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Navy Virginia (SSN-774) Class Attack Submarine Procurement: Background and Issues for Congress

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Summary

The Navy has been procuring Virginia (SSN-774) class nuclear-powered attack submarines (SSNs) since FY1998, and a total of 36 have been procured through FY2022. Since FY2011, Virginia-class boats have been procured at a rate of two per year. Virginia-class boats scheduled for procurement in FY2019-FY2023 are being procured under a multiyear procurement (MYP) contract.

The Virginia-class design has been updated multiple times since FY1998. Most Virginia-class boats procured in FY2019 and subsequent years are to be built with the Virginia Payload Module (VPM), an additional, 84-foot-long, mid-body section equipped with four large-diameter, vertical launch tubes for storing and launching additional Tomahawk missiles or other payloads. When procured at a rate of two boats per year, VPM-equipped Virginia-class SSNs have an estimated procurement cost of about $3.6 billion per boat.

The Navy's proposed budget requests the procurement of the 37th and 38th Virginia-class boats. The two boats have an estimated combined procurement cost of $7,250.6 million (i.e., about $7.3 billion). The two boats have received $1,938.3 million in prior-year "regular" advance procurement (AP) funding, and $778.1 million in Economic Order Quantity (EOQ) funding, which is an additional kind of AP funding that can occur under an MYP contract. The Navy's proposed FY2023 budget requests the remaining $4,534.2 million needed to complete the two boats' estimated combined procurement cost of $7,250.6 million. The Navy's proposed FY2023 budget also requests $2,025.7 million in AP funding for Virginia-class boats to be procured in one or more future years, bringing the total amount of FY023 procurement and AP funding requested for the procurement of Virginia-class boats in FY2023 and subsequent years to $6,559.8 million (i.e., about $6.6 billion). The Navy's proposed FY2023 budget additionally requests $304.5 million in cost-to-complete funding to cover cost growth on Virginia-class boats procured in prior years.

The Navy's current force-level goal, which was released in December 2016, calls for achieving and maintaining a fleet of 355 manned ships, including 66 SSNs. The Navy and the Office of the Secretary Defense have been working since 2019 to develop a successor Navy force-level goal to replace the 355-goal of 2016. Studies of this emerging force-level goal that have been released by the Navy in summary form suggest that the new force-level goal could call for achieving and maintaining a force of 66 to 72 SSNs.

The Navy's FY2023 five-year (FY2023-FY2027) shipbuilding plan includes a total of 10 Virginia-class boats, to be procured at a rate of two per year. The Navy's FY2023 30-year (FY2023-FY2052) shipbuilding plan, released on April 20, 2022, includes three alternative 30-year shipbuilding profiles for the period FY2028-FY2052. Under these profiles, SSNs would be procured during FY2028-FY2052 at a rate of 1.76 to 2.24 boats per year. Based on the three alternative shipbuilding profiles, the FY2023 30-year shipbuilding plan projects that the SSN force will reach a minimum of 46 boats in FY2028, return to 50 boats in FY2032, and grow to 60 to 69 SSNs by FY2052.

Potential oversight issues for Congress regarding the Virginia-class program include the SSN force-level goal and procurement rate, the industrial-base challenges of building both Virginia-class SSNs and Columbia-class ballistic missile submarines (SSBNs) at the same time, and cost and schedule risk in building the latest (i.e., Block V) version of the Virginia-class design.

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Introduction

This report provides background information and issues for Congress on the Virginia (SSN-774) class nuclear-powered attack submarine (SSN) program. The Navy has been procuring Virginia-class SSNs since FY1998, and a total of 36 have been procured through FY2021. Since FY2011, Virginia-class boats have been procured at a rate of two per year. The Navy's proposed FY2023 budget requests the procurement of the 37th and 38th Virginia-class boats.

The Virginia-class program poses multiple issues for Congress. Decisions that Congress makes on these issue could substantially affect U.S. Navy capabilities and funding requirements, and the U.S. shipbuilding industrial base.

The Navy's SSN(X) next-generation attack submarine program, which is to be the eventual successor to the Virginia-class SSN program, is discussed in another CRS product: CRS In Focus IF11826, *Navy Next-Generation Attack Submarine (SSN[X]) Program: Background and Issues for Congress*, by Ronald O'Rourke.

The Navy's Columbia (SSBN-826) class ballistic missile submarine program is discussed in another CRS report—CRS Report R41129, *Navy Columbia (SSBN-826) Class Ballistic Missile Submarine Program: Background and Issues for Congress*, by Ronald O'Rourke.

Background

U.S. Navy Submarines[1]

The U.S. Navy operates three types of submarines—nuclear-powered ballistic missile submarines (SSBNs),[2] nuclear-powered cruise missile and special operations forces (SOF) submarines (SSGNs),[3] and nuclear-powered attack submarines (SSNs). The SSNs are general-purpose submarines that can (when appropriately equipped and armed) perform a variety of peacetime and wartime missions, including the following:

- covert intelligence, surveillance, and reconnaissance (ISR), much of it done for national-level (as opposed to purely Navy) purposes;

[1] In U.S. Navy submarine designations, SS stands for submarine, N stands for nuclear-powered, B stands for ballistic missile, and G stands for guided missile (such as a cruise missile). Submarines can be powered by either nuclear reactors or non-nuclear power sources such as diesel engines or fuel cells. All U.S. Navy submarines are nuclear-powered. A submarine's use of nuclear or non-nuclear 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 non-nuclear-powered submarine can be armed with nuclear weapons.

[2] The SSBNs' basic mission is to remain hidden at sea with their nuclear-armed submarine-launched ballistic missiles (SLBMs) and thereby deter a strategic nuclear attack on the United States. The Navy's SSBNs are discussed in CRS Report R41129, *Navy Columbia (SSBN-826) Class Ballistic Missile Submarine Program: Background and Issues for Congress*, by Ronald O'Rourke, and CRS Report RL31623, *U.S. Nuclear Weapons: Changes in Policy and Force Structure*, by Amy F. Woolf.

[3] The Navy's four SSGNs are former Trident SSBNs that have been converted (i.e., modified) to carry Tomahawk cruise missiles and SOF rather than SLBMs. Although the SSGNs differ somewhat from SSNs in terms of mission orientation (with the SSGNs being strongly oriented toward Tomahawk strikes and SOF support, while the SSNs are more general-purpose in orientation), SSGNs can perform other submarine missions and are sometimes included in counts of the projected total number of Navy attack submarines. The Navy's SSGNs are discussed in CRS Report RS21007, *Navy Trident Submarine Conversion (SSGN) Program: Background and Issues for Congress*, by Ronald O'Rourke.

- covert insertion and recovery of SOF (on a smaller scale than possible with the SSGNs);
- covert strikes against land targets with the Tomahawk cruise missiles (again on a smaller scale than possible with the SSGNs);
- covert offensive and defensive mine warfare;
- anti-submarine warfare (ASW); and
- anti-surface ship warfare.

During the Cold War, ASW against Soviet submarines was the primary stated mission of U.S. SSNs, although covert ISR and covert SOF insertion/recovery operations were reportedly important on a day-to-day basis as well.[4] In the post-Cold War era, although ASW remained a mission, the SSN force focused more on performing the first three other missions listed above. With the shift in recent years from the post-Cold War era to a situation of renewed great power competition,[5] ASW against Russian and Chinese submarines has once again become a more prominent mission for U.S. Navy SSNs.

U.S. SSN Force Levels

Force-Level Goal

Goal Current Force-Level Goal of 66 Boats within 355-Ship Plan

The Navy's current force-level goal, released in December 2016, is to achieve and maintain a fleet of 355 manned ships, including 66 SSNs.[6]

Emerging Successor Force-Level Goal

The Navy and Department of Defense (DOD) since 2019 have been working to develop a new force-level goal to replace the 355-ship force-level goal. Studies of this emerging force-level goal that have been released by the Navy in summary form suggest that the new force-level goal could call for achieving and maintaining a force of 66 to 72 SSNs.[7]

For a review of SSN force-level goals since the Reagan Administration, see **Appendix A**.

Past and Current Force Levels

During most of the 1980s, when plans called for achieving a 600-ship Navy including 100 SSNs, the SSN force included more than 90 boats, peaking at 98 boats at the end of FY1987. The number of SSNs declined after that in a manner that roughly paralleled the decline in the total

[4] For an account of certain U.S. submarine surveillance and intelligence-collection operations during the Cold War, see Sherry Sontag and Christopher Drew with Annette Lawrence Drew, *Blind Man's Bluff* (New York: Public Affairs, 1998).

[5] For more on this shift, see CRS Report R43838, *Renewed Great Power Competition: Implications for Defense—Issues for Congress*, by Ronald O'Rourke.

[6] For more on the 355-ship force-level goal, see CRS Report RL32665, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, by Ronald O'Rourke.

[7] For the effort to develop a successor to the 355-ship goal of 2016, including the studies that the Navy has released in summary form, see CRS Report RL32665, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, by Ronald O'Rourke.

size of the Navy over the same time period. The 50 SSNs in service at the end of FY2021 included the following:

- 28 Los Angeles (SSN-688) class boats;
- 3 Seawolf (SSN-21) class boats; and
- 19 Virginia (SSN-774) class boats.

The three classes of SSNs listed above are discussed further later in this report. In addition to the 50 SSNs shown above, the Navy operates four Ohio (SSBN-726) class SSGNs. Compared to the Navy's SSNs, the SSGNs have a much larger capacity for carrying cruise missiles and SOF, but they are nevertheless general-purpose submarines that can perform missions performed by SSNs.

Projected Procurement Rates and Force Levels

The Navy's FY2023 five-year (FY2023-FY2027) shipbuilding plan includes a total of 10 Virginia-class boats, to be procured at a rate of two per year. The Navy's FY2023 30-year (FY2023-FY2052) shipbuilding plan, released on April 20, 2022, includes three alternative 30-year shipbuilding profiles for the period FY2028-FY2052. Under these profiles, SSNs would be procured during FY2028-FY2052 at a rate of 1.76 to 2.24 boats per year. Based on the three alternative shipbuilding profiles, the FY2023 30-year shipbuilding plan projects that the SSN force will reach a minimum of 46 boats in FY2028, return to 50 boats in FY2032, and grow to 60 to 69 SSNs by FY2052.[8] (The alternative shipbuilding profiles also include the procurement of four to six new SSGNs, with the first to be procured as early as FY2037 or as late as FY2042.)

In earlier years, the SSN force was projected to experience a valley or trough from the mid-2020s through the early 2030s. This valley was a projected consequence of having procured a relatively small number of SSNs during the 1990s, in the early years of the post-Cold War era. Under the FY2020 30-year (FY2020-FY2049) shipbuilding plan, for example, the number of SSNs was projected to reach a minimum of 42 boats (i.e., 24 boats, or about 36%, less than the current 66-boat force-level goal) in FY2027-FY2028. Some observers were concerned that this projected valley in SSN force levels could lead to a period of heightened operational strain for the SSN force, and perhaps a period of weakened conventional deterrence against potential adversaries such as China.[9] The projected SSN valley was first identified by CRS in 1995 and has been discussed in CRS reports and testimony every year since then.

A long-range Navy shipbuilding document released by the Navy on December 9, 2020, showed that the projected valley in SSN force levels had been essentially filled in, with projected SSN force levels for those years that did not drop below 50 boats and were as much as 11 boats higher than they are under the FY2020 30-year shipbuilding plan. The filling in of the valley was the result of a Navy plan to keep some existing Los Angeles-class SSNs remaining in service longer than they were projected to be under the FY2020 30-year shipbuilding plan. The Navy stated that

[8] For projected force levels each year from FY2023 to FY2052, see CRS Report RL32665, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, by Ronald O'Rourke.

[9] China took note of the valley. The November 2014 edition of a Chinese military journal, for example, included an article with a passage that translates as follows:

> ... in 2028, the [U.S. Navy] force of nuclear attack submarines will fall from the current number of 55 down to 41 boats. Some are concerned about whether this force level can meet the requirements of the Asia-Pacific rebalance."
>
> (Lyle Goldstein, "Evolution of Chinese Power Projection Capabilities," presentation to Center for a New American Security (CNAS) roundtable discussion, September 29, 2016, slide 7 of 41.)

these longer Los Angeles-class service lives reflected a previously announced Navy plan to refuel and extend the service lives of seven Los Angeles-class SSNs, along with "updated service life estimates for the remaining 688s based on current hull by hull utilization."[10] A November 17, 2021, press report stated

> The decline in the number of the Navy's attack submarines (SSNs) is leveling out sooner than was feared just a few years ago, made possible by the decision to extend the service lives of some older SSNs.
>
> Previously, the force level of SSNs was predicted to decline to a "trough" of 41 SSNs in the mid-2020s before the number would start to increase as the building of two Virginia-class SSNs per year hit its stride.
>
> With 50 submarines "we are at that inflection point right now," said Vice Adm. Bill Houston, commander, Naval Submarine Forces, speaking Nov. 17 at the Naval Submarine League's annual symposium in Arlington. "We are actually very stable right now [at 50] and we're starting to increase our numbers.
>
> "How are we doing that? Through an awful lot of hard work by those people who came before me and whose shoulders we're standing on right now; tremendous hard work from the shipbuilders and tremendous from the Navy, from the Department of Defense and from our overall government," Houston said.
>
> An important initiative is the service life extension of several Los Angeles-class SSNs.
>
> "There is additional margin in the Los Angeles class," he said. "We actually have reactor cores available which will refuel and extend a significant number of Los Angeles-class submarines."
>
> Houston was not specific in the number of Los Angles-class SSNs submarines that will go through life extensions. The Navy previously has mentioned consideration of extending the service lives of five to seven boats.
>
> "We found that on most of our Los Angeles [SSNs] had significant hull margins, so we were able to extend them, and they had the fuel to go longer," he said. "There are several Los Angeles's that we will physically refuel and add years on them. Just due to the absolutely incredible job we did when we built the Los Angeles and the Ohio [SSBN and SSGN] that we could extend those ships as long as we can."[11]

A November 18, 2021, press report stated

> The Navy is "systematically" assessing each one of its Los-Angeles class submarines to determine if their service lives can be extended for two to three years, a process a senior officer says will result in a 20% improvement in force projections compared to previous forecasts.
>
> Rear Adm. Doug Perry, director of undersea warfare requirements, told attendees at Naval Submarine League today that he most recently approved a three-year extension for the nuclear-powered attack submarine Alexandria (SSN 757) earlier this year.
>
> He added that each boat's extension is being assessed on a case-by-case basis.

[10] Source: Navy information paper on FY2022 Fiscal Planning Framework and SSN-688 class service live extension program questions, February 5, 2021, provided by Navy Office of Legislative Affairs to Congressional Budget Office (CBO) and CRS on February 5, 2021.

[11] Richard R. Burgess, "Vice Adm. Houston: Sub Force Approaching Inflection Point of 50 SSNs," *Seapower*, November 17, 2021.

> "We are currently forecast to sustain a force of 50 SSNs throughout this decade," Perry said. "And then as we build our Virginia-class submarines we will go above 50 and get up to the fiscal year 2016 force structure assessment requirement of 66 SSNs."
>
> At least one factor that has likely contributed to the Navy's ability to squeeze out two or three extra years of service life on some of its submarines is, ironically, its maintenance backlog.
>
> The service has taken harsh criticism from Capitol Hill for at times allowing some boats to sit in dock for several years at a time while awaiting servicing. That time in dock—and by extension time when the sub's reactor was not being used—likely comes into play when assessing whether the boat can sail past its original service life.
>
> The Navy is also starting to work on refueling "five still very capable" Los-Angeles submarines with new reactor cores, Perry said, potentially extending their service lives for an additional 10 years or more.
>
> The service for several years now has been experimenting with whether it could effectively refuel the submarines and had previously stated additional refuelings would be contingent initial trials. Perry also said Portsmouth Naval Shipyard had been selected as the best yard to do that work.[12]

Submarine Construction Industrial Base

U.S. Navy submarines are built by 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. These are the only two shipyards in the country capable of building nuclear-powered ships. GD/EB builds submarines only, while HII/NNS also builds nuclear-powered aircraft carriers and is capable of building other types of surface ships.

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

SSN Deployments Delayed Due to Maintenance Backlogs

In recent years, a number of the Navy's SSNs have had their deployments delayed due to capacity-related maintenance backlogs at the Navy's four government-operated naval shipyards (NSYs), which are the primary facilities for conducting depot-level maintenance work on Navy SSNs. Delays in deploying SSNs can put added operational pressure on other SSNs that are available for deployment. For additional background information on this issue, see **Appendix C**.

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[12] Justin Katz, "Navy Assessing LA Sub Fleet for Possible Life Extensions," *Breaking Defense*, November 18, 2021. See also Rich Abott, "Navy Assessing Los Angeles Subs For Life Extension," *Defense Daily*, November 19, 2021; David Axe, "To Keep Up Its Undersea Strength, The U.S. Navy Aims To Keep Old Submarines Longer," *Forbes*, November 22, 2021; Megan Eckstein, "US Navy Avoided a 2022 'Trough' in Submarine Fleet Size, but Industry Challenges Threaten Future Growth," *Defense News*, January 3, 2022.

[13] 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 these firms, the Navy states that a carrier nuclear propulsion plant is roughly equivalent to five submarine propulsion plants.

U.S. SSN Classes

Los Angeles (SSN-688) Class

A total of 62 Los Angeles-class submarines, commonly called 688s, were procured between FY1970 and FY1990 and entered service between 1976 and 1996. They are equipped with four 21-inch diameter torpedo tubes and can carry a total of 26 torpedoes or Tomahawk cruise missiles in their torpedo tubes and internal magazines. The final 31 boats in the class (SSN-719 and higher) were built with an additional 12 vertical launch system (VLS) tubes in their bows for carrying and launching another 12 Tomahawk cruise missiles. The final 23 boats in the class (SSN-751 and higher) incorporate further improvements and are referred to as Improved Los Angeles-class boats or 688Is. As of the end of FY2021, 34 of the 62 boats in the class had been retired.

Seawolf (SSN-21) Class

The Seawolf class was originally intended to include about 30 boats, but Seawolf-class procurement was stopped after three boats as a result of the end of the Cold War and associated changes in military requirements and defense spending levels. The three Seawolf-class submarines are the *Seawolf* (SSN-21), the *Connecticut* (SSN-22), and the *Jimmy Carter* (SSN-23). SSN-21 and SSN-22 were procured in FY1989 and FY1991 and entered service in 1997 and 1998, respectively. SSN-23 was originally procured in FY1992. Its procurement was suspended in 1992 and then reinstated in FY1996. It entered service in 2005. Seawolf-class submarines are larger than Los Angeles-class boats or previous U.S. Navy SSNs.[14] They are equipped with eight 30-inch-diameter torpedo tubes and can carry a total of 50 torpedoes or cruise missiles. SSN-23 was built to a lengthened configuration compared to the other two ships in the class.[15]

Virginia (SSN-774) Class

The Navy has been procuring Virginia-class SSNs (see **Figure 1**) since FY1998; the first entered service in October 2004. The Virginia-class design was developed to be less expensive and better optimized for post-Cold War submarine missions than the Seawolf-class design. The baseline Virginia-class design is slightly larger than the Los Angeles-class design but incorporates newer technologies, including technologies used in the Seawolf-class design. The Virginia-class design has been updated multiple times since FY1998.

Virginia-Class Program

Unit Procurement Cost

Most Virginia-class boats to be procured in FY2019 and subsequent years are to be built to a lengthened configuration that includes the Virginia Payload Module (see discussion below). When procured at a rate of two boats per year, VPM-equipped Virginia-class SSNs have an estimated procurement cost of about $3.6 billion per boat.

[14] Los Angeles-class boats have a beam (i.e., diameter) of 33 feet and a submerged displacement of about 7,150 tons. Seawolf-class boats have a beam of 40 feet. SSN-21 and SSN-22 have a submerged displacement of about 9,150 tons.

[15] SSN-23 is 100 feet longer than SSN-21 and SSN-22 and has a submerged displacement of 12,158 tons.

Figure 1. Virginia-Class Attack Submarine

Source: Cropped version of photograph accompanying Dan Ward, "Opinion: How Budget Pressure Prompted the Success of Virginia-Class Submarine Program," *USNI News*, November 3, 2014. The caption states that it shows USS Minnesota (SSN-783) under construction in 2012 and credits the photograph to the U.S. Navy.

Annual Procurement Quantities

Table 1 shows annual numbers of Virginia-class boats procured from FY1998 (the lead boat) through FY2022, and the numbers projected for procurement in FY2023-FY2027 under the Navy's FY2023 budget submission. A total of 36 Virginia-class boats have been procured through FY2026.

Table 1. Actual and Projected Virginia-Class Procurement Quantities

(Projected quantities for FY2023-FY2027 as shown in Navy's FY2023 budget submission)

FY98	1	**FY06**	1	**FY14**	2	**FY22**	2
FY99	1	**FY07**	1	**FY15**	2	***FY23***	2
FY00	0	**FY08**	1	**FY16**	2	***FY24***	2
FY01	1	**FY09**	1	**FY17**	2	***FY25***	2
FY02	1	**FY10**	1	**FY18**	2	***FY26***	2
FY03	1	**FY11**	2	**FY19**	2	***FY27***	2
FY04	1	**FY12**	2	**FY20**	2		
FY05	1	**FY13**	2	**FY21**	2		

Source: Table prepared by CRS based on U.S. Navy data.

Multiyear Contracting

With the exception of a single Virginia-class boat procured in FY2003, all Virginia-class boats have been procured or are being procured under multiyear contracting, meaning either a block buy contract or multiyear procurement (MYP) contract.[16]

FY2019-FY2023 MYP Contract

The Navy awarded the FY2019-FY2023 Virginia-class MYP contract—a fixed-price incentive fee (FPIF) contract—on December 2, 2019. The contract included nine Virginia-class boats (eight of which are to be built with the Virginia Payload Module, or VPM (see discussion below), plus an option for a 10th boat that, if procured, would also be built with the VPM. The contract also included a 10th shipset of supplier-made components, so that if the option for the 10th boat were exercised, the ship could be constructed in a timely manner. The option for the 10th boat could be awarded any time during the contract's five-year period.[17] As a result of Congress's decision to procure two Virginia-class boats in FY2021, rather than the one Virginia-class boat that the Trump Administration's FY2021 budget submission had requested, the FY2019-FY2023 MYP contract now includes 10 boats.

Joint Production Arrangement

Virginia-class boats are built jointly by GD/EB—the program's prime contractor—and HII/NNS). The arrangement for jointly building Virginia-class boats was proposed to Congress by GD/EB, HII/NNS, and the Navy, and agreed to by Congress in 1997, as part of Congress's action on the Navy's budget for FY1998, the year that the first Virginia-class boat was procured.[18] A primary aim of the arrangement was to minimize the cost of building Virginia-class boats at a relatively low annual rate in two shipyards (rather than entirely in a single shipyard) while preserving key submarine-construction skills at both shipyards.

Under the arrangement, GD/EB builds certain parts of each boat, HII/NNS builds certain other parts of each boat, and the yards have taken turns building the reactor compartments and performing final assembly of the boats. The arrangement has resulted in a roughly 50-50 division of Virginia-class profits between the two yards and preserves both yards' ability to build

[16] The first four Virginia-class boats, known as the Block I boats, were procured under an FY1998-FY2002 block buy contract. This was the first instance of block buy contracting—the mechanism of a block buy contract was essentially created for procuring the first four Virginia-class boats. The Virginia-class boat procured in FY2003 fell between the FY1998-FY2002 block buy contract and the subsequent FY2004-FY2008 MYP contract, and was contracted for separately. The next five Virginia-class boats, known as the Block II boats, were procured under an FY2004-FY2008 MYP contract. The next eight Virginia-class boats, known as the Block III boats, were procured under an FY2009-FY2013 MYP contract. The next 10 Virginia-class boats, known as the Block IV boats, were procured under an FY2014-FY2018 MYP contract. The next 10 Virginia-class boats, known as the Block V boats, are being procured under an FY2019-FY2023 MYP contract. For more on MYP and 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.

[17] For press reports about the contract, see, for example, Megan Eckstein, "Navy Awards $22B Contract to Electric Boat, Newport News Shipbuilding for 9 Block V Virginia Subs," *USNI News*, December 2, 2019; David B. Larter, "US Navy Awards Largest-Ever Shipbuilding Contract to Electric Boat for New Attack Submarines," *Defense News*, December 2, 2019; Rich Abott, "Navy Awards Largest Contract Ever, $22.2 Billion For 9 Block V Virginia Subs," *Defense Daily*, December 2, 2019.

[18] See Section 121 of the FY1998 National Defense Authorization Act (H.R. 1119/P.L. 105-85 of November 18, 1997).

submarine reactor compartments (a key capability for a submarine-construction yard) and perform submarine final-assembly work.[19]

Integrated Enterprise Plan (IEP)

Under a plan it calls the Integrated Enterprise Plan (IEP),[20] the Navy plans to build Columbia-class ballistic missile submarines jointly at GD/EB and HII/NNS, with most of the work going to GD/EB. As part of this plan, the Navy plans to adjust the division of work on the Virginia-class attack submarine program so that HII/NNS would receive a larger share of the final-assembly work for that program than it has received in the past.[21]

---

[19] The joint production arrangement is a departure from prior U.S. submarine construction practices, under which complete submarines were built in individual yards. The joint production arrangement is the product of a debate over the Virginia-class acquisition strategy within Congress, and between Congress and DOD, that occurred in 1995-1997 (i.e., during the markup of the FY1996-FY1998 defense budgets). The goal of the arrangement is to keep both GD/EB and HII/NNS involved in building nuclear-powered submarines, and thereby maintain two U.S. shipyards capable of building nuclear-powered submarines, while minimizing the cost penalties of using two yards rather than one to build a submarine design that is being procured at a relatively low annual rate. The joint production agreement cannot be changed without the agreement of both GD/EB and HII/NNS.

[20] The IEP was previously called the Submarine Unified Build Strategy, or SUBS.

[21] Key elements of IEP 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 Richard B. Burgess, "Submarine Admirals: 'Unified Build Strategy' Seeks Affordability for Future Sub Fleet," *Seapower*, July 8, 2016; Julia Bergman, "Congressmen Visit EB A Day After It Is Named Prime Contractor for Ohio Reaplcement 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. 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.

Virginia Payload Module (VPM)

The Navy plans to build most Virginia-class boats procured in FY2019 and subsequent years with the Virginia Payload Module (VPM), an additional, 84-foot-long, mid-body section equipped with four large-diameter, vertical launch tubes for storing and launching additional Tomahawk missiles or other payloads. The VPM's vertical launch tubes are to be used to store and fire additional Tomahawk cruise missiles or other payloads, including payloads with diameters larger than the 21-inch diameter of a torpedo or Tomahawk missile.[22] The four additional launch tubes in the VPM could carry a total of 28 additional Tomahawk cruise missiles (seven per tube),[23] which would increase the total number of torpedo-sized weapons (such as Tomahawks) carried by the Virginia-class design from about 37 to about 65—an increase of about 76%.[24]

Building Virginia-class boats with the VPM is intended to compensate for a sharp loss in submarine force weapon-carrying capacity that will occur with the retirement in FY2026-FY2028 of the Navy's four Ohio-class SSGNs. Each SSGN is equipped with 24 large-diameter vertical launch tubes, of which 22 can be used to carry up to seven Tomahawks each, for a maximum of 154 vertically launched Tomahawks per boat, or 616 vertically launched Tomahawks for the four boats. Twenty-two Virginia-class boats built with VPMs could carry 616 Tomahawks in their VPMs.

Acoustic and Other Improvements

The Virginia-class design has been updated multiple times since FY1998. In addition to the VPM, the Navy is introducing acoustic and other improvements to the Virginia-class design that are intended to help maintain the design's superiority over Russian and Chinese submarines.[25]

Schedule and Cost Performance

Earlier Record

The Virginia-class program experienced cost growth in its early years that was due in part to annual procurement rates that were lower than initially envisaged and challenges in restarting

[22] For an illustration of the VPM, see http://www.gdeb.com/news/advertising/images/VPM_ad/VPM.pdf, which was accessed by CRS on March 1, 2012.

[23] Michael J. Conner, "Investing in the Undersea Future," *U.S. Naval Institute Proceedings*, June 2011: 16-20.

[24] A Virginia-class SSN can carry about 25 torpedoes in its four horizontal torpedo tubes and associated torpedo room, and an additional 12 Tomahawk cruise missiles (which are torpedo-sized) in its bow-mounted vertical lunch tubes, for a total of about 37 torpedo-sized weapons. Another 28 Tomahawks in four mid-body vertical tubes would increase that total by about 76%.

[25] For press reports discussing these improvements, see Kris Osborn, "The Navy Wants to Turn Its Nuclear Attack Submarines Into 'Spy' Ships," *National Interest*, May 28, 2018; Kris Osborn, "Navy Launches Most High-Tech & Stealthy Attack Sub Ever," *Scout Warrior*, November 18, 2017; Megan Eckstein, "Navy Considering Mid-Block Virginia-Class Upgrades, SSGN Construction in Late 2030s," *USNI News*, November 2, 2017; Zachary Cohen, "US Launches 'Most Advanced' Stealth Sub Amid Undersea Rivalry," *CNN*, October 26, 2017; Franz-Stefan Gady, "US Navy Christens Most Advanced Attack Sub Ever," *The Diplomat*, October 17, 2017; Douglas Ernst, "Navy Christens Its 'Most Advanced' Attack Submarine Ever," *Washington Times*, October 16, 2017; Dave Majumdar, "Stealth and Armed to the Teeth: US Navy's Big Plan for Submarine Dominance," *National Interest*, July 9, 2016; Kris Osborn, "'Acoustic Superiority': US Navy's Secret Submarine Plan to Dominate the Seas," *National Interest*, June 20, 2016; Dave Majumdar, "This Is How the U.S. Navy's Submarine Force Dominates the World's Oceans," *National Interest*, May 17, 2016; Megan Eckstein, "Submarines To Become Stealthier Through Acoustic Superiority Upgrades, Operational Concepts," *USNI News*, March 1, 2016.

submarine production at Newport News Shipbuilding.[26] The lead ship in the program, however, was delivered within four months of the target date that had been established about a decade earlier, and subsequent boats in the program were delivered largely on cost and ahead of schedule.[27] The Virginia (SSN-774) class program received a David Packard Excellence in Acquisition Award from DOD in 2008.

More-Recent Reported Delays Relative to Targeted Delivery Dates

Beginning in March and April 2019, it was reported that GD/EB, HII/NNS, and their supplier firms were experiencing challenges in meeting scheduled delivery times as the Virginia-class program was transitioning from production of two "regular" Virginia-class boats per year to two VPM-equipped boats per year. As a result of these challenges, it was reported, the program experienced months-long delays in efforts to build boats relative to their targeted delivery dates.[28] A February 10, 2022, press report stated

> Huntington Ingalls Industries is planning an investment in its submarine-industrial base to help stabilize production as demand for sub components increases.
>
> This comes as the parent company reported optimism for getting back to on-time delivery, even as its Newport News Shipbuilding yard missed two submarine milestones at the end of 2021.
>
> Chris Kastner, HII's chief operating officer and soon-to-be CEO, said Feb. 10 during the company's quarterly earnings call that Block IV Virginia-class submarines Montana and New Jersey were nearing milestones that were expected to take place by the end of 2021.
>
> Montana launched [i.e., put into the water for the final stages of its construction] in March [2021], but it was meant to complete sea trials and be delivered to the U.S. Navy by the end of the year. Instead, the shipyard announced Feb. 7 [2022] that the submarine had completed its initial round of sea trials, which will be followed by further at-sea activity before the Navy takes ownership of the boat.
>
> New Jersey was christened and achieved pressure hull complete during 2021, meaning all hull sections were joined as a watertight unit. But it didn't achieve float-off as planned. Kastner said that would happen soon.
>
> "While we did not achieve our projected end-of-year milestones, the [Virginia-class submarine] program continues to improve its progress towards a consistent two-per-year cadence," he said in his opening remarks during the call.
>
> Later, in response to a question, he added that Virginia-class production "is pretty stable. Missed milestones at the end of the year related to Montana and New Jersey, but those will happen here momentarily. But they're pressing towards getting back to a two-a-year cadence; the team is very focused on that."...

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[26] See Statement of Ronald O'Rourke, Specialist in National Defense, Congressional Research Service, before the House Armed Services Committee Subcommittee on Seapower and Expeditionary Forces Hearing on Submarine Force Structure and Acquisition Policy, March 8, 2007, Table 10 on pp. 14-15.

[27] For discussions of recent exceptions, see Christopher P. Cavas, "US Navy Submarine Program Loses Some of Its Shine," *Defense News*, March 13, 2017; David B. Larter, "Virginia-Class Attack Sub Delivers late As US Navy Aims to Get Program Back on Course," *Defense News*, June 26, 2018.

[28] 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. See also David B. Larter, "The US Navy, Seeking Savings, Shakes Up Its Plans for More Lethal Attack Submarines," *Defense News*, April 3, 2019.

> "It's pretty encouraging from a modules standpoint at Newport News last year. They met their commitment on modules, so they're getting some stability in the manufacturing organization at Newport News," he said.[29]

A January 24, 2022, press report stated

> General Dynamics Electric Boat is just weeks from delivering attack submarine Oregon to the Navy, about 16 months after Oregon was originally due and nearly two years after the Connecticut shipyard delivered its last submarine.
>
> This Block IV Virginia-class attack submarine has suffered from a complex web of factors, some related to the COVID-19 pandemic now entering its third year, but most related to the prioritization of the Columbia-class ballistic missile submarine program, Electric Boat President Kevin Graney said in an update on the yard's performance.
>
> On the workforce side, he said, the Columbia program—not just a top priority for the shipyard, but also for the Navy and the Pentagon—is "staffed up to where we need to be right now" to keep the first-in-class Columbia on track for a 2027 delivery and 2030 maiden deployment. But that's come at the expense of the Virginia program production line.
>
> "To achieve Columbia, we did take some resources from Virginia to support that. And I think at this point right now, any new folks that we're adding to the business ... will be largely dedicated to Virginia. And that's because that Columbia manning right now is fairly stable and will be for the foreseeable future," Graney said in a Jan. 24 virtual event hosted by the shipyard.
>
> As a result, that means the newest and least experienced workers are being assigned to the Virginia SSN production line, and any shortfalls in manning are expected to solely affect SSNs. Graney said the training pipeline was halted in early 2020 due to COVID but was restarted in late 2020 and continued to produce new shipbuilders throughout 2021.
>
> Still, like the rest of the labor market, Graney said Electric Boat is seeing higher attrition and a tougher time hiring. While not unique to the shipyard, those conditions are disproportionately affecting Virginia SSN construction.
>
> Submarine Oregon was originally meant to deliver in the fall of 2020, but the delivery date continued to slip. With people and materials prioritized to Columbia, Oregon had material challenges and a higher re-work rate, Graney said.
>
> Oregon went out for sea trials in December, and Graney said the boat's propulsion system was "flawless." There are some "relatively small items" that remain to be addressed elsewhere on the boat, he added, but by the end of the week the submarine should be back out to sea for its final trials with the Navy's Board of Inspection and Survey.
>
> "Once that completes, we are fast-tracked to get to delivery—I think the timeline generally from INSURV [the Navy Board of Inspection and Survey's inspection] to delivery is about a week, so we are poised to get that boat delivered, and I think USS Montana will be right on her heels," Graney said....
>
> Graney said a second submarine, the Hyman G. Rickover, is also on track for delivery from Electric Boat this year. This would come after an extended pause in submarine deliveries: Vermont delivered in April 2020, with Oregon next in line and on track for a February 2022 delivery.
>
> Though not a primary factor on Oregon, Graney noted COVID has caused some challenges for the yard and its workforce.

[29] Megan Eckstein, "Huntington Ingalls Considers Industrial Base Investment, as Sub Construction Lags Behind," *Defense News*, February 10, 2022.

> The workforce is now 86% vaccinated, a figure it reached through incentives rather than mandates, Graney said. Still, the omicron variant of the virus led to a surge in COVID case numbers that hit the New England area earliest in the U.S. In the eight weeks since Thanksgiving, Electric Boat has seen its highest case count of the whole pandemic, according to Graney. In fact, 42% of all reported cases among employees have happened just in these last eight weeks.
>
> "How that hits us, especially coming off of the holiday shutdown that we do between Christmas and new year, we ended up with a lot of people unable to come in because of the protocols associated with COVID. And, unfortunately, it hit our senior ranks—that is, our leadership ranks, supervisors, first-line supervisors and above—disproportionately relative to the rank and file. So, hard to lead a crew of people when your leader's 'on the beach' suffering from COVID," Graney said.
>
> "I think we're getting better here with each passing week, each passing day … and I hope to be out of the woods here with regard to any additional impact from omicron in the coming week or two," he added.[30]

December 2021 Determinations Pursuant to Defense Production Act (DPA)

On December 21, 2021, President Biden signed three determinations permitting the use of the Defense Production Act (DPA) to strengthen the U.S. submarine industrial base for the purpose of increasing production of Virginia-class submarines. For more on these determinations, see **Appendix D**.

FY2023 Funding Request

The Navy's proposed budget requests the procurement of the 37th and 38th Virginia-class boats. The two boats have an estimated combined procurement cost of $7,250.6 million (i.e., about $7.3 billion). The two boats have received $1,938.3 million in prior-year "regular" advance procurement (AP) funding and $778.1 million in Economic Order Quantity (EOQ) funding, which is an additional kind of AP funding that can occur under an MYP contract. The Navy's proposed FY2023 budget requests the remaining $4,534.2 million needed to complete the two boats' estimated combined procurement cost of $7,250.6 million. The Navy's proposed FY2023 budget also requests $2,025.7 million in AP funding for Virginia-class boats to be procured in one or more future years, bringing the total amount of FY023 procurement and AP funding requested for the procurement of Virginia-class boats in FY2023 and subsequent years to $6,559.8 million (i.e., about $6.6 billion). The Navy's proposed FY2023 budget additionally requests $304.5 million in cost-to-complete funding to cover cost growth on Virginia-class boats procured in prior years.

Issues for Congress

SSN Force-Level Goal and Procurement Rate

One issue for Congress concerns the SSN force-level goal and procurement rate. As mentioned earlier, the Navy's current force-level goal, which was released in December 2016, calls for achieving and maintaining a fleet of 355 manned ships, including 66 SSNs. The Navy and the Office of the Secretary Defense have been working since 2019 to develop a successor Navy

[30] Megan Eckstein, "Electric Boat Readies to Deliver Attack Sub Oregon, Almost Two Years After Last Delivery," *Defense News*, January 24, 2022.

force-level goal to replace the 355-goal of 2016. Studies of this emerging force-level goal that have been released by the Navy in summary form suggest that the new force-level goal could call for achieving and maintaining a force of 66 to 72 SSNs.

As also mentioned earlier, the Navy's FY2023 five-year (FY2023-FY2027) shipbuilding plan includes a total of 10 Virginia-class boats, to be procured at a rate of two per year. The Navy's FY2023 30-year (FY2023-FY2052) shipbuilding plan, released on April 20, 2022, includes three alternative 30-year shipbuilding profiles for the period FY2028-FY2052. Under these profiles, SSNs would be procured during FY2028-FY2052 at a rate of 1.76 to 2.24 boats per year. Based on the three alternative shipbuilding profiles, the FY2023 30-year shipbuilding plan projects that the SSN force will reach a minimum of 46 boats in FY2028, return to 50 boats in FY2032, and grow to 60 to 69 SSNs by FY2052. Potential questions for Congress include the following:

- Should the Navy's next force-level goal—the successor to the 355-ship goal of 2016—include an SSN force-level goal of 66 boats, 72 boats, or some other number of boats?
- What are the potential operational implications of the SSN force declining to a minimum of 46 boats in FY2028, and of remaining below 60 boats until at least FY2045, as projected in the Navy's FY2023 30-year (FY2023-FY2052) shipbuilding plan?

In assessing these questions, Congress may consider several factors, including but not necessarily limited to the following:

- U.S. national security strategy and national defense strategy, and the contributions that SSNs make to fulfilling those strategies;
- the funding that would be needed each year to procure SSNs and operate and support the SSN force, and the potential impact of SSN-related funding requirements on funding available for other Navy or DOD programs; and
- the capacity of the submarine construction industrial base.

Regarding the first factor above, DOD officials and other observers view SSNs as useful for implementing certain elements of the national defense strategy, particularly because of their ability to evade China's improving anti-access/area-denial (A2/AD) forces.

Regarding the second factor above, as noted earlier, when procured at a rate of two boats per year, VPM-equipped Virginia-class SSNs have an estimated procurement cost of about $3.6 billion per boat. Increasing the size of the SSN force would increase the SSN force's annual operation and support costs.

The third factor above—the capacity of the submarine construction industrial base—is discussed further in the next section.

Industrial-Base Capacity for Building Both Virginia- and Columbia-Class Boats

A related issue for Congress concerns the ability of the submarine construction industrial base to execute the work associated with procuring two VPM-equipped Virginia-class SSNs plus one Columbia-class SSBN per year from the mid-2020s to the mid-2030s. Some observers have expressed concern about the industrial base's capacity for executing such a workload without encountering bottlenecks or other production problems in one or both of these programs.

Concerns about the ability of the submarine construction industrial base to execute such a workload have been heightened by the earlier-noted 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 transitions from production of two "regular" Virginia-class boats per year to two VPM-equipped boats per year.[31]

The capacity of the submarine construction industrial base can be expanded over time through actions for increasing shipyard and supplier firm production facilities and workforces. Congress in recent years has provided funding for expanding the capacity of the submarine construction industrial base toward a level sufficient to execute an annual procurement rate of two VPM-equipped Virginia-class boats and one Columbia-class boat per year. The Navy's report on its FY2023 30-year (FY2023-FY2052) 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 capacity 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 years building Columbia class SSBNs, Virginia class SSNs, next generation SSNs, and Ford class CVNs. The PB2023 request included additional industrial base funding to reduce the production risk, stabilize the more than 350 critical suppliers, and help enable recruitment and retention of the skilled production workforce.[32]

Some observers have expressed interest in expanding the capacity of the submarine construction industrial base to support a procurement rate of three Virginia-class boats plus one Columbia-class boat per year (referred to in short as 3+1). The Navy testified in June 2021 that increasing the capacity of the submarine construction industrial base to support a 3+1 rate would require "$1.5 [billion] to $2 billion of further investment by ourselves plus industry, and an increase in the workforce."[33]

As noted earlier, on December 21, 2021, President Biden signed three determinations permitting the use of the Defense Production Act (DPA) to strengthen the U.S. submarine industrial base for the purpose of increasing production of Virginia-class submarines.

Potential oversight questions for Congress include the following:

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[31] 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.

[32] 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. 10.

[33] Spoken testimony by Jay Stefany, Acting Assistant Secretary of the Navy for Research, Development and Acquisition (i.e., the Navy's acting acquisition executive), as quoted in Megan Eckstein, "US Navy Needs $50M to Get Submarine Construction Back on Track after COVID-19," *Defense News*, June 9, 2021.

- Do the Navy, the submarine shipyards, and submarine supplier firms agree on the question of the capacity of the industrial base to support various potential combined Virginia- and Columbia-class workloads?
- What steps are the Navy, the submarine builders, and submarine supplier firms taking to bring the capacity of the industrial base more into alignment with desired submarine procurement rates?[34] What are the costs of these steps, and what portion of these costs will be borne by the government?
- What impact will the December 21, 2021, presidential determinations relating to the DPA have on the capacity of the submarine construction industrial base to build both Virginia- and Columbia-class submarines? What actions do the determinations make possible that were not previously permitted? What actions are included in the proposed FY2023 budget, and at what cost? What would be the specific effect of these actions, and how long would they take to implement?

Cost and Schedule Risk in Virginia-Class Block V Design

Another potential issue for Congress concerns cost and schedule risk in building the Block V version of the Virginia-class submarine—the version to be procured during the FY2019-FY2023 Virginia-class MYP contract. A June 2021 Government Accountability Office (GAO) report—the 2021 edition of GAO's annual report surveying DOD major acquisition programs—stated the following regarding the Block V version of the Virginia-class design:

> **Current Status**
>
> The Navy modified an existing contract in December 2019 to build nine Block V submarines with options for three more for a $22 billion target price. However, Block V work is already costing more than expected, due in part to the same inefficiencies, such as inadequate staffing levels, affecting earlier blocks. Persistent problems with Block IV construction progress and delays due to COVID-19 on both blocks add risk to Block V's delivery schedule. For example, from February to August 2020, delivery dates for eight of

[34] Regarding one possible step, a December 19, 2021, press report states

> Electric Boat, which navigates a demanding submarine construction schedule for the U.S. Navy, faces new competition for critically needed workers when hundreds of billions of dollars flow from Washington for public works construction and repairs.
>
> The sub builder is now looking to one possible pipeline for new hires that has long been overlooked in the male-dominated construction industry: women.
>
> Electric Boat, a subsidiary of General Dynamics Corp., is looking to hire more women, who now comprise 14% of the 17,800 workers. In the last year, Electric Boat increased the number of employees with a diverse background by about 11%.
>
> "The whole purpose is to demonstrate that work historically dominated by males is absolutely a viable career path for women," Electric Boat President Kevin Graney said.
>
> This year recruiters have participated in 119 job fairs, virtual and in person, and Electric Boat is expanding its reach to areas far beyond Groton.
>
> Welders are among the most critical jobs that Electric Boat must fill as it builds submarines that cost as much as $3 billion each. They also will be in demand on state and local bridge and other construction projects as money is released in the Infrastructure Investment and Jobs Act signed into law in November by President Joe Biden.
>
> "It exacerbates a tough situation already," Graney said in a recent interview. "Demand for skilled labor will increase significantly as we try to grow. It's a challenge."
>
> (Stephen Singer, "Electric Boat Faces a New Challenge in Making Submarines: Competing for Welders as Federal Money Is Readied for Infrastructure Work. Part of the Answer Might Be Hiring More Women," *Hartford Courant*, December 19, 2021.)

> the 10 remaining Block IV submarines were further delayed by 4 months on average, though program officials stated that Block V has schedule margin to absorb some Block IV delays. They stated that the overall increase in submarine workload and resulting increase of inexperienced new hires at both the suppliers and the shipbuilders, along with long-term challenges meeting staffing levels, are driving these unfavorable cost trends for both blocks. The shipbuilders are mitigating these trends by shifting workers and re-allocating work tasks from different sites, and expanding hiring to add capacity. However, the Navy and shipbuilders will need to manage resources across VCS and the Columbia class submarine program, which started construction in late 2020, further stressing labor resources.
>
> By August 2020, work on contract—including the value of materials and labor hours—for the first Block V submarine was 32 percent complete and the second—the first to incorporate the VPM—was 22 percent complete, but higher materials costs and the same inefficient labor performance could result in these submarines costing more than planned if unmitigated. Work on VPM detail design was 75 percent complete when construction started—short of the program's initial goal of 86 percent—which increases risk of cost and schedule growth.
>
> **Program Office Comments**
>
> We provided a draft 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 has reduced construction time by 2 years from the first submarine. It noted that although efforts to deliver two submarines per year has led to longer construction times, it expects this growth to be offset by reductions in post-delivery activities before the submarines enter service. The program also stated that quality is improving and submarines are delivered within budget.[35]

Additional Issues

Shortage of Spare Parts for Virginia-Class Boats Undergoing Maintenance

Another issue for Congress concerns a shortage of spare parts for existing Virginia-class boats undergoing maintenance. A June 21, 2021, press report states

> The U.S. Navy has swapped more than 1,600 parts among its new Virginia-class submarines since 2013 to ease maintenance bottlenecks as components that are supposed to last 33 years wear out decades sooner.
>
> Parts are being shuttled regularly among the nuclear-powered fast-attack submarines so that vessels in the $166 billion class built by General Dynamics Corp. and Huntington Ingalls Industries Inc. can return to operations, according to data from the Naval Sea Systems Command and the Congressional Budget Office[36]….
>
> If a part isn't available for a sub that's finishing refurbishment, shipyard maintenance workers may be forced to borrow, or "cannibalize," one from a submarine entering maintenance in order to reduce delays. Most cannibalized parts are for non-propulsion electronic systems, but the Navy declined to specify which ones are affected, citing operational security.

[35] Government Accountability Office, *Weapon Systems Annual Assessment: Updated Program Oversight Approach Needed*, GAO-21-222, June 2021, p. 196.

[36] This is a reference to a recent CBO report: Congressional Budget Office, *The Capacity of the Navy's Shipyards to Maintain Its Submarines*, March 2021, 21 pp.

> The number of swapped parts for the submarines, which began entering service in 2004, increased from 100 in 2013 to 171 in 2016, 201 in 2018 and 452 in 2019 before declining to 318 last year. The Navy projects the number will drop to 82 between this year and next….
>
> The big disadvantage of cannibalizing parts from one submarine to another is the extra workload involved, according to the Congressional Budget Office, as well as the risk that a part might be damaged during the extra steps. The Navy doesn't know how much the swaps add to workload, saying that at this point "there is limited range and depth of data."…
>
> Some parts identified to last 33 years based on engineering analysis and testing,"were subject to degradation" such as "corrosion caused by complex galvanic interactions," or when two dissimilar metals or electrical parts come in contact for an extended period of time, "that had not been predicted in some operating environments," the Navy said….
>
> The Navy's submarine leaders are "not satisfied with any material cannibalization that limits our submarine fleet's ability to respond to national tasking and is taking all steps necessary to avoid these scenarios," the command said. It said it is ordering parts earlier to "reduce material work stoppages and maintenance delays awaiting components."
>
> According to the Navy, 70% of the part swaps were between Block I subs that first entered service in 2004 and Block II vessels initially delivered in 2008.
>
> Flaws in contractor quality and parts that were out of specification "contribute to a small percentage" of premature parts wear, the Navy said.[37]

Classified Recommendations in December 2019 DOT&E Report

Another oversight issue for Congress concerns 15 classified recommendations for the Virginia-class program mentioned in a December 2019 report from DOD's Director, Operational Test and Evaluation (DOT&E)—DOT&E's annual report for FY2019.[38] (The Virginia-class program was not covered in detail in DOT&E's January 2021 annual report for FY2020.)

Substandard Steel

Another issue for Congress concerns substandard steel used for building Navy submarines between 1985 and 2017, a problem that investigators discovered in 2017 and that was first reported in 2020.[39]

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[37] Anthony Capaccio, "U.S. Navy's Deadliest New Sub Is Hobbled over Spare Parts," *Bloomberg*, June 21, 2021.

[38] Department of Defense, Director, Operational Test & Evaluation, *FY2019 Annual Report*, December 2019, p. 162.

[39] For press reports on this issue, see, for example, Gene Johnson, "Metallurgist Gets 2.5 Years for Faking Tests on Sub Parts," *Associated Press*, February 14, 2022; Gene Johnson (Associated Press), "Feds Say Company Provided Subpar Steel for US Navy Subs," *Defense News*, June 15, 2020; Sam LaGrone, "Navy Has 'Mitigated' Risk of Suspect Steel From Company in Federal Fraud Case," *USNI News*, June 19, 2020; Julia Bergman, "Submarine Supplier Mishaps Lead to Call for Hearing," *New London Day*, June 16 (updated June 17), 2020; Gene Johnson, "Metallurgist Admits Faking Steel-Test Results for Navy Subs," *Associated Press*, November 8, 2021; Agence France-Presse, "US Navy Boosts Monitoring of Subs After Falsified Steel Tests," *France 24*, November 10, 2021; Geoff Ziezulewicz, "Navy Says It Ensured Sub Safety After Fake Strength Tests Surfaced, But Won't Detail How," *Defense News, Navy Times*, January 6, 2022.

Problem with Hull Coating

Another issue for Congress concerns a problem with the hull coating used on Virginia-class boats that was first reported years ago, and then again 2017[40] and 2019.[41]

Defective Parts

Another issue for Congress concerns three Virginia-class boats that were reported in 2016 to have been built with defective parts.[42]

Legislative Activity for FY2023

Congressional Action on FY2023 Funding Request

The Navy's proposed budget requests the procurement of the 37th and 38th Virginia-class boats. The two boats have an estimated combined procurement cost of $7,250.6 million (i.e., about $7.3 billion). The two boats have received $1,938.3 million in prior-year "regular" advance procurement (AP) funding and $778.1 million in Economic Order Quantity (EOQ) funding, which is an additional kind of AP funding that can occur under an MYP contract. The Navy's proposed FY2023 budget requests the remaining $4,534.2 million needed to complete the two boats' estimated combined procurement cost of $7,250.6 million. The Navy's proposed FY2023 budget also requests $2,025.7 million in AP funding for Virginia-class boats to be procured in one or more future years, bringing the total amount of FY023 procurement and AP funding requested for the procurement of Virginia-class boats in FY2023 and subsequent years to $6,559.8 million (i.e., about $6.6 billion). The Navy's proposed FY2023 budget additionally requests $304.5 million in cost-to-complete funding to cover cost growth on Virginia-class boats procured in prior years.

Table 2 summarizes congressional action on the Navy's FY2023 budget funding request for the procurement of Virginia-class boats in FY2023 and subsequent years. The table does not include the above-mentioned $304.5 million in cost-to-complete funding that has been requested to cover cost growth on Virginia-class boats procured in prior years.

[40] See William Cole, "Navy Subs Still Show Issue with Stealth Coating," *Military.com*, March 6, 2017.

[41] See James Clark, "Whistleblower Accuses Largest US Military Shipbuilder of Putting 'American Lives at Risk' by Falsifying Tests on Submarine Stealth Coating," *Task & Purpose*, October 3, 2019.

[42] For press reports on this issue, see, for example, David Larter, "Secret Weld: How Shoddy Parts Disabled A $2.7 Billion Submarine," *Navy Times*, March 28, 2016; Sydney J. Freedberg Jr., "Welding Problems Fixed For Virginia Subs; Carter Tours Electric Boat," *Breaking Defense*, May 24, 2016; and David Larter, "Attack Sub Minnesota Rejoins Fleet After Parts Fiasco," *Navy Times*, June 4, 2016.

Table 2. Congressional Action on FY2023 Funding Request

Millions of dollars, rounded to nearest tenth, under Navy's original FY2023 budget submission

		Authorization			Appropriation		
	Request	**HASC**	**SASC**	**Enacted**	**HAC**	**SAC**	**Enacted**
Virginia class procurement	4,534.2						
Virginia class advance procurement (AP)	2,025.7						
(Quantity)	*(2)*						
TOTAL	**6,559.8**						

Source: Table prepared by CRS based on Navy's original FY2023 budget submission, committee and conference reports, and explanatory statements on FY2023 National Defense Authorization Act and FY2023 DOD Appropriations Act.

Notes: HASC is House Armed Services Committee, **SASC** is Senate Armed Services Committee, **SAC** is Senate Appropriations Committee, **HAC** is House Appropriations Committee. The table does not include $304.5 million in additional cost-to-complete funding that has also been requested for FY2023 to cover cost growth on Virginia-class boats procured in prior years.

Appendix A. Past SSN Force-Level Goals

This appendix summarizes attack submarine force-level goals since the Reagan Administration (1981-1989).

The Reagan-era plan for a 600-ship Navy included an objective of achieving and maintaining a force of 100 SSNs.

The George H. W. Bush Administration's proposed Base Force plan of 1991-1992 originally called for a Navy of more than 400 ships, including 80 SSNs.[43] In 1992, however, the SSN goal was reduced to about 55 boats as a result of a 1992 Joint Staff force-level requirement study (updated in 1993) that called for a force of 51 to 67 SSNs, including 10 to 12 with Seawolf-level acoustic quieting, by the year 2012.[44]

The Clinton Administration, as part of its 1993 Bottom-Up Review (BUR) of U.S. defense policy, established a goal of maintaining a Navy of about 346 ships, including 45 to 55 SSNs.[45] The Clinton Administration's 1997 QDR supported a requirement for a Navy of about 305 ships and established a tentative SSN force-level goal of 50 boats, "contingent on a reevaluation of peacetime operational requirements."[46] The Clinton Administration later amended the SSN figure to 55 boats (and therefore a total of about 310 ships).

The reevaluation called for in the 1997 QDR was carried out as part of a Joint Chiefs of Staff (JCS) study on future requirements for SSNs that was completed in December 1999. The study had three main conclusions:

- "that a force structure below 55 SSNs in the 2015 [time frame] and 62 [SSNs] in the 2025 time frame would leave the CINC's [the regional military commanders-in-chief] with insufficient capability to respond to urgent crucial demands without gapping other requirements of higher national interest. Additionally, this force structure [55 SSNs in 2015 and 62 in 2025] would be sufficient to meet the modeled war fighting requirements";
- "that to counter the technologically pacing threat would require 18 Virginia class SSNs in the 2015 time frame"; and

[43] For the 80-SSN figure, see Statement of Vice Admiral Roger F. Bacon, U.S. Navy, Assistant Chief of Naval Operations (Undersea Warfare) in U.S. Congress, House Armed Services Committee, Subcommittee on Seapower and Strategic and Critical Materials, *Submarine Programs*, March 20, 1991, pp. 10-11, or Statement of Rear Admiral Raymond G. Jones Jr., U.S. Navy, Deputy Assistant Chief of Naval Operations (Undersea Warfare), in U.S. Congress, Senate Armed Services Committee, Subcommittee on Projection Forces and Regional Defense, *Submarine Programs*, June 7, 1991, pp. 10-11.

[44] See Richard W. Mies, "Remarks to the NSL Annual Symposium," *Submarine Review*, July 1997, p. 35; "Navy Sub Community Pushes for More Subs than Bottom-Up Review Allowed," *Inside the Navy*, November 7, 1994, pp. 1, 8-9; *Attack Submarines in the Post-Cold War Era: The Issues Facing Policymakers*, op. cit., p. 14; Robert Holzer, "Pentagon Urges Navy to Reduce Attack Sub Fleet to 50," *Defense News*, March 15-21, 1993, p. 10; Barbara Nagy, " Size of Sub Force Next Policy Battle," *New London Day*, July 20, 1992, pp. A1, A8.

[45] Secretary of Defense Les Aspin, U.S. Department of Defense, *Report on the Bottom-Up Review*, October 1993, pp. 55-57.

[46] Secretary of Defense William S. Cohen, U.S. Department of Defense, *Report of the Quadrennial Defense Review*, May 1997, pp. 29, 30, 47.

- "that 68 SSNs in the 2015 [time frame] and 76 [SSNs] in the 2025 time frame would meet all of the CINCs' and national intelligence community's highest operational and collection requirements."[47]

The conclusions of the 1999 JCS study were mentioned in discussions of required SSN force levels, but the figures of 68 and 76 submarines were not translated into official DOD force-level goals.

The George W. Bush Administration's report on the 2001 QDR revalidated the amended requirement from the 1997 QDR for a fleet of about 310 ships, including 55 SSNs. In revalidating this and other U.S. military force-structure goals, the report cautioned that as DOD's "transformation effort matures—and as it produces significantly higher output of military value from each element of the force—DOD will explore additional opportunities to restructure and reorganize the Armed Forces."[48]

DOD and the Navy conducted studies on undersea warfare requirements in 2003-2004. One of the Navy studies—an internal Navy study done in 2004—reportedly recommended reducing the attack submarine force level requirement to as few as 37 boats. The study reportedly recommended homeporting a total of nine attack submarines at Guam and using satellites and unmanned underwater vehicles (UUVs) to perform ISR missions now performed by attack submarines.[49]

In March 2005, the Navy submitted to Congress a report projecting Navy force levels out to FY2035. The report presented two alternatives for FY2035—a 260-ship fleet including 37 SSNs and 4 SSGNs, and a 325-ship fleet including 41 SSNs and 4 SSGNs.[50]

In May 2005, it was reported that a newly completed DOD study on attack submarine requirements called for maintaining a force of 45 to 50 boats.[51]

In February 2006, the Navy proposed to maintain in coming years a fleet of 313 ships, including 48 SSNs.

Although the Navy's ship force-level goals have changed repeatedly in subsequent years, the figure of 48 SSNs remained unchanged until December 2016, when the Navy released a force-level objective for achieving and maintaining a force of 355 ships, including 66 SSNs.

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[47] Department of Navy point paper dated February 7, 2000. Reprinted in *Inside the Navy*, February 14, 2000, p. 5.

[48] U.S. Department of Defense, *Quadrennial Defense Review*, September 2001, p. 23.

[49] Bryan Bender, "Navy Eyes Cutting Submarine Force," *Boston Globe*, May 12, 2004, p. 1; Lolita C. Baldor, "Study Recommends Cutting Submarine Fleet," *NavyTimes.com*, May 13, 2004.

[50] U.S. Department of the Navy, *An Interim Report to Congress on Annual Long-Range Plan for the Construction of Naval Vessels for FY 2006*. The report was delivered to the House and Senate Armed Services and Appropriations Committees on March 23, 2005.

[51] Robert A. Hamilton, "Delegation Calls Report on Sub Needs Encouraging," *The Day (New London, CT)*, May 27, 2005; Jesse Hamilton, "Delegation to Get Details on Sub Report," *Hartford (CT) Courant*, May 26, 2005.

Appendix B. Options for Funding SSNs

This appendix presents information on some alternative profiles for funding the procurement of SSNs. These alternatives include but are not necessarily limited to the following:

- **two years of advance procurement (AP) funding followed by full funding**—the traditional approach, under which there are two years of AP funding for the SSN's long-leadtime components, followed by the remainder of the boat's procurement funding in the year of procurement;
- **one year of AP funding followed by full funding**—one year of AP funding for the SSN's long-leadtime components, followed by the remainder of the boat's procurement funding in the year of procurement;
- **full funding with no AP funding (single-year full funding, aka point-blank full funding)**—full funding of the SSN in the year of procurement, with no AP funding in prior years;
- **incremental funding**—partial funding of the SSN in the year of procurement, followed by one or more years of additional funding increments needed to complete the procurement cost of the ship; and
- **advance appropriations**—a form of full funding that can be viewed as a legislatively locked in form of incremental funding.[52]

Navy testimony to Congress in early 2007, when Congress was considering the FY2008 budget, suggested that two years of AP funding are required to fund the procurement of an SSN, and consequently that additional SSNs could not be procured until FY2010 at the earliest.[53] This testimony understated Congress's options regarding the procurement of additional SSNs in the near term. Although SSNs are normally procured with two years of AP funding (which is used primarily for financing long-leadtime nuclear propulsion components), Congress can procure an SSN without prior-year AP funding, or with only one year of AP funding. Consequently, Congress at that time had the option of procuring an additional SSN in FY2009 and/or FY2010.

Single-year full funding has been used in the past by Congress to procure nuclear-powered ships for which no prior-year AP funding had been provided. Specifically, Congress used single-year full funding in FY1980 to procure the nuclear-powered aircraft carrier CVN-71, and again in FY1988 to procure the CVNs 74 and 75. In the case of the FY1988 procurement, under the Administration's proposed FY1988 budget, CVNs 74 and 75 were to be procured in FY1990 and FY1993, respectively, and the FY1988 budget was to make the initial AP payment for CVN-74. Congress, in acting on the FY1988 budget, decided to accelerate the procurement of both ships to

[52] For additional discussion of these funding approaches, see CRS Report RL32776, *Navy Ship Procurement: Alternative Funding Approaches—Background and Options for Congress*, by Ronald O'Rourke.

[53] For example, at a March 1, 2007, hearing before the House Armed Services Committee on the FY2008 Department of the Navy budget request, Representative Taylor asked which additional ships the Navy might want to procure in FY2008, should additional funding be made available for that purpose. In response, Secretary of the Navy Donald Winter stated in part: "The Virginia-class submarines require us to start with a two-year advanced procurement, to be able to provide for the nuclear power plant that supports them. So we would need to start two years in advance. What that says is, if we were able to start in '08 with advanced procurement, we could accelerate, potentially, the two a year to 2010." (Source: Transcript of hearing.) Navy officials made similar statements before the same subcommittee on March 8, 2007, and before the Senate Armed Services Committee on March 29, 2007.

FY1988, and fully funded the two ships that year at a combined cost of $6.325 billion. The ships entered service in 1995 and 1998, respectively.[54]

The existence in both FY1980 and FY1988 of a spare set of Nimitz-class reactor components was not what made it possible for Congress to fund CVNs 71, 74, and 75 with single-year full funding; it simply permitted the ships to be built more quickly. What made it possible for Congress to fund the carriers with single-year full funding was Congress's constitutional authority to appropriate funding for that purpose.

Procuring an SSN with one year of AP funding or no AP funding would not materially change the way the SSN would be built—the process would still encompass two or three years of advance work on long-leadtime components, and an additional five or six years or so of construction work on the ship itself. The outlay rate for the SSN could be slower, as outlays for construction of the ship itself would begin one or two years later than normal, and the interval between the recorded year of full funding and the year that the ship enters service would be longer than normal.

Congress in the past has procured certain ships in the knowledge that those ships would not begin construction for some time and consequently would take longer to enter service than a ship of that kind would normally require. When Congress procured two nuclear-powered aircraft carriers (CVNs 72 and 73) in FY1983, and another two (CVNs 74 and 75) in FY1988, it did so in both cases in the knowledge that the second ship in each case would not begin construction until some time after the first.

[54] In both FY1988 and FY1980, the Navy had a spare set of Nimitz (CVN-68) class nuclear propulsion components in inventory. The existence of a spare set of components permitted the carriers to be built more quickly than would have otherwise been the case, but it is not what made the single-year full funding of these carriers possible. What made it possible was Congress's authority to appropriate funds for the purpose.

Appendix C. SSN Deployments Delayed Due to Maintenance Backlogs

This appendix presents additional background information on delays in SSN deployments due to a backlog in SSN maintenance at the Navy's four government-operated naval shipyards (NSYs), which are the primary facilities for conducting depot-level maintenance work on Navy SSNs. Delays in deploying SSNs can put added operational pressure on other SSNs that are available for deployment.

A February 16, 2022, press report stated

> The U.S. Navy attack submarine force inventory is at a low, and maintenance backlogs are making it harder to conduct important development work, the commander of the submarine force in U.S. Pacific Fleet said this week.
>
> Rear Adm. Jeffrey Jablon said the SSN fleet sits at just 47 today—down from 50 attack subs in the fall, due in part to submarine decommissionings happening as planned while new deliveries from industry run behind schedule.
>
> That 47 is further diminished by maintenance challenges, he said while speaking at a Feb. 16 panel at the WEST 2022 conference, cohosted by the U.S. Naval Institute and AFCEA International.
>
> In fiscal 2016, because of idle time for subs awaiting maintenance—on boats which have exceeded their operational limits and were no longer allowed to submerge under the water until they underwent maintenance—the Navy lost about 360 days of operations.
>
> In FY21, the fleet lost nearly 1,500 days to idle time—the equivalent of taking four submarines out of the fleet.
>
> Additionally, Jablon said in FY21 the fleet lost the equivalent of 3.5 submarines to repair periods that ran longer than planned.
>
> "That's about seven and a half SSNs that I cannot use last year because of awaiting maintenance or maintenance delay," he said.
>
> Even with that smaller fleet, he told Defense News, "we meet all our operational commitments. We're able to ensure that our ships are combat ready when they deploy. We meet the requirements of our combatant commanders that are placed upon us."
>
> But "it results in less ability to do tactical development at sea," Jablon added, noting it also cuts into commanding officers' discretionary time at sea to bolster training in particular areas.
>
> "We're still able to prepare the ship to be combat ready when they deploy," he said, but "it's more difficult, it's more deliberate, it takes more input from the [type commander] staff to do that."[55]

A September 22, 2020, press report stated

> It has been five years since the attack submarine Boise returned from its last patrol, and this whole time she has been waiting on some loving care and attention in the shipyards.
>
> On Monday [September 21], the check cleared for roughly $351.8 million that covers the initial planning and work as part of her overhaul at Huntington Ingalls Newport News

[55] Megan Eckstein, "Submarine Maintenance Backlogs and Delays Take Toll on Fleet's Development Work at Sea," *Defense News*, February 16, 2022.

Shipbuilding where she has been in dry dock since earlier this year. Another contract covering the full engineering overhaul is in negotiations, according to Naval Sea System Command spokesperson Colleen O'Rourke,[56] work that will include significant maintenance on the nuclear propulsion system and modernization upgrades.

The running tab on Boise so far is $355 million, with advanced planning money already awarded, according to the Defense Department contract announcement. The work under this contract is scheduled to wrap up in May 2023, eight years after the sub left the operational fleet.

While Boise could be wrapped up by 2023—the overhaul was initially scheduled for 25 months—it's possible the repairs could take longer, O'Rourke said.

The bill will be paid out of 2020 Operations & Maintenance funding, according to the contract announcement.

Boise has been something of a cause célèbre among congressional leaders, who have pointed to the ship's long wait to enter the shipyard as emblematic of the Navy's struggle with maintenance delays. The issue with attack submarines has been complicated, because while that work would typically be done in the public shipyards, those have been backed up with aircraft carriers and the Ohio-class ballistic missile subs.

Some of the Navy's problems will resolve themselves after ballistic missile subs are refueled, said Bryan Clark, a retired submarine officer and analyst with the Center for Strategic and Budgetary Assessments, in a 2019 interview.

"The big factor here is that attack submarines are last in line when it comes to maintenance," Clark explained then. "And that maintenance is done in the public yards, both the refueling and non-refueling overhauls. So that's why you see submarines like Boise who have been waiting a long time to get in, because carriers had a lot of maintenance backlog".

"And working through that backlog pushed SSBN refuelings back, and that in turn pushed attack subs to the end of the line. Now that they are working through the carrier backlog and the SSBN refueling is now largely completed, that's going to mean the attack submarines can be brought back into the public shipyards. So that's a structural issue that's going to work itself out."

But other aspects of the Navy's quest to dig out of the submarine backlog are thornier and will require the service to make long-term commitments to private shipyards, Clark said. One of the main issues with assigning attack subs to private shipyards is that they are not necessarily set up as maintenance shops: They're more so built and organized as new construction yards.

Naval Sea Systems Command acknowledged as much in a statement to the Virginian Pilot as part of a story on the delays of Columbus and Helena, which the command attributed to "the workforce's inexperience in conducting submarine maintenance, which differs greatly from new construction."…

In an interview with USNI News, former Naval Sea Systems Command head Vice Adm. Thomas Moore said he thought Boise would go better than previous attempts at maintaining attack boats in private shipyard.

"I think we are well-positioned on Boise, certainly way better than we were on Helena and Columbus, when we learned so many lessons the hard way," Moore said. "They hadn't

[56] Colleen O'Rourke is no relation to Ronald O'Rourke.

done submarine work in 10 years, and I think we underestimated how they had atrophied in that skill set. I think they did as well.

"And the other thing is, I think we recognized that we probably put too much on their plate, with multiple [maintenance] availabilities [i.e., ship maintenance projects] on their plate at one time."[57]

An August 2020 GAO report on maintenance delays on aircraft carriers and submarines stated

The Navy's four shipyards completed 38 of 51 (75 percent) maintenance periods late for aircraft carriers and submarines with planned completion dates in fiscal years 2015 through 2019, for a combined total of 7,424 days of maintenance delay. For each maintenance period completed late, the shipyards averaged 113 days late for aircraft carriers and 225 days late for submarines.

Maintenance Delays at Navy Shipyards for Fiscal Years 2015 through 2019

Aircraft Carriers
- 8 of 18 on time
- 1,128 days of maintenance delay

Submarines
- 5 of 33 on time
- 6,296 days of maintenance delay

Source: GAO analysis of Navy data (text); U.S. Navy/T. Nguyen (aircraft carrier); U.S. Navy/D. Amodo (submarine). | GAO-20-588

Unplanned work and workforce factors—such as shipyard workforce performance and capacity (having enough people to perform the work)—were the main factors GAO identified as causing maintenance delays for aircraft carriers and submarines. The Navy frequently cited both factors as contributing to the same days of maintenance delay. Unplanned work—work identified after finalizing maintenance plans—contributed to more than 4,100 days of maintenance delays. Unplanned work also contributed to the Navy's 36 percent underestimation of the personnel resources necessary to perform maintenance. The workforce factor contributed to more than 4,000 days of maintenance delay on aircraft carriers and submarines during fiscal years 2015 through 2019.

The Navy has taken steps but has not fully addressed the unplanned work and workforce factors causing the most maintenance delays. First, the Navy updated planning documents to improve estimates and plans to annually update these data, but knowing whether changes improve results may take several years. Second, the Navy has consistently relied on high levels of overtime to carry out planned work. GAO's analysis found that high overtime among certain production shops, such as painting or welding, averaged from 25 to 32 percent for fiscal years 2015 through 2019, with peak overtime as high as 45 percent. Furthermore, shipyard officials told us that production shops at all four shipyards are working beyond their capacity. Overtime at such rates has been noted as resulting in diminished productivity. Third, the Navy initiated the Shipyard Performance to Plan initiative in the fall of 2018 to address the unplanned work and workforce factors, but it has not yet developed 13 of 25 planned metrics that could improve the Navy's understanding of the causes of maintenance delays. In addition, the Shipyard Performance to Plan initiative does not include goals, milestones, and a monitoring process along with fully developed metrics to address unplanned work and workforce weaknesses. Without fully developing metrics and implementing goals, action plans, milestones, and a monitoring process, the shipyards are not likely to address unplanned work and workforce

[57] David B. Larter, "The Hapless Attack Sub Boise Could Return to the Fleet in 2023 After 8 Years Sidelined," *Defense News*, September 22, 2020.

> weaknesses and the Navy is likely to continue facing maintenance delays and reduced time for training and operations with its aircraft carriers and submarines.[58]

A May 26, 2020, press report stated

> After years of struggling to conduct attack submarine maintenance—with the four public naval shipyards prioritizing SSN work last, behind a backlog of ballistic-missile sub and aircraft carrier work, and private shipyards finding it tough to resume submarine repair work after years of only doing new construction—the Navy appears back on track for its SSN maintenance, the head of Naval Sea Systems Command told USNI News.
>
> The move of attack submarine USS Boise (SSN-764) to the dry dock at Newport News Shipbuilding in Virginia is the most visible sign of things moving in the right direction, after the sub has been sitting pier side at nearby Norfolk Naval Shipyard for more than four years waiting for maintenance to begin.
>
> The Navy had previously hoped to get Boise into Newport News as early as 2018, but the private yard struggled with its first two Los Angeles-class SSN maintenance periods—for USS Helena (SSN-725) and USS Columbus (SSN-762)—and didn't have the room for the sub or the workforce to start working on it. As Boise lingered, it became a focal point in the discussion about a lack of repair capacity and a backup of work at the four public naval shipyards.
>
> But, NAVSEA Commander Vice Adm. Tom Moore told USNI News, the Navy is moving into a new era of on-time submarine maintenance….
>
> Moore told USNI News in an interview last week that "I think we are well-positioned on Boise, certainly way better than we were on Helena and Columbus, when we learned so many lessons the hard way: that, one, they hadn't done submarine work in 10 years, and I think we underestimated how they had atrophied in that skill set, and I think they did as well; and the other thing is, I think we recognized that we probably put too much on their plate, with multiple availabilities on their plate at one time." …
>
> Moore said that Electric Boat likely won't be a provider of submarine maintenance for much longer–aside from an availability for USS Hartford (SSN-768) that starts in November 2021, the Connecticut yard will have its hand full with construction of Columbia-class SSBNs and Block V Virginia-class SSNs. Moore said it's important to get the sub repair capability reconstituted at Newport News Shipbuilding so that one private yard can serve as part of the SSN repair community….
>
> Moore acknowledged that the bulk of the Navy's problems in recent years was that its four public shipyards, tasked with maintaining nuclear-powered submarines and aircraft carriers, did not have the capacity to keep up with demand….
>
> If the plan can be executed, Moore said the anticipated work at Norfolk Naval Shipyard matches the workforce capacity, meaning there should be no more backlog….
>
> Though Boise has remained a "problem child" for longer than anticipated, Moore noted in the recent interview that SSN maintenance is wrapping up on time more and more as capacity at the public yards grows….
>
> Moore said he was confident NAVSEA was in a good position on SSN maintenance because a whole set of improvements had been made in tandem in recent years: not only was the [naval shipyard] workforce now up to its goal of 36,700 personnel, but an effort to

[58] Government Accountability Office, *Navy Shipyards[:] Actions Needed to Address the Main Factors Causing Maintenance Delays for Aircraft Carriers and Submarines*, GAO-20-588, August 2020, summary page.

> create better business practices is underway and the first projects in a 20-year Shipyard Infrastructure Optimization Plan (SIOP) program are already hitting the waterfront.[59]

A March 2019 Navy report to Congress states that in response to the above committee report language

> The Navy submitted an initial [submarine maintenance] plan in December 2018, that reflected FY 2019 budget information. The Navy has [now] updated this plan to incorporate data from the President's FY 2020 budget submitted on March 11, 2019….
>
> … In the post-Cold War and post 9/11 era, there have been decades of decisionmaking associated with the re-posturing of defense strategies, such as: the reduction in maintenance capacity and flexibility though Base Realignment and Closures (BRAC), increased Operational Tempo (OPTEMPO), evolution of submarine life cycle maintenance plans, budget reductions, and budget uncertainties that have contributed to the current challenges facing the submarine fleet.
>
> The root cause of submarine idle time and associated loss of operational availability, as discussed in the recent Government Accountability Office (GAO) report 19-229, "Actions Needed to Address Costly Maintenance Delays Facing the Attack Submarine Fleet" (issued November 2018), is largely due to public shipyard capacity not keeping pace with growing maintenance requirements that have been building for a number of years prior to the USS BOISE (SSN 764) FY 2016 Engineered Overhaul (EOH). The workload to capacity mismatch resulted in lower priority attack submarine (SSN) availabilities (as compared to ballistic missile submarines and nuclear-powered aircraft carriers) being delivered late and a bow-waving of workload from one fiscal year to the next that could not be executed. The workload backlog exacerbated the public shipyard workload-to-capacity mismatch and contributed to an increasing trend in late SSN [maintenance] deliveries.
>
> The Navy has taken several actions to improve the workload-to-capacity balance at the public shipyards. Notably, over 20,600 workers were hired from FY 2013 through FY 2018, which after accounting for attrition, increased total end strength from 29,400 to 36,700. However, the accelerated hiring resulted in 56 percent of the production workforce having less than five years of experience. The less experienced workforce requires a greater investment in training, as described in the Navy's Report to Congress on the Naval Shipyard Development Plan (issued March 2018), which offers some near term productivity gains. The Navy has also taken additional actions to balance workload at our public shipyards by outsourcing four submarine maintenance availabilities to the private sector and plans to outsource another two submarine availabilities to the private shipyards starting in FY 2020 and FY 2021. Additionally, to ensure on-time delivery from maintenance availabilities, availability inductions have been rescheduled to occur when the shipyards have the capacity to accomplish the availability(s) within programmed schedule durations. This necessary action to improve the on-time delivery of current maintenance availabilities has resulted in some additional submarine maintenance backlog and some accumulation of idle time. Based on actions and initiatives the Navy is currently pursuing to improve submarine operational availability and the outsourcing of two additional submarine availabilities to the private sector, the Navy assesses that the submarine idle time will be eliminated by the end of FY 2023 and the submarine maintenance backlog will be worked off by the end of FY 2023.[60]

A November 2018 GAO report on the issue stated the following:

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[59] Megan Eckstein, "NAVSEA Says Attack Sub Repairs Much Improved as USS Boise Enters Yard Following 4-Year Wait," *USNI News*, May 26, 2020.

[60] U.S. Navy, *President's FY 2020 Budget Update to Report to Congress on Submarine Depot Maintenance Prepared by Secretary of the Navy*, generated March 12, 2019, with cover letters dated March 21, 2019, provided to CRS by Navy Office of Legislative Affairs on March 27, 2019, pp. 3-4.

> The Navy has been unable to begin or complete the vast majority of its attack submarine maintenance periods on time resulting in significant maintenance delays and operating and support cost expenditures. GAO's analysis of Navy maintenance data shows that between fiscal year 2008 and 2018, attack submarines have incurred 10,363 days of idle time and maintenance delays as a result of delays in getting into and out of the shipyards. For example, the Navy originally scheduled the USS Boise to enter a shipyard for an extended maintenance period in 2013 but, due to heavy shipyard workload, the Navy delayed the start of the maintenance period. In June 2016, the USS Boise could no longer conduct normal operations and the boat has remained idle, pierside for over two years since then waiting to enter a shipyard…. GAO estimated that since fiscal year 2008 the Navy has spent more than $1.5 billion in fiscal year 2018 constant dollars to support attack submarines that provide no operational capability—those sitting idle while waiting to enter the shipyards, and those delayed in completing their maintenance at the shipyards.
>
> The Navy has started to address challenges related to workforce shortages and facilities needs at the public shipyards. However, it has not effectively allocated maintenance periods among public shipyards and private shipyards that may also be available to help minimize attack submarine idle time. GAO's analysis found that while the public shipyards have operated above capacity for the past several years, attack submarine maintenance delays are getting longer and idle time is increasing. The Navy may have options to mitigate this idle time and maintenance delays by leveraging private shipyard capacity for repair work. But the Navy has not completed a comprehensive business case analysis as recommended by Department of Defense guidelines to inform maintenance workload allocation across public and private shipyards. Navy leadership has acknowledged that they need to be more proactive in leveraging potential private shipyard repair capacity. Without addressing this challenge, the Navy risks continued expenditure of operating and support funding to crew, maintain, and support attack submarines that provide no operational capability because they are delayed in getting into and out of maintenance.[61]

The House Appropriations Committee, in its report (H.Rept. 115-769 of June 20, 2018) on the FY2019 DOD Appropriations Act (H.R. 6157) stated the following:

> SUBMARINE MAINTENANCE SHORTFALLS
>
> The Committee recognizes that the nuclear-capable public naval shipyards are backlogged with submarine maintenance work, while private nuclear-capable shipyards have underutilized capacity. The Los Angeles (SSN–688) class submarines are especially impacted by this backlog, which significantly reduces their operational availability for missions in support of combatant commanders. The Committee directs the Secretary of the Navy to submit a report to the congressional defense committees not later than 90 days after the enactment of this Act that outlines a comprehensive, five-year submarine maintenance plan that restores submarine operational availability and fully utilizes both public and private nuclear-capable shipyards in accordance with all applicable laws. The plan should strive to provide both private and public shipyards with predictable frequency of maintenance availabilities and estimate any potential cost savings that distributing the workload may deliver. (Page 71)

[61] Government Accountability Office, *Navy Readiness[:] Actions Needed to Address Costly Maintenance Delays Facing the Attack Submarine Fleet*, GAO-19-229, November 2018, summary page.

Appendix D. December 2021 Determinations Pursuant to Defense Production Act (DPA)

This appendix presents background information on three determinations signed by President Biden on December 21, 2021, permitting the use of the Defense Production Act (DPA)[62] to strengthen the U.S. submarine industrial base for the purpose of increasing production of Virginia-class submarines.

A December 21, 2021, memorandum from President Biden to Secretary of Defense Lloyd Austin stated

> By the authority vested in me as President by the Constitution and the laws of the United States of America, including section 303 of the Defense Production Act of 1950, as amended (the "Act") (50 U.S.C. 4533), I hereby determine, pursuant to section 303(a)(5) of the Act, that:
>
> (1) Large Scale Fabrication, Shipbuilding Industrial Base Expansion for Resilience and Robustness, and Maritime Workforce Training Pipelines in support of Virginia Class attack submarine production are industrial resources, materials, or critical technology items essential to the national defense;
>
> (2) without Presidential action under section 303 of the Act, United States industry cannot reasonably be expected to provide the capability for the needed industrial resource, material, or critical technology item in a timely manner; and
>
> (3) purchases, purchase commitments, or other action pursuant to section 303 of the Act are the most cost-effective, expedient, and practical alternative method for meeting the need.
>
> Pursuant to section 303(a)(7)(B) of the Act, I find that action to expand the domestic production capability for these supply chains is necessary to avert an industrial resource or critical technology item shortfall that would severely impair national defense capability. Therefore, I waive the requirements of section 303(a)(l)-(a)(6) of the Act for the purpose of expanding the domestic production capability for these supply chains.
>
> Ensuring a robust, resilient, and competitive domestic defense industrial base that has the capability, capacity, and workforce to meet the Virginia Class submarine undersea warfighting mission is essential to our national security.
>
> You are authorized and directed to publish this determination in the Federal Register.[63]

A December 22, 2021, DOD statement about the presidential determinations stated

> The president signed on Dec. 21, 2021 three determinations permitting the use of the Defense Production Act (DPA) to strengthen the U.S. submarine industrial base. The expansion of the authority will allow the U.S. Navy to maintain its maritime superiority.
>
> Scaling the production of Virginia Class Attack Submarines will ensure the U.S. Navy can meet its missions to maintain open sea lanes for global communication and commerce, enhance diplomatic partnerships, and grow a robust underwater warfare capability.

[62] For more on the DPA, see CRS Report R43767, *The Defense Production Act of 1950: History, Authorities, and Considerations for Congress*, by Heidi M. Peters, and CRS In Focus IF11767, *The Defense Production Act Committee (DPAC): A Primer*, by Michael H. Cecire.

[63] White House, "Memorandum on the Presidential Determination Pursuant to Section 303 of the Defense Production Act of 1950, as amended," December 21, 2021.

> Through the DPA, the U.S. Navy can make key investments with the manufacturers and suppliers executing the submarine shipbuilding plan.
>
> These activities will strengthen the shipbuilding industrial base and allow its heavy manufacturing and large scale fabrication suppliers to meet growing demand and expand the maritime workforce training pipeline.
>
> The department continues to work with key stakeholders to use the DPA authorities to address risks and challenges across the Submarine Enterprise supply chain. These authorities expand options and opportunities to accelerate and scale critical investments across key markets.[64]

Regarding Title III of the DPA, DOD states

> The Defense Production Act (DPA) Title III program is dedicated to ensuring the timely availability of essential domestic industrial resources to support national defense and homeland security requirements. The program works in partnership with the Uniformed services, other government agencies, and industry to identify areas where critical industrial capacity is lagging or non-existent. Once an area is identified, the program engages with domestic companies to mitigate these risks using grants, purchase commitments, loans, or loan guarantees. By executing its mission, the DPA Title III program reduces the nation's reliance on foreign supply chains and ensures the integrity of materials supplied to the American Warfighter.
>
> The DPA Title III program, governed by 50 USC 4531-4534, is one of the key investment tools of the [DOD] Industrial Policy office.[65]

A December 22, 2021, Navy information paper states

> The Defense Production Act (DPA) Title III program is dedicated to ensuring the timely availability of essential domestic industrial resources to support national defense and homeland security requirements. The program works in partnership with the Uniformed services, other government agencies, and industry to identify areas where critical industrial capacity is lagging or non-existent. Once these fragilities, vulnerabilities, or opportunities are identified, DPA authorities are uniquely positioned to allow engagement with domestic suppliers that mitigate capacity and capability risks using grants, purchase commitments, loans, or loan guarantees
>
> As the U.S. Navy continues to build a more lethal force that maintains maritime superiority, enables sea lanes of global communication and commerce, and ensures diplomatic partnerships, strategic undersea warfare remains the foundation. With VIRGINIA Class (VCS) currently challenged to meet a two per year production cadence, increasing the capacity and capabilities of the submarine industrial base is necessary to achieve the generational increase in demand. This demand will continue to grow with serial production of one (1) COLUMBIA Class (CLB) submarine plus two VIRGINIA Class (VCS) submarines per year expected to start in Fiscal Year 2026.
>
> DPA Title III authorities granted in these PDs support Navy efforts to achieve and sustain consistent production of the VCS Program, meeting schedule and a cadence of two VCS per year in accordance with authorizations and appropriations, concurrent with the national priority CLB Class Ballistic Missile Submarine Program. Specific areas of focus for leveraging these authorities are: strategic sourcing expansion, shipbuilding industrial base

[64] Department of Defense, "Defense Production Act Title III Presidential Determinations for Submarine Industrial Base Production Capacity Essential to the Virginia Class Attack Submarine Program," December 22, 2021.

[65] Department of Defense, "Defense Production Act (DPA) Title III," undated, accessed January 3, 2022.

expansion for resilience and robustness, and growing the maritime workforce training pipeline.

Specific projects with associated costs and timelines to support sustained 1 CLB + 2 VCS per year are being refined, and the Navy will consider where this DPA Title III authority will best mitigate capacity and capability risks.[66]

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[66] Navy information paper entitled "Defense Production Act Title III—Presidential Determination for Virginia Class Production," December 22, 2021, provided to CRS and CBO by Navy Office of Legislative Affairs on January 7, 2022. See also Sten Spinella, "Defense Production Expansion Could Bring Help to Region's Submarine Industry," *New London Day*, January 3, 2022.