



Navy Ohio Replacement (SSBN[X]) Ballistic Missile Submarine Program: Background and Issues for Congress

Ronald O'Rourke
Specialist in Naval Affairs

October 25, 2012

Congressional Research Service

7-5700

www.crs.gov

R41129

Summary

The Navy's proposed FY2013 budget requests \$564.9 million for continued research and development work on the Ohio replacement program (ORP), a program to design and build a new class of 12 ballistic missile submarines (SSBNs) to replace the Navy's current force of 14 Ohio-class SSBNs. The Ohio replacement program is also known as the SSBN(X) program.

Under the Navy's FY2012 budget, the first Ohio replacement boat was scheduled to be procured in FY2019, and Ohio replacement boats were to enter service on a schedule that would maintain the Navy's SSBN force at 12 boats. The Navy's proposed FY2013 budget defers the procurement of the first Ohio replacement boat by two years, to FY2021. As a result of this deferment, the Navy's SSBN force will drop to 11 or 10 boats for the period FY2029-FY2041.

The Navy in 2011 estimated the average procurement cost of boats 2 through 12 in the Ohio replacement program at \$5.6 billion each in FY2010 dollars, and is working to reduce that figure to a target of \$4.9 billion each in FY2010 dollars. Even with this cost-reduction effort, observers are concerned about the impact the Ohio replacement program will have on the Navy's ability to procure other types of ships at desired rates in the 2020s and early 2030s.

Potential oversight issues for Congress for the Ohio replacement program include the following:

- the reasons for deferring the start of SSBN(X) procurement by two years, to FY2021, the cost and operational impact of this decision, and whether it would be feasible and cost effective to restore the start of procurement to FY2019, as planned under the FY2012 budget;
- the plan to design the SSBN(X) with 16 SLBM tubes rather than 20;
- the likelihood that the Navy will be able to reduce the average procurement cost of boats 2-12 in the program to the target figure of \$4.9 billion each in FY2010 dollars;
- the accuracy of the Navy's estimate of the procurement cost of each SSBN(X);
- the prospective affordability of the Ohio replacement program and its potential impact on funding available for other Navy shipbuilding programs; and
- the question of which shipyard or shipyards will build SSBN(X)s.

This report focuses on the Ohio replacement program as a Navy shipbuilding program. CRS Report RL33640, *U.S. Strategic Nuclear Forces: Background, Developments, and Issues*, by Amy F. Woolf, discusses the SSBN(X) as an element of future U.S. strategic nuclear forces in the context of strategic nuclear arms control agreements.

Contents

Introduction.....	1
Background.....	1
U.S. Navy SSBNs in General.....	1
Mission of SSBNs.....	1
Current Ohio-Class SSBNs.....	2
Summary of U.S. SSBN Designs.....	4
U.S.-UK Cooperation on SLBMs and the New UK SSBN.....	6
Ohio Replacement Program.....	8
Program Origin and Early Milestones.....	8
Planned Procurement Quantity: 12 SSBN(X)s to Replace 14 Ohio-Class Boats.....	10
Procurement and Replacement Schedule.....	10
SSBN(X) Design Features.....	12
Program Acquisition Cost.....	13
Common Missile Compartment (CMC).....	14
Program Funding.....	15
Issues for Congress.....	16
Two-Year Deferral in Start of Procurement.....	17
A Design with 16 vs. 20 SLBM Tubes.....	18
Overview.....	18
Testimony in 2011.....	19
Section 242 Report.....	22
Likelihood That Navy Will Reach \$4.9 Billion Target Cost.....	24
Accuracy of Navy’s Estimated Unit Procurement Cost.....	25
Program Affordability and Impact on Other Navy Shipbuilding Programs.....	27
Reducing the Planned Number of SSBN(X)s.....	28
Altering Procurement Schedule to Make More Use of Incremental Funding.....	29
Procuring SSBN(X)s Outside Navy’s Shipbuilding Budget.....	32
Construction Shipyard(s).....	35
Legislative Activity for FY2013.....	37
FY2013 Funding Request.....	37
FY2013 National Defense Authorization Act (H.R. 4310/S. 3254).....	38
House.....	38
Senate.....	39
FY2013 DOD Appropriations Act (H.R. 5856).....	40
House.....	40
Senate.....	40

Figures

Figure 1. Ohio (SSBN-726) Class SSBN.....	4
---	---

Tables

Table 1. U.S. SSBN Classes.....	5
---------------------------------	---

Table 2. Navy Schedule for Procuring SSBN(X)s and Replacing Ohio-Class SSBNs 11
Table 3. Ohio Replacement Program Funding..... 16
Table 4. Navy SSBN(X) Procurement Schedule and a Notional Alternative Schedule..... 31
Table 5. Construction Shipyards of U.S. SSBNs 36

Contacts

Author Contact Information..... 40

Introduction

This report provides background information and potential oversight issues for Congress on the Ohio replacement program (ORP), a program to design and build a new class of 12 ballistic missile submarines (SSBNs) to replace the Navy's current force of 14 Ohio-class SSBNs. The Ohio replacement program is also known as the SSBN(X) program. The Navy's proposed FY2013 budget requests \$564.9 million for continued research and development work on the Ohio replacement program. Decisions that Congress makes on the Ohio replacement program could substantially affect U.S. military capabilities and funding requirements, and the U.S. shipbuilding industrial base.

This report focuses on the Ohio replacement program as a Navy shipbuilding program. Another CRS report discusses the SSBN(X) as an element of future U.S. strategic nuclear forces in the context of strategic nuclear arms control agreements.¹

Background

U.S. Navy SSBNs in General

Mission of SSBNs

The U.S. Navy operates three kinds of submarines—nuclear-powered attack submarines (SSNs), nuclear-powered cruise missile submarines (SSGNs), and nuclear-powered ballistic missile submarines (SSBNs).² The SSNs and SSGNs are multi-mission ships that perform a variety of peacetime and wartime missions.³ They do not carry nuclear weapons.⁴

¹ CRS Report RL33640, *U.S. Strategic Nuclear Forces: Background, Developments, and Issues*, by Amy F. Woolf.

² In the designations SSN, SSGN, SSBN, and SSBN(X), the SS stands for submarine, N stands for nuclear-powered (meaning the ship is powered by a nuclear reactor), G stands for guided missile (such as a cruise missile), B stands for ballistic missile, and (X) means the design of the ship has not yet been determined.

As shown by the "Ns" in SSN, SSGN, and SSBN, all U.S. Navy submarines are nuclear-powered. Other navies operate non-nuclear powered submarines, which are powered by energy sources such as diesel engines. 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.

³ These missions include covert intelligence, surveillance, and reconnaissance (ISR), much of it done for national-level (as opposed to purely Navy) purposes; covert insertion and recovery of special operations forces (SOF); covert strikes against land targets with the Tomahawk cruise missiles; covert offensive and defensive mine warfare; anti-submarine warfare (ASW); and anti-surface ship warfare. The Navy's four SSGNs, which are converted former SSBNs, can carry larger numbers of Tomahawks and SOF personnel than can the SSNs. SSGN operations consequently may focus more strongly on Tomahawk and SOF missions than do SSN operations. For more on the Navy's SSNs and SSGNs, see CRS Report RL32418, *Navy Virginia (SSN-774) Class Attack Submarine Procurement: Background and Issues for Congress*, by Ronald O'Rourke, and CRS Report RS21007, *Navy Trident Submarine Conversion (SSGN) Program: Background and Issues for Congress*, by Ronald O'Rourke.

⁴ The Navy's non-strategic nuclear weapons—meaning all of the service's nuclear weapons other than submarine-launched ballistic missiles (SLBMs)—were removed from Navy surface ships and submarines under a unilateral U.S. nuclear initiative announced by President George H. W. Bush in September 1991. The initiative reserved a right to rearm SSNs at some point in the future with nuclear-armed Tomahawk land attack missiles (TLAM-Ns) should (continued...)

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

Navy SSBNs, which are sometimes referred to informally as “boomers,”⁶ form one leg of the U.S. strategic nuclear deterrent force, or “triad,” which also includes land-based intercontinental ballistic missiles (ICBMs) and land-based long-range bombers. At any given moment, some of the Navy's SSBNs are conducting nuclear deterrent patrols. The Navy's report on its FY2011 30-year shipbuilding plan states: “These ships are the most survivable leg of the Nation's strategic arsenal and provide the Nation's only day-to-day assured nuclear response capability.”⁷ The Department of Defense's (DOD's) report on the 2010 Nuclear Posture Review (NPR), released on April 6, 2010, states that “strategic nuclear submarines (SSBNs) and the SLBMs they carry represent the most survivable leg of the U.S. nuclear Triad.”⁸

Current Ohio-Class SSBNs

The Navy currently operates 14 Ohio (SSBN-726) class SSBNs. The boats are commonly called Trident SSBNs or simply Tridents because they carry Trident SLBMs.

A total of 18 Ohio-class SSBNs were procured in FY1974-FY1991. The ships entered service in 1981-1997. The boats were designed and built by General Dynamics' Electric Boat Division (GD/EB) of Groton, CT, and Quonset Point, RI. They were originally designed for 30-year service lives but were later certified for 42-year service lives, consisting of two 20-year periods of operation separated by a two-year mid-life nuclear refueling overhaul, called an engineered refueling overhaul (ERO). The nuclear refueling overhaul includes both a nuclear refueling and overhaul work on the ship that is not related to the nuclear refueling.

(...continued)

conditions warrant. Navy TLAM-Ns were placed in storage to support this option. DOD's report on the 2010 Nuclear Posture Review (NPR), released on April 6, 2010, states that the United States will retire the TLAM-Ns. (Department of Defense, *Nuclear Posture Review Report*, April 2010, pp. xiii and 28.)

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

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

⁷ U.S. Navy, *Report to Congress on Annual Long-Range Plan for Construction of Naval Vessels for FY 2011*, February 2010, p. 15.

⁸ Department of Defense, *Nuclear Posture Review Report*, April 2010, p. 22. The next sentence in the report states: “Today, there appears to be no viable near or mid-term threats to the survivability of U.S. SSBNs, but such threats—or other technical problems—cannot be ruled out over the long term.” The report similarly states on page 23: “Today, there appears to be no credible near or mid-term threats to the survivability of U.S. SSBNs. However, given the stakes involved, the Department of Defense will continue a robust SSBN Security Program that aims to anticipate potential threats and develop appropriate countermeasures to protect current and future SSBNs.”

Ohio-class SSBNs each carry 24 SLBMs. The first eight boats in the class were originally armed with Trident I C-4 SLBMs; the final 10 were armed with larger and more-capable Trident II D-5 SLBMs. The Clinton Administration's 1994 Nuclear Posture Review (NPR) recommended a strategic nuclear force for the START II strategic nuclear arms reduction treaty that included 14 Ohio-class SSBNs, all armed with D-5s. This recommendation prompted interest in the idea of converting the first four Ohio-class boats (SSBNs 726-729) into SSGNs, so as to make good use of the 20 years of potential operational life remaining in these four boats, and to bolster the U.S. SSN fleet. The first four Ohio-class boats were converted into SSGNs in 2002-2008,⁹ and the next four (SSBNs 730-733) were backfitted with D-5 SLBMs in 2000-2005, producing the current force of 14 Ohio-class SSBNs, all of which are armed with D-5 SLBMs.

Eight of the 14 Ohio-class SSBNs are homeported at Bangor, WA, in Puget Sound; the other six are homeported at Kings Bay, GA, close to the Florida border.

Unlike most Navy ships, which are operated by single crews, Navy SSBNs are operated by alternating crews (called the Blue and Gold crews) so as to maximize the percentage of time that they spend at sea in deployed status. The Navy consequently maintains 28 crews to operate its 14 Ohio-class SSBNs.

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

The Navy has initiated a program to refurbish and extend the service lives of D-5 SLBMs to 2042 "to match the OHIO Class submarine service life."¹⁰

Figure 1 shows an Ohio-class SSBN with the hatches to some of its SLBM launch tubes open.

⁹ For more on the SSGN conversion program, see CRS Report RS21007, *Navy Trident Submarine Conversion (SSGN) Program: Background and Issues for Congress*, by Ronald O'Rourke.

¹⁰ Statement of Rear Admiral Stephen Johnson, USN, Director, Strategic Systems Programs, Before the Subcommittee on Strategic Forces of the Senate Armed Services Committee [on] FY2011 Strategic Systems, March 17, 2010, p. 4.

Figure 1. Ohio (SSBN-726) Class SSBN
With the hatches to some of its SLBM launch tubes open



Source: U.S. Navy file photo accessed by CRS on February 24, 2011, at <http://www.navy.mil/management/photodb/photos/101029-N-1325N-005.jpg>.

Summary of U.S. SSBN Designs

The Navy has operated four classes of SSBNs since 1959. **Table 1** compares the current Ohio-class SSBN design to the three earlier U.S. SSBN designs. As shown in the table, the size of U.S. SSBNs has grown over time, reflecting in part a growth in the size and number of SLBMs carried on each boat. The Ohio class carries an SLBM (the D-5) that is much larger than the SLBMs carried by earlier U.S. SSBNs, and it carries 24 SLBMs, compared to the 16 on earlier U.S. SSBNs.¹¹ In part for these reasons, the Ohio-class design, with a submerged displacement of 18,750 tons, is more than twice the size of earlier U.S. SSBNs.

¹¹ The larger size of the Ohio-class design also reflects a growth in size over time in U.S. submarine designs due to other reasons, such as providing increased interior volume for measures to quiet the submarine acoustically, so as to make it harder to detect.

Table I. U.S. SSBN Classes

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

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

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

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

The George Washington-class boats were procured as modifications of SSNs that were already under construction. Three of the boats were converted into SSNs toward the ends of their lives and were decommissioned in 1983-1985. The two boats that remained SSBNs throughout their lives were decommissioned in 1981.

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

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

A total of 18 Ohio-class SSBNs were built. The first four, which entered service in 1981-1984, were converted into SSGNs in 2002-2008. The remaining 14 boats entered service in 1984-1997.

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

SSBNs are also operated by the United Kingdom, France, Russia, and China.¹² The UK's four Vanguard-class SSBNs, which entered service in 1993-1999, each carry 16 Trident II D-5 SLBMs. Previous classes of UK SSBNs similarly carried earlier-generation U.S. SLBMs.¹³ The UK's use of U.S.-made SLBMs on its SSBNs is one element of a long-standing close cooperation between the two countries on nuclear-related issues that is carried out under the 1958 Agreement for Cooperation on the Uses of Atomic Energy for Mutual Defense Purposes (also known as the Mutual Defense Agreement). Within the framework established by the 1958 agreement, cooperation on SLBMs in particular is carried out under the 1963 Polaris Sales Agreement and a 1982 Exchange of Letters between the two governments.¹⁴ The Navy testified in March 2010 that

¹² India in July 2009 launched a nuclear-powered submarine that is equipped with four vertical launch tubes for launching 12 short-range SLBMs or cruise missiles; the ship is expected to enter service in 2012.

¹³ Although the SLBMs on UK SSBNs are U.S.-made, the nuclear warheads on the missiles are of UK design and manufacture.

¹⁴ A March 18, 2010, report by the UK Parliament's House of Commons Foreign Affairs Committee stated:

During the Cold War, the UK's nuclear co-operation with the United States was considered to be at the heart of the [UK-U.S.] 'special relationship'. This included the 1958 Mutual Defence Agreement, the 1963 Polaris Sales Agreement (PSA) (subsequently amended for Trident), and the UK's use of the US nuclear test site in Nevada from 1962 to 1992. The co-operation also encompassed agreements for the United States to use bases in Britain, with the right to store nuclear weapons, and agreements for two bases in Yorkshire (Fylingdales and Menwith Hill) to be upgraded to support US missile defence plans.

In 1958, the UK and US signed the Mutual Defence Agreement (MDA). Although some of the appendices, amendments and Memoranda of Understanding remain classified, it is known that the agreement provides for extensive co-operation on nuclear warhead and reactor technologies, in particular the exchange of classified information concerning nuclear weapons to improve design, development and fabrication capability. The agreement also provides for the transfer of nuclear warhead-related materials. The agreement was renewed in 2004 for another ten years.

The other major UK-US agreement in this field is the 1963 Polaris Sales Agreement (PSA) which allows the UK to acquire, support and operate the US Trident missile system. Originally signed to allow the UK to acquire the Polaris Submarine Launched Ballistic Missile (SLBM) system in the 1960s, it was amended in 1980 to facilitate purchase of the Trident I (C4) missile and again in 1982 to authorise purchase of the more advanced Trident II (D5) in place of the C4. In return, the UK agreed to formally assign its nuclear forces to the defence of NATO, except in an extreme national emergency, under the terms of the 1962 Nassau Agreement reached between President John F. Kennedy and Prime Minister Harold Macmillan to facilitate negotiation of the PSA.

Current nuclear co-operation takes the form of leasing arrangements of around 60 Trident II D5 missiles from the US for the UK's independent deterrent, and long-standing collaboration on the design of the W76 nuclear warhead carried on UK missiles. In 2006 it was revealed that the US and the UK had been working jointly on a new 'Reliable Replacement Warhead' (RRW) that would modernise existing W76-style designs. In 2009 it emerged that simulation testing at Aldermaston on dual axis hydrodynamics experiments had provided the US with scientific data it did not otherwise possess on this RRW programme.

The level of co-operation between the two countries on highly sensitive military technology is, according to the written submission from Ian Kearns, "well above the norm, even for a close alliance relationship". He quoted Admiral William Crowe, the former US Ambassador to London, who likened the UK-US nuclear relationship to that of an iceberg, "with a small tip of it sticking out, but beneath the water there is quite a bit of everyday business that goes on between our two governments in a fashion that's unprecedented in the world." Dr Kearns also commented that the personal bonds between the US/UK scientific and technical establishments were deeply rooted.

(House of Commons, Foreign Affairs Committee, *Sixth Report Global Security: UK-US Relations*, March 18, 2010, paragraphs 131-135; <http://www.publications.parliament.uk/pa/cm200910/cmselect/cmaff/114/11402.htm>; paragraphs 131-135 are included in the section of the report

(continued...)

“the United States and the United Kingdom have maintained a shared commitment to nuclear deterrence through the Polaris Sales Agreement since April 1963. The U.S. will continue to maintain its strong strategic relationship with the UK for our respective follow-on platforms, based upon the Polaris Sales Agreement.”¹⁵

The first Vanguard-class SSBN was originally projected to reach the end of its service life in 2024, but an October 2010 UK defense and security review report states that the lives of the Vanguard class ships will now be extended by a few years, so that the four boats will remain in service into the late 2020s and early 2030s.¹⁶

The UK plans to replace the four Vanguard-class boats with three or four next-generation SSBNs called Successor class SSBNs. The October 2010 UK defense and security review report states that each new Successor class SSBN is to be equipped with 8 D-5 SLBMs, rather than 12 as previously planned. The report states that “‘Initial Gate’—a decision to move ahead with early stages of the work involved—will be approved and the next phase of the project will start by the end of [2010]. ‘Main Gate’—the decision to start building the submarines—is required around 2016.”¹⁷ The first new boat is to be delivered by 2028, or about four years later than previously planned.¹⁸

The UK has wanted the Successor SSBNs to carry D-5 SLBMs, and for any successor to the D-5 SLBM to be compatible with, or be capable of being made compatible with, the D-5 launch system. President George W. Bush, in a December 2006 letter to UK Prime Minister Tony Blair, invited the UK to participate in any program to replace the D-5 SLBMs, and stated that any successor to the D-5 system should be compatible with, or be capable of being made compatible with, the launch system for the D-5 SLBM.

The United States is assisting the UK with certain aspects of the Successor SSBN program. In addition to the modular Common Missile Compartment (CMC) discussed below (see “Common Missile Compartment (CMC)” in the following section on the Ohio replacement program), the United States is assisting the UK with the new PWR-3 reactor plant¹⁹ to be used by the Successor SSBN. A December 2011 press report states that “there has been strong [UK] collaboration with the US [on the Successor program], particularly with regard to the CMC, the PWR, and other propulsion technology,” and that the design concept selected for the Successor class employs “a

(...continued)

available at <http://www.publications.parliament.uk/pa/cm200910/cmselect/cmfa/114/11406.htm>.)

¹⁵ Statement of Rear Admiral Stephen Johnson, USN, Director, Strategic Systems Programs, Before the Subcommittee on Strategic Forces of the Senate Armed Services Committee [on] FY2011 Strategic Systems, March 17, 2010, p. 6.

¹⁶ *Securing Britain in an Age of Uncertainty: The Strategic Defence and Security Review*, Presented to Parliament by the Prime Minister by Command of Her Majesty, October 2010, p. 39.

¹⁷ *Securing Britain in an Age of Uncertainty: The Strategic Defence and Security Review*, Presented to Parliament by the Prime Minister by Command of Her Majesty, October 2010, p. 5, 38-39. For more on the UK’s Successor SSBN program as it existed prior to the October 2010 UK defense and security review report, see Richard Scott, “Deterrence At A Discount?” *Jane’s Defence Weekly*, December 23, 2009: 26-31.

¹⁸ *Securing Britain in an Age of Uncertainty: The Strategic Defence and Security Review*, Presented to Parliament by the Prime Minister by Command of Her Majesty, October 2010, p. 39.

¹⁹ PWR3 means pressurized water reactor, design number 3. U.S. and UK nuclear-powered submarines employ pressurized water reactors. Earlier UK nuclear-powered submarines are powered by reactor designs that the UK designated PWR-2 and PWR-1.

new propulsion plant based on a US design, but using next-generation UK reactor technology (PWR-3) and modern secondary propulsion systems.²⁰ The U.S. Navy states that:

Naval Reactors, a joint Department of Energy/Department of Navy organization responsible for all aspects of naval nuclear propulsion, has an ongoing technical exchange with the UK Ministry of Defence under the US/UK 1958 Mutual Defence Agreement. The US/UK 1958 Mutual Defence Agreement is a Government to Government Atomic Energy Act agreement that allows the exchange of naval nuclear propulsion technology between the US and UK.

Under this agreement, Naval Reactors is providing the UK Ministry of Defence with US naval nuclear propulsion technology to facilitate development of the naval nuclear propulsion plant for the UK's next generation SUCCESSOR ballistic missile submarine. The technology exchange is managed and led by the US and UK Governments, with participation from Naval Reactors prime contractors, private nuclear capable shipbuilders, and several suppliers. A UK based office comprised of about 40 US personnel provide full-time engineering support for the exchange, with additional support from key US suppliers and other US based program personnel as needed.

The relationship between the US and UK under the 1958 mutual defence agreement is an ongoing relationship and the level of support varies depending on the nature of the support being provided. Naval Reactors work supporting the SUCCESSOR submarine is reimbursed by the UK Ministry of Defence.²¹

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

The December 2011 press report states that "the UK is also looking at other areas of cooperation between Successor and the Ohio Replacement Programme. For example, a collaboration agreement has been signed off regarding the platform integration of sonar arrays with the respective combat systems."²²

Ohio Replacement Program

Program Origin and Early Milestones

Although the eventual need to replace the Ohio-class SSBNs has been known for many years, the Ohio replacement program can be traced more specifically to an exchange of letters in December 2006 between President George W. Bush and UK Prime Minister Tony Blair concerning the UK's desire to participate in a program to extend the service life of the Trident II D-5 SLBM into the 2040s, and to have its next-generation SSBNs carry D-5s. Following this exchange of letters, and

²⁰ Sam LaGrone and Richard Scott, "Strategic Assets: Deterrent Plans Confront Cost Challenges," *Jane's Navy International*, December 2011: 17 and 18.

²¹ Source: E-mail to CRS from Navy Office of Legislative Affairs, June 25, 2012.

²² Sam LaGrone and Richard Scott, "Strategic Assets: Deterrent Plans Confront Cost Challenges," *Jane's Navy International*, December 2011: 19.

with an awareness of the projected retirement dates of the Ohio-class SSBNs and the time that would likely be needed to develop and field a replacement for them, DOD in 2007 began studies on a next-generation sea-based strategic deterrent (SBSD).²³ The studies used the term sea-based strategic deterrent (SBSD) to signal the possibility that the new system would not necessarily be a submarine.

An Initial Capabilities Document (ICD) for a new SBSBD was developed in early 2008²⁴ and approved by DOD's Joint Requirements Oversight Committee (JROC) on June 20, 2008.²⁵ In July 2008, DOD issued a Concept Decision providing guidance for an analysis of alternatives (AOA) for the program; an acquisition decision memorandum from John Young, DOD's acquisition executive, stated the new system would, barring some discovery, be a submarine.²⁶ The Navy established an Ohio replacement program office at about this same time.²⁷ The AOA reportedly began in the summer or fall of 2008.²⁸ The AOA was completed, with final brief to the Office of the Secretary of Defense (OSD), on May 20, 2009. The final AOA report was completed in September 2009. An AOA Sufficiency Review Letter was signed by OSD's Director, Cost Assessment & Program Evaluation (CAPE) on December 8, 2009.²⁹

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

The OHIO Replacement Program achieved Milestone A and has been approved to enter the Technology Development Phase of the Dept. of Defense Life Cycle Management System as of Jan. 10, 2011.

This milestone comes following the endorsement of the Defense Acquisition Board (DAB), chaired by Dr. Carter (USD for Acquisition, Technology, and Logistics) who has signed the program's Milestone A Acquisition Decision Memorandum (ADM).

The DAB endorsed replacing the current 14 Ohio-class Ballistic Missile Submarines (SSBNs) as they reach the end of their service life with 12 Ohio Replacement Submarines, each comprising 16, 87-inch diameter missile tubes utilizing TRIDENT II D5 Life Extended

²³ In February 2007, the commander of U.S. Strategic Command (STRATCOM) commissioned a task force to support an anticipated Underwater Launched Missile Study (ULMS). On June 8, 2007, the Secretary of the Navy initiated the ULMS. Six days later, the commander of STRATCOM directed that a Sea Based Strategic Deterrent (SBSD) capability-based assessment (CBA) be performed. In July 2007, the task force established by the commander of STRATCOM provided its recommendations regarding capabilities and characteristics for a new SBSBD. (Source: Navy list of key events relating to the ULMS and SBSBD provided to CRS and the Congressional Budget Office (CBO) on July 7, 2008.)

²⁴ On February 14, 2008, the SBSBD ICD was approved for joint staffing by the Navy's Resources and Requirements Review Board (R3B). On April 29, 2008, the SBSBD was approved by DOD's Functional Capabilities Board (FCB) to proceed to DOD's Joint Capabilities Board (JCB). (Source: Navy list of key events relating to the ULMS and SBSBD provided to CRS and CBO on July 7, 2008.)

²⁵ Navy briefing to CRS and CBO on the SBSBD program, July 6, 2009.

²⁶ Navy briefing to CRS and CBO on the SBSBD program, July 6, 2009.

²⁷ An August 2008 press report states that the program office, called PMS-397, "was established within the last two months." (Dan Taylor, "Navy Stands Up Program Office To Manage Next-Generation SSBN," *Inside the Navy*, August 17, 2008.)

²⁸ "Going Ballistic," *Defense Daily*, September 22, 2008, p. 1.

²⁹ *Department of Defense Fiscal Year (FY) 2012 Budget Estimates, Navy, Justification Book Volume 2, Research, Development, Test & Evaluation, Navy Budget Activity 4*, entry for PE0603561N, Project 3220 (pdf page 345 of 888).

missiles (initial loadout). The decision came after the program was presented to the Defense Acquisition Board (DAB) on Dec. 9, 2010.

The ADM validates the program's Technology Development Strategy and allows entry into the Technology Development Phase during which warfighting requirements will be refined to meet operational and affordability goals. Design, prototyping, and technology development efforts will continue to ensure sufficient technological maturity for lead ship procurement in 2019.³⁰

Planned Procurement Quantity: 12 SSBN(X)s to Replace 14 Ohio-Class Boats

Navy plans call for procuring 12 SSBN(X)s to replace the current force of 14 Ohio-class SSBNs. In explaining the planned procurement quantity of 12 boats, the Navy states that 10 operational SSBNs—meaning boats not encumbered by lengthy maintenance actions—are needed to meet strategic nuclear deterrence requirements for having a certain number of SSBNs at sea at any given moment. The Navy states that a force of 14 Ohio-class boats was needed to meet this requirement because, during the middle years of the Ohio class life cycle, three and sometimes four of the boats are non-operational at any given moment on account of being in the midst of mid-life nuclear refueling overhauls. The Navy states that 12 rather than 14 SSBN(X)s will be needed to meet the requirement for 10 operational boats because the mid-life overhauls of SSBN(X)s, which will not include a nuclear refueling, will require less time (about two years) than the mid-life refueling overhauls of Ohio-class boats (which require three or something more than three years), the result being that only two SSBN(X)s (rather than three or sometimes four) will be in the midst of mid-life overhauls at any given moment during the middle years of the SSBN(X) class life cycle.³¹

Procurement and Replacement Schedule

Table 2 shows the Navy's proposed schedule for procuring 12 SSBN(X)s, and for having SSBN(X)s replace Ohio-class SSBNs. As shown in **Table 2**, under the Navy's FY2012 budget, the first Ohio replacement boat was scheduled to be procured in FY2019, and Ohio replacement boats were to enter service on a schedule that would maintain the Navy's SSBN force at 12 boats. As also shown in **Table 2**, the Navy's proposed FY2013 budget defers the procurement of the first Ohio replacement boat by two years, to FY2021. As a result of this proposed deferment, the Navy's SSBN force would drop to 11 or 10 boats for the period FY2029-FY2041. The Navy states that the reduction to 10 boats during this period is acceptable in terms of meeting strategic nuclear deterrence requirements, because during these years, all 10 of the SSBNs in service will be operational (i.e., none of them will be in the midst of a mid-life overhaul). The Navy acknowledges that there is some risk in having the SSBN force drop to 10 boats, because it provides little margin for absorbing an unforeseen event that might force an SSBN into an unscheduled and lengthy maintenance action.³² (See also the discussion above in "Planned Procurement Quantity: 12 SSBN(X)s to Replace 14 Ohio-Class Boats.")

³⁰ Source: Email from Navy Office of Legislative Affairs to CRS, February 3, 2011.

³¹ Source: Navy update briefing on Ohio replacement program to CRS and Congressional Budget Office (CBO), September 17, 2012.

³² Source: Navy update briefing on Ohio replacement program to CRS and Congressional Budget Office (CBO), September 17, 2012. A September 28, 2012, press report similarly quotes Rear Admiral Barry Bruner, the Navy's director of undersea warfare, as stating that "During this time frame, no major SSBN overhauls are planned, and a force (continued...)"

Table 2. Navy Schedule for Procuring SSBN(X)s and Replacing Ohio-Class SSBNs

Fiscal Year	Schedule in FY2012 Budget				Schedule under FY2013 Budget			
	Number of SSBN(X)s procured each year	Cumulative number of SSBN(X)s in service	Ohio-class SSBNs in service	Combined number of Ohio-class SSBNs and SSBN(X)s in service	Number of SSBN(X)s procured each year	Cumulative number of SSBN(X)s in service	Ohio-class SSBNs in service	Combined number of Ohio-class SSBNs and SSBN(X)s in service
2019	1		14	14			14	14
2020			14	14			14	14
2021			14	14	1		14	14
2022	1		14	14			14	14
2023			14	14			14	14
2024	1		14	14	1		14	14
2025	1		14	14			14	14
2026	1		14	14	1		14	14
2027	1		13	13	1		13	13
2028	1		12	13	1		12	12
2029	1	1	11	12	1		11	11
2030	1	2	10	12	1	1	10	11
2031	1	3	9	12	1	2	9	11
2032	1	4	8	12	1	2	8	10
2033	1	5	7	12	1	3	7	10
2034		6	6	12	1	4	6	10
2035		7	5	12	1	5	5	10
2036		8	4	12		6	4	10
2037		9	3	12		7	3	10
2038		10	2	12		8	2	10
2039		11	1	12		9	1	10
2040		12		12		10	0	10
2041		12		12		11	0	11
2042		12		12		12	0	12

Source: Navy FY2012 and FY2013 budget submissions.

(...continued)

of 10 SSBNs will support current at-sea presence requirements,” and that “This provides a low margin to compensate for unforeseen issues that may result in reduced SSBN availability. The reduced SSBN availability during this time frame reinforces the importance of remaining on schedule with the Ohio Replacement program to meet future strategic requirements. As the Ohio Replacement ships begin their mid-life overhauls in 2049, 12 SSBNs will be required to offset ships conducting planned maintenance.” (Michael Fabey, U.S. Navy Defends Boomer Submarine Replacement Plans,” *Aerospace Daily & Defense Report*, September 28, 2012: 3.)

SSBN(X) Design Features

Although the design of the SSBN(X) has not yet been fully determined, the boat's design will reflect the following:

- The SSBN(X) is to be designed for a 40-year expected service life.³³
- Unlike the Ohio-class design, which requires a mid-life nuclear refueling,³⁴ the SSBN(X) is to be equipped with a life-of-the-ship nuclear fuel core (a nuclear fuel core that is sufficient to power the ship for its entire expected service life).³⁵ Although the SSBN(X) will not need a mid-life nuclear refueling, it will still need a mid-life non-refueling overhaul (i.e., an overhaul that does not include a nuclear refueling) to operate over its full 40-year life.
- The SSBN(X) is to be equipped with an electric-drive propulsion train, as opposed to the mechanical-drive propulsion train used on other Navy submarines. The electric-drive system is expected to be quieter (i.e., stealthier) than a mechanical-drive system.³⁶
- The SSBN(X) is to have SLBM launch tubes that are the same size as those on the Ohio class (i.e., tubes with a diameter of 87 inches and a length sufficient to accommodate a D-5 SLBM).
- The SSBN(X) will have a beam (i.e., diameter)³⁷ of 43 feet, compared to 42 feet on the Ohio-class design.³⁸
- Instead of 24 SLBM launch tubes, as on the Ohio-class design, the SSBN(X) is to have 16 SLBM launch tubes.
- Although the SSBN(X) is to have fewer launch tubes than the Ohio-class SSBN, it is to have a submerged displacement about the same as that of the Ohio-class design.³⁹ As of late 2011, the design for the SSBN(X) reportedly had an

³³ U.S. Navy, *Report to Congress on Annual Long-Range Plan for Construction of Naval Vessels for FY 2011*, February 2010, p. 24.

³⁴ As mentioned earlier (see “Current Ohio-Class SSBNs”), the Ohio-class boats receive a mid-life nuclear refueling overhaul, called an Engineered Refueling Overhaul (ERO), which includes both a nuclear refueling and overhaul work on the ship that is not related to the nuclear refueling.

³⁵ U.S. Navy, *Report to Congress on Annual Long-Range Plan for Construction of Naval Vessels for FY 2011*, February 2010, p. 5. The two most recent classes of SSNs—the Seawolf (SSN-21) and Virginia (SSN-774) class boats—are built with cores that are expected to be sufficient for their entire 33-year expected service lives.

³⁶ Source: Spoken testimony of Admiral Kirkland Donald, Deputy Administrator for Naval Reactors, and Director, Naval Nuclear Propulsion, National Nuclear Security Administration, at a March 30, 2011, hearing before the Strategic Forces Subcommittee of the Senate Armed Services Committee, as shown in the transcript of the hearing. See also Dave Bishop, “What Will Follow the Ohio Class?” *U.S. Naval Institute Proceedings*, June 2012: 31; and Sam LaGrone and Richard Scott, “Strategic Assets: Deterrent Plans Confront Cost Challenges,” *Jane’s Navy International*, December 2011: 16.

³⁷ Beam is the maximum width of a ship. For Navy submarines, which have cylindrical hulls, beam is the diameter of the hull.

³⁸ Dave Bishop, “What Will Follow the Ohio Class?” *U.S. Naval Institute Proceedings*, June 2012: 31. (Bishop is program manager for the Ohio replacement program.) See also Sam LaGrone and Richard Scott, “Strategic Assets: Deterrent Plans Confront Cost Challenges,” *Jane’s Navy International*, December 2011: 15 and 16.

³⁹ A May 2010 CBO report states that “in a recent briefing to CBO and the Congressional Research Service, the Navy stated that an SSBN(X) would probably be about the same size and have roughly the same displacement as an Ohio (continued...)”

estimated submerged displacement of 19,737 tons, though that figure likely has since changed.⁴⁰

- The Navy states that “owing to the unique demands of strategic relevance, [SSBN(X)s] must be fitted with the most up-to-date capabilities and stealth to ensure they are survivable throughout their full 40-year life span.”⁴¹

In an article published in June 2012, the program manager for the Ohio replacement program stated that “the current configuration of the Ohio replacement is an SSBN with 16 87-inch-diameter missile tubes, a 43-foot-diameter hull, fairwater planes,⁴² electric-drive propulsion, [an] X-stern,⁴³ accommodations for 155 personnel, and a common submarine radio room⁴⁴ tailored to the SSBN mission.”⁴⁵

Program Acquisition Cost

A March 2012 GAO report assessing major DOD weapon acquisition programs states that the estimated total acquisition cost of the SSBN(X) program is \$90,433.5 million (about \$90.4 billion) in constant FY2012 dollars, including \$11,142.8 million (about \$11.1 billion) in research and development costs and \$79,290.7 million (about \$79.3 billion) in procurement costs.⁴⁶

The Navy estimates the procurement cost of the lead ship in the program at \$11.7 billion in constant FY2012 dollars, including \$4.5 billion in detailed design and nonrecurring engineering (DD/NRE) costs for the entire class, and \$7.2 billion in hands-on construction costs for the ship itself.⁴⁷ (It is a traditional budgeting practice for Navy shipbuilding programs to attach the DD/NRE costs for a new class of ships to the procurement cost of the lead ship in the class.)

(...continued)

class submarine, even though it might have only 16 or 20 missile tubes.” (Congressional Budget Office, *An Analysis of the Navy’s Fiscal Year 2011 Shipbuilding Plan*, May 2010, p. 16.)

⁴⁰ Sam LaGrone and Richard Scott, “Strategic Assets: Deterrent Plans Confront Cost Challenges,” *Jane’s Navy International*, December 2011: 15 and 16.

⁴¹ U.S. Navy, *Report to Congress on Annual Long-Range Plan for Construction of Naval Vessels for FY 2011*, February 2010, p. 24.

⁴² The term fairwater planes means that the submarine’s forward diving planes are mounted on the ship’s hull, near the bow, rather than on the ship’s sail (aka “conning tower”).

⁴³ The term X-stern means that the steering and diving fins at the stern of the ship are, when viewed from the rear, in the diagonal pattern of the letter X, rather than the vertical-and horizontal pattern of a plus sign (which is referred to as a cruciform stern).

⁴⁴ The common submarine radio room is a standardized (i.e., common) suite of submarine radio room equipment that is being installed on other U.S. Navy submarines.

⁴⁵ Dave Bishop, “What Will Follow the Ohio Class?” *U.S. Naval Institute Proceedings*, June 2012: 31. See also Sam LaGrone and Richard Scott, “Strategic Assets: Deterrent Plans Confront Cost Challenges,” *Jane’s Navy International*, December 2011: 15 and 16.

⁴⁶ Government Accountability Office, *Defense Acquisitions[:] Assessments of Selected Weapons Programs*, GAO-12-400SP, March 2012, p. 152. The report states on page 161 that cost figures in the report are presented in constant FY2012 dollars.

⁴⁷ Department of the Navy, *Annual Report to Congress on Long-Range Plan for Construction of Naval Vessels for FY2013*, April 2012, p. 15.

The Navy in February 2010 preliminarily estimated the procurement cost of each Ohio replacement boat at \$6 billion to \$7 billion in FY2010 dollars.⁴⁸ Following the Ohio replacement program's December 9, 2010, Milestone A acquisition review meeting (see "Program Origin and Early Milestones"), DOD issued an Acquisition Decision Memorandum (ADM) that, among other things, established a target average unit procurement cost for boats 2-12 in the program of \$4.9 billion in constant FY2010 dollars.⁴⁹ The Navy is working to achieve this target cost, and estimated in 2011 that its cost-reduction efforts have reduced the estimated average unit procurement cost of boats 2-12 to \$5.6 billion each in constant FY2010 dollars.⁵⁰ The Navy is examining potential further measures to bring the cost of boats 2-12 closer to the \$4.9 billion target cost.

The Navy's FY2013 30-year (FY2013-FY2042) shipbuilding plan, submitted to Congress on March 28, 2012, expresses costs in constant FY2012 dollars. The plan translates the above target cost of \$4.9 billion in constant FY2010 dollars to \$5.3 billion in constant FY2012 dollars, and states:

This plan assumes the average recurring affordability target for the second through twelfth SSBN(X)s will be \$6.025B [billion] per boat. This cost reflects a concerted DoN [Department of the Navy] effort to rationalize the boat's requirements, which cut the projected cost for the boats by nearly \$1 billion. The SSBN(X) Milestone A Acquisition Decision Memorandum established an even lower affordability target of \$5.3B per boat. While DoN cannot yet state with certainty it will achieve this aggressive target, it is committed to meeting this goal. Indeed, the DoN PB2012 budget submission [the President's budget for FY2012—that is, that Navy's proposed FY2012 budget] added \$150M [million] in research and development dollars to explore ways to drive down the recurring costs for follow-on boats.⁵¹

The above cost figures do not include costs for refurbishing D-5 SLBMs so as to extend their service lives to 2042.

Common Missile Compartment (CMC)

Current U.S. and UK plans call for the SSBN(X) and the UK's Successor SSBN to use a missile compartment—the middle section of the boat with the SLBM launch tubes—of the same general design.⁵² As mentioned earlier (see "U.S.-UK Cooperation on SLBMs"), the UK's SSBN is to be armed with eight SLBMs, or half the number to be carried by the SSBN(X). The modular design

⁴⁸ Department of the Navy, *Report to Congress on Annual Long-Range Plan for Construction of Naval Vessels for FY 2011*, February 2010, p. 20.

⁴⁹ Christopher J. Castelli, "DOD: New Nuclear Subs Will Cost \$347 Billion To Acquire, Operate," *Inside the Navy*, February 21, 2011; Elaine M. Grossman, "Future U.S. Nuclear-Armed Vessel to Use Attack-Submarine Technology," *Global Security Newswire*, February 24, 2011; Jason Sherman, "Navy Working To Cut \$7.7 Billion From Ohio Replacement Program," *Inside the Navy*, February 28, 2011. See also Christopher J. Castelli, "DOD Puts 'Should-Cost' Pressure On Major Weapons Programs," *Inside the Navy*, May 2, 2011.

⁵⁰ Source: Navy briefing for CRS and Congressional Budget Office on Navy submarine programs, March 16, 2012.

⁵¹ Department of the Navy, *Annual Report to Congress on Long-Range Plan for Construction of Naval Vessels for FY2013*, April 2012, pp. 15-16.

⁵² Statement of Rear Admiral Stephen Johnson, USN, Director, Strategic Systems Programs, Before the Subcommittee on Strategic Forces of the Senate Armed Services Committee [on] FY2011 Strategic Systems, March 17, 2010, p. 6, which states: "The OHIO Replacement programs includes the development of a common missile compartment that will support both the OHIO Class Replacement and the successor to the UK Vanguard Class."

of the CMC will accommodate this difference. Since the UK's first Vanguard-class SSBN was originally projected to reach the end of its service life in 2024—three years before the first Ohio-class SSBN is projected to reach the end of its service life—design work on the CMC began about three years sooner than would have been required to support the Ohio replacement program alone. This is the principal reason why the FY2010 budget included a substantial amount of research and development funding for the CMC. The UK is providing some of the funding for the design of the CMC, including a large portion of the initial funding.

A March 2010 Government Accountability office (GAO) report stated:

According to the Navy, in February 2008, the United States and United Kingdom began a joint effort to design a common missile compartment. This effort includes the participation of government officials from both countries, as well as industry officials from Electric Boat Corporation and BAE Systems. To date, the United Kingdom has provided a larger share of funding for this effort, totaling just over \$200 million in fiscal years 2008 and 2009.⁵³

A March 2011 GAO report stated:

The main focus of OR [Ohio Replacement program] research and development to date has been the CMC. The United Kingdom has provided \$329 million for this effort since fiscal year 2008. During fiscal years 2009 and 2010, the Navy had allocated about \$183 million for the design and prototyping of the missile compartment.⁵⁴

A May 2010 press report stated that “the UK has, to date, funded the vast majority of [the CMC’s] upfront engineering design activity and has established a significant presence in Electric Boat’s Shaw’s Cove CMC design office in New London, CT.”⁵⁵

Under the October 2010 UK defense and security review report (see “U.S.-UK Cooperation on SLBMs”), the UK now plans to deliver its first Successor class SSBN in 2028, or about four years later than previously planned.

Program Funding

Table 3 shows funding for the Ohio replacement program. The table shows U.S. funding only; it does not include funding provided by the UK to help pay for the design of the CMC. As can be seen in the table, Navy’s proposed FY2013 budget requests \$564.9 million for continued research and development work on the program.

⁵³ Government Accountability Office, *Defense Acquisitions[:] Assessments of Selected Weapon Programs*, GAO-10-388SP, March 2010, p. 152.

⁵⁴ Government Accountability Office, *Defense Acquisitions[:] Assessments of Selected Weapon Programs*, GAO-11-233SP, March 2011, p. 147.

⁵⁵ Sam LaGrone and Richard Scott, “Deterrent Decisions: US and UK Wait on Next Steps for SSBN Replacements,” *Jane’s Navy International*, May 2010, pp. 10-11.

Table 3. Ohio Replacement Program Funding
(Millions of then-year dollars, rounded to nearest tenth; totals may not add due to rounding)

	FY08	FY09	FY10	FY11	FY12	FY13 (req.)	FY14 (proj.)	FY15 (proj.)	FY16 (proj.)	FY17 (proj.)
Research and development (R&D) funding										
PE0101221N/Project 3198	0	9.7	0	0	0	0	0	0	0	0
PE0603561N/Project 3220	0	0	363.4	431.4	781.6	483.1	793.5	861.4	1,037.4	708.9
PE0603561N/Project 9999	4.9	3.2	4.0	0	0	0	0	0	0	0
PE0603570N/Project 3219	0	0	107.5	178.3	285.4	81.8	296.0	360.4	420.8	409.7
Total R&D funding	4.9	12.9	474.9	609.7	1,067.0	564.9	1,089.5	1,221.8	1,458.2	1,118.6
Procurement funding	0	0	0	0	0	0	0	0	0	777.8
TOTAL all funding	4.9	12.9	474.9	609.7	1,067.0	564.9	1,089.5	1,221.8	1,458.2	1,896.4

Source: Navy FY2013 budget submission.

Notes: PE means Program Element, that is, a research and development line item. A Program Element may include several projects. **PE0101221N/Project 3198** is Underwater Launch Missile System (ULMS) project within the PE for Strategic Submarine and Weapons System Support. **PE0603561N/Project 3220** is SBSD project within the PE for Advanced Submarine System Development. **PE0603561N/Project 9999** is Congressional funding additions within the PE for Advanced Submarine System Development. **PE0603570N/Project 3219** is SSBN(X) reactor plant project within the PE for Advanced Nuclear Power Systems. **Procurement funding** shown in FY2017 is advance procurement funding for first SSBN(X), which is scheduled to be procured in FY2021.

Issues for Congress

Potential oversight issues for Congress for the Ohio replacement program include the following:

- the reasons for deferring the start of SSBN(X) procurement by two years, to FY2021, the cost and operational impact of this decision, and whether it would be feasible and cost effective to restore the start of procurement to FY2019, as planned under the FY2012 budget;
- the plan to design the SSBN(X) with 16 SLBM tubes rather than 20;
- the plan to procure 12 SSBN(X)s rather than 13 or 14;
- the likelihood that the Navy will be able to reduce the average procurement cost of boats 2-12 in the program to the target figure of \$4.9 billion each in FY2010 dollars;
- the accuracy of the Navy's estimate of the procurement cost of each SSBN(X);
- the prospective affordability of the Ohio replacement program and its potential impact on funding available for other Navy shipbuilding programs; and
- the question of which shipyard or shipyards will build SSBN(X)s.

Each of these issues is discussed below.

Two-Year Deferral in Start of Procurement

One oversight issue for Congress concerns the reasons for deferring the start of SSBN(X) procurement by two years, to FY2021, the cost and operational impact of this decision, and whether it would be feasible and cost effective to restore the start of procurement to FY2019, as planned under the FY2012 budget.

The two-year deferral reduced funding requirements for the Ohio replacement program within the FY2013-FY2017 Future Years Defense Program (FYDP); its effect on the program's total research and development cost and its total procurement cost over the longer run is less clear. As shown in **Table 2**, the two year deferral would reduce the SSBN force to 11 or 10 boats for the period FY2029-FY2041.

In explaining the two-year deferral, Secretary of Defense Leon Panetta stated on January 26, 2012, that “our review determined that we could achieve better cost control by delaying the next-generation ballistic missile submarine for two years without harming the survivability of our nuclear deterrent.”⁵⁶

In a follow-on briefing that same day, Ashton Carter, the Under Secretary of Defense for Acquisition, Technology, and Logistics (i.e., DOD's acquisition executive), stated that the two-year deferral

is not a strategic decision; this is a managerial decision made partly for budgetary reasons but mostly because that puts the Ohio class replacement on a more predictable and stable schedule....

With respect to the schedule [for the program], the schedule as it was [under the FY2012 budget], was an aggressive one, maybe even verging on optimistic. So I—all I'm saying is this is a safer schedule; we're sure we can make this schedule. So it's a little more secure; so, from a managerial point of view, a better place to be.⁵⁷

At a February 16, 2012, hearing before the House Armed Services Committee on the Department of the Navy's proposed FY2013 budget, the following exchange occurred:

REPRESENTATIVE MIKE MCINTYRE:

Admiral, I wanted to ask you, with the Ohio Class SSBNs scheduled to begin retiring in 2027, how will delaying the Ohio Class replacement program by two years affect the Navy's ability to meet STRATCOM's [U.S. Strategic Command's] at-sea requirements [for nuclear deterrent forces]?

ADMIRAL JONATHAN GREENERT, CHIEF OF NAVAL OPERATIONS:

Well, what we'll have to do, we—we owe a certain number of submarines in a certain number of time. [sic] I can't give you those numbers specifically due to the classification. But the point here is we have to measure the ability to meet that operational availability

⁵⁶ Source: Transcript of “Major Budget Decisions Briefing from the Pentagon,” January 26, 2012, available online at <http://www.defense.gov/transcripts/transcript.aspx?transcriptid=4962>.

⁵⁷ Source: Transcript of “Major Budget Decisions Briefing at the Pentagon,” January 26, 2012, available online at <http://www.defense.gov/transcripts/transcript.aspx?transcriptid=4963>.

during that timeframe. We've done that. We've evaluated it. And it is equivalent to that—the operational availability of SSBNs that we provide today.

Today's numbers are acceptable to Strategic Command. We'll work with them in the future, but they look the same.

REPRESENTATIVE MCINTYRE:

And would you say in all candor that the delay in the Ohio Class replacement program is being done solely for budget reasons?

ADMIRAL GREENERT:

Predominantly budget reasons, but there is an advantage to this, and that is the design feature will be much more mature when we get to construction.⁵⁸

Potential oversight questions for Congress include the following:

- What impact does the two-year deferral have on the Ohio replacement program's estimated total research and development cost and its estimated total procurement cost?
- How much risk was there in the program's development schedule under the FY2012 budget, and how much mitigation of that risk is achieved by the two-year deferral?
- What is the potential for restoring the FY2019 procurement date for the first Ohio replacement boat, and how quickly would a decision need to be made on this issue before the potential for restoring the FY2019 date would be lost? What would be the impact on Ohio replacement program funding requirements in FY2013 and within the FY2013-FY2017 FYDP of a decision to restore the FY2019 date?

A Design with 16 vs. 20 SLBM Tubes

Overview

Another oversight issue for Congress concerns the plan to design the SSBN(X) with 16 SLBM tubes rather than 20—one of several decisions made to reduce the estimated average procurement cost of boats 2 through 12 in the program to \$5.6 billion in FY2010 dollars.⁵⁹ Some observers are

⁵⁸ Source: Transcript of hearing.

⁵⁹ At a March 30, 2011, hearing before the Strategic Forces subcommittee of the Senate Armed Services Committee, Admiral Kirkland Donald, Deputy Administrator for Naval Reactors and Director, Naval Nuclear Propulsion, National Nuclear Security Administration, when asked for examples cost efficiencies that are being pursued in his programs, stated:

The—the Ohio replacement [program] has been one that we've obviously been focused on here for—for several years now. But in the name of the efficiencies, and one of the issues as we work through the Defense Department's acquisition process, we were the first program through that new process that Dr. [Aston] Carter [the DOD acquisition executive] headed up.

But we were challenged to—to drive the cost of that ship down, and as far as our part was concerned, one of the key decisions that was made that—that helped us in that regard was a

(continued...)

concerned that designing the SSBN(X) with 16 tubes rather than 20 would create a risk that U.S. strategic nuclear forces might not have enough capability in the 2030s and beyond to fully perform their deterrent role. These observers note that to comply with the New Start Treaty limiting strategic nuclear weapons, DOD plans to operate in coming years a force of 14 Trident SSBNs, each with 20 operable SLBM tubes (4 of the 24 tubes on each boat are to be rendered inoperable), for a total of 240 tubes, whereas the Navy in the Ohio replacement program is planning a force of 12 SSBNs each with 16 tubes, for a total of 192 tubes, or 20% less than 240. These observers also cite the uncertainties associated with projecting needs for strategic deterrent forces out to the year 2080, when the final SSBN(X) is scheduled to leave service. These observers have asked whether the plan to design the SSBN(X) with 16 tubes rather than 20 is fully supported within all parts of DOD, including U.S. Strategic Command (STRATCOM).

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

Testimony in 2011

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

I'm very comfortable with where we're going with SSBN-X. The decision and the recommendation that I made with regard to the number of tubes—launch tubes are consistent with the new START treaty. They're consistent with the missions that I see that ship having to perform. And even though it may be characterized as a cost cutting measure, I believe it sizes the ship for the missions it will perform.⁶⁰

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

REPRESENTATIVE TURNER:

General Kehler, thank you so much for your continued thoughts and of course your leadership. One item that we had a discussion on was the triad, of looking to—of the Navy

(...continued)

decision to go from 20 missile tubes to 16 missile tubes, because what that allowed us to do was to down rate the—the propulsion power that was needed, so obviously, it's a – it's a small[er] the reactor that you would need.

But what it also allowed us to do was to go back [to the use of existing components]. The size [of the ship] fell into the envelope where we could go back and use components that we had already designed for the Virginia class [attack submarines] and bring those into this design, not have to do it over again, but several of the mechanical components, to use those over again.

And it enabled us to drive the cost of that propulsion plant down and rely on proven technology that's—pumps and valves and things like that don't change like electronics do.

So we're pretty comfortable putting that in ship that'll be around 'til 2080. But we were allowed to do that.

(Source: Transcript of hearing.)

⁶⁰ Source: Transcript of hearing.

and the tube reductions of 20 to 16, as contained in other hearings on the Hill today. I would like your thoughts on the reduction of the tubes and what you see driving that, how you see it affecting our strategic posture and any other thoughts you have on that?

AIR FORCE GENERAL C. ROBERT KEHLER, COMMANDER, U.S. STRATEGIC COMMAND

Thank you, Mr. Chairman. Well, first of all, sir, let me say that the—in my mind anyway, the discussion of Trident and Ohio-class replacement is really a discussion in the context of the need to modernize the entire triad. And so, first of all, I think that it's important for us to recognize that that is one piece, an important piece, but a piece of the decision process that we need to go through.

Second, the issue of the number of tubes is not a simple black-and-white answer. So let me just comment here for a minute.

First of all, the issue in my mind is the overall number of tubes we wind up with at the end, not so much as the number of tubes per submarine.

Second, the issue is, of course, we have flexibility and options with how many warheads per missile per tube, so that's another consideration that enters into this mixture.

Another consideration that is important to me is the overall number of boats and the operational flexibility that we have with the overall number of boats, given that some number will need to be in maintenance, some number will need to be in training, et cetera.

And so those and many other factors—to include a little bit of foresight here, in looking ahead to 20 years from now in antisubmarine warfare environment that the Navy will have to operate in, all of those bear on the ultimate sideways shape configuration of a follow-on to the Ohio.

At this point, Mr. Chairman, I am not overly troubled by going to 16 tubes. As I look at this, given that we have that kind of flexibility that I just laid out; given that this is an element of the triad and given that we have some decision space here as we go forward to decide on the ultimate number of submarines, nothing troubles me operationally here to the extent that I would oppose a submarine with 16 tubes.

I understand the reasons for wanting to have 20. I understand the arguments that were made ahead of me. But as I sit here today, given the totality of the discussion, I am—as I said, I am not overly troubled by 16. Now, I don't know that the gavel has been pounded on the other side of the river yet with a final decision, but at this point, I am not overly troubled by 16.⁶¹

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

REPRESENTATIVE LARSEN:

General Benedict, we have had this discussion, not you and I, I am sorry. But the subcommittee has had a discussion in the past with regards to the Ohio-class replacement program.

⁶¹ Source: Transcript of hearing.

The new START, though, when it was negotiated, assumed a reduction from 24 missile tubes per hole to, I think, a maximum a maximum of 20.

The current configuration [for the SSBN(X)], as I understand it, would move from 24 to 16.

Can you discuss, for the subcommittee here, the Navy's rationale for that? For moving from 24 to 16 as opposed to the max of 20?

NAVY REAR ADMIRAL TERRY BENEDICT, DIRECTOR, STRATEGIC SYSTEMS PROGRAMS (SSP):

Sir, as part—excuse me, as part of the work-up for the milestone A [review for the SSBN(X) program] with Dr. Carter in OSD, SSP supported the extensive analysis at both the OSD level as well as STRATCOM's analysis.

Throughout that process, we provided, from the SWS [strategic weapon system] capability, our perspective. Ultimately that was rolled up into both STRATCOM and OSD and senior Navy leadership and in previous testimony, the secretary of the Navy, the CNO, and General Chilton have all expressed their confidence that the mission of the future, given their perspectives, is they see the environment today can be met with 16.

And so, as the acquisition and the SWS provider, we are prepared to support that decision by leadership, sir.

REPRESENTATIVE LARSEN:

Yes.

And your analysis supports—did your analysis that fed into this, did you look at specific numbers then?

REAR ADMIRAL BENEDICT:

Sir, we looked at the ability of the system, again, SSP does not look at specific targets with...

REPRESENTATIVE LARSEN:

Right. Yes, yes, yes.

REAR ADMIRAL BENEDICT:

Our input was the capability of the missile, the number of re-entry bodies and the throw weight that we can provide against those targets and based on that analysis, the leadership decision was 16, sir.⁶²

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

SENATOR SESSIONS:

⁶² Source: Transcript of hearing.

Admiral Benedict, according to recent press reports, the Navy rejected the recommendations of Strategic Command to design the next generation of ballistic missile submarines with 20 missile tubes instead of opting for only 16 per boat.

What is the basis for the Navy's decision of 16? And I'm sure cost is a factor. In what ways will that decision impact the overall nuclear force structure associated with the command?

NAVY REAR ADMIRAL TERRY BENEDICT, DIRECTOR, STRATEGIC SYSTEMS PROGRAMS (SSP):

Yes, sir. SSP supported the Navy analysis, STRATCOM's analysis, as well as the OSD analysis, as we proceeded forward and towards the Milestone A decision [on the SSBN(X) program] that Dr. Carter conducted.

Based on our input, which was the technical input as the—as the director of SSP, other factors were considered, as you stated. Cost was one of them. But as the secretary, as the CNO, and I think as General Kehler submitted in their testimony, that given the threats that we see today, given the mission that we see today, given the upload capability of the D-5, and given the environment as they saw today, all three of those leaders were comfortable with the decision to proceed forward with 16 tubes, sir.

SENATOR SESSIONS:

And is that represent your judgment? To what extent were you involved—were you involved in that?

REAR ADMIRAL BENEDICT:

Sir, we were involved from technical aspects in terms of the capability of the missile itself, what we can throw, our range, our capability. And based on what we understand the capability of the D-5 today, which will be the baseline missile for the Ohio Replacement Program, as the director of SSP I'm comfortable with that decision.⁶³

Section 242 Report

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

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

(a) Report Required- Not later than 180 days after the date of the enactment of this Act, the Secretary of the Navy and the Commander of the United States Strategic Command shall jointly submit to the congressional defense committees a report on each of the options described in subsection (b) to replace the Ohio-class ballistic submarine program. The report shall include the following:

⁶³ Source: Transcript of hearing.

(1) An assessment of the procurement cost and total life-cycle costs associated with each option.

(2) An assessment of the ability for each option to meet—

(A) the at-sea requirements of the Commander that are in place as of the date of the enactment of this Act; and

(B) any expected changes in such requirements.

(3) An assessment of the ability for each option to meet—

(A) the nuclear employment and planning guidance in place as of the date of the enactment of this Act; and

(B) any expected changes in such guidance.

(4) A description of the postulated threat and strategic environment used to inform the selection of a final option and how each option provides flexibility for responding to changes in the threat and strategic environment.

(b) Options Considered- The options described in this subsection to replace the Ohio-class ballistic submarine program are as follows:

(1) A fleet of 12 submarines with 16 missile tubes each.

(2) A fleet of 10 submarines with 20 missile tubes each.

(3) A fleet of 10 submarines with 16 missile tubes each.

(4) A fleet of eight submarines with 20 missile tubes each.

(5) Any other options the Secretary and the Commander consider appropriate.

(c) Form- The report required under subsection (a) shall be submitted in unclassified form, but may include a classified annex.

Subsection (c) above states the report “shall be submitted in unclassified form, but may include a classified annex.” The report as submitted was primarily the classified annex, with a one-page unclassified summary, the text of which is as follows (underlining as in the original):

The National Defense Authorization Act (NDAA) for Fiscal Year 2012 (FY12) directed the Secretary of the Navy and the Commander of U.S. Strategic Command (USSTRATCOM) to jointly submit a report to the congressional defense committees comparing four different options for the OHIO Replacement (OR) fleet ballistic missile submarine (SSBN) program. Our assessment considered the current operational requirements and guidance. The four SSBN options analyzed were:

1. 12 SSBNs with 16 missile tubes each
2. 10 SSBNs with 20 missile tubes each
3. 10 SSBNs with 16 missile tubes each

4. 8 SSBNs with 20 missile tubes each

The SSBN force continues to be an integral part of our nuclear Triad and contributes to deterrence through an assured second strike capability that is survivable, reliable, and credible. The number of SSBNs and their combined missile tube capacity are important factors in our flexibility to respond to changes in the threat and uncertainty in the strategic environment.

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

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

The classified annex contains detailed analysis that is not releasable to the public.⁶⁴

Likelihood That Navy Will Reach \$4.9 Billion Target Cost

Another oversight issue for Congress is the likelihood that the Navy will be able to achieve DOD's goal of reducing the average unit procurement cost of boats 2-12 in the program to \$4.9 billion each in FY2010 dollars. As mentioned earlier, as of early 2011, the Navy estimated that its cost-reduction efforts had reduced the average unit procurement cost of boats 2-12 to \$5.6 billion each in FY2010 dollars, leaving another \$700 million or so in cost reduction to reach the \$4.9 billion target cost.

Measures that the Navy has taken to reduce the average unit procurement cost of boats 2-12 to about \$5.6 billion include, among other things, reducing the number of SLBM launch tubes from 20 to 16, and making the launch tubes no larger in diameter than those on the Ohio-class design.⁶⁵ The Navy is examining potential further measures to bring the cost of boats 2-12 closer to the \$4.9 billion target cost. An October 19, 2012, press report quoted Rear Admiral David Johnson, the program executive officer for submarines, as stating that in achieving the additional \$700 million reduction in per-boat procurement cost, "I think one of the biggest effectors we can do is buying the ship smartly.... We can probably get somewhere in the range of \$300 million-plus per ship out [of the estimated cost], just by buying the ships smartly, encouraging a long production run in industry and the vendor base."⁶⁶

⁶⁴ Report and Cost Assessment of Options for OHIO-Class Replacement Ballistic Missile Submarine, Unclassified Summary, received from Navy Legislative Affairs Office, August 24, 2012. See also Christopher J. Castelli, "Classified Navy Assessment On SSBN(X) Endorses Program Of Record," *Inside the Navy*, September 10, 2012.

⁶⁵ The Navy had examined the option of equipping the SSBN(X) with tubes greater in diameter than those on the Ohio-class design, so as to support an option of arming the boats many years from now with a new SLBM that is larger in diameter than the D-5 SLBM.

⁶⁶ As quoted in Lee Hudson, "Navy Plans To Award Ohio Replacement R&D Contract In December," *Inside the Navy*, (continued...)

Potential oversight questions include the following:

- How did DOD settle on the figure of \$4.9 billion in FY2010 dollars as the target average unit procurement cost for boats 2-12 in the program? On what analysis was the selection of this figure based?
- How difficult will it be for the Navy to reach this target cost? What options is the Navy examining to achieve the additional \$700 million or so in unit procurement cost savings needed to reach it?
- Would a boat costing \$4.9 billion have sufficient capability to perform its intended missions?
- What, if anything, does DOD plan to do if the Navy is unable to achieve the \$4.9 billion target cost figure? If \$4.9 billion is the target figure, is there a corresponding “ceiling” figure higher than \$4.9 billion, above which DOD would not permit the Ohio replacement program to proceed? If no such figure exists, should DOD establish one?

Accuracy of Navy’s Estimated Unit Procurement Cost

Another oversight issue for Congress concerns the accuracy of the Navy’s estimate of the procurement cost of each SSBN(X). The accuracy of the Navy’s estimate is a key consideration in assessing the potential affordability of the Ohio replacement program, including its potential impact on the Navy’s ability to procure other kinds of ships during the years of SSBN(X) procurement. Some of the Navy’s ship designs in recent years, such as the Gerald R. Ford (CVN-78) class aircraft carrier,⁶⁷ the San Antonio (LPD-17) class amphibious ship⁶⁸ and the Littoral Combat Ship (LCS),⁶⁹ have proven to be substantially more expensive to build than the Navy originally estimated.

The accuracy of the Navy’s estimate can be assessed in part by examining known procurement costs for other recent Navy submarines—including Virginia (SSN-774) class attack submarines (which are currently being procured), Seawolf (SSN-21) class attack submarines (which were procured prior to the Virginia class), and Ohio (SSBN-726) class ballistic missile submarines—and then adjusting these costs for the Ohio replacement program so as to account for factors such as differences in ship displacement and design features, changes over time in submarine technologies (which can either increase or reduce a ship’s procurement cost, depending on the exact technologies in question), advances in design for producibility (i.e., design features that are intended to make ships easier to build), advances in shipyard production processes (such as modular construction), and changes in submarine production economies of scale (i.e., changes in

(...continued)

October 22, 2012.

⁶⁷ For more on the CVN-78 program, see CRS Report RS20643, *Navy Ford (CVN-78) Class Aircraft Carrier Program: Background and Issues for Congress*, by Ronald O'Rourke.

⁶⁸ For more on the LPD-17 program, see CRS Report RL34476, *Navy LPD-17 Amphibious Ship Procurement: Background, Issues, and Options for Congress*, by Ronald O'Rourke.

⁶⁹ For more on the LCS program, see CRS Report RL33741, *Navy Littoral Combat Ship (LCS) Program: Background and Issues for Congress*, by Ronald O'Rourke.

the total number of attack submarines and ballistic missile submarines under construction at any one time).

The Navy's estimated unit procurement cost for the program at any given point will reflect assumptions on, among other things, which shipyard or shipyards will build the boats, and how much Virginia-class construction will be taking place in the years when SSBN(X)s are being built. Changing the Navy's assumption about which shipyard or shipyards will build SSBN(X)s could reduce or increase the Navy's estimated unit procurement cost for the boats. If shipbuilding affordability pressures result in Virginia-class boats being removed from the 30-year shipbuilding plan during the years of SSBN(X) procurement, the resulting reduction in submarine production economies of scale could make SSBN(X)s more expensive to build than the Navy estimates.

A July 2012 Congressional Budget Office (CBO) report on the cost of the Navy's shipbuilding programs stated (with cost figures expressed in constant FY2012 dollars):

The design, cost, and capabilities of the SSBN(X)—the submarine slated to replace the Ohio class—are among the most significant uncertainties in the Navy's and CBO's analyses of future shipbuilding....

The recent cost history of the program illustrates the uncertainty. The Navy's [FY]2007 and [FY]2008 shipbuilding plans included an assumption that the first SSBN(X) would cost \$4.8 billion (in 2012 dollars) and that subsequent ships in the class would cost \$3.6 billion apiece. The [FY]2012 plan, in contrast, estimated the costs of the SSBN(X) class at an average of \$6.5 billion, which was down from an estimated \$7.7 billion apiece under the 2011 plan. That cost history highlights the uncertainty that remains in determining how much a future class of SSBNs will cost....

The Navy currently estimates the cost of the lead SSBN(X) at \$11.7 billion. The average cost of follow-on ships is \$6.0 billion, and the Navy has stated an objective of reducing that cost to \$5.0 billion. All told, the Navy estimates that building 12 of the submarines will cost \$78 billion, or an average of \$6.5 billion each.

In comparison, CBO estimates that the lead SSBN(X) will cost \$13.3 billion on the basis of its scheduled purchase in [FY]2021. Estimating the cost of the first submarine of a class is particularly difficult because it is not clear how much the Navy will need to spend on nonrecurring engineering and detail design. The Navy spent about \$2 billion on those items for the lead Virginia class attack submarine. The historical track record for the lead ship of new classes of submarines in the 1970s and 1980s indicates that there is little difference in those items on a per-ton basis between a lead attack submarine and a lead SSBN. In addition, CBO assumed that the cost of nonrecurring items is proportional to the weight of submarines. Therefore, CBO estimated that nonrecurring items would cost about \$5 billion for the lead SSBN(X), which will be approximately the size of an Ohio class submarine and thus about 2½ times the size of a Virginia class submarine. The Navy's estimate for the lead SSBN(X) reflects the fact that the service estimates that nonrecurring costs will be \$4.5 billion.

Overall, 12 SSBN(X)s would cost a total of about \$90 billion in CBO's estimation, or an average of \$7.5 billion each. That average includes the \$13.3 billion estimated cost of the lead ship and a \$7.0 billion average estimated cost for the 2nd through 12th ships. Research and development would cost an additional \$10 billion to \$15 billion, for a total program cost of \$100 billion to \$110 billion. (Note that CBO's estimate under the [FY]2012 plan was an

average of \$7.4 billion per submarine; the estimate for the [FY]2013 plan is higher primarily because the purchases occur two years later than under the [FY]2012 plan, thus incurring two additional years of cost growth.)⁷⁰

Program Affordability and Impact on Other Navy Shipbuilding Programs

Another oversight issue for Congress concerns the prospective affordability of the Ohio replacement program and its potential impact on funding available for other Navy shipbuilding programs. Even with the Navy's current effort to reduce the estimated unit procurement cost of the SSBN(X) toward DOD's target figure, observers are concerned that the Ohio replacement program could crowd out funding for other Navy shipbuilding programs in the 2020s and early 2030s. The Navy's March 2012 report on its FY2013 30-year (FY2013-FY2042) shipbuilding plan acknowledges the issue, stating:

This high cost for replacing the nation's secure, second-strike nuclear deterrent force will have a disproportionate impact on DoN [Department of the Navy] shipbuilding plans and associated costs throughout the mid-term planning period [FY2023-FY2032] and into the early years of the far-term planning period [FY2033-FY2042]....

Obviously, spending \$5-6B [billion] per year for a single ship over a 10 to 12-year period will strain the DoN's yearly shipbuilding accounts, since the Department must continue to build other ships through this period to maintain the overall battle force inventory at about 300 ships.⁷¹

An October 19, 2012, press report stated:

The Navy admiral overseeing submarine construction said Thursday [October 18] that if the price tag for building the newest vessels remains where it is today, there will have to be cutbacks to the Virginia-class [attack submarine] program.⁷²

Newport News Shipbuilding and General Dynamics Electric Boat, along with the Navy, have already brought down the cost to build Virginia-class fast-attack subs and are in the process of doubling their production, from one sub a year to two.

But when another program to replace the nation's aging fleet of Ohio-class ballistic missile subs ramps up, there won't be as much money to go around.

"I don't think we get Virginia and Ohio replacement at the same time if we don't continue to press down on the cost of Virginia and keep pressing on the cost of Ohio replacement," said Rear Adm. David Johnson, who spoke to reporters at the Naval Submarine League's annual symposium just outside of Washington, D.C.⁷³

⁷⁰ Congressional Budget Office, *An Analysis of the Navy's Fiscal Year 2013 Shipbuilding Plan*, July 2012, pp. 16-17, 19.

⁷¹ Department of the Navy, *Annual Report to Congress on Long-Range Plan for Construction of Naval Vessels for FY2013*, April 2012, pp. 15-16.

⁷² For more on the Virginia-class program, see CRS Report RL32418, *Navy Virginia (SSN-774) Class Attack Submarine Procurement: Background and Issues for Congress*, by Ronald O'Rourke.

⁷³ Michael Welles, "Sub Cost Must Continue To Fall, Admiral Says," *Newport News Daily Press*, October 19, 2012. (continued...)

A March 2012 GAO report assessing major DOD weapon acquisition programs states:

Affordability has been an early focus of the [Ohio Replacement (OR)] program. Due to its high cost, Navy officials have stated the OR program could stress Navy shipbuilding budgets in the 2020 to 2030 time frame. Program officials stated that they are trying to reduce the average procurement unit cost from an estimated \$5.6 billion to \$4.9 billion (in fiscal year 2010 dollars). The program is considering procuring OR [boats] as part of a block buy with the Virginia-class [attack] submarine to reduce procurement costs by an estimated 13 percent, and is lining up its production schedule to match that program in case this option is pursued. The Navy also decided to use 16 87-inch diameter tubes per submarine, which, while fewer than the Ohio-class, is expected to reduce costs while meeting the anticipated future strategic requirement based on arms reduction trends. According to the [OR] program [office], a four-way competition is ongoing to develop prototype tubes and efficient manufacturing processes for outfitting these tubes into the hull, including the use of a “quad pack” configuration that could reduce cost and construction time....

[OR] Program officials said they plan to have the three-dimensional design [for the boat] complete prior to starting construction on the lead ship to minimize rework, delays, and the potential for cost growth.⁷⁴

In addition to making further changes and refinements in the design of the SSBN(X), options for reducing the cost of the Ohio replacement program and the program’s potential impact on funding available for other Navy shipbuilding programs include the following:

- reducing the planned number of SSBN(X)s;
- altering the schedule for procuring the SSBN(X)s so as to create additional opportunities for using incremental funding for procuring the ships; and
- funding the procurement of SSBN(X)’s outside the Navy’s shipbuilding budget.

Each of these options is discussed below.

Reducing the Planned Number of SSBN(X)s

Some observers over the years have advocated or presented options for an SSBN force of fewer than 12 SSBNs. CBO, for example, has at times in the past presented options for reducing the SSBN force to 10 boats as a cost-reduction measure.⁷⁵ A June 2010 report by a group known as

(...continued)

Another October 19, 2012, press report similarly stated:

The Navy will procure Ohio-class replacement ballistic missile submarines over Virginia-class attack submarines if budget pressures cause the service to choose between the two platforms, according to the program executive officer for submarines.

The service must continue to drive down the cost of Virginia-class subs and Ohio-class replacement subs, because if any instability arises, the Navy may lose an attack submarine [from the budget], Rear Adm. David Johnson told reporters during a media roundtable Oct. 18 at the Naval Submarine League’s annual symposium in Falls Church, VA.

(Lee Hudson, “PEO Subs: Navy Will Procure Ohio Replacement Subs Over Virginia Subs,” *Inside the Navy*, October 22, 2012.)

⁷⁴ Government Accountability Office, *Defense Acquisitions[:] Assessments of Selected Weapons Programs*, GAO-12-400SP, March 2012, p. 152.

⁷⁵ See, for example, Congressional Budget Office, *Rethinking the Trident Force*, July 1993, 78 pp.; and Congressional (continued...)

the Sustainable Defense Task Force recommends reducing the SSBN force to seven boats;⁷⁶ a September 2010 report from the Cato Institute recommends reducing the SSBN force to six boats.⁷⁷

Views on whether a force of fewer than 12 SSBN(X)s would be adequate could depend on, among other things, assessments of strategic nuclear threats to the United States and the role of SSBNs in deterring such threats as a part of overall U.S. strategic nuclear forces, as influenced by the terms of strategic nuclear arms control agreements.⁷⁸ Reducing the number of SSBNs below 12 could also raise a question as to whether the force should continue to be homeported at both Bangor, WA, and Kings Bay, GA, or consolidated at a single location.

U.S. strategic nuclear deterrence plans require a certain number of strategic nuclear warheads to be available for use on a day-to-day basis. After taking into account warheads on the other two legs of the strategic nuclear triad, as well as the number of warheads on an SSBN's SLBMs, this translates into a requirement for a certain number of SSBNs to be on station (i.e., within range of expected targets) in Pacific and Atlantic waters at any given moment. The SSBN force is sized to support this requirement. Given the time needed for at-sea training operations, restocking SSBNs with food and other consumables, performing maintenance and repair work on the SSBNs, and transiting to and from deterrent patrol areas, only a fraction of the SSBN force can be on patrol at any given moment. The Navy's position (see "Planned Procurement Quantity: 12 SSBN(X)s to Replace 14 Ohio-Class Boats" in "Background") is that the requirement for having a certain number of SSBNs on patrol at any given moment translates into a need for a force of 14 Ohio-class boats, and that this requirement can be met in the future by a force of 12 SSBN(X)s.

Altering Procurement Schedule to Make More Use of Incremental Funding

Another option for managing the potential impact of the Ohio replacement program on other Navy shipbuilding programs would be to stretch out the schedule for procuring SSBN(X)s and make greater use of split funding (i.e., two-year incremental funding) in procuring them.⁷⁹ This option would not reduce the total procurement cost of the Ohio replacement program—to the contrary, it might increase the program's total procurement cost somewhat by reducing production learning curve benefits in the Ohio replacement program.⁸⁰ This option could, however, reduce the impact of the Ohio replacement program on the amount of funding available for the procurement of other Navy ships in certain individual years. This might reduce the amount of disruption that the Ohio replacement program causes to other shipbuilding programs in those years, which in turn might avoid certain disruption-induced cost increases for those other

(...continued)

Budget Office, *Budget Options*, March 2000, p. 62.

⁷⁶ *Debt, Deficits, and Defense, A Way Forward[:]* Report of the Sustainable Defense Task Force, June 11, 2010, pp. 19-20.

⁷⁷ Benjamin H. Friedman and Christopher Preble, *Budgetary Savings from Military Restraint*, Washington, Cato Institute, September 23, 2010 (Policy Analysis No. 667), pp. 8.

⁷⁸ For further discussion, see CRS Report RL33640, *U.S. Strategic Nuclear Forces: Background, Developments, and Issues*, by Amy F. Woolf.

⁷⁹ Under split funding, a boat's procurement cost is divided into two parts, or increments. The first increment would be provided in the fiscal year that the boat is procured, and the second would be provided the following fiscal year.

⁸⁰ Procuring one SSBN(X) every two years rather than at the Navy's planned rate of one per year could result in a loss of learning at the shipyard in moving from production of one SSBN to the next.

programs. The annual funding requirements for the Ohio replacement program might be further spread out by funding some of the SSBN(X)s with three- or four-year incremental funding.⁸¹

Table 4 shows the Navy's currently planned schedule for procuring 12 SSBN(X)s and a notional alternative schedule that would start two years earlier and end two years later than the Navy's currently planned schedule. Although the initial ship in the alternative schedule would be procured in FY2019, it could be executed as if it were funded in FY2021. Subsequent ships in the alternative schedule that are funded earlier than they would be under the Navy's currently planned schedule could also be executed as if they were funded in the year called for under the Navy's schedule. Congress in the past has funded the procurement of ships whose construction was executed as if they had been procured in later fiscal years.⁸² The ability to stretch the end of the procurement schedule by two years, to FY2035, could depend on the Navy's ability to carefully husband the use of the nuclear fuel cores on the last two Ohio-class SSBNs, so as to extend the service lives of these two ships by one or two years. Alternatively, Congress could grant the Navy the authority to begin construction on the 11th boat a year before its nominal year of procurement, and the 12th boat two years prior to its nominal year of procurement.

⁸¹ The Navy, with congressional support, currently uses split funding to procure large-deck amphibious assault ships (i.e., LHAs). The Navy currently is permitted by Congress to use four-year incremental funding for procuring the first three Ford (CVN-78) class carriers (i.e., CVN-78, CVN-79, and CVN-80); the authority was granted in §121 of the FY2007 defense authorization act [H.R. 5122/P.L. 109-364 of October 17, 2006].

⁸² Congress funded the procurement of two aircraft carriers (CVNs 72 and 73) in FY1983, and another two (CVNs 74 and 75) in FY1988. Although CVN-73 was funded in FY1983, it was built on a schedule consistent with a carrier funded in FY1985; although CVN-75 was funded in FY1988, it was built on a schedule consistent with a carrier funded in FY1990 or FY1991.

Table 4. Navy SSBN(X) Procurement Schedule and a Notional Alternative Schedule

Fiscal year	Navy's Schedule	Boat might be particularly suitable for 2-, 3-, or 4-year incremental funding	Notional alternative schedule	Boat might be particularly suitable for 2-, 3-, or 4-year incremental funding
2019				X
2020				
2021		X		X
2022				
2023				X
2024		X		
2025				X
2026				
2027				
2028				
2029				
2030				
2031				X
2032				
2033		X		X
2034		X		
2035		X		X
2036				
2037				X
Total	12		12	

Source: Navy's current plan is taken from the Navy's Fy2013 budget submission. Potential alternative plan prepared by CRS.

Notes: Notional alternative schedule could depend on Navy's ability to carefully husband the use of the nuclear fuel cores on the last two Ohio-class SSBNs, so as to extend the service lives of these two ships by one or two years. Alternatively, Congress could grant the Navy the authority to begin construction on the 11th boat a year before its nominal year of procurement, and the 12th boat two years prior to its nominal year of procurement. Under Navy's schedule, the boat to be procured in FY2033 might be particularly suitable for 4-year incremental funding, and boat to be procured in FY2034 might be particularly suitable for 3- or 4-year incremental funding.

A December 19, 2011, press report states:

The Office of Management and Budget's Nov. 29[, 2011,] passback memorandum to the Defense Department [regarding the FY2013 DOD budget] warns that the effort to build replacements for aging Ohio-class submarines is not exempt from rules requiring each new vessel to be fully funded in a single year....

Spreading the cost of a big-ticket ship over more than one year—an approach referred to as “incremental funding”—is only allowed when a program meets three criteria, OMB writes....

“OMB does not anticipate that the OHIO Replacement program will meet these criteria,” the passback memo states.⁸³

⁸³ Christopher J. Castelli, “White House Opposes Incremental Funding For Multibillion-Dollar Sub,” *Inside the Navy*, December 19, 2011.

Procuring SSBN(X)s Outside Navy's Shipbuilding Budget

Some observers have suggested funding the procurement of SSBN(X)s outside the Navy's shipbuilding budget, so as to preserve Navy shipbuilding funds for other Navy shipbuilding programs. Among those who have raised this idea was Admiral Gary Roughead, the Chief of Naval Operations (CNO) until September 2011.⁸⁴ There would be some precedent for such an arrangement:

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

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

As a reference tool for better understanding DOD spending, DOD includes in its annual budget submission a presentation of the DOD budget reorganized into 11 program areas, of which one is strategic forces. The FY2013 budget submission, for example, shows that the strategic forces program area received about \$12.1 billion in funding in FY2012, and that about \$10.8 billion is requested for the program area for FY2013.⁸⁵

Supporters of funding the procurement of SSBN(X)s outside the Navy's shipbuilding budget might argue that this could help protect funding for other Navy shipbuilding programs. They could also argue that creating a new budget account for strategic nuclear forces of all kinds could help DOD better view potential tradeoffs in spending for various strategic nuclear forces programs and thereby help DOD better optimize the use of strategic forces funding.

Skeptics of funding the procurement of SSBN(X)s outside the Navy's shipbuilding budget could argue that it might do little to protect funding for other Navy shipbuilding programs, because if DOD were to move the SSBN(X)s out of the Navy's shipbuilding budget, DOD might also remove the funding that was there for the SSBN(X)s. They might also argue that shifting

⁸⁴ See, for example, Jason Sherman, "Roughead Wants SSBN(X) Program Funding Outside Shipbuilding Budget," *Inside the Navy*, February 14, 2011.

⁸⁵ Department of Defense, *National Defense Budget Estimates For FY 2013, March 2012*, Table 6-4, "Department of Defense TOA by Program," page 103. See also Table 6-5 on page 105, which presents the same data in constant FY2013 dollars. The other 10 program areas in addition to strategic forces are general purpose forces; C3, intelligence and space; mobility forces; guard and reserve forces; research and development; central supply and management; training, medical and other; administration and associated; support of other nations; and special operations forces. (A 12th category—other—shows relatively small amounts of funding.)

SSBN(X)s out of the Navy's shipbuilding budget would make it harder to track and maintain oversight over Navy shipbuilding activities, and that creating a new budget account for strategic nuclear forces of all kinds could endanger the Ohio replacement program by making it more visible to those who might support reduced spending on nuclear-weapon-related programs.

A March 11, 2010, press report stated: "The massive cost of replacing the Navy's nuclear ballistic missile submarines will be shouldered in the coming years by diverting funds from other naval and Pentagon programs and perhaps by boosting the defense budget, but the program should not get its own special funding stream, according to Deputy Defense Secretary William Lynn."⁸⁶

A March 28, 2011, press report stated that SSBN(X)s

will be funded within the shipbuilding account, not in a separate account as the sea service's top admiral has advocated, according to Pentagon acquisition chief Ashton Carter.

"It's been in the shipbuilding account and our plan is it's going to stay in the shipbuilding account," Carter told *Inside the Pentagon* March 21 in a brief interview. "We just have to make it so that it is digestible for the Navy in the context of other shipbuilding needs. And we want the same things they want. We can manage through that path for decades."⁸⁷

At an April 13, 2011, hearing on DOD acquisition before the Defense subcommittee of the House Appropriations Committee, the following exchange took place:

REPRESNTATIVE CRENSHAW: Dr. Carter, I want to ask about Abrams tanks, kind of the modification of the start and stop. But – but real quick, we – we talked about the ballistic missiles submarines and was encouraged to hear that we've got a handle on the cost. We spent a lot of money on the development. I think we start construction in 2019.

But even – even if we – you end up with a boat that costs \$5 billion and we have 12 of those, that's \$60 billion. And we talked about the difficult choices that's going to present in terms of surface ships, I just want to pose the question, if – is it under consideration to consider those submarines like a national asset?

For instance, we – we fund the ballistic missile defense outside of the budget of the services because it's truly a national asset. And I wondered, it's a lot of money. And – and it's – those – those submarines are one-third of our nuclear triad. Is consideration being given to consider those being funded as a national asset outside the ship-building program which would take away some of the difficult choice in terms of the service ships versus the submarines?

ASHTON CARTER, UNDER SECRETARY OF DEFENSE FOR ACQUISITION, TECHNOLOGY, AND LOGISTICS: The – the best I can do is cite something that Secretary Gates said which is that he had considered that, then was not attracted to that idea. I'm paraphrasing, but I think their basic reason was, "Look, the money is going to show up somewhere anyway. And we're not going to hide \$60 billion by re-labeling. So, let's keep it in a way we've – we've done it."

⁸⁶ Christopher J. Castelli, "Lynn: Navy, DOD To Shoulder SSBN(X) Cost Without Separate Fund," *Inside the Pentagon*, March 11, 2010.

⁸⁷ Christopher J. Castelli, "Carter: Multibillion-Dollar Nuclear Subs Will Stay In Shipbuilding Account," *Inside the Navy*, March 28, 2011.

And I think it was the gist of the secretary's response. So – so, Secretary Gates had considered it and was not attracted to the idea. Although he – he thoroughly recognizes the premise of your question which is there's a lot of money. And as a practical matter it will compete with those things in the defense budget.

And that's one of the reasons why we've got to get the cost down.⁸⁸

An August 1, 2011, press report stated:

[Admiral Jonathan Greenert, who became the Chief of Naval Operations in September 2011, told] Sen. Jack Reed (D-R.I.) discussions are still underway in the Pentagon to have the defense-wide budget share with the Navy some of the costs of the Ohio-class SSBN(X) next-generation ballistic missile submarine, which is projected to dominate the Navy's shipbuilding budget starting at the end of this decade. "If confirmed, I intend to try to continue those discussions," Greenert [said] during his confirmation hearing. "In the [2020s], we have a phenomenon, an unfortunate one, where many of the ships built in the [1980s] will now come due for retirement. That's right when the Ohio replacement comes in. So we'll work very hard to make sure we got the requirements right. We'll work very hard with the acquisition community to drive that cost down but we may even so need some assistance, I believe, in the shipbuilding budget if we're going to meet our goals."⁸⁹

At a March 29, 2012, hearing before the Senate Armed Services Committee to consider the nominations of several people for various DOD positions, the following exchange occurred:

SENATOR JACK REED: Secretary Kendall, one of the issues that we have talked about is the nuclear infrastructure to create and maintain nuclear devices. There is another big part of that. That is the delivery platforms. And where you are facing a significant set of challenges, the lead procurement item is the Ohio class replacement submarine, but the Air Force is talking about the need ultimately to replace their fleet. You have to make, I presume, improvements in ground-based systems.

When the services look individually at the cost—and I have got more fidelity with respect to the Navy—these are very, very expensive platforms. They crowd out spending for other necessary ships in the Navy's case. And I think there is a very compelling case because this is a strategic issue that the services alone should not fundamentally share the burden, that in fact there has to be some DOD defense money because of the strategic nature committed to help the services. And I think the most immediate situation is in the Navy.

Can you reflect on that and share your views?

Mr. FRANK KENDALL III.⁹⁰ Yes, Senator Reed. The Department [of Defense] basically builds its budget as a budget for the entire Department, and we do make tradeoffs that sometimes cut across the Services? [sic] lines in order to do that. Last fall, what we went through was a period where we formulated the strategy, the Strategic Guidance that we published, and that was used to guide the budget process. So that was all done with regard to priorities to support the strategy. It was not about the service portfolio specifically. At the end, we came to a decision about the best mix of systems to do that, and we tried to take into

⁸⁸ Source: Transcript of hearing.

⁸⁹ "Boomer Sharing," *Defense Daily*, August 1, 2011: 1-2.

⁹⁰ Kendall at the time of the hearing was nominated for the position of Under Secretary of Defense for Acquisition, Technology and Logistics (USD ATL)—the DOD acquisition executive. He was subsequently confirmed for the position.

account the long-term issues that you alluded to which include the 30-year shipbuilding plan which we just sent over which does show that the Ohio replacement does add substantially to that account. We are going to have to find some other way besides the shipbuilding account obviously to pay that bill.

We have put cost caps on both the SSBN-X, the Ohio replacement, and on the new bomber in order to try to control the costs and keep them within an affordable range. But there is going to be a challenge to us to do this, and it has to be done on a defense-wide DOD basis.⁹¹

Construction Shipyard(s)

Another potential issue for Congress regarding the Ohio replacement program is which shipyard or shipyards would build SSBN(X)s. Two U.S. shipyards are capable of building nuclear-powered submarines—General Dynamics’ Electric Boat Division (GD/EB) of Groton, CT, and Quonset Point, RI, and Newport News Shipbuilding (NNS), of Newport News, VA, which forms part of Huntington Ingalls Industries (HII). GD/EB’s primary business is building nuclear-powered submarines; it can also perform submarine overhaul work. NNS’s primary lines of business are building nuclear-powered aircraft carriers, building nuclear-powered submarines, and performing overhaul work on nuclear-powered aircraft carriers.

Table 5 shows the numbers of SSBNs built over time by GD/EB, NNS, and two government-operated naval shipyards (NSYs)—Mare Island NSY, located in the San Francisco Bay area, and Portsmouth NSY of Portsmouth, NH, and Kittery, ME. Mare Island NSY is no longer in operation. NSYs have not built new Navy ships since the early 1970s; since that time, they have focused solely on overhauling and repairing Navy ships.

As can be seen in the table, the Ohio-class boats were all built by GD/EB, and the three previous SSBN classes were built partly by GD/EB, and partly by NNS. GD/EB was the builder of the first boat in all four SSBN classes. The most recent SSBNs built by NNS were the *George C. Marshall* (SSBN-654) and *George Washington Carver* (SSBN-656), which were Lafayette/Benjamin Franklin-class boats that were procured in FY1964 and entered service in 1966.

⁹¹ Transcript of hearing.

Table 5. Construction Shipyards of U.S. SSBNs

	George Washington (SSBN-598) class	Ethan Allen (SSBN-608) class	Lafayette/Benjamin Franklin (SSBN-616/640) class	Ohio (SSBN-726) class
Fiscal years procured	FY58-FY59	FY59 and FY61	FY61-FY64	FY77-FY91
Number built by GD/EB	2	2	13	18
Number built by NNS	1	3	10	
Number built by Mare Island NSY	1		6	
Number built by Portsmouth NSY	1		2	
Total number in class	5	5	31	18

Source: Prepared by CRS based on data in Norman Polmar, *The Ships and Aircraft of the U.S. Fleet*, Annapolis, Naval Institute Press, various editions. NSY means naval shipyard.

Notes: GD/EB was the builder of the first boat in all four SSBN classes. The George Washington-class boats were procured as modifications of SSNs that were already under construction. A total of 18 Ohio-class SSBNs were built; the first four were converted into SSGNs in 2002-2008, leaving 14 in service as SSBNs.

There are at least five basic possibilities for building SSBN(X)s:

- **build all SSBN(X)s at GD/EB**—the approach that was used for building the Ohio-class SSBNs;
- **build all SSBN(X)s at NNS**;
- **build some SSBN(X)s GD/EB and some at NNS**—the approach that was used for building the George Washington-, Ethan Allen-, and Lafayette/Benjamin Franklin-class SSBNs;
- **build each SSBN(X) jointly at GD/EB and NNS, with final assembly of the boats alternating between the yards**—the approach currently being used for building Virginia-class SSNs;⁹² and

⁹² Under the joint-production arrangement for Virginia-class boats, GD/EB builds certain parts of each boat, NNS builds certain other parts of each boat, and the two yards take turns building the reactor compartment and performing final assembly work. GD/EB is the final assembly yard for the first Virginia-class boat, the third one, and so on, while NNS is the final assembly yard for the second boat, the fourth one, and so on. The arrangement provides a roughly 50-50 split in profits between the two firms for the production of Virginia-class SSNs. The agreement governing the joint-production arrangement cannot be changed without the consent of both firms. Virginia-class SSNs are the first U.S. nuclear-powered submarines to be built jointly by two shipyards; all previous U.S. nuclear-powered submarines were built under the more traditional approach of building an entire boat within a single yard.

The Virginia-class joint-production arrangement was proposed by the two shipyards, approved by the Navy, and then approved by Congress as part of its action on the FY1998 defense budget. A principal goal of the arrangement is to preserve submarine-construction skills at two U.S. shipyards while minimizing the cost of using two yards to build a class of submarines that is procured at a relatively low rate of one or two boats per year. Preserving submarine-construction skills at two yards is viewed as a hedge against the possibility of operations at one of the yards being disrupted by a natural or man-made disaster.

The joint-production arrangement is more expensive than single-yard strategy of building all Virginia-class boats at one shipyard (in part because the joint-production strategy splits the learning curve for reactor compartment construction and final assembly work on Virginia-class SSNs), but it is less expensive than a separate-yard strategy of building complete Virginia-class separately at both yards (in part because a separate-construction strategy splits the learning curve for all aspects of Virginia-class construction work, and because, in the absence of other submarine-construction (continued...))

- **build each SSBN(X) jointly at GD/EB and NNS, with one yard—either GD/EB or NNS—performing final assembly on every boat.**

In assessing these five approaches, policymakers may consider a number of factors, including their potential costs, their potential impacts on employment levels at GD/EB and NNS, and the relative value of preserving SSBN-unique construction skills (such as those relating to the construction and installation of SLBM compartments) at one shipyard or two. The relative costs of these five approaches could depend on a number of factors, including the following:

- each yard's share of SSBN(X) production work (if both yards are involved);
- the number of SSNs procured during the years of SSBN(X) procurement (which can affect economies of scale in submarine production);
- whether the current joint-production arrangement for the Virginia class remains in effect during those years;⁹³ and
- the volume of non-submarine-construction work performed at the two shipyards during these years, which would include in particular aircraft carrier construction and overhaul work at NNS.

A January 12, 2011, press report stated:

While the [SSBN(X)] submarine-building contracts would likely be competitively bid, [Electric Boat President John] Casey says he doubts any other company—even its attack-submarine-building partner Northrop Grumman [now NNS]—can secure the work. Electric Boat built the existing Ohio-class fleet.

“We have every intention of building every one of those ships,” he says. “There’s no one else [who was] involved in designing and building that [Ohio-class] platform.”⁹⁴ It’s up to us to convince people we can do it at the right price.”⁹⁵

Legislative Activity for FY2013

FY2013 Funding Request

As shown in **Table 3**, the Navy’s proposed FY2013 budget requests \$564.9 million in research and development funding for the Ohio replacement program, including \$483.1 million for Project 3220 (SBSD—sea-based strategic deterrent) in PE0603561N (Advanced Submarine System

(...continued)

work, a procurement rate of one or two Virginia-class boats per year is viewed as insufficient to sustain a meaningful competition between the two yards for contracts to build the boats).

⁹³ The agreement governing the joint-production arrangement for the Virginia class cannot be changed without the consent of both yards.

⁹⁴ The bracketed words in this sentence were inserted by CRS following a February 8, 2011, telephone call to CRS from Electric Boat in which Electric Boat stated that sentence in Mr. Casey’s quote refers to Electric Boat being the sole designer and builder of the current Ohio-class SSBNs.

⁹⁵ Michael Fabey, “Electric Boat Recruits Engineers For Ohio-Class Sub Replacement,” *Aerospace Daily & Defense Report*, January 12, 2011: 1-2.

Development), and \$81.8 million for Project 3219 (SSBN[X] reactor plant) in PE0603570N (Advanced Nuclear Power Systems).

FY2013 National Defense Authorization Act (H.R. 4310/S. 3254)

House

Section 121 of H.R. 4310 as reported by the House Armed Services Committee (H.Rept. 112-479 of May 11, 2012) states:

SEC. 121. RETIREMENT OF NUCLEAR-POWERED BALLISTIC SUBMARINES.

Section 5062 of title 10, United States Code, is amended by adding at the end the following new subsection:

“(e)(1) Beginning October 1, 2012, the Secretary of the Navy may not retire or decommission a nuclear-powered ballistic missile submarine if such retirement or decommissioning would result in the active or commissioned fleet of such submarines consisting of less than 12 submarines.

“(2) The limitation in paragraph (1) shall not apply to a nuclear-powered ballistic submarine that has been converted to carry exclusively non-nuclear payloads as of October 1, 2012.”

H.Rept. 112-479 states:

Perhaps the most troubling aspect of the Navy shipbuilding plan is how it will be able to afford the Ohio class replacement ballistic missile submarine and still have a viable program for other ships. This will have to be addressed in coming years. The budget request delayed the start of construction of the first submarine by 2 years until fiscal year 2021. This delay means that the ballistic missile submarine force dips to 10 submarines for almost 10 years in a couple of decades. To maintain a credible undersea nuclear deterrent, the committee recommends restoring the research and development funding that was reduced in the fiscal year 2013 budget request to allow the Department of Defense time to determine how to keep the program on track. Elsewhere in this Act, the committee includes a provision [Section 121] that would prevent the Secretary of the Navy from having fewer than 12 ballistic missile submarines at a time. (Pages 35-36)

The report recommends increasing by \$374.4 million the Navy’s FY2013 request for research and development funding for PE0603561N, Advanced Submarine System Development, with the increase being for “Program increase.” (Page 418) The report recommends approving the Navy’s FY2013 request for research and development funding for PE0603570N, Advanced Nuclear Power Systems. (Page 419)

The report also states:

Naval Reactors

The Naval Reactors program is responsible for all aspects of naval nuclear propulsion efforts, including reactor plant technology design and development, reactor plant operation and maintenance, and reactor retirement and disposal. The program ensures the safe and reliable operation of reactor plants in nuclear-powered submarines and aircraft carriers that represent over 40 percent of the Navy’s combatants.

The fiscal year 2013 budget request proposed to delay procurement of the OHIO-class ballistic missile submarine replacement by two years from previous schedule. The committee disagrees with this decision, and supports procurement of the OHIO-class replacement submarines on the original schedule. To support this, the committee recommends \$1.2 billion for the Naval Reactors program, an increase of \$99.0 million to the budget request. This increase will support continued development of an advanced “life-of-the-boat” nuclear reactor for the OHIO-class replacement submarine program. (Page 328)

The report also states:

Report on Potential Use of Low-Enriched Uranium for Naval Reactors

The committee is aware of a study conducted by the Director, Naval Reactors in 1995 to assess the technical, environmental, economic, and proliferation implications of using low-enriched uranium (LEU) in place of highly-enriched uranium (HEU) in Naval nuclear propulsion systems. The committee notes that the report concluded that “the use of LEU in U.S. Naval reactor plants is technically feasible, but uneconomic and impractical.”

The committee directs the Director, Naval Reactors to submit a report to the congressional defense committees by March 1, 2013, that describes any updates to the findings and conclusions from the 1995 report, including any changes in the estimated costs for fabricating HEU and LEU life-of-ship cores, the ability to refuel nuclear-propelled submarines and ships without extending the duration or frequency of major overhauls, and the overall health of the technology base that may be required to utilize LEU in Naval nuclear propulsion systems. (Page 329)

Senate

The Senate Armed Services Committee, in its report (S.Rept. 112-173 of June 4, 2012) on S. 3254, recommends approving the Navy’s FY2013 funding requests for PE0603561N (Advanced Submarine System Development) and PE0603570N (Advanced Nuclear Power Systems). (Page 373)

The report states:

Naval reactors

The committee recommends \$1.1 billion for naval reactors, including a \$37.9 million increase above the budget request for the Ohio-class replacement reactor program. This program was decreased by \$70.0 million relative to the fiscal year 2012 budget projection for fiscal year 2013. The committee notes that the Naval Reactors program is under strong pressure in the 5-year budget profile to meet its design specifications for the Ohio-class replacement reactor and recommends that the NNSA support any necessary changes needed to the Ohio-class reactor replacement program to ensure it is properly synchronized with the main submarine program which has slipped by 2 years. The committee remains concerned by the 2-year delay of the Ohio-class replacement program, and directs Naval Reactors to deviate as little as possible from the schedule identified in the fiscal year 2012 budget. (Page 285)

FY2013 DOD Appropriations Act (H.R. 5856)

House

The House Appropriations Committee, in its report (H.Rept. 112-493 of May 25, 2012) on H.R. 5856, recommends approving the Navy's FY2013 funding requests for PE0603561N (Advanced Submarine System Development) and PE0603570N (Advanced Nuclear Power Systems). (Page 221)

The report states:

STRATEGIC SUBMARINE REPLACEMENT

The Committee is concerned with the national security and programmatic risks associated with the Department's decision to delay the Ohio class ballistic missile submarine replacement program. The Committee expects the Secretary of the Navy to conduct close and frequent oversight of this program to ensure that these risks are minimized. (Page 231)

Senate

The Senate Appropriations Committee, in its report (S.Rept. 112-196 of August 2, 2012) on H.R. 5856, recommends approving the Navy's request for \$483.1 million in FY2013 research and development funding for the Ohio replacement program in Project 3220 of PE0603561N (Advanced Submarine System Development), and also transferring this funding from PE0603561N/Project 3220 to a newly created Navy research and development Program Element that would be specifically for the Ohio replacement program. (Page 183, lines 44 and 44A, and page 189, lines 44 and 44X) The committee recommends approving the Navy's FY2013 funding request for PE0603570N (Advanced Nuclear Power Systems). (Page 183, line 48)

Author Contact Information

Ronald O'Rourke
Specialist in Naval Affairs
rorourke@crs.loc.gov, 7-7610