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Navy Attack Submarine Force-Level Goal and Procurement Rate: Background and Issues for Congress

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Summary

Of the 281 ships in the Navy at the end of FY2006, 55 were nuclear-powered attack submarines (SSNs). The Navy is planning to maintain in coming years a fleet of 313 ships, including 48 SSNs.

The Navy is currently procuring Virginia (SSN-774) class SSNs. The first was procured in FY1998, a total of nine have been procured through FY2007, and the first two had entered service as of the end of FY2006.

The FY2008-FY2013 Future Years Defense Plan (FYDP) proposes procuring one Virginia-class boat per year through FY2011, and then two boats per year starting in FY2012.

The Navy's proposed FY2008 budget requests $2,571.3 million in the Navy's shipbuilding budget (the Shipbuilding and Conversion, Navy, or SCN, appropriation account) for the Virginia-class program. This total includes $1,796.2 million to complete the procurement funding for the Virginia-class boat that the Navy is requesting to procure in FY2008, which would be the tenth ship in the program. The total estimated procurement cost of this ship is $2,653.7 million, and the ship has received a total of $857.5 million in prior-year funding. The $2,571.3 million being requested for the program for FY2008 also includes, among other things, $702.7 million in advance procurement funding for Virginia-class boats to be procured in future years.

The Navy's 30-year SSN procurement plan, if implemented, would not be sufficient to maintain a force of 48 SSNs consistently over the long run. The Navy projects that the SSN force under this plan would fall below 48 boats during the 14-year period 2020-2033, reaching a minimum of 40 boats in 2028-2029. In addition, for the first time in about 50 years, there is currently no new submarine being designed, which has led to a decline in work for submarine designers and engineers.

Issues for Congress include the following: Is 48 the correct number of SSNs to meet future needs? Should the start of two-per-year Virginia-class procurement be accelerated from FY2012 to an earlier year, so as to come closer to maintaining a force of 48 SSNs in the 2020s-2030s, and if so, how might that be done financially? How should the submarine design and engineering base be maintained in coming years?

There are several potential options for mitigating the projected SSN shortfall, including, among other things, compressing SSN construction times, increasing SSN operational tempo, extending SSN service lives, and procuring SSNs that are in addition to those the Navy plans to procure. Congress has several options for procuring additional SSNs in the near term, and for providing additional work to the submarine design and engineering base. This report will be updated as events warrant.

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Introduction

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The issue for Congress is whether to approve, reject, or modify the administration's plans for the future size of the SSN force, for procuring Virginia-class submarines, and for maintaining the submarine design and engineering base.

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

Congress's decisions on these issues could significantly affect future Navy capabilities, Navy funding requirements, and the submarine industrial base.

Background

Submarines in the U.S. Navy

Types of Submarines. Submarines are one of four principal categories of combat ships that traditionally have helped define the size and structure of the U.S. Navy. The other three are aircraft carriers, surface combatants (e.g., cruisers, destroyers, frigates, and Littoral Combat Ships), and amphibious ships.[2]

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.[3] 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.

Roles and Missions. U.S. Navy submarines fall into three types — nuclear-powered ballistic missile submarines (SSBNs), nuclear-powered cruise missile submarines (SSGNs), and nuclear-powered attack submarines (SSNs).[4]

SSBNs. 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. Although this mission is often associated with the Cold War-era nuclear competition between the United States and the Soviet Union, it has continued, with some modifications, in the post-Cold War

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[2] The Navy also includes mine warfare ships and a variety of auxiliary and support ships.

[3] Until recently, an exception for the U.S. Navy was the non-combat auxiliary submarine Dolphin (AGSS-555), a small submarine that the Navy used for research and development work. As a non-combat research asset, the Dolphin was not included in counts of the total number of submarines (or battle force ships of all kinds) in the Navy. The Dolphin was decommissioned on January 15, 2007.

Until the 1950s, the U.S. Navy included many non-nuclear-powered combat submarines. Following the advent of nuclear power in the mid-1950s, construction of new non-nuclear-powered combat submarines ended and the total number of non-nuclear-powered combat submarines in Navy service began to decline. The Navy's last in-service non-nuclear-powered combat submarine was retired in 1990.

Most military submarines around the world are non-nuclear-powered. Five countries — the United States, the United Kingdom (UK), France, Russia, and China — operate nuclear-powered submarines. The United States and the UK operate all-nuclear submarine fleets, while the other three countries operate both nuclear- and non-nuclear-powered submarines.

[4] In the designations SSBN, SSGN, and SSN, 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).

era.[5] As of the end of FY2006, the Navy included 14 Ohio (SSBN-726) class SSBNs, which are commonly called Trident submarines because they carry Trident SLBMs. Each Trident SSBN can carry 24 Trident SLBMs.

SSGNs. The Navy's SSGNs, which are a new addition to the fleet,[6] are former Trident SSBNs that are being converted (i.e., modified) to carry Tomahawk cruise missiles and special operations forces (SOF) rather than SLBMs. A total of four SSGNs are planned; the first was completed in January 2006, and the fourth is scheduled to be completed by September 2007. Upon reentering service as SSGNs, the ships are scheduled to remain in operation for about 20 years.[7]

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.

SSNs. The SSNs — the focus of this report — are general-purpose submarines that 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;
- 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.

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[5] For a discussion of U.S. strategic nuclear weapons policy and force structure, see CRS Report RL31623, *U.S. Nuclear Weapons: Changes in Policy and Force Structure*, by Amy F. Woolf.

[6] The Navy in the late 1950s and early 1960s built and operated two non-nuclear-powered cruise missile submarines (or SSGs — the Grayback [SSG-574] and the Growler [SSG-577]) and one nuclear-powered cruise missile submarine (the Halibut [SSGN-587]). The submarines could each carry two Regulus II strategic nuclear cruise missiles. In the mid-1960s, following the deployment of the Navy's initial SSBNs, the Regulus cruise missile was removed from service and the Grayback, Growler, and Halibut were converted into attack and auxiliary transport submarines.

[7] Each SSGN as converted will retain its 24 large (7-foot-diameter, 44-foot-long) SLBM launch tubes. In one possible configuration, 22 of these tubes would be used to carry a total of 154 Tomahawks (7 Tomahawks per tube) while the remaining two would be used as lockout chambers for an embarked force of 66 SOF personnel. In the future, the 24 tubes could be used to carry large numbers of other payloads, such as unmanned vehicles. The SSGNs as converted will also retain their four original 21-inch-diameter torpedo tubes and their internal torpedo magazines. In discussing the SSGNs, Navy officials often express a desire to take maximum advantage of the very large payload volume on each SSGN by developing new unmanned vehicles or other advanced payloads. For more on the Navy's SSGN conversion program, see CRS Report RS21007, *Navy Trident Submarine Conversion (SSGN) Program: Background and Issues for Congress*, by Ronald O'Rourke.

During the Cold War, ASW against the Soviet submarine force was the primary stated mission of U.S. SSNs, although covert ISR and covert SOF insertion/recovery operations were important on a day-to-day basis as well.[8] In the post-Cold War era, although maintaining a capability for conducting anti-submarine warfare against the Russian submarine force remains a mission, the SSN force now focuses more on performing missions oriented toward countries other than Russia and toward non-state entities such as terrorist organizations.

Attack Submarine Force-Level Goal

In February 2006, the Navy proposed to maintain in coming years a fleet of 313 ships, including 48 SSNs. Under this plan, SSNs would account for about 15% of the fleet. For a review of SSN force level goals since the Reagan Administration, see **Appendix A**.

Attack Submarine Force Levels

Historical. During the first half of the Cold War, the total number of attack submarines (both nuclear- and non-nuclear-powered) accounted for an increasing percentage of the total size of the Navy, increasing from roughly 10% of total battle force ships in the early 1950s to about 17% by the late 1970s. Since that time, attack submarines have accounted for roughly 17% to 22% of total battle force ships. At the end of FY2006, they accounted for about 20% (55 ships of 281).

The SSN force included more than 90 boats during most of the 1980s, peaked at 98 boats at the end of FY1987, and then began to decline. The force included 85 to 88 boats during the early 1990s, 79 boats at the end of FY1996, 65 boats at the end of FY1998, 57 boats at the end of FY1999, and 56 boats at the end of FY2000. It has since numbered 53 to 56 boats.

As of End of FY2006. The 55 SSNs in service at the end of FY2006 included the following:

- 50 Los Angeles (SSN-688) class boats;
- 3 Seawolf (SSN-21) class boats; and
- 2 Virginia (SSN-774) class boat.

Los Angeles (SSN-688) Class SSNs. 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) are equipped 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

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[8] 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).

improvements and are referred to as Improved Los Angeles class boats or 688Is. As of the end of FY2006, 12 of the 62 boats in the class had been retired.

Seawolf (SSN-21) Class SSNs. 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. 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 was commissioned into service on February 19, 2005. Seawolf-class submarines are larger than Los Angeles-class boats or previous U.S. Navy SSNs,[9] and are equipped with eight 30-inch-diameter torpedo tubes and can carry a total of 50 torpedoes or cruise missiles.

Virginia (SSN-774) Class Program

General. The Virginia-class attack submarine was designed to be less expensive and better optimized for post-Cold War submarine missions than the Seawolf-class design. The Virginia-class design is slightly larger than the Los Angeles-class design,[10] but incorporates newer technologies. Virginia-class boats currently cost about $2.7 billion each to procure.

Joint Production Arrangement. Virginia-class boats are built jointly by General Dynamics' Electric Boat Division (GD/EB) of Groton, CT, and Quonset Point, RI, and Northrop Grumman Newport News Shipbuilding (NGNN) of Newport News, VA.[11] Under the arrangement, GD/EB builds certain parts of each boat, NGNN builds certain other parts of each boat, and the yards take turns building the reactor compartments and performing final assembly of the boats. GD/EB is building the reactor compartments and performing final assembly on boats 1, 3, and so on, while NGNN is doing so on boats 2, 4, and so on. The arrangement results in a roughly 50-50 division of Virginia-class profits between the two yards and preserves both yards' ability to build submarine reactor compartments (a key capability for a submarine-construction yard) and perform submarine final-assembly work.

The joint production arrangement is a departure from past 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

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[9] 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. SSN-23 was built to a modified configuration. It is 100 feet longer than SSN-21 and SSN-22 and has a submerged displacement of 12,158 tons.

[10] Virginia-class boats have a beam of 34 feet and a submerged displacement of 7,800 tons.

[11] GD/EB and NGNN are the only two shipyards in the country capable of building nuclear-powered ships. GD/EB builds submarines only, while NGNN also builds nuclear-powered aircraft carriers and is capable of building other types of surface ships.

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 NGNN 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 low annual rate.

Procurement Through FY2006. As shown in **Table 1**, nine Virginia-class boats have been procured through FY2007.

Table 1. Virginia-Class Procurement, FY1998-FY2006

FY98	FY99	FY00	FY01	FY02	FY03	FY04	FY05	FY06	FY07
1	1	0	1	1	1	1	1	1	1

Boats in Service. The first two Virginia-class boats entered service on October 23, 2004 and September 9, 2006.

Multiyear Procurement. The five Virginia-class boats being procured in FY2004-FY2008 are being procured under a multiyear procurement (MYP) arrangement.[12] The Navy estimates that this MYP arrangement will reduce the total cost of the five boats by a total of about $400 million, or an average of $80 million per boat.[13]

Section 8008 of the conference report (H.Rept. 108-283 of September 24, 2003) on the FY2004 defense appropriations act (H.R. 2568/P.L. 108-87 of September 30, 2003) approved the five-boat MYP arrangement for FY2004-FY2009, "Provided, That the Secretary of the Navy may not enter into a multiyear contract for the procurement of more than one Virginia Class submarine per year." Accompanying report language stated that "The Navy's request to procure more than one submarine in fiscal year 2007 and 2008 is denied...."[14] The Navy and other observers interpreted Section 8008 and the accompanying report language as strongly cautioning the Navy against including funding in future budgets to support the procurement of a second boat in either FY2007 or FY2008.

The Navy plans to request congressional approval for a new MYP arrangement to cover the seven Virginia-class boats planned for procurement in FY2009-FY2013.

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[12] As part of its proposed FY2004 budget submitted to Congress in February 2003, the Navy requested multiyear procurement authority (MYP) to procure a total of seven Virginia-class boats during the five-year period FY2004-FY2008 (i.e., one boat per year for FY2004-FY2006, then two boats per year for FY2007-FY2008). Congress, as part of its action on the FY2004 defense budget, granted authority in appropriation bill language for a five-boat MYP during this period (i.e., one boat per year for FY2004-FY2008).

[13] The Navy estimated that a seven-boat MYP arrangement would have reduced the cost of the seven boats in question by an average of about $115 million per boat.

[14] H.Rept. 108-283, p. 185.

Planned Procurement Rates. When Virginia-class procurement began in the 1990s, DOD originally projected that the procurement rate would increase to two boats per year in FY2002. (The originally envisaged procurement profile for the Virginia-class program for the years FY1998-FY2002 was 1-0-1-0-2.) In subsequent budgets, the date for starting two-per-year procurement was progressively pushed back, and it is now FY2012. **Table 2** shows planned Virginia-class procurement in FYDPs submitted since the mid-1990s.

Table 2. Planned Virginia-Class Procurement in Various FYDPs

FYDP (date submitted)	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13
FY95-99 (2/94)	1	0														
FY96-01 (2/95)	1	0	1	0												
FY97-01 (3/96)	1	1[a]	1	1[a]												
FY98-03 (2/97)	1	1	0	1	1	0										
FY99-03 (2/98)		1	0	1	1	0										
FY00-05 (2/99)			0	1	1	1	1	1								
FY01-05 (2/00)				1	1	1	1	1								
FY2002 (6/01)[b]					1											
FY03-07 (2/02)						1	1	1	1	1						
FY04-09 (2/03)							1	1	1	2	2	2				
FY05-09 (2/04)								1	1	1	1	2				
FY06-11 (2/05)									1	1	1	1	1	1		
FY07-11 (2/06)										1	1	1	1	1		
FY08-13 (2/07)											1	1	1	1	2	2

Source: Prepared by CRS using Navy data.

a. Included at Congressional direction, but not funded in the plan.

b. Submission for FY2002 budget only; no FYDP for FY2002-FY2007 submitted.

Cost-Reduction Goal. The Navy says that its plan to increase Virginia-class procurement to two per year starting in FY2012 is contingent on being able to reduce the procurement cost of Virginia-class submarines to $2.0 billion each in constant FY2005 dollars, compared to a current cost of about $2.4 billion each in constant FY2005 dollars. The Navy has established cost-reduction targets for several of its shipbuilding programs, but the Virginia-class program is apparently the only program that must meet its cost reduction target as an internal Navy condition for retaining all ships of that type in the Navy's shipbuilding program.

The Navy calculates that the target cost of $2.0 billion in constant FY2005 dollars translates into about $2.6 billion for a boat procured in FY2012, and about $2.7 billion for a boat procured in FY2013.

The Navy says that, in constant FY2005 dollars, about $200 million of the $400 million in sought-after cost reductions would be accomplished simply through the improved economies of scale (e.g., better spreading of shipyard fixed costs and improved learning rates) of producing two submarines per year rather than one per year. The remaining $200 million in sought-after cost reductions, the Navy says, is to be accomplished through changes in the ship's design and in the shipyard

production process. The design changes, the Navy says, are scheduled to be ready for boats procured in FY2012. Consequently, the Navy says, the $2.0 billion target cost cannot be fully achieved before FY2012. The Navy says that if improved economies of scale and changes in the ship's design and in the shipyard production process are insufficient to achieve the $2.0-billion target, it may consider reducing the capabilities of the Virginia class in certain areas until the target is achieved.[15]

The Navy's goal to reduce the cost of each Virginia-class boat to $2.0 billion in constant FY2005 dollars as a condition for increasing the procurement rate to two boats per year in FY2012 is a goal that the Navy has set for itself. While Congress may take this goal into account, it need not control congressional action. Congress may decide to fund the procurement of two boats per year in FY2012 or some other year even if the goal is not met.

Funding Requirements for Accelerated Production. Some observers have proposed accelerating the start of two-per-year Virginia-class production to a year earlier than FY2012, so as to mitigate a projected future shortfall in SSNs that is discussed in the next section. **Table 3** shows the additional funding that the Navy says would be needed in FY2008-FY2011 to accelerate the start of two-per-year Virginia-class procurement to FY2010. As shown in the table, the Navy estimates that this would require adding $400 million in additional funding in FY2008, and a total of $5.1 billion in additional funding through FY2011.

Table 3. Funding for Accelerated Virginia-Class Procurement

(procurement funding in billions of then-year dollars, rounded to nearest tenth)

	FY08	FY09	FY10	FY11	FY08-FY11 total
FY2007-FY2011 FYDP					
Ship quantity	1	1	1	1	4
Program funding	2.5	3.4	3.7	3.7	13.3
Acceleration of two-per year procurement to FY2009					
Ship quantity	1	1	2	2	6
Program funding	2.9	4.2	5.9	5.4	18.4
Additional funding for acceleration relative to FY2009-FY2011 FYDP					
	0.4	0.8	2.2	1.7	5.1

Source: U.S. Navy, *Report to Congress on Accelerating Virginia-Class Submarine Construction*, February 2007.

[15] For more on the Navy's plan for reducing the procurement cost of the Virginia-class design, see Statement of Ms. Allison Stiller, Deputy Assistant Secretary of the Navy (Ship Programs) and RDML {Rear Admiral] William Hilarides, Program Executive Officer for Submarines, Before the Seapower and Expeditionary Forces Subcommittee of the House Armed Services Committee [hearing on] Force Structure Requirements and Alternative Funding Strategies for the United States Submarine Fleet, March 8, 2007, and William Hilarides, "2 For 4 in 2012, The Virginia-Class Road Ahead," *U.S. Naval Institute Proceedings*, June 2006: 68-69.

Submarine Construction Industrial Base

General. In addition to GD/EB and NGNN, the submarine construction industrial base includes scores of supplier firms, as well as laboratories and research facilities, in numerous states. About 80% of the total procured material from supplier firms (measured in dollars rather than pieces, parts, or purchase orders) comes from single or sole source suppliers. Observers in recent years have expressed concern for the continued survival of many of these firms. For nuclear-propulsion component suppliers, an additional source of stabilizing work is the Navy's nuclear-powered aircraft carrier construction program.[16] In terms of work provided to these firms, a carrier nuclear propulsion plant is roughly equivalent to five submarine propulsion plants.

Design and Engineering Portion. The part of the submarine industrial base that some observers are currently most concerned about is the design and engineering portion, much of which is resident at GD/EB and NGNN. (A small portion is resident at a some of the component makers.) With Virginia-class design work now winding down and no other submarine-design projects underway, the submarine design and engineering base is facing the near-term prospect, for the first time in about 50 years, of having no major submarine-design project on which to work.

Navy and industry officials, some Members of Congress, and some other observers are concerned that unless a major submarine-design project is begun soon, the submarine design and engineering base will begin to atrophy through the departure of experienced personnel. Rebuilding an atrophied submarine design and engineering base, Navy and industry officials believe, could be time-consuming, adding time and cost to the task of the next submarine-design effort, whenever it might begin. Concern about this possibility among some Navy and industry officials has been strengthened by the UK's difficulties a few years ago in designing its new Astute-class SSN. The UK submarine design and engineering base atrophied for lack of work, and the subsequent Astute-class design effort experienced considerable delays and cost overruns. Submarine designers and engineers from GD/EB were assigned to the Astute-class project to help the UK overcome these problems.[17]

Projected SSN Shortfall

The Projected Shortfall. The Navy's 30-year SSN procurement plan, if implemented, would not be sufficient to maintain a force of 48 SSNs consistently over the long run. As shown in **Table 4**, the Navy projects that the SSN force under

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[16] For more on this program, see CRS Report RS20643, *Navy CVN-21 Aircraft Carrier Program: Background and Issues for Congress*, by Ronald O'Rourke.

[17] See, for example, Andrew Chuter, "U.K. Spending Mounts for U.S. Help on Sub," *Defense News*, September 13, 2005: 4; Richard Scott, "Electric Boat Provides Project Director for Astute Class," *Jane's Navy International*, May 2004: 33; Richard Scott, "Astute Sets Out on the Long Road to Recovery," *Jane's Navy International*, December 2003, pp. 28-30; Richard Scott, "Recovery Plan Shapes Up for Astute Submarines," *Jane's Defence Weekly*, November 19, 2003, p. 26.

this plan would fall below 48 boats during the 14-year period 2020-2033, reaching a minimum of 40 boats in 2028-2029. Since the Navy plans to retire the four SSGNs by 2028 without procuring any replacements for them, no SSGNs would be available in 2028 and subsequent years to help compensate for a drop in SSN force level below 48 boats.

Table 4. SSN Force Level, 2008-2037 (Navy Projection)

08	**09**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
52	53	52	52	53	54	51	51	49	49	48	49	47	47	46
23	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**
46	45	44	43	42	40	40	41	43	44	46	48	49	51	52

Source: *Report to Congress on Annual Long-Range Plan for Construction of Naval Vessels for FY 2008*, p. 6.

The potential for the Navy's long-range SSN procurement plan to produce a shortfall in the SSN force over the long run has been discussed by CRS since 1995, in the form of testimony to Congress in 1995, 1997, 1999, 2000, 2002, 2004, and 2006, a 1997 CRS presentation to a Defense Science Board task force on the submarine of the future, which issued its report in 1998;[18] a 1999-2000 CRS report,[19] a 2002 CRS report,[20] and this report since its inception in 2004.

Navy Study. In testimony to Congress in 2006, Navy officials have stated that the Navy has conducted a study on options for mitigating the projected SSN shortfall.[21] Navy officials have testified that employing a combination of options could reduce the maximum SSN shortfall from the currently projected figure of 8 boats to something like 2 or 3 boats. Specific options mentioned by the Navy are discussed in the next section.

Potential Options for Mitigating the Shortfall

In addition to reducing submarine construction time, potential options for mitigating the projected SSN shortfall include:

- reducing SSN construction time;

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[18] U.S. Department of Defense, Office of the Under Secretary of Defense For Acquisition & Technology, *Report of the Defense Science Board Task Force on [the] Submarine of the Future*, July 1998, pp. 7, 19-20.

[19] CRS Report RL30045, *Navy Attack Submarine Programs: Background and Issues for Congress* (out of print; for a copy, contact the author at 707-7610), by Ronald O'Rourke.

[20] CRS Report RL31372, *Navy Shipbuilding in the FY2003 Defense Budget: Issues for Congress* (out of print; for a copy, contact the author at 707-7610), by Ronald O'Rourke.

[21] See, for example, the testimony of Navy officials before the Seapower and Expeditionary Forces subcommittee of the House Armed Services Committee on March 8, 2006, and before the Senate Armed Services Committee on March 29, 2007. The discussion of Navy views in this section and the following section is based on this testimony.

- taking steps to improve the operational availability of SSNs;
- extending SSN service life; and
- procuring SSNs in addition to those that the Navy plans to procure.

Each of these options is discussed below.

Reducing SSN Construction Time. One option for mitigating the projected SSN shortfall, Navy officials have testified, concerns the Navy's plan for reducing the construction time of Virginia-class submarines by one year — from about six years to about five years. This effort forms part of the Navy's Virginia-class cost-reduction effort. The Navy hopes to fully achieve a one-year reduction in construction time with the boats to be procured in FY2012. This reduction in construction time, Navy officials have testified, will increase the size of the SSN force in coming years by two boats above current projections.[22]

Increasing SSN Operational Availability. A second option for mitigating the projected SSN shortfall that Navy officials have mentioned would be to increase the operational tempo of SSNs during the time of the shortfall, so that a force of less than 48 boats could, for a time, look more like a force of 48 boats in terms of the total number of deployed SSNs or the total number of SSN days on station.

Possible steps that could be taken to increase SSN operational availability include but are not necessarily limited to the following, some of which could be combined:

- rescheduling planned SSN maintenance away from the shortfall years (i.e., accelerating it to years before the shortfall, or deferring it to years after the shortfall);
- increasing average SSN transit speeds between home port and overseas operating areas during the shortfall period, so as to increase the fraction of deployed time that is actually spent on station;
- reducing transit distances to overseas operating areas during the shortfall period by temporarily transferring some SSNs from home ports in the continental United States to more-forward home ports such as Pearl Harbor or Guam; and
- operating SSNs during the shortfall period with an average of more than one crew per boat.

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[22] Although Navy officials did not provide a more detailed explanation in their testimony, it can be observed that, in a program in which boats are being procured at a rate of two per year, accelerating by one year the deliveries of all boats procured on or after a certain date will produce a one-time benefit of a single year in which four boats will be delivered to the Navy, rather than two. In the case of the Virginia-class program, this year might be around FY2018.

Although these measures could, for a time at least, make a force of fewer than 48 SSNs look more like a force of 48 SSNs in terms of the total number of deployed SSNs or the total number of SSN days on station, they have some potential disadvantages:

- Rescheduling planned maintenance away from the shortfall years could reduce average SSN operational availability in years before or after the shortfall. If, in the years before or after the shortfall, the SSN fleet is at or not much above the 48-boat figure, then this might lead to a shortfall in the number of SSNs deployed (or the total number of SSN days on station) in these other years.

- Accelerating planned maintenance for an SSN to a year prior to the shortfall period might lead to a longer-than-optimal interval for that SSN between the accelerated maintenance availability and the SSN's next planned maintenance availability. If such a lengthened interval were deemed undesirable, subsequent maintenance availabilities might need to be similarly accelerated, which could result, toward the end of the ship's life, in a need to schedule one more maintenance availability than would normally be required for an SSN with a 33-year life. This could increase the SSN's total life-cycle maintenance costs and increase the fraction of its life spent in maintenance.

- Deferring planned maintenance for an SSN to a year after the shortfall might lead to a longer-than-optimal interval for that SSN between the previous maintenance availability and the deferred availability. This could complicate the task of maintaining the SSN's material condition during the final years of the lengthened interval.

- Increasing average SSN transit speeds could expend nuclear fuel core life more quickly, which could complicate the task of keeping SSNs in service for 33 years. If SSNs are retired prior to age 33, it could eventually reduce SSN force levels below what they otherwise would be.

- Temporarily shifting the home ports of SSNs could require the construction at the more-forward home ports of additional SSN basing and support facilities that might not be fully utilized after the SSNs are subsequently transferred back to home ports in the continental United States. Shifting SSNs to more-forward home ports, and then returning them years later to home ports in the continental United States, could also impact the quality of life of SSN crew members and their families.

- Operating SSNs during the shortfall period with an average of more than one crew per boat could shorten SSN lives to something less than 33 years by expending nuclear fuel core life and basic ship

mechanical life more quickly. If SSNs are retired prior to age 33, it could eventually reduce SSN force levels below what they otherwise would be.

Extending SSN Service Life. A third option for mitigating the projected SSN shortfall that Navy officials have mentioned would be to extend SSN service life by one or more years, from the current figure of 33 years to 34 or more years. Navy officials have testified that the Navy has identified 19 Los Angeles-class boats as candidates for service life extension, and that extending the lives of some or all of these boats could provide an additional 10 SSN deployments.

More generally, as shown in **Table 5**, extending the currently planned 33-year service life of SSNs by one to four years could reduce or eliminate the projected SSN shortfall. Each year of service life extension would reduce the total duration of the shortfall and increase by two boats the minimum size of the SSN force.

Table 5. SSN Shortfall and Service-Life Extension

(shortfall years in lighter gray; maximum shortfall years in darker gray)

	20	21	22	23	24	25	26	27	28	29	30	31	32	33
No extension*	47	47	46	46	45	44	43	42	40	40	41	43	44	46
1-year extension	51	49	49	48	48	47	46	45	44	42	42	43	45	46
2-year extension	52	53	51	51	50	50	49	48	47	46	44	44	45	47
3-year extension	55	54	55	53	53	52	52	51	50	49	48	46	46	47
4-year extension	56	57	56	57	55	55	54	54	53	52	51	50	48	48

Source: Prepared by CRS based on Navy data.

* Baseline situation — no changes to current Navy plan.

Issues to include in examining the feasibility and cost of extending SSN service lives by one to four years would include, among other things, the mechanical condition of the boats and the operational implications of husbanding pressure hull cycles[23] and nuclear fuel core life enough so that it could suffice for 34 to 37 years of ship operation rather than 33. Due to the potential need to husband pressure hull cycles and core life, this option might not be compatible with the previously discussed options of increasing SSN transit speed or operating SSNs with an average or more than one crew per boat.

Procuring Additional SSNs. Increasing the number of SSNs procured above Navy plans could reduce or eliminate the SSN shortfall. Adding eight SSNs to the Navy's 30-year shipbuilding plan between FY2008 and FY2022 would eliminate the shortfall. Each SSN that is added to the plan between FY2008 and FY2022 would increase by one boat the minimum size of the SSN force. Increasing the number of SSNs to be procured also generally reduces the duration of the shortfall period.

[23] Each time the submarine submerges and resurfaces, the pressure hull is compresses and then relaxes. Over time, these cycles of submerging and resurfacing can fatigue the metal in the pressure hull.

Since the Navy plans to procure two SSNs per year starting in FY2012, adding SSNs to the shipbuilding plan during the period FY2012-FY2022 would result in years in which three SSNs are to be procured. Some observers have questioned whether it would be affordable to procure three SSNs in a given year while also meeting other Navy funding needs. Interest consequently has sometimes focused on the alternative of adding SSNs to the period FY2008-FY2011, a period during which the Navy currently plans to procure one SSN per year. Since FY2008-FY2011 is a four-year period, this results in a potential maximum addition of four SSNs to the shipbuilding plan.

As shown in **Table 6**, adding one to four SSNs to the shipbuilding plan in the period FY2008-FY2011 would reduce the duration and maximum depth of the shortfall.

Table 6. SSN Shortfall and Procuring Additional SSNs

(shortfall years in lighter gray; maximum shortfall years in darker gray)

	20	21	22	23	24	25	26	27	28	29	30	31	32	33
0 add'l boats*	47	47	46	46	45	44	43	42	40	40	41	43	44	46
1 add'l boat	48	48	47	47	46	45	44	43	41	41	42	44	45	47
2 add'l boats	49	49	48	48	47	46	45	44	42	42	43	45	46	48
3 add'l boats	50	50	49	49	48	47	46	45	43	43	44	46	47	49
4 add'l boats	51	51	50	50	49	48	47	46	44	44	45	47	48	50

Source: Prepared by CRS based on Navy data.
* Baseline situation — no changes to current Navy plan.

Combining Life Extension and Procuring Additional SSNs. **Table 7** shows the matrix of potential options that results from combining SSN service life extension (if feasible) with procurement of additional SSNs in FY2008-FY2011. Points that arise from **Table 7** include the following:

- The duration and maximum depth of the shortfall could be significantly reduced by
  - — extending SSN service life by 1 year and procuring 3 or 4 additional SSNs, or
  - — extending SSN service life by 2 years and procuring 1, 2, or 3 additional SSNs, or
  - — extending SSN service live by 3 years and procuring no additional SSNs or 1 additional SSN;

- The shortfall could be eliminated by
  - — extending SSN service life by 2 years and procuring 4 additional SSNs, or
  - — extending SSN service life by 3 years and procuring 2 additional SSNs, or
  - — extending SSN service life by 4 years and procuring no additional SSNs.

- Procuring more additional SSNs than would be needed to significantly reduce or eliminate the shortfall could
  - — hedge against
    - — unforeseen events (such as collisions or other accidents) that could result in the early removal of one or more SSNs from service, or
    - — the possibility that measures to extend the service lives of some SSNs prove less than fully successful, or
  - — permit the Navy to consistently maintain a force of more than 48 SSNs, should it be decided that 48 is not enough.

Table 7. Life Extension Combined With Additional SSNs

(shortfall years in lighter gray; maximum shortfall years in darker gray)

	20	21	22	23	24	25	26	27	28	29	30	31	32	33
No service-life extension of existing boats, plus procurement in FY08-FY11 of...														
0 add'l boats*	47	47	46	46	45	44	43	42	40	40	41	43	44	46
1 add'l boat	48	48	47	47	46	45	44	43	41	41	42	44	45	47
2 add'l boats	49	49	48	48	47	46	45	44	42	42	43	45	46	48
3 add'l boats	50	50	49	49	48	47	46	45	43	43	44	46	47	49
4 add'l boats	51	51	50	50	49	48	47	46	44	44	45	47	48	50
1-year service-life extension of existing boats, plus procurement in FY08-FY11 of...														
0 add'l boats	51	49	49	48	48	47	46	45	44	42	42	43	45	46
1 add'l boat	52	50	50	49	49	48	47	46	45	43	43	44	46	47
2 add'l boats	53	51	51	50	50	49	48	47	46	44	44	45	47	48
3 add'l boats	54	52	52	51	51	50	49	48	47	45	45	46	48	49
4 add'l boats	55	53	53	52	52	51	50	49	48	46	46	47	49	50
2-year service-life extension of existing boats, plus procurement in FY08-FY11 of...														
0 add'l boats	52	53	51	51	50	50	49	48	47	46	44	44	45	47
1 add'l boat	53	54	52	52	51	51	50	49	48	47	45	45	46	48
2 add'l boats	54	55	53	53	52	52	51	50	49	48	46	46	47	49
3 add'l boats	55	56	54	54	53	53	52	51	50	49	47	47	48	50
4 add'l boats	56	57	55	55	54	54	53	52	51	50	48	48	49	51
3-year service-life extension of existing boats, plus procurement in FY08-FY11 of...														
0 add'l boats	55	54	55	53	53	52	52	51	50	49	48	46	46	47
1 add'l boat	56	55	56	54	54	53	53	52	51	50	49	47	47	48
2 add'l boats	57	56	57	55	55	54	54	53	52	51	50	48	48	49
3 add'l boats	58	57	58	56	56	55	55	54	53	52	51	49	49	50
4 add'l boats	59	58	59	57	57	56	56	55	54	53	52	50	50	51
4-year service-life extension of existing boats, plus procurement in FY08-FY11 of...														
0 add'l boats	56	57	56	57	55	55	54	54	53	52	51	50	48	48
1 add'l boat	57	58	57	58	56	56	55	55	54	53	52	51	49	49
2 add'l boats	58	59	58	59	57	57	56	56	55	54	53	52	50	50
3 add'l boats	59	60	59	60	58	58	57	57	56	55	54	53	51	51
4 add'l boats	60	61	60	61	59	59	58	58	57	56	55	54	52	52

Source: Prepared by CRS based on Navy data.

* Baseline situation — no changes to current Navy plan.

Alternative Funding Approaches for Additional SSNs

Alternatives for funding the procurement of one to four additional SSNs in the period FY2008-FY2011 include but are not necessarily limited to the following:

- **full funding with advance procurement** — the traditional approach, under which there are two years or so of advance procurement funding for the SSN's long-leadtime components, followed by the remainder of the boat's procurement funding in the year of procurement;

- **single-year full funding** — full funding of the SSN in the year of procurement, with no advance procurement 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 which can be viewed as a legislatively locked in form of incremental funding.[24]

Procuring SSNs Without Advance Procurement Funding. Navy testimony to Congress in 2007 has suggested that two years of advance procurement funding are required to fund the procurement of an SSN, and consequently that additional SSNs could not be procured until FY2010 at the earliest.[25] This testimony understates Congress' options regarding the procurement of additional SSNs in the near term. Although SSNs are normally procured with two years of advance procurement funding (which is used primarily for financing long-leadtime nuclear propulsion components), an SSN can be procured without advance procurement funding, or with only one year of advance procurement funding. Consequently, Congress has the option of procuring an additional SSN in FY2008 or FY2009, even though no advance procurement funding has been provided for such ships in prior-year budgets. Doing so would not materially change the way such an SSN would be built — the process would still encompass about two years of advance work on long-leadtime components, and an additional six years or so of construction work on the

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[24] 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.

[25] 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.

ship itself. The outlay rate for the SSN could be slower, as outlays for construction of the ship itself would begin two years later than normal (for an SSN procured in FY2008 or FY2009 with no advance procurement funding) or one year later than normal (for an SSN procured in FY2009 with a single year of advance procurement funding in FY2008).

Procuring SSNs With Single-Year Full Funding. Single-year full funding has been used in the past by Congress to procure nuclear-powered ships for which no prior-year advance procurement funding had been provided. Specifically, Congress used single-year full funding in FY1988 to procure the nuclear-powered aircraft carriers CVN-74 and CVN-75, and in FY1980 to procure the nuclear-powered aircraft carrier CVN-71. In the case of the FY1988 procurement, under the Administration's proposed FY1988 budget, CVN-74 and CVN-75 were to be procured in FY1990 and FY1993, and the FY1988 budget was to make the initial advance procurement payment for CVN-74. Congress, in acting on the FY1988 budget, decided to accelerate the procurement of both ships to 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.[26]

Procuring SSNs in a 2-1-2 Pattern. Some potential approaches for procuring additional boats in FY2008-FY2011 (see the Options For Congress section) would result in a pattern of procuring two boats in a given year, followed by one boat the following year, and two boats the year after that — a 2-1-2 pattern. Navy testimony to Congress in 2007 has suggested that if the procurement rate were increased in a given year to two boats, it would not be best, from a production efficiency point of view, to decrease the rate to a single boat the following year, and then increase it again to two boats the next year, because of the workforce fluctuations such a profile would produce.[27]

This statement may overstate the production-efficiency disadvantages of a 2-1-2 pattern. If two boats were procured in a given year, followed by one boat the next year — a total of three boats in 24 months — the schedule for producing the three boats could be phased so that, for a given stage in the production process, the production rate would be one boat every eight months. A production rate of one boat every eight months might actually help the industrial base make the transition from

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[26] 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' authority to appropriate funds for the purpose.

[27] 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: "If we're going to go to two a year in 2010, we really need to go to two a year for 2010, 2011 and out from there on. We don't want to go to two a year and then back to one a year. I think that would create too much stress into the workforce there." (Source: Transcript of hearing.) Navy officials made similar statements before Senate Armed Services Committee on March 29, 2007.

the current schedule of one boat every twelve months (one boat per year) to one boat every six months (two boats per year). Viewed this way, a 2-1-2 pattern might actually lead to some benefits in production efficiency on the way to a steady rate of two boats per year. The Navy's own 30-year (FY2008-FY2037) SSN procurement plan calls for procuring SSNs in a 1-2-1-2 pattern in FY2029-FY2037.

Issues for Congress

48-Boat Attack Submarine Force-Level Goal

Is 48 the correct number of SSNs to meet future needs?

Some observers have argued that the Navy in coming years should maintain a force of more than 48 SSNs. The Navy has defended the 48-boat force-level goal. For additional discussion of this issue, see **Appendix B**.

Accelerated Virginia-Class Procurement

Should the start of two-per-year Virginia-class procurement be accelerated from FY2012 to an earlier year, so as to come closer to maintaining a force of 48 SSNs in the 2020s-2030s, and if so, how might that be done financially?

Navy View. Those who support the position that two-per-year Virginia-class procurement should not start until FY2012 could argue the following:

- Given constraints on Navy funding, the Navy cannot afford to accelerate the start of two-per-year procurement to a year earlier than FY2012 without reducing funding for one or more other Navy programs budgeted that year. Accommodating the additional funding that would be needed between FY2008 and FY2011 to accelerate the start of two-per-year procurement to FY2010 would require substantial reductions to other Navy programs. The operational risk that would be created by reducing funding for these other programs is greater than the operational risk that would result from waiting until FY2012 to start two-per-year procurement of Virginia-class boats.

- The Navy can take steps to mitigate the projected SSN shortfall. In addition, although the force will be below 48 boats for 14 years, for some of these years, the shortfall will be only one or two or three boats.

- The Navy can mitigate or eliminate the projected SSN shortfall without accelerating the start of two-per-year Virginia-class procurement by adding additional SSNs to the procurement plan in the 11-year period FY2012-FY2022.

- If two Virginia-class boats were procured per year before FY2012, those boats would not meet the Navy's unit procurement cost target of $2.0 billion each in FY2005 dollars, because certain cost-reducing technologies needed to meet the $2.0-billion target will not be ready until FY2012.

Alternative View. Supporters of accelerating Virginia-class procurement to a year earlier than FY2012 could argue one or more of the following:

- The operational risks of allowing the SSN force to drop below 48 are unacceptable. The Navy has described the 48-boat goal as a moderate-risk force, so dropping substantially below 48 boats would imply a high-risk force. If the force drops to 40 boats, as currently projected, the Navy would be without one of every six SSNs it is supposed to have. Although the deepest part of the projected SSN shortfall lasts only a certain number of years, potential adversaries can know in advance when this will occur and make plans to take advantage of it.

- Taking steps to increase the operational availability of SSNs during the shortfall period have their own potential disadvantages, including the possibility of reducing SSN operational availability in the years before or after the shortfall, which could create a virtual SSN shortfall in those years. If the Navy attempts to manage the SSN shortfall by shifting SSNs from some operational areas to others, it could increased operational risks in the vacated areas.

- Accelerating the start of two-per-year Virginia-class procurement to FY2010 would mitigate the projected SSN shortfall by creating a force that would bottom out at 42 boats rather than 40, and by reducing the projected duration of the shortfall period from 14 years (FY2020-FY2033) to nine years (FY2024-FY2032).

- The Navy may find it very difficult to fund three Virginia-class boats per year in future years without forcing undue reductions in other Navy programs. Accelerating the start of two-per-year Virginia-class procurement to a year earlier than FY2012 would reduce the number of years in FY2012 and beyond where three SSNs per year would need to be procured to further mitigate, or fully eliminate, the SSN shortfall.

- Accelerating the start of two-per-year Virginia-class procurement to a year earlier than FY2012 would mitigate a potential roller-coaster effect on shipyard and supplier-firm workloads and employment levels that would result if SSNs were procured for several years at one per year, then increased at some future point to three per year, then fell back to 1.5 or two per year.

- Accelerating the start of two-per-year Virginia-class procurement to a year earlier than FY2012 would permit the Navy to begin reaping

sooner the cost-reducing effects of procuring two SSNs per year. The boats might cost more than the Navy's target of $2.0 billion each in FY2005 dollars, but this is an internal Navy goal that need not control congressional action.

Maintaining the Design and Engineering Base

How should the submarine design and engineering base be maintained in coming years?

Navy and industry officials appear to agree that preserving the submarine design and engineering base over the next several years will require funding submarine design and engineering work that is in addition to the amount of such work currently planned. In assessing options for additional submarine design and engineering work, issues of interest include the total volume of work that the options would provide, and the number of submarine design and engineering skills they would engage and thereby help preserve.

Potential Options for Congress

Options for Procuring Additional SSNs in FY2008-FY2011

This section discusses some potential funding approaches for procuring one to four additional boats in FY2008-FY2011. The examples shown are illustrative but not exhaustive, as there are many possible permutations.

Procuring One Additional Boat. One potential approach to fund a single additional boat in FY2008-FY2011 would be to procure the boat in FY2011 using the traditional approach — full funding in FY2011 with advance procurement in FY2009 and FY2010. This option would require little or no additional procurement funding in FY2008.

A second potential approach would be to procure the boat in FY2010 using the traditional approach — full funding in FY2010 and advance procurement funding in FY2008 and FY2009. As discussed earlier in this report, the Navy estimates that this approach would require $400 million in additional advance procurement funding in FY2008. This approach would also preserve an option for adding a second additional boat in FY2011, should Congress decide next year that it wanted to fund a second additional boat in FY2011.

Procuring Two Additional Boats. **Table 8** below shows three potential profiles for procuring two additional boats in FY2008-FY2011 (i.e., a total of six boats during this period).

Table 8. Some Potential Profiles for Procuring Two Additional Boats

FY08	FY09	FY10	FY11
1	1	2	2
1	2	1	2
2	1	2	1

In first profile **in Table 8**, the additional boats in FY2010 and FY2011 could be funded in the traditional manner, with advance procurement funding starting in FY2008 for the FY2010 boat and in FY2009 for the FY2011 boat.

In the second profile in **Table 8**, the additional boat in FY2009 could be procured with single-year full funding in FY2009, which would not require any additional funding in FY2008. Under this approach, the boat might enter service in FY2017, as opposed to FY2015 for a boat procured in FY2009 that had received traditional advance procurement funding starting in FY2007. Alternatively, the second boat in FY2009 could be procured with a combination of funding in FY2008 and FY2009 (and perhaps also FY2010). Under this approach, the FY2008 funding might be limited to the $400 million that the Navy states would be required for long-leadtime components, and the boat might enter service in FY2016.

In the third profile in **Table 8**, the additional boat in FY2008 could be funded using either single-year full funding in FY2008, or two-year incremental funding (i.e., split funding) in FY2008 and FY2009. In either case, the boat might enter service in FY2016, as opposed to FY2014 for a boat procured in FY2008 that had received advance procurement funding starting in FY2006. The additional boat in FY2010 could be procured with advance procurement funding starting in FY2008 (which might permit the boat to enter service in FY2016) or with advance procurement funding starting in FY2009 (which might permit the boat to enter service in FY2017). The remainder of the boat's procurement cost could be fully funded in FY2010, or divided between FY2010 and FY2011 (split funding).

Procuring Three Additional Boats. **Table 9** below shows two potential profiles for procuring three additional boats in FY2008-FY2011 (i.e., a total of seven boats during this period).

Table 9. Some Potential Profiles for Procuring Three Additional Boats

FY08	FY09	FY10	FY11
2	1	2	2
1	2	2	2

In the first profile in **Table 9**, the additional boat in FY2008 could be procured using either single-year full funding in FY2008, or split funding in FY2008 and FY2009. In either case, the boat might enter service in FY2016, as opposed to FY2014 for a boat procured in FY2008 that had received advance procurement funding starting in FY2006. In the second profile, the additional boat in FY2009

could be procured with single-year full funding in FY2009, or with a combination of funding in FY2008 and FY2009, in which case the FY2008 funding might be limited to the $400 million that the Navy states would be required for long-leadtime components.

Procuring Four Additional Boats. If four additional boats were procured in FY2008-FY2011, with one additional boat in each year, then the additional boat in FY2008 could be procured using either single-year full funding or incremental funding. The second boat could be procured with advance procurement funding in FY2008 followed by either full funding in FY2009 or incremental funding in FY2009 and one or more subsequent years. The additional boats in FY2010 and FY2011 could be funded in the traditional manner, with advance procurement funding starting in FY2008 and FY2009, respectively.

Options for Submarine Design and Engineering Base

Options for providing additional work for the submarine design and engineering base over the next few years include the following:

- **Expanded Virginia-class modification effort.** The Navy is currently funding certain work to modify the Virginia-class design, in part to reach the Navy's Virginia-class cost-reduction target. The scope of this effort could be expanded to include a greater number and variety of modifications. An expanded modification effort would add to the amount of submarine design and engineering work currently programmed, but by itself might not be sufficient in terms of volume of work or number of skills areas engaged to fully preserve the submarine design and engineering base.

- **New Advanced SEAL Delivery System (ASDS).** The ASDS is a mini-submarine that is attached to the back of an SSGN or SSN to support operations by Navy special operations forces (SOF), who are called SEALs, an acronym that stands for Sea, Air, and Land. DOD has decided, after building one copy of the current ASDS design, not to put that design into serial production. Some observers have proposed developing a new ASDS design with the intention of putting this new design into serial production. This option, like the previous one, would add to the amount of submarine design and engineering work currently programmed, but by itself might not be sufficient in terms of volume of work or number of skills areas engaged to fully preserve the submarine design and engineering base.

- **Diesel-electric submarine for Taiwan.** In April 2001, the Bush Administration announced a proposed arms-sales package for Taiwan that included, among other things, eight diesel-electric

submarines.[28] Since foreign countries that build diesel-electric submarines appear reluctant to make their designs available for a program to build such boats for Taiwan, some observers have proposed that the United States develop its own design for this purpose. This option would generate a substantial volume of work and engage many skill areas. Uncertainty over whether and when this project might occur could make it difficult to confidently incorporate it into an integrated schedule of work for preserving the U.S. design and engineering base. Although the project would engage many skill areas, it might not engage all of them. Skills related to the design of nuclear propulsion plants, for example, might not be engaged. In addition, this project might raise concerns regarding the potential for unintended transfer of sensitive U.S. submarine technology — an issue that has been cited by the Navy in the past for not supporting the idea of designing and building diesel-electric submarines in the United States for sale to foreign buyers.[29]

- **New SSN design**. Developing a completely new SSN design as the successor to the Virginia-class design would fully support the design and engineering base for several years. The Navy in the past has estimated that the cost of this option would be roughly equivalent to the procurement cost of three SSNs. The House version of the FY2006 defense authorization bill (H.R. 1815) proposed this idea, but the idea was not supported by the Navy, in large part because of its cost, and the conference version of the bill did not mandate it.

- **Accelerated start of next SSBN design.** Given the ages of the Navy's 14 current SSBNs, work on a replacement SSBN design would normally not need to start for several years. The start of this project, however, could be accelerated to FY2008. The project could then be carried out as a steady-state effort over several years, rather than as a more-concentrated effort starting several years from now. This option could provide a significant amount of submarine design and engineering work for several years, and could engage all submarine design and engineering skills. The total cost of this effort would be comparable to that of the previous option of designing a new SSN, but this option would accelerate a cost that the Navy

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[28] For more on the proposed arms sales package, including the diesel-electric submarines, see CRS Report RL30957, *Taiwan: Major U.S. Arms Sales Since 1990*, by Shirley A. Kan.

[29] An additional issue that some observers believe might be behind Navy resistance to the idea of designing and building diesel-electric submarines in the United States for sale to foreign buyers, but which these observers believe the Navy is unwilling to state publicly, is a purported fear among Navy officials that the establishment of a U.S. production line for such boats would lead to political pressure for the Navy to accept the procurement of such boats for its own use, perhaps in lieu of nuclear-powered submarines. The Navy argues that non-nuclear-powered submarines are not well suited for U.S. submarine operations, which typically involve long, stealthy transits to the operating area, long submerged periods in the operating area, and long, stealthy transits back to home port.

already plans to incur, whereas the option for designing a new SSN would be an additional cost.

The Navy has acknowledged the need to devise a strategy to preserve the submarine design and engineering base, and asked the RAND Corporation to study the issue. The RAND report, which is to be published shortly, concludes that accelerating the start of design work on the next SSBN, and carrying out this work as a steady-state effort over several years, could maintain the submarine design and engineering base for several years. An exception, RAND found, relates to designers and engineers employed by about 50 supplier firms that design the submarine components they make for the Navy. The RAND report concluded that accelerating the start of design work of the next SSBN might not help maintain the designers and engineers at some of these firms.[30]

Legislative Activity for FY2008

The Navy's proposed FY2008 budget requests $2,571.3 million in the Navy's shipbuilding budget (the Shipbuilding and Conversion, Navy, or SCN, appropriation account) for the Virginia-class program. This total includes $1,796.2 million to complete the procurement funding for the Virginia-class boat that the Navy is requesting to procure in FY2008, which would be the tenth ship in the program. The total estimated procurement cost of this ship is $2,653.7 million, and the ship has received a total of $857.5 million in prior-year funding. The $2,571.3 million being requested for the program for FY2008 also includes, among other things, $702.7 million in advance procurement funding for Virginia-class boats to be procured in future years.

[30] RAND briefing on the study provided to Navy, industry, and congressional staff (including CRS), February 9, 2007.

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.[31] 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.[32]

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.[33] 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."[34] 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

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[31] 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.

[32] 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.

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

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

> 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
>
> - "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."[35]

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 Department of Defense (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."[36]

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.[37]

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.[38]

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

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

[37] 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.

[38] 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.

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.[39]

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

[39] 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. Views Regarding 48-Boat SSN Force-Level Goal

This appendix summarizes the Navy's view and an alternative view regarding the appropriateness of the Navy's 48-boat SSN force-level goal.

Navy View.[40] In support of its position that 48 is the correct number of SSNs to meet future needs, the Navy in 2006 argued the following:

- The figure of 48 SSNs was derived from a number of force-level studies that converged on a figure of about 48 boats, making this figure an analytical "sweet spot."

- A force of 48 boats is a moderate-risk (i.e., acceptable-risk) force, as opposed to the low-risk force called for in the 1999 JCS study.

- A force of 48 boats will be sufficient in coming years to maintain about 10 forward-deployed SSNs on a day-to-day basis — the same number of forward-deployed boats that the Navy has previously maintained with a force of more than 50 SSNs. The Navy will be able to maintain 10 forward-deployed SSNs in coming years with only 48 boats because the force in coming years will include an increased number of newer SSNs that require less maintenance over their lives and consequently are available for operation a greater percentage of the time.

- U.S. regional military commanders would prefer a day-to-day forward-deployed total of about 18 SSNs, but total of 10 will be sufficient to meet their most important needs.

- All 10 of the forward-deployed SSNs are needed for day-to-day missions such as intelligence, surveillance and reconnaissance (ISR), while about 7.5 of these submarines are also needed to ensure that an adequate number of SSNs are in position for the opening phases of potential conflicts in various locations.

On the issue of meeting U.S. regional military commanders' requirements for day-to-day forward-deployed SSNs, the Navy states:

> Each Combatant Commander (COCOM) requests assets to execute required missions utilizing the Global Force Management Process. Broad categories of mission types are used to make requests including: National and Fleet ISR, Exercise and Training (supporting US tactical development), Exercise and Operations (supporting US engagement strategy), Carrier Strike Group (CSG) /Expeditionary Strike Group (ESG) tasking, OPLAN (war plans) support, and Other. As assignment of Critical, High Priority, Priority or Routine is assigned

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[40] This section is based on Navy testimony to the Projection Forces subcommittee of the House Armed Services Committee on March 28, 2006, and to the Seapower subcommittee of the Senate Armed Services Committee on March 29, and April 6, 2006.

> to each of the requested missions. The theater allocation request process prior to 2004 did not include a priority breakdown. In general, ISR missions have been assigned as Critical or High Priority requirements. Other mission areas have been assigned from High Priority to Routine, based on the relative importance to the theater commander. No allocation is currently requested to support OPLAN or Other mission areas.
>
> Each COCOM has authority to use its allocated SSNs as required to meet current national and theater priorities. The CJCS [Chairman Joint Chiefs of Staff] allocation order to the Submarine Force strictly directs an allotted number of SSN days of presence be provided, capable of meeting each theaters' [sic] taskings. The breakdown of mission priorities into Critical, High Priority, Priority and Routine is predominantly a construct to demonstrate how a COCOM could meet their priorities, given a specific level of SSN presence. It serves as an aid to the CJCS in apportioning limited SSN presence to the various theaters.
>
> The number of SSNs allocated against Critical Missions enabled COCOMs to meet all requirements in 2004 and 2005, and 99% of the requirements in 2006. For High Priority missions, sufficient SSNs were allocated to meet 25%, 50% and 34% of requirements in 2004, 2005, and 2006 respectively. Overall, the number of SSNs forward deployed was sufficient to cover 66%, 61% and 54% of Combatant Commanders' requested SSN mission taskings in 2004, 2005, and 2006 respectively.[41]

Alternative View. Some observers believe that more than 48 SSNs will be needed to meet future needs. One such observer — retired Vice Admiral Albert Konetzni, Jr., a former commander of the U.S. Pacific Fleet submarine force — argued the following in 2006:[42]

- The Navy's SSN force-level analyses called for a force of 48 to 60 SSNs. In this context, a force of 48 SSNs looks more like a sour spot than a sweet spot.
- The Navy's SSN force-level analyses reflect "reverse engineering," in which an SSN force-level number is selected at the outset for affordability reasons, and assumptions used in the force-level study are then adjusted to produce that figure.
- The 1999 JCS study on SSN requirements remains valid today.

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[41] Source: Written response by Vice Admiral Charles L. Munns, Commander Naval Submarine Forces, to a question posed by Representative Rob Simmons at a March 28, 2006, hearing before the Projection Forces Subcommittee of the House Armed Services Committee on submarine force structure. Munns' written response was provided to CRS on July 5, 2006, by the office of Representative Simmons and is used here with the permission of that office.

[42] These points are based on Konetzni's testimony to the Projection Forces subcommittee of the House Armed Services Committee on March 28, 2006.

- All of the U.S. regional military commanders' requirements for day-to-day forward-deployed SSNs, and not just the 60% or so of those requirements that are being met, are critical.

- In light of the potential size of China's submarine force in 2020, a force of 48 SSNs in that year will be insufficient.[43]

[43] For more on China's submarine force, and China's naval modernization effort in general, see CRS Report RL33153, *China Naval Modernization: Implications for U.S. Navy Capabilities — Background and Issues for Congress*, by Ronald O'Rourke.