving and maintaining a fleet of 355 ships, including, among other things, 12 Columbia-class ballistic missile submarines. The force-level goal of 12 Columbia-class boats was determined by the calculations described in the previous section. These calculations, which relate to the specialized mission strategic nuclear deterrence performed by SSBNs, are largely separate from the calculations that the Navy uses to determine force-level goals for the other types of ships that make up the Navy.

Planned Procurement Schedule

As noted earlier, the Navy procured the first Columbia-class boat in FY2021. The Navy wants to procure the second boat in the class in FY2024, and the remaining 10 boats at a rate of one per year from FY2026 through FY2035. Under the Navy's FY2024 budget submission, the first boat is to be delivered in October 2027, the second in April 2030, the third in August 2032, the fourth in September 2032, and the fifth in August 2033. After being delivered in October 2027, the lead boat is to undergo substantial testing, with the aim of having it be ready for its first deterrent patrol in 2031.

Taking into account both projected delivery dates for Columbia-class boats and projected retirement dates for Ohio-class boats, the Navy's FY2023 30-year (FY2023-FY2052) shipbuilding plan projects that the SSBN force will include 14 boats through FY2026, 13 boats in FY2027-FY2028, 12 boats in FY2029, 11 boats in FY2030-2032, and 12 boats in FY2033-FY2052 (except for FY2040-FY2041, when it is projected to include 13 boats).[18] The Navy has stated in earlier years that a reduction of the SSBN force to 11 boats during the transition of the force from the Ohio class to the Columbia class would be acceptable in terms of meeting strategic nuclear deterrence requirements, because during those transition years, all 11 of the SSBNs in service will be operational (i.e., none of them will be in the midst of a lengthy midlife overhaul). The Navy acknowledged that there would be some risk in having the SSBN force drop to 11 boats, because it would provide little margin for absorbing an unforeseen event that might force an SSBN into an unscheduled and lengthy maintenance action. The Navy is planning to extend the service lives of a few Ohio-class boats so as to minimize the period during which the SSBN force drops below 12 boats.[19]

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.

[17] 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.

[18] For more on the Navy's 30-year shipbuilding plan, see CRS Report RL32665, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, by Ronald O'Rourke.

[19] 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 (continued...)

Columbia-Class 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 now 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.

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).[20] As mentioned earlier,

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.

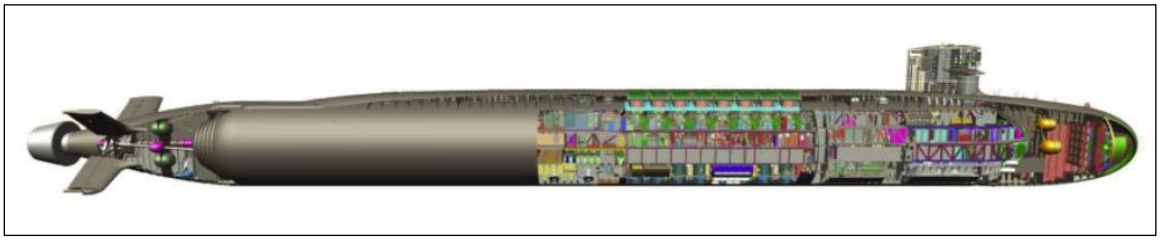
[20] Statement of Rear Admiral Stephen Johnson, USN, Director, Strategic Systems Programs, Before the Subcommittee on Strategic Forces of the Senate Armed Services Committee [on] FY2011 Strategic Systems, March 17, 2010, p. 6, (continued...)

Dreadnought-class SSBNs are to each be armed with eight D-5 SLBMs, or half the number to be carried by the Columbia class. The modular design of the CMC will accommodate this difference. The UK provided some of the funding for the design of the CMC, including a large portion of the initial funding.[21]

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

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.

Tight Schedule for Designing and Building Lead Boat

The schedule for designing and building the lead Columbia-class boat and having it ready for its scheduled first deterrent patrol in 2031 has little margin for absorbing unforeseen delays due to technical challenges or funding-related issues. A delay in designing and building the lead boat could put at risk the Navy's ability to have the boat ready for its first scheduled deterrent patrol in 2031, when it is to deploy in the place of the first retiring Ohio-class SSBN. 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 focused on anticipating, monitoring, and mitigating risks to the lead boat's construction schedule, so as to ensure that the schedule will be executed without significant delay.

Program Cost

Program Acquisition Cost

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

- The Navy's FY2024 budget submission estimated the total procurement cost of the 12-ship class at $112.7 billion in then-year dollars.

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."

[21] 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.

- A June 2023 Government Accountability Office (GAO) report assessing selected major DOD weapon acquisition programs stated that the estimated total acquisition (development plus procurement) cost of the Columbia-class program as of December 2021 was $114,132 million (about $114.1 billion) in constant FY2023 dollars, including $15,062 million (about $15.1 billion) in research and development costs and $98,700 million ($98.7 billion) in procurement costs.[22]

The above estimates do not include military construction (MilCon) costs (which are a third component, along with development and procurement costs, of total acquisition cost) or estimated costs for refurbishing D-5 SLBMs so as to extend their service lives to about 2040.

Estimated Procurement Costs of First Five Boats

The Navy's FY2024 budget submission estimates the procurement costs of the first and second boats at $15,179.1 million and $9,285.3 million (i.e., about $15.2 billion and $9.3 billion), respectively. The first boat's procurement cost is much higher than that of subsequent boats in the class because the first 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 DD/NRE costs for a new class of ship into the total procurement cost of the first ship in the class.) The first boat's estimated procurement cost includes $6,557.6 million for plans, meaning, meaning (essentially) the DD/NRE costs for the class. Excluding costs for plans, the estimated hands-on construction cost of the first ship is $8,621.5 million. The third, fourth, and fifth boats in the class, which are programmed for procurement in FY2026, FY2027, and FY2028, have estimated procurement costs of about $8.2 billion or $8.3 billion each.

Operation and Support (O&S) Cost

The Navy as of January 2017 estimated the average annual operation and support (O&S) cost of each Columbia-class boat at $119 million per year.[23]

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 originally with 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 more recent 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 the cost of Columbia-class boats and other Navy nuclear-powered ships (i.e., aircraft carriers and attack submarines). The Navy states 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.[24]

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[22] Government Accountability Office, *Weapon Systems Annual Assessment[:] Programs Are Not Consistently Implementing Practices That Can Help Accelerate Acquisitions*, GAO-23-106059, June 2023, p. 159.

[23] *Columbia Class MS [Milestone] B, Congressional Notification*, January 6, 2017, p. 1.

[24] 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.

For additional background information on the NSBDF, see **Appendix E**.

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),[25] so that HII/NNS will receive a larger share of the final-assembly work for that program than it has received in the past.[26]

Cost-Plus Incentive Fee (CPIF) Contract for First Two Ships

The Navy is using a cost-plus incentive fee (CPIF) contract to procure the first two Columbia-class ships. The contract includes a single option for both ships, but the Navy states that this is not a block buy contract,[27] even though the ships are to be procured in differing fiscal years (FY2021 and FY2024), because, with regard to the second ship, the option relates to the execution of the

[25] 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.

[26] Key elements of the Navy's 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 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.

[27] For more on block buy contracting, see CRS Report R41909, *Multiyear Procurement (MYP) and Block Buy Contracting in Defense Acquisition: Background and Issues for Congress*, by Ronald O'Rourke.

ship's advance procurement (AP) funding and the Navy technically is not making a commitment to continuing with construction of the second ship beyond what is funded with AP funding until that ship is authorized in FY2024 and full funding (as opposed to AP funding) is provided for the ship.[28] The Navy reportedly is considering using a five-ship block buy contract for the third through seventh boats in the program.[29]

Use of Incremental Funding for Procuring First Two Boats

The first two boats in the class are being funded with incremental funding, meaning that the procurement cost of each boat has been divided into multiple annual increments.[30] The procurement of the first boat was funded with three increments in FY2021-FY2023, and the procurement of the second boat is programmed to be funded with two increments in FY2024 and FY2025. **Table 1** shows the funding profiles for the first two boats. Note that this table does not show advance procurement (AP) funding for third and subsequent boats in the class.

Table 1. Procurement Funding Profiles for First Two Boats

Millions of dollars, rounded to nearest tenth

Fiscal year	First boat (SSBN-826)	Second boat (SSBN-827)
FY2017	773.1 (AP)	0
FY2018	802.3 (AP)	59.5 (AP)
FY2019	3,016.0 (AP)	139.1 (AP)
FY2020	1,636.4 (AP)	148.5 (AP)
FY2021	2,869.0 (FF)	1,110.7 (AP)
FY2022	3,003.0 (FF)	1,271.4 (AP)
FY2023	3,079.2 (FF)	769.1 (AP)
FY2024 (requested)	*0*	*2,443.6 (FF)*
FY2025 (programmed)	*0*	*3,343.4 (FF)*
Total	**15,179.1**	**9,285.3**

Source: CRS table based on Navy's FY2024 budget submission.

Notes: Totals may not add due to rounding. Table does not show advance procurement (AP) funding for third and subsequent boats in the class. AP funding 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.

[28] Source: Telephone discussion with Navy Office of Legislative Affairs, June 24, 2020.

[29] Rich Abott, "Navy Planning Five-Ship Block Buy Of Columbia SSBNs, Little Margin Left On First Sub," *Defense Daily*, November 1, 2022; Justin Katz, "Navy Plans to Seek Block Buy for Next Five Columbia-Class Subs," *Breaking Defense*, November 1, 2022.

[30] 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.

FY2024 Funding Request

Columbia-Class Procurement Funding Requested in FY2024 Budget Submission

The Navy's proposed FY2024 budget requests $2,443.6 million (i.e., about $2.4 billion) in procurement funding for the second boat and $3,390.7 million (i.e., about $3.4 billion) in advance procurement (AP) funding for Columbia-class boats to be procured in FY2026 and subsequent years.

Additional Funding for Submarine Industrial Base Requested on October 20, 2023

In addition to the above requested funds, on October 20, 2023, the Administration submitted a request for FY2024 emergency supplemental funding for national security priorities that includes, among other things, a total of $3,393.2 million (i.e., about $3.4 billion) in funding for the submarine industrial base to support construction of new submarines and maintenance of existing submarines, as follows:

- $557.758 million in the Operation and Maintenance, Navy (OMN) appropriation account for improvements at the four government-operated naval shipyards (NSYs) that maintain the Navy's nuclear-powered ships, including the Navy's submarines;
- $2,055.0 million in the Shipbuilding and Conversion, Navy (SCN) appropriation account (i.e., the Navy's shipbuilding account) to increase production rates and submarine availability through initiatives in supplier development, shipbuilder and supplier infrastructure, workforce development, technology advancements, and strategic sourcing;
- $393.57 million in the Other Procurement, Navy (OPN) appropriation account to increase production rates and submarine availability through initiatives in supplier development, shipbuilder and supplier infrastructure, workforce development, technology advancements, and strategic sourcing;
- $7.0 million in the Research, Development, Test and Evaluation, Navy (RDTEN) appropriation account to increase production rates and submarine availability through initiatives in supplier development, shipbuilder and supplier infrastructure, workforce development, technology advancements, and strategic sourcing;
- $281.914 million in the Military Construction, Navy and Marine Corps appropriation account to support infrastructure work at the NSYs to improve the ability to maintain the readiness of the fleet; and
- $98.0 million in the National Nuclear Security Administration (NNSA) of the Department of Energy (DOE) for Naval Reactors (i.e., the Naval Nuclear Propulsion Program) to support hiring and infrastructure expansion at the Government-Owned, Contractor-Operated Naval Nuclear Laboratory sites in order to meet growing mission demands to provide the trilateral security partnership between Australia, United Kingdom, and United States (i.e., AUKUS) with nuclear propulsion plants.[31]

[31] Source: Attachment 4: Submarine Industrial Base (pages 58-63) to letter dated October 20, 2023, from Shalanda D. (continued...)

Anomalies for Program Under Continuing Resolutions (CRs)

Anomaly Requested

As discussed in another CRS report,[32] continuing resolutions (CRs) that are used to fund government operations for a portion of a fiscal year pending the enactment of full-year appropriations for that fiscal year typically prohibit, among other things, increasing a procurement quantity for a program compared with the program's procurement quantity in the prior year (aka year-to-year quantity increases). A CR used to fund government operations for a portion of FY2024 that includes such a prohibition could thus prohibit the Navy from proceeding with the procurement of the Columbia-class boat that is requested for procurement in FY2024 (i.e., from executing a procurement quantity of one for the program in FY2024) because the Navy did not procure a Columbia-class boat in FY2023 (i.e., the program had a procurement quantity of zero in FY2023).

As also discussed in the other CRS report, the potential impacts of a CR on program execution can be avoided or mitigated if the CR includes special provisions, called anomalies, for exempting individual programs or groups of programs from the general provisions of the CR. The Navy requested an anomaly for the Columbia-class program to permit the procurement and timely execution under a CR of the Columbia-class SSBN requested for procurement in FY2024.[33]

Anomaly Provided in H.R. 5860/P.L. 118-15

The Continuing Appropriations Act, 2024 and Other Extensions Act (H.R. 5860/P.L. 118-15 of September 30, 2023)—a CR that funded government operations until November 17, 2023—includes an anomaly (Section 124) that permits the Navy to proceed with the procurement of the Columbia-class SSBN that the Navy has requested for procurement in FY2024. Specifically, the provision permits the Navy to apportion funds for that purpose in an amount not to exceed $621.27 million.

Additional Anomaly Provided and Existing Anomaly Amended in H.R. 6363/P.L. 118-22

The Further Continuing Appropriations and Other Extensions Act, 2024 (H.R. 6363/P.L. 118-22 of November 16, 2023)—a CR that amends P.L. 118-15 (see above) so as to, among other things, fund some government operations (including operations of the Department of Energy, which provides funding for the development of the Columbia-class nuclear propulsion system)[34] until January 19, 2024, and other government operations (including DOD operations) until February 2, 2024—amends P.L. 118-15 to include an additional anomaly (Section 140) for the Columbia-class program permitting the Navy to apportion advance procurement (AP) funds for the program

Young, Office of Management and Budget, to The Honorable Patrick McHenry, Speaker Pro Tempore of the House of Representatives, accessed October 23, 2023, at https://www.whitehouse.gov/wp-content/uploads/2023/10/Letter-regarding-critical-national-security-funding-needs-for-FY-2024.pdf.

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

[33] Tony Bertuca, "Columbia-Class Sub Included in White House's CR 'Anomalies' Request," *Inside Defense*, August 31, 2023; Connor O'Brien, "White House Seeks Stopgap Exemption to Prevent Delays to New Sub Fleet," *Politico Pro*, August 31, 2023.

[34] The Department of Energy budget provides funding for the Naval Nuclear Propulsion Program (aka Naval Reactors), whose work includes the development of the Columbia-class nuclear propulsion system.

in an amount not to exceed $3,338.413 million (i.e., about $3.34 billion). In addition, Section 101(6) of P.L. 118-22 amends Section 124 of P.L. 118-15 to increase the amount in Section 124 of P.L. 118-15 from $621.27 million to $663.07 million.

Existing Anomaly Further Amended in H.R. 2872/P.L. 118-35

The Further Additional Continuing Appropriations and Other Extensions Act, 2024 (H.R. 2872/P.L. 118-35 of January 19, 2024)—a CR that further amends P.L. 118-15 (see above) so as to, among other things, fund some government operations (including operations of the Department of Energy, which provides funding for the development of the Columbia-class nuclear propulsion system) until March 1, 2024, and other government operations (including DOD operations) until March 8, 2024—includes a provision (Section 101[4]) that further increases the amount in Section 124 of P.L. 118-15 (as amended by Section 101(6) of P.L. 118-22) from $663.07 million to $2,199.26 million.

CR Extended by H.R. 7463

The Extension of Continuing Appropriations and Other Matters Act, 2024 (H.R. 7463), which the House and Senate passed on February 29, 2024, further amends P.L. 118-15 (see above) so as to, among other things, fund some government operations (including operations of the Department of Energy, which provides funding for the development of the Columbia-class nuclear propulsion system) until March 8, 2024, and other government operations (including DOD operations) until March 22, 2024.

Issues for Congress

Risk of Schedule Delay in Designing and Building Lead Boat

Overview

One oversight issue for Congress is the risk of a delay in designing and building the lead Columbia-class boat. As mentioned earlier, the schedule for designing and building the lead boat and having it ready for its scheduled first deterrent patrol in 2031 has little margin for absorbing unforeseen delays due to technical challenges or funding-related issues. A delay in designing and building the lead boat could put at risk the Navy's ability to have the boat ready for its first scheduled deterrent patrol in 2031, when it is to deploy in the place of the first retiring Ohio-class SSBN. Risks of a delay in designing and building the lead boat relate to technical challenges or funding-related issues, such as lapses in appropriations or restrictions on spending during periods when DOD is funded under continuing resolutions.

At least two technical challenges have already been reported in the Columbia-class program, one first reported in 2017 involving an electric motor,[35] and another first reported in 2018 involving faulty welds in the first missile tube sections being built for the lead boat.[36] Navy officials have

[35] See, for example, John Grady, "Navy to Congress: Columbia-class Submarine Program Still on Schedule with Little Margin for Error," *USNI News*, March 21, 2018; Julia Bergman, "Columbia Submarine Prototype Has First Glitch," *The Day (New London)*, May 5, 2017; Anthony Capaccio, "Navy Sub's Overheating Motor First Glitch in $126 Billion System," *Bloomberg*, May 4, 2017. See also Government Accountability Office, *Columbia Class Submarine[:] Overly Optimistic Cost Estimate Will Likely Lead to Budget Increases*, GAO-19-497, April 2019, p. 19.

[36] See, for example, Dan Leone, "BWXT Still Having Problems With Missile Tubes For Nuclear Subs," *Defense Daily*, (continued...)

stated that neither of these challenges jeopardized the leads boat's schedule for being ready for its first patrol in 2031, in part because the Navy—recognizing that it had not built SSBN missile tube sections in many years—had built 23 months of margin into the schedule for manufacturing the missile tube sections. (This is in part why manufacturing of missile tube sections began well ahead of fabrication work on other parts of the submarine.) The problem with the welds reportedly absorbed up to 15 months of that margin, but even after absorbing that delay, 8 or more months of margin remained, and the Navy is working to regain some of the lost margin.

Technical challenges could arise in various parts of the ship. One area that may bear close watching is the ship's electric-drive propulsion system, which is quite different than the mechanical-drive system used in other Navy nuclear-powered submarines.[37]

Until such time that the Navy can find ways to generate additional margin inside the program's schedule, the program appears to be in a situation where many things need to go right, and few things can go wrong, between now and 2031 for the lead boat to be ready for its first patrol in 2031.[38] In assessing this situation, it can be noted on the one hand that the Columbia-class program's status as the Navy's top priority program means that the program can be a top claimant for funding, facilities, and personnel (including engineers, supervisors, and managers) that can be used to reduce the risk of occurrence of technical challenges that could threaten the lead boat's 2031 first-patrol date. On the other hand, it can be noted that the lead ship in the Columbia-class program, like the lead ships in most Navy shipbuilding programs, is serving as the program's prototype, creating an inherent risk of technical challenges.

Navy Perspective

An October 23, 2023, press report stated

August 9, 2022, David B. Larter, "The US Navy's Top Acquisition Priority Stumbles Out of the Gate," *Defense News*, August 6, 2018; Colin Clark and Sydney J. Freedberg Jr., "Nuke Sub Launch Tube Problems Found: 'Warning Flags Are Up,'" *Breaking Defense*, August 7, 2018; Ben Werner, "Navy Evaluating Possible Columbia-class Sub Delays Caused by Missile Tube Weld Issues," *USNI News*, August 8, 2018; Jason Sherman, "Supplier of Faulty Welding on Subs Working to Understand Scope of Defects," *Inside the Navy*, August 10, 2018; Ben Werner, "'Substantial' Columbia-class Missile Tube Weld Fix Will Cost $27 Million, Take a Year," *USNI News*, November 7, 2019; Megan Eckstein, "Columbia-class Program Upping Oversight of Vendors, Components to Stave Off Further Delays," *USNI News*, November 8, 2019; Paul McLeary, "Navy Rushes To Check Contractors After Submarine 'Debacle,'" *Breaking Defense*, November 8, 2018; Dan Leone, "Welding Mistake With Columbia Missile Tubes Was Bigger Problem Than BWXT Thought," *Defense Daily*, November 9, 2018; Marjorie Censer, "BWX Technologies Takes $27 Million Charge for Missile Tube Rework," *Inside the Navy*, November 12, 2018; Justin Katz and Mallory Shelbourne, "Navy Conducting New Inspections of Columbia-Class Submarine Vendors," *Inside the Navy*, November 12, 2018.

See also Government Accountability Office, *Columbia Class Submarine[:] Overly Optimistic Cost Estimate Will Likely Lead to Budget Increases*, GAO-19-497, April 2019, pp. 19-20.

[37] The Navy in the past has built two electric-drive nuclear-powered submarines—the one-of-a-kind attack submarine Tullibee (SSN-597), which was commissioned in 1960 and decommissioned in 1988, and the one-of-a-kind attack submarine Glenard P. Lipscomb (SSN-685) which was commissioned in 1974 and decommissioned in 1990. Those two submarines, however, were designed many years ago, and used electric-drive technology that was different from that in the Columbia-class design. The Navy in recent years has built some surface ships with electric-drive propulsion systems, including 14 Lewis and Clark (TAKE-1) dry cargo ships and three Zumwalt (DDG-1000) destroyers, but the electric-drive technology in those ships, though more modern than that of SSNs 597 and 685, is different and in some respects less advanced than that planned for the Columbia-class design. The Navy has never before built a series-production nuclear-powered submarine class with electric-drive propulsion, and has never built a ship of any kind (surface or submarine) using the combination of advanced electric-drive technologies planned for the Columbia-class design.

[38] For additional discussion, see, for example, Jon Harper, "Columbia-Class Program Must Navigate Sea of Risks," *National Defense*, November 5, 2018; Dan Leone, "Officers Send Conflicting Signals on Columbia Program Margin," *Defense Daily*, February 28, 2019.

The U.S. Navy is working to accelerate remaining construction work on the first Columbia-class ballistic missile submarine to brace for potential delays during the first-in-class boat's testing later this decade.

The Navy and prime contractor General Dynamics' Electric Boat originally built a six-month buffer into the construction schedule for the future District of Columbia, the first ballistic missile submarine built since the 1990s.

That buffer has been fully eroded due to both pandemic-related challenges and contractor performance, leaders have confirmed, though the boat is still on its contractually mandated schedule.

Rear Adm. Scott Pappano, the program executive officer for strategic submarines, told Defense News at a summit here earlier this month he's working with the shipbuilders to regain that buffer "to give us the opportunity to have problems in testing as the lead ship."

Pappano said District of Columbia is through the first phase of structural work and well into the second phase of outfitting. The boat began advanced construction in 2019 and construction in 2020.

Eyeing the upcoming final assembly and test phase, Pappano said "the good news is we know how to test ships. We know how to do final assembly and test." But there are differences between this Columbia-class boomer and the Virginia-class attack submarine the Navy has built for the past 20 years—chiefly, a strategic weapon system for the nuclear weapons the boomer carries and a first-of-its-kind integrated propulsion system.

"I want to buy more margin back" to allow for challenges in these areas, he said, noting the Navy and industry are seeking to accelerate the remaining outfitting and final assembly work.

Because the Columbia-class SSBN is the Navy's top acquisition priority and a key effort for the Defense Department as well, the government-industry team has given the Columbia program the resources it needs to stay on schedule, even at the expense of the Virginia submarine program.

Defense News previously reported that, because the Columbia production line was filled first with experienced workers, the Virginia production line at shipbuilding partner HII's Newport News Shipbuilding wasn't fully staffed until February. At Electric Boat, the newest employees were assigned to the Virginia program, meaning there were more mistakes and longer rework time, exacerbating existing delays.

Pappano confirmed the industrial base is prioritizing Columbia work, but said it needs to do so even more.

"Get me the best people, the best crews, the best supervisors," he said. "Have the right people working to drive that first-time quality. First-time quality is going to be the key to buying back margin."

Though the Navy will formally procure the second sub of the class, the future Wisconsin, this fiscal year—facilitated by a measure Congress included in the continuing resolution now funding the government—advanced construction work has already been underway for a couple years.

Pappano said, in that advanced construction work, he's already seeing improvements on Wisconsin compared to District of Columbia, which is necessary to meet Wisconsin's shorter contractual build schedule.

The first submarine was allotted 84 months for the build and test cycle; Wisconsin will have 80. By the end of the 12-submarine program, that will be whittled down to 70 months.[39]

GAO Perspective

A June 2023 GAO report assessing selected major DOD weapon acquisition programs additionally stated the following regarding the Columbia-class program:

Technology Maturity, Design Stability, and Production Readiness

As we reported last year, the program considers all of SSBN 826's critical technologies mature, though three systems remain below our definition of maturity. We consider technologies mature after successful testing of a prototype near or at the planned operational system configuration in a realistic environment. The program plans to have two of the three remaining technologies reach maturity in fiscal year 2025, but one will remain immature until after lead submarine delivery, planned for April 2027.

The shipbuilder completed basic and functional design before the start of formal construction on the lead ship. However, the program is still at risk of costly and time-consuming design changes if deficiencies emerge during testing or production of its critical technologies. The program also remains behind on producing design products—in particular, work instructions that detail how to build the submarine—because of ongoing challenges using a software-based design tool. These, in turn, contributed to delays in construction of the lead submarine.

As we reported last year, the shipbuilder accelerated its schedule for construction of the lead submarine to reduce the risk of a delivery delay. However, as of September 2022, the shipbuilder was behind this accelerated schedule not only due to design delays, but also because of late delivery of supplier materials and a need for rework due to quality problems.

Program officials stated that the shipbuilder attempted to overcome these delays, in part, by reassigning workers from Virginia class submarine construction. This contributed to delays on the Virginia class program. Program officials stated that additional workers may need to be reassigned to Columbia in the future. The Navy also identified a need for the shipbuilder to improve hiring and training both in the near term and for when the program reaches an annual cadence for follow-on submarine construction. Program officials told us that the shipbuilder plans to continue adding staff to Columbia class lead ship construction until it overcomes delays. In September 2022, we reported that the Navy cannot rely on the shipbuilder's schedule for the lead submarine to plan for on-time delivery because it did not substantially meet all of our leading practices for program schedules. Meeting these leading practices would enable the program to determine how schedule risks affect the program's ability to meet key dates, such as delivery.

Software and Cybersecurity

The program office reported no significant updates related to software development or cybersecurity.

Other Program Issues

The program's estimated procurement cost decreased by roughly 4 percent since our last assessment. However, this decrease occurred because of an update to the calculation used for inflation and because the Navy no longer includes supplier development funding in its estimate. The supplier base is among the program's top risks because the program will need quality and timely materials to produce submarines on time. The Navy removed supplier

[39] Megan Eckstein, "Navy Aims to Hasten Remaining Columbia Sub Work in Case of Test Delays," *Defense News*, October 23, 2023.

development funding from the cost estimate because it considers these as costs shared with, for example, the Virginia class program.

Per the program's updated acquisition strategy, the Navy plans to begin early procurement and construction on one submarine per year from fiscal year 2023 through 2032. The Navy plans for each follow-on submarine to have a progressively shorter construction schedule, based in part on early construction efforts. In order to achieve this schedule goal, the shipbuilder would need to overcome staffing issues and build the submarines in a shorter amount of time than it achieved on any of its recent submarines.

Program Office Comments

We provided a draft of this assessment to the program office for review and comment. The program office provided technical comments, which we incorporated where appropriate. The program office stated that it is positioned to deliver the capabilities needed to meet strategic deterrent requirements on cost and schedule. It also stated that it took actions to reduce risks, such as ensuring stable requirements, executing manufacturing readiness and supplier base efforts, and pursuing cost reduction actions. It added that the program exceeded 83 percent overall design maturity by the start of lead ship construction–higher than achieved for other submarine classes—and it worked through initial design tool issues that delayed design products. Further, it noted that the Navy took actions to address construction performance challenges in 2022. The program office stated that the Navy conducts schedule reviews for this program similar to those conducted for previous submarine classes. It noted that the program continues to comply with all Navy, DOD, and statutory requirements associated with managing critical technologies and engineering integration efforts.[40]

A January 2023 GAO report on the Columbia-class program stated

> The Navy plans to deliver the first, or lead, Columbia class submarine—the largest and most complex submarine in its history—more quickly than it did for the lead submarines of prior classes, such as the Virginia class program. But the shipbuilder has not conducted a schedule risk analysis of the lead submarine's construction schedule. Both GAO leading practices and Department of Defense (DOD) guidance identify schedule risk analysis as a critical tool for understanding and managing program risks that could impact the schedule....
>
> Without a statistical schedule risk analysis, programs have limited insight into how schedule risks could affect the likelihood of achieving key program milestones, including delivery, and the amount of margin—or a reserve of extra time—needed to manage critical risks and avoid delays.
>
> After more than a year of full-scale construction on the lead Columbia submarine, the shipbuilders are facing delays because of challenges with design, materials, and quality. The shipbuilders are working to mitigate delays using additional shipyard resources, such as more staff to complete work more quickly. Because of the Columbia class program's essential role in strategic deterrence, it has priority status over most national defense related programs, including the Virginia class program. The shipbuilder added staff to the Columbia class program who were originally planned for the Virginia class program, contributing to delays for that program. However, long-term planning does not account for shared risks between these programs that are likely to present production challenges and could result in additional costs. Without updated long-term planning, the Navy cannot be

[40] Government Accountability Office, *Weapon Systems Annual Assessment[:] Programs Are Not Consistently Implementing Practices That Can Help Accelerate Acquisitions*, GAO-23-106059, June 2023, p. 160.

certain that the fiscal year 2024 budget request will be sufficient to meet the production schedule it has planned for these submarine classes.[41]

Risk of Cost Growth

Overview

Another oversight issue for Congress is the risk of cost growth in the program. As detailed by CBO[42] and GAO,[43] lead ships in Navy shipbuilding programs in many cases have turned out to be more expensive to build than the Navy had estimated. As discussed in further detail below, CBO has concluded that there is a significant risk of cost growth in the Columbia-class program.

As mentioned earlier, Navy officials have stated consistently since 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. Given this, the impact of cost growth in the Columbia-class program in a situation of finite DOD funding might be not so much on the execution of the Columbia-class program itself as on the consequent affordability of other DOD programs, perhaps particularly other Navy shipbuilding programs. The issue of the potential impact of the Columbia-class program on the affordability of other DOD programs is discussed in a subsequent section of this report.

Navy Perspective

A July 31, 2023, Navy information paper provided to CRS and CBO states that as of October 2022, the Navy had assigned a confidence level of 46% to its estimated procurement cost for the lead ship in the Columbia class (excluding costs for plans) and a confidence level of 51% to its estimated average procurement cost for ships 2 through 12 in the program.[44] What this means is that the Navy as of October 2022 had calculated that there was a 54% chance that the procurement cost of the first Columbia-class boat (excluding costs for plans), and a 49% chance that the estimated average procurement cost for ships 2 through 12 in the program, would turn out to be greater than what the Navy estimates. A June 24, 2021, Navy information paper provided to CRS and CBO presented earlier (August 2020) confidence levels for the lead ship (excluding cost for plans) and ships 2 through 12, and corresponding estimated unit procurement costs. **Table 2** shows those confidence levels and corresponding estimated unit procurement costs.

[41] Government Accountability Office, *Columbia Class Submarine[:] Program Lacks Essential Schedule Insight amid Continuing Construction Challenges*, GAO-23-106292, highlights page.

[42] See CBO, *An Analysis of the Navy's Fiscal Year 2019 Shipbuilding Plan*, October 2018, p. 25, including Figure 10.

[43] See Government Accountability Office, *Navy Shipbuilding[:] Past Performance Provides Valuable Lessons for Future Investments*, GAO-18-238SP, June 2018, p. 8.

[44] Navy information paper, "Update on Confidence Levels for COLUMBIA Lead Ship and Follow Ship," July 31, 2023, received by CRS and CBO from Navy Legislative Affairs Office, August 2, 2023.

Table 2. Navy Confidence Levels as of August 2020 for Estimated Columbia-Class Unit Procurement Costs

Billions of constant 2021 dollars

Confidence level decile	End cost of lead ship (less plans)	Average end cost of ships 2-12
30%	$8.3	$6.5
40%	$8.5	$6.8
50%	$8.8	$7.1
60%	$9.0	$7.4
70%	$9.2	$7.7
80%	$9.5	$8.1

Source: Navy information paper, "Update on Confidence Levels for COLUMBIA Lead Ship and Follow Ship," June 24, 2021, received by CRS and CBO from Navy Legislative Affairs Office, July 29, 2021.

Note: End cost of lead ship includes cost for the ship's missile tube module, which was funded through the Navy's research and development account.

CBO Perspective

An October 2023 CBO report on the cost of the Navy's shipbuilding programs states

> The cost of the 11 Columbia class submarines included in the 2024 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 2028 at a cost of $15.8 billion (in [constant [FY]2023 dollars). As of June 30, 2023, the ship was 36 percent complete. Subsequent ships in the class would cost $7.7 billion, on average. The total procurement cost for the 12 submarines would be $100.2 billion [in constant FY2023 dollars] (which includes appropriations of $21.4 billion from 2017 to 2023), or $8.4 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. On the basis of a calculation of cost risk completed in October 2022, the Navy has stated that there is a 54 percent chance that the cost of the first Columbia class submarine will exceed its estimates and a 46 percent chance that it will cost less than estimated. The likelihood that subsequent ships in the class would cost more or less than estimated was nearly even—49 percent and 51 percent, respectively.
>
> Moreover, the Navy's estimates for Columbia class ships have not yet been updated to reflect existing conditions in the submarine industrial base. As previously mentioned, the Navy estimates that the Virginia class submarines it will buy in 2025 and 2026 will cost about 15 percent more than the ones purchased in 2022 and 2023, after adjusting for inflation. The Navy has attributed a large portion of that increase in the cost of future Virginia class submarines to poor performance in the building shipyards, a fragile industrial base for suppliers of many components, and other challenges. Columbia class ships are being built in those same shipyards and will probably be affected by the same conditions. Nevertheless, the Navy continues to rely on its 2021 cost estimate for the Columbia class, which it plans to update later this year.

> CBO's estimate for the Columbia class program reflects current industry conditions and is therefore 19 percent greater than the Navy's. CBO estimates that purchasing the first Columbia class submarine would cost $17.5 billion—$1.7 billion more than the Navy estimates. Including appropriations from 2017 to 2023, CBO estimates that, all told, 12 Columbia class submarines would cost $119 billion (of which $100 billion would be appropriated between 2024 and 2036). The 11 submarines set to follow the lead ship would cost $9.2 billion each, on average—$1.5 billion more per submarine than the Navy estimates.
>
> 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 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.[45]

Cost-Plus Incentive Fee (CPIF) Contract

Another aspect of the issue of the risk of cost growth in the program concerns the Navy's intent to use a cost-plus incentive fee (CPIF) contract rather than a fixed-priced contract to procure the first two ships in the class. Skeptics could argue that using a CPIF contract will increase the risk of cost growth on the first two ships because it will insulate the builders from much of the financial risk of cost growth, providing them with a reduced incentive to control costs. They could argue that while the Navy has used cost-plus type contracts for lead ships in other shipbuilding programs, the Navy in this case is proposing to use one for a two-ship contract, extending the risk of cost growth to the second ship in the program. They could argue that while insulating builders from the risks and uncertainties of building lead ships has been a traditional shipbuilding consideration, the risks in this case are to be reduced by the Navy's strategy of bringing the Columbia-class design to a high state of completion prior to starting construction on the lead ship.

Supporters of using a cost-plus type contract could argue that doing so is a traditional approach for procuring a lead ship in a Navy shipbuilding program that recognizes that the lead ship in effect serves as the program's prototype and thus presents the builders with substantial risks and uncertainties regarding construction costs, even with a design that has been brought to a high state of completion prior to starting construction. They could argue that this is particularly true in this case, given that this is the first lead ship in a Navy SSBN program to start construction in about 47 years.[46] They could argue that builders will still have an incentive to control costs because of the incentive fee in the contract, and because they understand that cost growth in the Columbia-

[45] CBO, *An Analysis of the Navy's Fiscal Year 2024 Shipbuilding Plan*, October 2023, pp. 25-27.

[46] The lead ship in the Ohio-class SSBN program was procured in FY1974—47 years before the scheduled FY2021 procurement date for the lead ship in the Columbia-class program.

class program could reduce funding available for other Navy priorities, including procurement of Virginia-class attack submarines that these firms also build.

Change in Estimated Procurement Costs Since FY2021 Budget Submission

Table 3 shows changes in the estimated procurement costs of the first and second Columbia-class boats (SSBNs 826 and 827, respectively) since the Navy's budget submission for FY2021, when the first Columbia-class boat was procured.

Table 3. Change in Estimated Procurement Costs Since FY2021 Budget

Millions of then-year dollars, rounded to nearest tenth

Boat and budget	Estimated cost	Change from prior year	Cumulative change since FY2021
First boat (SSBN-826)			
FY21 budget	14,393.4	—	—
FY22 budget	15,030.5	+637.1 (+4.4%)	+637.1 (+4.4%)
FY23 budget	15,179.1	+148.6 (+1.0%)	+785.7 (+5.5%)
FY24 budget	15,179.1	0	+785.7 (+5.5%)
Second boat (SSBN-827)			
FY21 budget	9,326.1	—	—
FY22 budget	n/a	n/a	n/a
FY23 budget	9,280.2	n/a	-45.9 (-0.5%)
FY24 budget	9,285.3	+5.1 (+0.05%)	-40.8 (-0.4%)

Source: Table prepared by CRS based on Navy's FY2021-FY2024 budget submissions.

Note: n/a means not available.

As can be seen in the table, the estimated cost of the first Columbia-class boat increased by $637.1 million, or 4.4%, from the FY2021 budget submission to the FY2022 budget submission. Of the $637.1 million increase, $549.8 million (more than 86% of the increase) was in the estimated cost of the boat's plans. As discussed earlier, the cost of plans for the first Columbia-class boat means (essentially) the detail design/nonrecurring engineering (DD/NRE) costs for the Columbia class. (As also noted earlier, it is a long-standing Navy budgetary practice to incorporate the DD/NRE costs for a new class of ship into the total procurement cost of the first ship in the class.) Because the cost for plans for the first boat in a class is largely a nonrecurring expense, the increase in the estimated cost of the first boat's plans might not imply a similar increase in the (much smaller) plans costs for the second and subsequent boats in the class. Excluding the change in the estimated cost for plans, the estimated cost of the first Columbia-class boat increased in the Navy's FY2022 budget submission by $87.3 million, or about 0.6%, from the FY2021 submission to the FY2022 submission. As can also be seen in the table, the estimated cost of the second boat in the class has decreased 0.4% from the FY2021 budget submission to the FY2024 budget submission.

Program Affordability and Impact on Other Navy Shipbuilding Programs

Another issue for Congress—one that observers have focused on for several years—concerns the potential impact of the Columbia-class program on funding that will be available for other Navy programs, including other shipbuilding programs, particularly during the 10-year period FY2026-FY2035, when the Navy plans to procure one Columbia-class boat per year. Other things held equal, cost growth in the Columbia-class program (see the earlier discussion of the risk of cost growth in the program) could reinforce concerns about the potential impact of the Columbia-class program on funding that will be available for other Navy programs, including other shipbuilding programs. Even without such cost growth, however, this issue would remain as a matter of concern.

The Navy's FY2024 budget submission projects that the Columbia-class program will require more than $8 billion per year in then-year dollars in procurement and advance procurement (AP) funding each year beginning in FY2026. Ten to 15 years ago, when the Navy's shipbuilding budget was being funded at a level of roughly $14 billion per year, observers were concerned that the Columbia-class program during the period FY2026-FY2035 could absorb as much as half of the Navy's future shipbuilding budgets, leaving relatively little funding available for all other Navy shipbuilding programs. Since then, the Navy's shipbuilding budget has increased to roughly $32 billion per year. (For FY2024, the Navy is requesting a total shipbuilding budget of $32.8 billion.) In a context of a shipbuilding budget of about $32 billion per year, a Columbia-class requirement of more than $8 billion per year does not loom as large proportionately as it once did. Even so, concern remains about funding that will be available for the procurement of other kinds of ships. The Navy's report on its FY2023 30-year (FY2023-FY2052) shipbuilding plan states that "the fiscal impact of the Columbia class increased significantly in FY2021 with procurement of the lead SSBN. The impact grows across the FYDP to FY2026 when annual full procurements will be required to support serial production through FY2035."[47]

The creation of the National Sea-Based Deterrence Fund (NSBDF) and the amending of the statute governing the fund to include special acquisition authorities can be viewed as one response to concerns about the potential impact of the Columbia-class program on funding that will be available for other Navy programs, including other shipbuilding programs. For additional information about the NSBDF, see **Appendix E**.

Another potential option for reducing the potential impact of the Columbia-class program on funding that will be available for other Navy programs, including other shipbuilding programs, would be to reduce the Columbia-class program to something fewer than 12 boats. Over the years, for various reasons, some observers have advocated or presented options for an SSBN force of fewer than 12 SSBNs. A November 2013 CBO report on options for reducing the federal budget deficit, for example, presented an option for reducing the SSBN force to 8 boats as a cost-reduction measure.[48] Earlier CBO reports have presented options for reducing the SSBN force to 10 boats as a cost-reduction measure.[49] CBO reports that present such options also provide notional arguments for and against the options. A June 2010 report by a group known as the

[47] See U.S. Navy, *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for Fiscal Year 2023*, April 2022, p. 17.

[48] CBO, *Options for Reducing the Deficit: 2014 to 2023*, November 2013, pp. 68-69.

[49] See, for example, CBO, *Rethinking the Trident Force*, July 1993, 78 pp.; and CBO, *Budget Options*, March 2000, p. 62.

Sustainable Defense Task Force recommended reducing the SSBN force to 7 boats,[50] a September 2010 report from the Cato Institute recommended reducing the SSBN force to 6 boats,[51] and a September 2013 report from a group organized by the Stimson Center recommended reducing the force to 10 boats.[52]

Views on whether a force of fewer than 12 Columbia-class boats would be appropriate could depend on, among other things, assessments of strategic nuclear threats to the United States and the role of SSBNs in deterring such threats as a part of overall U.S. strategic nuclear forces, as influenced by the terms of strategic nuclear arms control agreements.[53] Reducing the number of SSBNs below 12 could also raise a question as to whether the force should continue to be homeported at both Bangor, WA, and Kings Bay, GA, or consolidated at a single location. The Navy's position is that the current requirement for having a certain number of SSBNs on patrol translates into a need for a force of 14 Ohio-class boats, and that this requirement can be met in the future by a force of 12 Columbia-class boats.

Industrial-Base Challenges of Building Both Columbia- and Virginia-Class Boats

Overview

A related issue for Congress concerns the ability of the submarine construction industrial base to execute the work associated with procuring one Columbia-class SSBN plus two Virginia-class SSNs per year (a procurement rate referred to in short as 1+2). Policymakers and other observers have expressed concern about the industrial base's capacity for executing a 1+2 workload without encountering bottlenecks or other production problems in one or both of these programs. In a nutshell, the challenge for the industrial base—both shipyards and supplier firms—is to ramp up production from one "regular" Virginia-class boat's work per year (the volume of work prior to FY2011) to the equivalent of about five "regular" Virginia-class boats' work per year (the approximate volume of work represented by two Virginia Payload Module (VPM)-equipped Virginia-class boats and one Columbia-class boat).[54] In other words, the challenge for the industrial base is to quintuple the pre-2011 volume of annual production by 2028.

Concerns about the ability of the submarine construction industrial base to execute the workload resulting from a sustained 1+2 procurement rate were heightened starting in 2019 by reports about challenges faced by the two submarine-construction shipyards and associated supplier firms in meeting scheduled delivery times for Virginia-class boats as the Virginia-class program

[50] *Debt, Deficits, and Defense, A Way Forward[:] Report of the Sustainable Defense Task Force*, June 11, 2010, pp. 19-20.

[51] Benjamin H. Friedman and Christopher Preble, Budgetary Savings from Military Restraint, Washington, Cato Institute, September 23, 2010 (Policy Analysis No. 667), p. 8.

[52] *Strategic Agility: Strong National Defense for Today's Global and Fiscal Realities*, Stimson, Washington, DC, 2013, p. 29. (Sponsored by the Peter G. Peterson Foundation, Prepared by Stimson, September 2013.)

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

[54] Starting in FY2019, the Navy began to procure a lengthened version of the Virginia-class design that incorporates the Virginia Payload Module (VPM), 84-foot-long, mid-body section equipped with four large-diameter, vertical launch tubes for storing and launching additional Tomahawk missiles or other payloads. If building a "regular" Virginia-class boat is viewed as requiring one unit of work, then building a VPM-equipped Virginia-class boat can be viewed as requiring about 1.25 units of work, and building a Columbia-class boat can be viewed as requiring about 2.5 units of work. On this basis, building two VPM-equipped Virginia-class boats and one Columbia-class boat would require about five units of work (1.25 + 1.25 + 2.5 = 5.0).

transitions from production of two "regular" Virginia-class boats per year to two VPM-equipped boats per year.[55]

Although Virginia-class submarines are being procured at a rate of two boats per year, Navy officials have noted that deliveries of Virginia-class submarines from GD/EB and HII/NNS have averaged 1.2 boats per year for the past five years.[56] On March 29, 2023, Secretary of the Navy Carlos Del Toro testified that the Virginia-class production rate was at that point about 1.4 boats per year.[57] At an April 28, 2023, briefing on the Virginia-class program for CRS and CBO, Navy officials stated that the rate as of that date was about 1.3 boats per year.[58] A March 31, 2023, press report stated that Navy officials estimate that it will take another five years—until 2028—before the delivery rate will increase to 2.0 boats per year.[59] In advance policy questions submitted for a September 14, 2023, hearing before the Senate Armed Services Committee to consider her nomination to be Chief of Naval Operations, Admiral Lisa Franchetti, the Vice Chief of Naval Operations, stated that the Navy's goal is to stabilize the Virginia-class construction rate at 1.4 boats per year by the end of 2023, increase it to at least 1.5 boats per year by the end of 2024, and increase it to 2.0 boats per year by 2028.[60]

The Navy's report on its FY2024 30-year (FY2024-FY2053) shipbuilding plan states

> Within the overall industrial base, including both shipyards and suppliers, varying levels of capacity and risk exist. Nuclear powered ship production, a unique capability with little to no opportunity for commercial or dual use production, is provided by two private shipyards that are currently facilitized and certified to construct nuclear powered ships and will be at capacity for the next 15-plus years building Columbia class SSBNs, Virginia class SSNs, next generation SSNs, and Ford class CVNs. Industrial base funding was provided in FY2023 to increase infrastructure, reduce production risk, help stabilize the more than 350 critical suppliers, and help enable recruitment, training and retention of the

[55] See, for example, Government Accountability Office, *Columbia Class Submarine[:] Overly Optimistic Cost Estimate Will Likely Lead to Budget Increases*, GAO-19-497, April 2019, pp. 20-23; David B. Larter, "Late Is the New Normal for Virginia-Class Attack Boats," *Defense News*, March 20, 2019; Megan Eckstein, "Navy: Lack of Submarine Parts Slowing Down Maintenance, New Construction," *USNI News*, March 26, 2019; David B. Larter, "The US Navy, Seeking Savings, Shakes Up Its Plans for More Lethal Attack Submarines," *Defense News*, April 3, 2019; Anthony Capaccio, "U.S. Navy Sub Firepower Upgrade Delayed by Welding Flaws," *Bloomberg*, August 13, 2019; Paul McLeary, "Weld Problems Spread To Second Navy Sub Program," *Breaking Defense*, August 14, 2019; David B. Larter, "Questions About US Navy Attack Sub Program Linger as Contract Negotiations Drag," *Defense News*, August 16, 2019; Emma Watkins, "Will the U.S. Navy Soon Have a Missile-Tube Problem?" *National Interest*, August 19, 2019; David B. Larter, "As CNO Richardson Departs, US Submarine Builders Face Pressure," *Defense News*, August 22, 2019; David B. Larter, "After a Leadership Shakeup at General Dynamics, a Murky Future for Submarine Building," *Defense News*, October 28, 2019; Rich Abott, "Navy Says Virginia Sub Delays Due To Faster Production Rate," *Defense Daily*, November 6, 2019.

[56] See, for example, Megan Eckstein, "Navy Frustration Building over Late Weapons, Ship Deliveries," *Defense News*, January 11, 2023; Rich Abott, "Fleet Forces And SecNav Argue For More Maintenance Yards," *Defense Daily*, January 12, 2023.

[57] Sam LaGrone, "SECNAV Del Toro: Virginia Attack Sub Construction 'Significantly Behind,' District of Columbia Submarine 10% Behind Schedule," *USNI News*, March 29 (updated March 30), 2023. See also Rich Abott, "SECNAV: Columbia Sub 10 Percent Behind, Virginia Subs Improving But Still Behind," *Defense Daily*, March 30, 2023.

[58] Navy briefing on Virginia-class program for CRS and CBO, April 28, 2023.

[59] Sam LaGrone, "Navy Estimates 5 More Years for Virginia Attack Sub Production to Hit 2 Boats a Year," *USNI News*, March 31, 2023.

[60] Senate Armed Services Committee, Advance Policy Questions for Admiral Lisa M. Franchetti, USN, Nominee for Appointment to be Chief of Naval Operations, p. 31.

> skilled production workforce. The PB2024 request includes funding to continue these efforts.[61]

The Navy has testified that meeting both U.S. Navy needs and additional needs under the AUKUS (Australia-UK-US) security agreement announced in September 2021 would require increasing the Virginia-class production rate further, to 2.33 boats per year. Under the nomenclature used here, such a combined Columbia-plus-Virginia procurement rate would be expressed as 1+2.33.[62]

The Navy and industry are working to build up the capacity of the submarine industrial base to support a 1+2.33 procurement rate by sometime after 2028. Building up the industrial base's capacity to a 1+2.33 capacity will require investing several billion dollars for capital plant expansion and improvements and workforce development at both the two submarine-construction shipyards (GD/EB and HII/NNS) and submarine supplier firms. Some of this funding has been provided in FY2023 and prior years, some of it is requested for FY2024, some of it would be requested in FY2025 and subsequent years, and some of it would be provided, under the AUKUS proposed Pillar 1 pathway, by Australia. The funding requested for FY2024 includes both funding in the Navy's FY2024 budget submission, and the supplemental funding for the submarine industrial base that was requested on October 20, 2023.

At an October 25, 2023, hearing on the submarine industrial base and its ability to support the AUKUS framework before the Seapower and Projection Forces Subcommittee of the House Armed Services Committee, the Navy provided testimony on its plan to increase the industrial base's capacity to support the production of 2.33 Virginia-class boats per year and thus a combined Columbia-plus-Virginia procurement rate of 1+2.33. The Navy's testimony on its plan is reprinted in **Appendix F**.

Press Reports

A September 8, 2023, press report stated

> The U.S. Navy expects the submarine-industrial base to start delivering attack submarines on time by 2028—more than a decade after vendors and shipbuilders began struggling to keep up with growing demand, made worse by the pandemic and the seismic disruption it brought to the labor market.
>
> In fact, the Navy says, industry will have additional capacity by the early 2030s to start increasing the size of the attack sub fleet, which is currently smaller than its required size and would be more so following the sale of a couple boats to Australia as part of the AUKUS trilateral pact.
>
> To get there, the sea service anticipates spending $6.3 billion to bolster the submarine-industrial base—on top of the annual cost of buying and repairing submarines.
>
> But has the first tranche of investments yielded enough progress to warrant the Navy's optimism?
>
> Here's a closer look at how the submarine-industrial base is faring after the first $2.3 billion went toward shoring up two shipbuilders and their thousands of suppliers….
>
> The Navy spent $2.3 billion from fiscal 2018 to fiscal 2023 "to build and strengthen the Submarine Industrial Base's capacity, capability and resiliency," Whitney Jones, director

[61] See U.S. Navy, *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for Fiscal Year 2024* March 2023, p. 9.

[62] For more on the submarine component of the AUKUS agreement, see CRS Report RL32418, *Navy Virginia-Class Submarine Program and AUKUS Submarine Proposal: Background and Issues for Congress*, by Ronald O'Rourke.

of the Navy's Submarine Industrial Base initiative, told Defense News in a written statement.

This money was spent across five main lines of effort.

First is supplier development, after what Jones called the "slow but sustained degradation of domestic manufacturing over the past 40 years."

This money would boost the production capacity of existing suppliers, develop new suppliers in areas where there may be a single vendor building a critical part, and addressing market sectors where there has been a significant demand increase, such as electrical and electronics subcomponents.

For example, Scot Forge received more than $20 million as part of this effort. The company, part of the castings and forgings market that has struggled to keep up with demand, used the money to buy more production equipment. It has since seen a 100% increase in capacity to process large forgings, Jones said, and reduced its costs by 30%.

In this fiscal year, the Navy will infuse about $70 million into the raw material market, an area where material must be delivered on time to keep submarine construction on schedule, and which has been "especially impacted by market fluctuations and post-pandemic realities," Jones said.

The second area is shipyard infrastructure, to ensure General Dynamics Electric Boat and HII's Newport News Shipbuilding can ramp up their production to a rate that will, in FY26, hit its highest rate by tonnage since World War II: one Columbia-class ballistic missile submarine and two Virginia-class attack submarines with the Virginia Payload Module insert each year, dubbed a 1+2 production rate….

The shipyards are making their own investments. For example, Newport News Shipbuilding spokesman Todd Corillo told Defense News the yard is in the midst of making $1.9 billion in capital investments that started in 2016 and will run through 2025, which include facilities to accelerate submarine production.

The Navy is also pitching in with support for the facilities and equipment needed to keep up with growing demand.

The third effort, strategic outsourcing, appears to be taking some of this growing work away from the two shipyards. Jones said the Navy is looking to move at least 5 million production hours a year in large-scale steel fabrication, outfitting and other heavy manufacturing work to other locations, allowing the shipyards to focus on outfitting, final assembly and testing….

The fourth effort is workforce development, as companies in the submarine-industrial base of all sizes and in all locations struggle to recruit and retain the workers they need.

And the fifth is investing in new manufacturing technologies that can make work processes more efficient, such as automated welding, robotics and additive manufacturing.

In total, Jones said, the Navy and the submarine-industrial base are executing 79 projects in the current fiscal year aimed at boosting the capability, capacity and quality of work in the sub-tier supply chain, in support of the so-called 1+2 production rate of Columbia and Virginia submarines….

Even as the sector tries to ramp up to the 1+2 delivery schedule by FY26, it is also being asked to build more spare parts to improve the performance of submarine repair activities.

The Navy proposed spending $2.4 billion from FY24 to FY28 to further infuse cash into the supply chain and churn out parts to support submarine maintenance….

During an Aug. 3 earnings call, HII President Chris Kastner said the company, through the second quarter of this year, "hired over 3,200 craftsmen and women on a solid pace to meet

> our full year plan of approximately 5,000. Although we're meeting our hiring targets, attrition remains high and labor is still the greatest risk to meeting our plan."
>
> He called labor "the largest obstacle, the largest risk" on the Virginia-class program, and said the company would have to focus on recruiting, training and retaining skilled workers for years to come….
>
> Beyond outlining previous and upcoming initiatives, [Jones] highlighted an effort to use data analytics to identify the best uses for this submarine-industrial base money.
>
> The Navy team "must quantitatively and qualitatively describe challenges, gaps, and the impact of efforts/investments," she said.
>
> As part of that effort, her office has mapped out and performed a risk assessment of the 16,000 suppliers in the submarine-industrial base. It identified the more than 200 million parts the two shipbuilders will need to buy in the next 10 years, and found 15 critical chokepoints that could threaten these future purchasing plans.[63]

Strategic Outsourcing

One option for addressing industrial-base challenges of building both Columbia-class boats and Virginia-class SSNs at the same time is to increase the use of shipyards other than GD/EB and HII/NNS, as well as other manufacturing facilities, in building components of Columbia- and/or Virginia-class boats—a practice sometimes referred to as strategic outsourcing. An October 21, 2022, press report states

> The U.S. Navy is pouring billions of dollars into shoring up the companies that help build nuclear-powered submarines and aircraft carriers.
>
> But these companies, and especially prime contractors General Dynamics Electric Boat and HII's Newport News Shipbuilding, cannot hire enough people to keep up with demand.
>
> So they're outsourcing work that was previously done in-house, two admirals said.
>
> Rear Adm. Jon Rucker, the program executive officer for attack submarines, said the Navy spent more than $1 billion between fiscal 2018 and fiscal 2022, and that the service is committed to $2.4 billion from fiscal 2023 to fiscal 2027.
>
> These funds cover supplier development, workforce development, shipbuilder infrastructure, the development of technologies such as additive manufacturing and nondestructive testing, government oversight, and strategic outsourcing.
>
> In terms of tonnage of submarine construction, the Navy will see a 5.5 times increase from FY11 to FY25. But the number of suppliers has dropped to about 5,000, compared to 17,000 companies during the last submarine construction surge in the 1980s, Rucker said last month at an American Society of Naval Engineers conference.
>
> Rucker said the Navy is trying to target its investments where it can make the most impact: 350 companies are considered "critical suppliers" in the submarine-industrial base, and 55% of those are located in six states. So workforce development dollars are focused on those states to do the most good for critical suppliers in need of more workers. This effort could see the establishment of new training sites in Virginia and Pennsylvania.
>
> Outsourcing is becoming more important as some regions realize they aren't receiving enough interest for people to join the manufacturing industry, despite federal and state government efforts to create manufacturing training opportunities.

[63] Megan Eckstein, "The US Navy Is Spending Billions to Stabilize Vendors. Will It Work?" *Defense News*, September 8, 2023.

> "We are saturated in certain areas of the country. The Northeast is one of those. If we cannot bring the people to the work, we're going to take the work to the people," Rucker said.
>
> Today, he explained, Electric Boat outsources 1.1 million hours' worth of work a year and Newport News Shipbuilding outsources 900,000 hours as they build new Virginia- and Columbia-class submarines.
>
> By 2025, that combined 2 million hours will grow to 5 million, he said—which equates to half the work to build a Virginia submarine.
>
> Rucker said companies across the U.S. are building structural pieces of submarines, including some large modules, that were previously built at Electric Boat and Newport News facilities. Now they're constructed by companies with available workers and space, and then shipped to the shipyard for assembly.[64]

A December 6, 2022, news release from Austal USA of Mobile, AL—a shipyard that builds conventionally powered surface ships for the Navy—states

> Production has commenced at Austal USA's shipyard in Mobile, Ala., in support of their strategic partnership with General Dynamics Electric Boat (GDEB) to support the U.S. Navy's recapitalization of the nation's nuclear submarine fleet. Leveraging Austal USA's lean manufacturing techniques and modern steel production line facilities, a focus factory approach is being used to expand production capacity of the submarine industrial base.
>
> As part of the partnership, Austal USA is constructing and outfitting Command and Control Systems Modules (CCSM) and Electronic Deck Modules (EDM) for the Virginia- and Columbia-class programs. GDEB commenced on-the-job training efforts in April 2022 to provide certification for skilled trades and supervisory positions to ensure consistent work practices and adherence to quality assurance standards....
>
> Work commenced in late November on two tanks for a Virginia class submarine. The first CCSM is scheduled to arrive at Austal USA's Mobile shipyard in late January 2023 for initial outfitting efforts. The work will support a gradual ramp up to full fabrication and outfitting of CCSMs and EDMs across both submarine classes beginning in 2026.[65]

Potential Oversight Questions for Congress

Potential oversight questions for Congress include the following:

- What is the total estimated cost of actions needed to increase the capacity of the submarine-construction industrial base to a 1+2 annual production rate? What portion of this cost has been funded through FY2023, and what portion remains to be funded in FY2024 and subsequent years? How much of that remaining cost has been requested for FY2024 itself? What portions of all these costs are to be funded by government, and what portions are to be funded by industry?
- What impacts might there be on the Columbia- and/or Virginia-class programs if the Navy and industry fall short of their goals for increasing the production capacity of the submarine construction industrial base to support a 1+2 rate by 2028 and perhaps a 1+2.33 rate sometime after that?

[64] Megan Eckstein, "Defense Firms Outsource Sub, Carrier Construction amid Labor Woes," *Defense News*, October 21, 2022.

[65] Austal USA, "Austal USA Commences Submarine Work," December 6, 2022. See also Justin Katz, "Known for LCS, Alabama-Based Austal USA Starts Submarine Work," *Breaking Defense*, January 19, 2023; Rojoef Manuel, "Austal, General Dynamics Team Up for US Navy Nuclear Submarine Production," *Defense Post*, December 8, 2022; Rich Abott, "Austal Starts Submarine Construction Support Work," *Defense Daily*, December 12, 2022.

Legislative Activity for FY2024

Continuing Appropriations Act, 2024 and Other Extensions Act (H.R. 5860/P.L. 118-15)

Anomaly Requested for Program Under a Continuing Resolution (CR)

As discussed in another CRS report,[66] continuing resolutions (CRs) that are used to fund government operations for a portion of a fiscal year pending the enactment of full-year appropriations for that fiscal year typically prohibit, among other things, increasing a procurement quantity for a program compared with the program's procurement quantity in the prior year (aka year-to-year quantity increases). A CR used to fund government operations for a portion of FY2024 that includes such a prohibition could thus prohibit the Navy from proceeding with the procurement of the Columbia-class boat that is requested for procurement in FY2024 (i.e., from executing a procurement quantity of one for the program in FY2024) because the Navy did not procure a Columbia-class boat in FY2023 (i.e., the program had a procurement quantity of zero in FY2023).

As also discussed in the other CRS report, the potential impacts of a CR on program execution can be avoided or mitigated if the CR includes special provisions, called anomalies, for exempting individual programs or groups of programs from the general provisions of the CR. The Navy requested an anomaly for the Columbia-class program to permit the procurement and timely execution under a CR of the Columbia-class SSBN requested for procurement in FY2024.[67]

Anomaly Provided in H.R. 5860/P.L. 118-15

The Continuing Appropriations Act, 2024 and Other Extensions Act (H.R. 5860/P.L. 118-15 of September 30, 2023)—a CR that funded government operations until November 17, 2023—includes an anomaly (Section 124) that permits the Navy to proceed with the procurement of the Columbia-class SSBN that the Navy has requested for procurement in FY2024. Specifically, the provision permits the Navy to apportion funds for that purpose in an amount not to exceed $621.27 million.

Additional Anomaly Provided in H.R. 6363/P.L. 118-22

The Further Continuing Appropriations and Other Extensions Act, 2024 (H.R. 6363/P.L. 118-22 of November 16, 2023)—a CR that amends P.L. 118-15 (see above) so as to, among other things, fund some government operations until January 19, 2024, and other government operations (including DOD operations) until February 2, 2024—amends P.L. 118-15 to include an additional anomaly (Section 140) for the Columbia-class program permitting the Navy to apportion advance procurement (AP) funds for the program in an amount not to exceed $3,338.413 million (i.e., about $3.34 billion).

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

[67] Tony Bertuca, "Columbia-Class Sub Included in White House's CR 'Anomalies' Request," *Inside Defense*, August 31, 2023; Connor O'Brien, "White House Seeks Stopgap Exemption to Prevent Delays to New Sub Fleet," *Politico Pro*, August 31, 2023.

Summary of Congressional Action on FY2024 Funding Request

Table 4 summarizes congressional action on the Navy's FY2024 procurement and advance procurement (AP) funding request for the Columbia-class program.

Table 4. Congressional Action on FY2024 Funding Request

Millions of then-year dollars, rounded to nearest tenth; totals may not add due to rounding

		Authorization			Appropriation		
	Request	**HASC**	**SASC**	**Final**	**HAC**	**SAC**	**Final**
FY2024 Procurement Funding Request for Virginia-Class Program (all in SCN account)							
Procurement	2,443.6	2,531.6	2,443.6	2,443.6	2,443.6	2,443.6	
Advance procurement (AP)	3,390.7	3,390.7	3,390.7	3,390.7	3,390.7	3,390.7	
Total Columbia class	***5,834.3***	***5,922.3***	***5,834.3***	***5,834.3***	***5,834.3***	***5,834.3***	
Emergency Supplemental Funding for Submarine Industrial Base (SIB) Requested on October 20, 2023							
		Authorization			**Appropriation**		
	Request	**House**	**Senate**	**Final**	**House**	**Senate**	**Final**
OMN account	557.8	n/a	n/a			557.8	
SCN account	2,055.0	n/a	n/a			2,155.0	
OPN account	393.6	n/a	n/a			293.6	
RDTEN account	7.0	n/a	n/a			7.0	
MilCon account	281.9	n/a	n/a			281.9	
Subtotal DOD	***3,295.2***					***3,295.2***	
DOE NNSA for NR	98.0	n/a	n/a			0	
Total SIB	***3,393.2***	***n/a***	***n/a***			***3,393.2***	

Source: Table prepared by CRS based on Navy's original FY2024 budget submission, committee and conference reports, and explanatory statements on FY2024 National Defense Authorization Act and FY2024 DOD Appropriations Act. Figures may not add due to rounding.

Notes: HASC is House Armed Services Committee; **SASC** is Senate Armed Services Committee; **HAC** is House Appropriations Committee; **SAC** is Senate Appropriations Committee. **SCN** is Shipbuilding and Conversion, Navy; **OMN** is Operation and Maintenance, Navy; **OPN** is Other Procurement, Navy; **RDTEN** is Research, Development, Test and Evaluation, Navy; **MilCon** is Military Construction, Navy and Marine Corps; **DOE NNSA for NR** is Department of Energy National Nuclear Security Administration for Naval Reactors (i.e., the Naval Nuclear Propulsion Program). n/a is not applicable—the House and Senate versions of the FY2024 National Defense Authorization Act (NDAA) were reported prior to the submission of the emergency supplemental funding request on October 20, 2023.

FY2024 National Defense Authorization Act (H.R. 2670/S. 2226)

House

The House Armed Services Committee, in its report (H.Rept. 118-125 of June 30, 2023) on H.R. 2670, recommended the funding levels shown in the HASC column of **Table 4**. The recommended increase of $88.0 million in procurement funding is for "Submarine industrial base." (Page 445)

Section 1012 of H.R. 2670 would expand the list of critical components that can be procured with multiyear contracts using funds executed through 10 U.S.C. 2218a, the statute that governs the National Sea-Based Deterrence Fund (NSBDF).

H.Rept. 118-125 states (emphasis added)

> Laser Peening Application to Ship and Submarine Construction, Maintenance, and Repair
>
> The committee notes that the Navy is facing challenges related to maintaining its aging fleet and procuring new ships and submarines. To address some of these challenges, the Navy continues to examine technologies that can extend the service life of newly constructed ships and submarines, as well as maintain the current fleet. Laser shock peening (laser peening) is a technology that has been proven to provide significant cost savings over the past 35 years in the aerospace, transportation, and power generation industries and will provide significant cost savings for the Navy and its shipbuilders as well.
>
> In ships and submarines, metal fatigue and resultant cracking can result in damage to key metal components such as propulsion shafting, propellers, rudders, water jets, etc. Without repairing these critical ship components, the damage can potentially lead to a part's unexpected failure. Material treated by laser peening is significantly more resistant to metal fatigue failures, thus extending the system's life. Laser peening has been supported in Congress since at least 2014 as a proven technology that has the potential of saving significant funding that would otherwise be necessary for future repairs or replacement of critical shipboard and submarine components. Similar savings have been seen in commercial industry and Department of Defense aviation.
>
> Therefore, the committee directs the Deputy Assistant Secretary of the Navy for Research, Development, Test and Evaluation (DASN RDTE) to provide a briefing to the House Committee on Armed Services by February 1, 2024, on the resources required for the U.S. Navy to fully implement a coordinated laser peening program, **particularly to support the Columbia-class**, to address the numerous metal fatigue related issues and costs rampant throughout the aviation, surface, and submarine fleet. (Page 110)

Senate

The Senate Armed Services Committee, in its report (S.Rept. 118-58 of July 12, 2023) on S. 2226, recommended the funding levels shown in the SASC column of **Table 4**.

Conference

The conference report (H.Rept. 118-301 of December 6, 2023) on H.R. 2670 recommended the funding levels shown in the authorization final column of **Table 4**.

Section 1016 of H.R. 2670 would expand the list of critical components that can be procured with multiyear contracts using funds executed through 10 U.S.C. 2218a, the statute that governs the National Sea-Based Deterrence Fund (NSBDF).

FY2024 DOD Appropriations Act (H.R. 4365/S. 2587)

House

The House Appropriations Committee, in its report (H.Rept. 118-121 of June 27, 2023) on H.R. 4365, recommended the funding levels shown in the HAC column of **Table 4**.

In H.R. 4365, the paragraph that makes appropriations for the Shipbuilding and Conversion, Navy (SCN) appropriation account (i.e., the Navy's shipbuilding budget) includes this provision

> … *Provided further*, That funds appropriated or otherwise made available by this Act for Columbia Class Submarine (AP) may be available for the purposes authorized by subsections (f), (g), (h) or (i) of section 2218a of title 10, United States Code [i.e., the statute that governs the National Sea-Based Deterrence Fund (NSBDF)], only in accordance with the provisions of the applicable subsection.

Senate

The Senate Appropriations Committee, in its report (S.Rept. 118-81 of July 27, 2023) on S. 2587, recommended the funding levels shown in the SAC column of **Table 4**.

In S. 2587, the paragraph that makes appropriations for the Shipbuilding and Conversion, Navy (SCN) appropriation account (i.e., the Navy's shipbuilding budget) includes this provision

> … *Provided further*, That funds appropriated or otherwise made available by this Act for Columbia Class Submarine (AP) may be available for the purposes authorized by subsections (f), (g), (h) or (i) of section 2218a of title 10, United States Code [i.e., the statute that governs the National Sea-Based Deterrence Fund (NSBDF)], only in accordance with the provisions of the applicable subsection.

S.Rept. 118-81 states

> *Submarine Construction Performance*.—The Committee continues to be concerned by VIRGINIA Class Submarine [VCS] construction cost and schedule performance which impact not only the construction and delivery to the fleet of VCS, but also affect the COLUMBIA Class Submarine [COL] construction schedule. The Committee notes that the fiscal year 2024 President's budget request includes funds for cost overruns of VCSs procured in fiscal years 2015, 2016, and 2017, and that cost overruns on additional ongoing new VCS construction programs are expected to exceed $3,000,000,000 in future years. The Secretary of the Navy is directed to submit to the congressional defense committees the most current cost and schedule estimates, by VCS and COL, with the submission of each annual President's budget request until delivery of the twelfth and final COLUMBIA hull. The report shall identify changes from the previous year, and include detailed explanations for all submarines not fully resourced to the Navy's cost estimate, as well as all projected cost-to-complete requirements for previously appropriated submarines. (Page 137)

Emergency Supplemental Appropriations

Senate

H.R. 815 was introduced in the House on February 2, 2023, and agreed to in the House by voice vote on March 7, 2023, as the Removing Extraneous Loopholes Insuring Every Veteran Emergency Act (aka RELIEVE Act).

Under Senate Amendment 1388 to H.R. 815—an amendment in the nature of a substitute that was proposed in the Senate on February 9, 2024, and agreed to in the Senate on February 12, 2024—H.R. 815 would become the National Security Act, 2024, of which Division A of H.R. 815 would be the National Security Supplemental Appropriations Act, 2024. Division A of H.R. 815 would provide the supplemental funding amounts shown in the Appropriations Senate column of the lower part of **Table 4**. Compared with the supplemental amounts requested on October 20, 2023, the amounts that would be provided by Division A of H.R. 815 would in effect transfer $100

million in requested supplemental funding from the Other Procurement, Navy (OPN) account to the Shipbuilding and Conversion, Navy (SCN) account, and would not provide the $98.0 million in funding that was requested for the Department of Energy (DOE) National Nuclear Security Administration (NNSA) for Naval Reactors (NR) in support of AUKUS Pillar 1.

House

Emergency supplemental appropriations acts introduced in the House since January 29, 2024, include H.R. 7113 (introduced January 29, 2024), H.R. 7217 (introduced February 5, 2024), H.R. 7271 (introduced February 7, 2024), and H.R. 7372 (introduced February 15, 2024).

Compared with the supplemental amounts requested on October 20, 2023, for the submarine industrial base, H.R. 7113, H.R. 7217, and H.R. 7271 would provide none of the requested funding, while H.R. 7372 would provide the same amounts as those that would be provided under Senate Amendment 1388 to H.R. 815 (i.e., the same amounts as shown in the Appropriations Senate column of the lower part of **Table 4**), except for the Military Construction (MilCon) account, for which H.R. 7372 would provide none of the requested funding.

On February 6, 2024, H.R. 7217 failed of passage/was not agreed to in House on a motion to suspend the rules and pass the bill.

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.[68] 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

[68] 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.[69] 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). 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.[70] The Navy testified in

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

[70] 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, 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

(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."[71]

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.[72]

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."[73] The first new boat is to be delivered by 2028, or about four years later than previously planned.[74]

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[75] 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."[76] 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 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

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> 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.

[71] 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.

[72] *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.

[73] *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.

[74] *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.

[75] 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.

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

> 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.[77]

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."[78]

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."[79]

[77] 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.

[78] 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.

[79] 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).[80] 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[81] and approved by DOD's Joint Requirements Oversight Committee (JROC) on June 20, 2008.[82] 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.[83] The Navy established an Columbia-class program office at about this same time.[84]

The AOA reportedly began in the summer or fall of 2008.[85] 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.[86] The AOA concluded that a new-design SSBN was the best option for replacing the Ohio-class SSBNs. (For

[80] 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.)

[81] 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.)

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

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

[84] 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.

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

[86] *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.[87]

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

[87] 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.[88]

[88] *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.[89]
- Unlike the Ohio-class design, which requires a midlife nuclear refueling,[90] 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).[91] 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.[92]
- 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)[93] of 43 feet, compared to 42 feet on the Ohio-class design,[94] and a length of 560 feet, the same as that of the Ohio-class design.[95]

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[89] 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.

[90] 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.

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

[92] 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.

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

[94] 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.

[95] 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.[96] 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."[97]

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

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

[97] 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.[98]

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.[99] 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

[98] "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/.

[99] 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.[100]

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

[100] 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.[101]

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...

[101] 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.[102]

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.[103]

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.

[102] Source: Transcript of hearing.

[103] 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.[104]

[104] 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 amended through July 17, 2022, 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.

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...."[105] 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....

[105] 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.

... 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....

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.[106]

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.[107]

[106] 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.

[107] 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.

Appendix F. October 25, 2023, Navy Testimony on Increasing Capacity of Submarine Industrial Base

At an October 25, 2023, hearing on the submarine industrial base and its ability to support the AUKUS framework before the Seapower and Projection Forces Subcommittee of the House Armed Services Committee, the Navy testified on its efforts (and associated funding) for increasing the capacity of the submarine construction industrial base to support a construction rate of one Columbia-class ballistic missile submarine (SSBN) per year plus 2.33 Virginia-class attack submarines (SSNs) per year (i.e., a "1+2.33" rate). This is the rate, the Navy testified, that would be sufficient to meet both U.S. Navy needs and needs under the AUKUS agreement for building SSNs while also building Columbia-class SSBNs for the U.S. Navy. The Navy's testimony stated

> **Submarine Industrial Base (SIB)**
>
> The US Submarine Force and our SIB [submarine industrial base] are crucial to the security of our Nation, and maintaining overmatch in the Undersea Warfare domain is one of the top priorities in the Department of Defense. Submarines, therefore, are one of the most important battle force vessels in our Navy. Forward deployed, combat-credible attack submarines project US decisive naval power essential in today's security environment. Construction and sustainment of our submarine force is complex, difficult, and requires a continuous focus on safety and nuclear stewardship. Our SIB is supporting the largest submarine recapitalization effort in nearly 50 years and at a time when American manufacturing and shipbuilding capacity has atrophied by more than 60 percent since the end of the Cold War.
>
> The US is simultaneously replacing our strategic Ballistic Missile Submarine (SSBN) force with the COLUMBIA Class, transitioning our SSN force from LOS ANGELES to VACL [Virginia class] , and replacing our Guided Missile Submarine (SSGN) capability[108] with 'strike optimized' VIRGINIA Payload Module (VPM) submarines. VPM includes a new hull section with additional vertical launch tubes for conventionally armed missiles to the VACL submarine design. Adding AUKUS requires us to improve our new-construction and sustainment efforts to ensure we meet our domestic requirements while supporting the trilateral partnership. Both our SIB uplift effort and the AUKUS program are executing aggressive and deliberate schedules designed to meet our national security needs. Continued partnership with Congress is foundational to our collective success in these two generational opportunities. The SIB, consisting of our public shipyards and two prime shipbuilders, General Dynamics Electric Boat (GDEB) and Huntington Ingalls Industries Newport News Shipbuilding (HII-NNS), along with the 16,000 suppliers (5,000 direct contractual relationships and 11,000 sub-tier vendors) across the country, support both our new-construction submarines and sustainment of the in-service submarine fleet.
>
> It has been nearly 50 years since the US ramped-up its submarine construction capability and infused equivalent volumes of complexity and work into the industrial base. Following the Cold War, the country underwent significant shifts in economics and culture, punctuated by a clear transition from a manufacturing-based economy to a services-based economy. This pivot undermined foundational industrial capabilities and capacities and

[108] This is a reference to the first four Ohio (SSBN-726) class SSBNs, which were converted into cruise missile and special operations forces (SOF) submarines (SSGNs). The four conversions were completed in 2005-2007. The SSGNs are to reach their ends of their service lives and be retired in FY2026-FY2028. 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.

challenged our ability to maintain the sufficiently skilled and sized workforce needed for a resilient and robust SIB.

In FY 2018, with leadership and support from Congress, the DON began infusing funding into the SIB to increase capability and capacity at new and existing suppliers to meet growing demand and increase resilience across the supply chain. In October 2020, the DON established the SIB Program within the Program Executive Office for Strategic Submarines (PEO SSBN). The SIB Program, in partnership with the Office of the Secretary of Defense Industrial Base Analysis and Sustainment program, is executing a holistic strategy to expand and strengthen the SIB by investing in six key areas: shipbuilder infrastructure, supply chain capability/capacity, scaling new technologies, addressing workforce trade skill gaps and constraints, expanding capacity via strategic outsourcing, and government oversight of expanded industrial base efforts.

The AUKUS partnership provides an unprecedented opportunity to leverage the capabilities of our partner nations, strengthen our defense industrial bases, create jobs, and drive innovation across our SSN force. AUKUS relies on a strong SIB that designs, delivers, maintains, and modernizes our apex predators of the oceans – SSNs. Our domestic industrial base will benefit from the industrial capabilities of our partner nations, such as joining with an Australian company to mature and scale metallic additive manufacturing across the SIB. Ultimately, AUKUS will increase commonality, interoperability, and therefore, warfighting lethality across our three submarine forces.

Australia's investment into the US SIB builds upon on-going efforts to improve industrial base capability and capacity, create jobs, and utilize new technologies. This contribution is necessary to augment VACL production from 2.0 to 2.33 submarines per year to support both US Navy and AUKUS requirements. Through sustained investment, consistent with our ongoing strategy, the ultimate goal is to increase repair capacity and capability of US shipyards to get more SSNs out of maintenance and back to the Fleet. AUKUS also presents a unique demand on the US SIB requiring a "Whole of Government, Whole of Industry" approach to achieve and sustain pace, including supporting both US and partner nation efforts.

Submarine Construction:

The current submarine construction rate, coupled with systemic challenges facing the US SIB, resulted in the current annual production rate of 1.2 to 1.3 VACL SSNs per year, compared to the goal of 2.0 VACL SSNs per year. This SSN construction rate, coupled with COLUMBIA Class SSBN serial production starting in FY 2026 (pending Congressional authorization and appropriations) is what we call "1+2," for the one COLUMBIA Class SSBN and two VACL SSNs per year.

The recapitalization process to achieve the 1+2 cadence increases the demand on the US SIB by a "workload equivalent" factor of five by 2028. 2015 was the last year the Navy was scheduled to deliver one VACL SSN (1.0). One COLUMBIA Class SSBN represents approximately 2.5 VACL SSNs in terms of build resources (manning) and tonnage. The addition of the VPM design equates to 1.25 legacy (2015) VACL SSNs. Thus, a 1.0 build rate from 2015 becomes 5.0 in 2028 to achieve 1+2 cadence (2.5 + (1.25 + 1.25)). The DON's submarine builders, GDEB and HII-NNS, and their supporting supplier base are working to achieve this 1+2 rate in 2028 by investing in workforce development and retention efforts, increasing capacity and capability through infrastructure and equipment upgrades, and partnering with the DON to mature and scale advanced manufacturing technology throughout the SIB….

SIB Recapitalization

The recapitalization of the US Submarine Force, plus the investment in AUKUS, requires continued and significant investments in US facilities, infrastructure, and workforce. Our

SIB recapitalization effort creates large numbers of hands-on jobs across the nation. Targeted workforce growth includes, but is not limited to

• Trades – Welders, Shipfitters, Electricians, Machinists, Pipefitters, Painters, and Electronics Technicians.

• Supporting Disciplines – Planners, Estimators, Material Managers, Contract Specialists, Information Technology Experts, Quality Assurance Specialists, and Project Leaders.

• STEM – Structural, Electrical, Mechanical, and Nuclear Engineers; Designers; Test Coordinators; Metallurgists; Computer Scientists; Logisticians; etc.

Significant investments into the submarine supplier base will produce increased volume of basic materials, specialized materials, and engineered components required for modern nuclear-powered submarine construction, such as

• Steel and specialty metals.

• High-tech castings and forgings.

• Electrical components.

• Combat Systems.

• Propulsion Plant components.

• Valves, pumps, pipes, fittings, and fans.

• Software and information systems.

In partnership with Congress, the Office of the Secretary of Defense and the DON made substantial SIB investments, with $2.3 billion across FY 2018 through FY 2023 currently in execution and $1.6 billion planned for FY 2024 through FY 2027. There is also an additional $2.2 billion for submarine sustainment efforts submitted in the President's Budget for FY 2024 through 2028. This much-needed resourcing is purposefully designed to help build and strengthen SIB capacity, capability, and resilience. These resources are primarily being utilized across six lines of effort, and are needed to support efforts to increase submarine construction and sustainment rates:

1. Supplier Development: Add capability and/or capacity to existing suppliers, reduce single/sole-source risks for resiliency and robustness, improve first time quality.

2. Shipyard Infrastructure: Accelerate investments in shipbuilder facilities, footprint, and machines/fixtures.

3. Strategic Outsourcing: Increase supplier capacity to shift non-core workload away from the two submarine shipbuilders to free up footprint, resources, and focus for shipbuilder-only work.

4. Workforce Development: Train current and future trades at sufficient rates, and help build adequate hiring pool for vendors and shipbuilders.

5. Government Oversight: Increase the Navy's oversight of the vendor base as result of lessons learned from historical quality and schedule adherence challenges.

6. Technology Opportunities: Implement additive manufacturing, and non-destructive test imaging technology to remove known production risk areas and bottlenecks.

The DON began execution of these SIB efforts several years ago as building facilities, growing workforces, and increasing production rates takes time. Our dividends are not fully matured yet. Some of the significant returns on this investment include:

• 194 suppliers in 31 states received funding to generate increased production and increase capacity.

• Approximately 4 million hours strategically sourced by EB and HII-NNS to key fabricators (goal is at least 6 million hours by 2026).

• Approximately 1,000 new workforce members in more than 120 second and third-tier key suppliers with more to come each year.

• Establishment of dedicated training centers trained more than 3,500 workers since 2020.

• Establishment of an industry-wide consortium for advanced manufacturing technology supplying critical submarine components from 6 crucial submarine-specific metals contributing to 75-percent of troubled submarine components.

The DON also worked with a non-profit partner to develop the workforce recruiting and support website, "Build Submarines.com." This site serves as a central hub of information to support workforce development efforts related to our national advertising campaign for the SIB including resources for those interested in submarine construction or SIB related careers. The DON is on a mission to make ship and submarine manufacturing a preferred profession again and it is a national imperative.

Deepening our cooperation and integration with AU [Australia] and the UK across the submarine enterprise presents a unique opportunity for innovation, growth, and mutual development. The partnership will create jobs, contribute to the diversification of ideas, and augment our collective technical and intellectual base. The partnership will also open up new markets and business opportunities, enhancing the resilience of both nations' economies. This will pave the way for additional joint ventures, thereby fostering a shared sense of purpose, knowledge exchange, and a more connected community of subject matter experts.[109]

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Disclaimer

[109] Joint Statement, Honorable Erik K. Raven, Under Secretary of the Navy, VADM William J. Houston, Commander, Naval Submarine Forces, [and] RDML Jonathan Rucker, Program Executive Officer, Attack Submarines, before the House Committee on Armed Services Subcommittee on Seapower and Projection Forces, October 25, 2023, pp. 4-8.