STATEMENT OF

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Chairman Taylor, Ranking Member Bartlett, distinguished members of the subcommittee, thank you for the opportunity to appear before you to discuss submarine force structure and acquisition policy. As requested, my testimony will focus on the following:

- the history, in brief, of the Virginia-class acquisition program, including the changes that have been made to the program of record over the years (pages 1-4);
- the historical trend in submarine force structure and an analysis of future submarine structure based on the current program of record (pages 5-14); and
- an analysis of the current and projected shipbuilding costs for Virginia-class submarines (pages 14-16).

In addition, Appendix A to this testimony discusses the attack submarine force level goal, and Appendix B discusses options for preserving the submarine design and engineering base.

Brief History Of Virginia-Class Program

Program Origin And Aims

The Navy initiated the Virginia-class program in the early 1990s with the goal of designing an attack submarine (SSN) that was less expensive to procure than the Seawolf (SSN-21) class, and better optimized for post-Cold War SSN missions. To make the Virginia class less expensive to procure than the Seawolf class, the Navy accepted a reduction relative to the Seawolf-class design in certain performance characteristics, such as maximum sustained speed and total weapon-carrying capacity, while maintaining other Seawolf-class performance characteristics, such as acoustic stealth. Features that help optimize the Virginia-class design for post-Cold War SSN missions include a reconfigurable torpedo room and a lock-in/lock-out chamber for special operations forces.

Joint Production Arrangement

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

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

The joint production arrangement is a departure from past U.S. submarine construction practices, under which complete submarines were built in individual yards. The joint production arrangement is the product of a debate over the Virginia-class acquisition strategy within Congress, and between Congress and DOD, that occurred in 1995-1997 (i.e., during the markup of the FY1996-FY1998 defense budgets). The goal of the arrangement is to keep both GD/EB and NGNN involved in building nuclear-powered submarines, and thereby maintain two U.S. shipyards capable of building nuclear-powered submarines, while minimizing the cost penalties of using two yards rather than one to build a submarine design that is being procured at a low annual rate.

Procurement Through FY2006

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

Table 1. Virginia-Class Procurement, FY1998-FY2006

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

Boats In Service

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

Multiyear Procurement

FY2004-FY2008 MYP. The Virginia-class boat requested for procurement in FY2008 is the fifth of five boats procured under a multiyear procurement (MYP) arrangement for FY2004-FY2008.[2] The Navy estimated that this MYP arrangement will reduce the total cost of the five boats by a total of about $400 million, or an average of $80 million per boat.[3]

Section 8008 of the conference report (H.Rept. 108-283 of September 24, 2003) on the FY2004 defense appropriations act (H.R. 2568/P.L. 108-87 of September 30, 2003) approved the five-boat MYP arrangement for FY2004-FY2008, "Provided, That the Secretary of the Navy may not enter into a multiyear contract for the procurement of more than one Virginia Class submarine per year." Accompanying report language stated that "The Navy's request to procure more than one submarine in fiscal year 2007 and 2008 is denied...."[4] The Navy and other observers interpreted Section 8008 and the accompanying report language as strongly cautioning the Navy against including funding in

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

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

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

future budgets to support the procurement of a second boat in either FY2007 or FY2008.

FY2009-FY2013 MYP. The Navy for FY2008 is requesting approval for a new MYP arrangement to cover the seven Virginia-class boats planned for procurement in FY2009-FY2013. The Navy estimates that this MYP could save as much as $1.3 billion, or an average of about $185 million per boat, compared to annual contracting.

The Navy believes that approving the MYP in FY2008 rather than FY2009 would greatly increase the probability of achieving the full $1.3 billion in savings because it would enhance the Navy's negotiating position with the shipbuilders and the vendor base.

GD/EB believes that approving the MYP in FY2008 rather than FY2009 could increase the savings of the MYP by as much as $50 million per boat, as long as about $500 million in advance procurement funding for the procurement of EOQ (Economic Order Quantity) components permitted under the MYP is also shifted from FY2009 to FY2008.

Deferral Of Start Of 2-Per-Year Procurement

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

Table 2. Planned Virginia-Class Procurement In Various FYDPs

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

Source: Prepared by CRS using Navy data.

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

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

Cost-Reduction Goal

The Navy says its plan to increase Virginia-class procurement to two per year starting in FY2012 is contingent on being able to reduce the procurement cost of Virginia-class submarines to $2.0 billion each in constant FY2005 dollars, compared to a current cost of about $2.4 billion each in constant FY2005 dollars. The Navy calculates that the target cost of $2.0 billion in constant FY2005 dollars translates into about $2.6 billion for a boat procured in FY2012, and about $2.7 billion for a boat procured in FY2013.

Funding Requirements For Accelerated Production

Some observers have proposed accelerating the start of two-per-year Virginia-class procurement to a year earlier than FY2012, so as to mitigate a projected future shortfall in SSNs that is discussed in the next section. **Table 3** shows the additional funding that the Navy in 2006 said would have been needed as an addition to last year's FYDP (i.e., the FY2007-FY2011 FYDP) to accelerate the start of two-per-year procurement to FY2009, using the traditional approach for funding the procurement of SSNs. As shown in the table, the Navy estimated that this would have involved adding $400 million in additional funding in FY2007, and a total of $7.4 billion in additional funding over the FY2007-FY2011 FYDP. The $400 million in additional FY2007 funding was authorized but not appropriated.

Table 3. 2006 Navy Estimate Of Funding For Accelerated Virginia-Class Procurement In FY2007-FY2011 FYDP

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

	FY07	FY08	FY09	FY10	FY11	FY09-FY11 total
FY2007-FY2011 FYDP						
Ship quantity	1	1	1	1	1	5
Funding	2.5	2.5	3.5	3.8	3.8	16.1
Acceleration of two-per year procurement to FY2009						
Ship quantity	1	1	2	2	2	8
Funding	2.9	3.1	6.0	5.9	5.6	23.5
Additional funding for acceleration relative to FY2009-FY2011 FYDP						
	0.4	0.6	2.5	2.1	1.8	7.4

Source: U.S. Navy Office of Legislative Affairs, March 3, 2006.

Using the traditional approach for funding the procurement of SSNs, accelerating the start of two-per year procurement in the current (FY2008-FY2013) FYDP to FY2010 might involve adding between $400 million and $500 million in funding to the amount the Navy has requested for FY2008. As discussed in the next section, however, there are other funding approaches for accelerating the start of two-year procurement to FY2010 or some other near-term year.

Submarine Force Structure And Procurement Options

Past And Current SSN Force Levels

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

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

As of end of FY2006, the SSN force included a total of 55 boats, or about 20% of the Navy's total force of 281 ships. The 55 SSNs include the following:

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

SSN Force-Level Goal: 48 Boats

The Navy's 313-ship force structure plan, first presented to Congress in February 2006, includes 48 SSNs. Under this plan, SSNs would account for about 15% of the fleet. For a review of SSN force level goals since the Reagan Administration, see **Appendix A** of this testimony.

Projected SSN Shortfall

The Navy's 30-year (FY2008-FY2037) SSN procurement plan calls for procuring one SSN per year in FY2008-FY2011, two SSNs per year in FY2012-FY2028, and 1.5 SSNs per year (in a 1-2-1-2 pattern) in FY2029-FY2037. This plan, if implemented, would not be sufficient to maintain a force of 48 SSNs consistently over the long run. As shown in **Table 4**, the Navy projects that the SSN force under this plan would fall below 48 boats during the 14-year period 2020-2033, reaching a minimum of 40 boats in 2028-2029. Since the Navy plans to retire the four converted Trident SSGNs by 2028 without procuring any replacements for them, no SSGNs would be available in 2028 and subsequent years to help compensate for a drop in SSN force level below 48 boats.

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

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

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

The potential for the Navy's long-range SSN procurement plan to produce a shortfall in the SSN force over the long run has been discussed by CRS since 1995, in the form of testimony to Congress in 1995, 1997, 1999, 2000, 2002, 2004, and 2006, a 1997 CRS presentation to a Defense Science Board task force on the submarine of the future, which issued its report in 1998;[5] a 1999-2000 CRS report,[6] a 2002 CRS report,[7] and a third CRS report since 2004.[8]

Options For Mitigating Or Eliminating The Shortfall

There are at least three potential options for mitigating or eliminating the projected SSN shortfall:

- take steps to temporarily increase the operational availability of SSNs during the shortfall period;
- extend SSN service life; and
- increase the number of SSNs procured above Navy plans.

Each of these options is discussed below.

Increasing SSN Availability During Shortfall Period

Taking steps to temporarily increase the operational availability of SSNs during the shortfall period could make a force of fewer than 48 SSNs look temporarily more like a force of 48 SSNs in terms of the total number of deployed SSNs or the total number of SSN days on station. Possible steps that could be taken include but are not necessarily limited to the following, some of which could be combined:

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

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

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

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

[8]CRS Report RL32418, *Navy Attack Submarine Force-Level Goal and Procurement Rate: Background and Issues for Congress*, by Ronald O'Rourke.

States to more-forward home ports such as Pearl Harbor or Guam; and

- operating SSNs during the shortfall period with an average of more than one crew per boat.

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

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

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

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

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

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

- Operating SSNs during the shortfall period with an average of more than one crew per boat could shorten SSN lives to something less than 33 years by expending nuclear fuel core life and basic ship mechanical life more quickly. If SSNs are retired prior to age 33, it could eventually reduce SSN force levels below what they otherwise would be.

Extending SSN Service Life

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

Table 5. SSN Shortfall, FY2020-FY2033, As Function Of Service-Life Extension

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

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

Source: Prepared by CRS based on Navy data.

* Baseline situation — no changes to current Navy plan.

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

Procuring Additional SSNs

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

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

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

Table 6. SSN Shortfall, FY2020-FY2033, As Function Of Procuring Additional SSNs In FY2008-FY2011

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

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

Source: Prepared by CRS based on Navy data.

* Baseline situation — no changes to current Navy plan.

Combining Service-Life Extension and Procuring Additional SSNs

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

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

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

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

Table 7. SSN Shortfall, FY2020-FY2033, As Function Of Service-Life Extension and Procuring Additional SSNs

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

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

Source: Prepared by CRS based on Navy data.

* Baseline situation — no changes to current Navy plan.

Alternative Funding Approaches For Procuring Additional SSNs

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

- **full funding with advance procurement** — the traditional approach, under which there are two years or so of advance procurement funding for the SSN's long-leadtime components, followed by the remainder of the boat's procurement funding in the year of procurement;
- **single-year full funding** — full funding of the SSN in the year of procurement, with no advance procurement funding in prior years;
- **incremental funding** — partial funding of the SSN in the year of procurement, followed by one or more years of additional funding increments needed to complete the procurement cost of the ship; and
- **advance appropriations** — a form of full funding which can be viewed as a legislatively locked in form of incremental funding.[9]

Procuring SSNs Without Advance Procurement Funding

Recent Navy testimony to the full House Armed Services Committee suggested that two years of advance procurement funding are required to fund the procurement of an SSN, and consequently that additional SSNs could not be procured until FY2010 at the earliest.[10] This testimony understates Congress' options regarding the procurement of additional SSNs in the near term. Although SSNs are normally procured with two years of advance procurement funding (which is used primarily for financing long-leadtime nuclear propulsion components), an SSN can be procured without advance procurement funding, or with only one year of advance procurement funding. Consequently, Congress has the option of procuring an additional SSN in FY2008 or FY2009, even though no advance procurement funding has been provided for such ships in prior-year budgets. Doing so would not materially change the way such an SSN would be built — the process would still encompass about two years of advance work on long-leadtime components, and an additional six years or so of construction work on the ship itself. The outlay rate for the SSN could be slower, as outlays for construction of the ship itself would begin two years later than normal (for an SSN procured in FY2008 or FY2009 with no advance procurement funding) or one year later than normal (for an SSN procured in FY2009 with a single year of advance procurement funding in FY2008).

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

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

Procuring SSNs With Single-Year Full Funding

Single-year full funding has been used in the past by Congress to procure nuclear-powered ships for which no prior-year advance procurement funding had been provided. Specifically, Congress in FY1988 used single-year full funding to procure the nuclear-powered aircraft carriers CVN-74 and CVN-75. Under the Administration's proposed FY1988 budget, these two ships were to be procured in FY1990 and FY1993, and the FY1988 budget was to make the initial advance procurement payment for CVN-74. Congress, in acting on the FY1988 budget, decided to accelerate the procurement of both ships to FY1988, and fully funded the two ships that year at a combined cost of $6.325 billion. The ships entered service in 1995 and 1998, respectively.

Procuring SSNs In A 2-1-2 Pattern

Some potential approaches for procuring additional boats in FY2008-FY2011 (see next section) would result in a pattern of procuring two boats in a given year, followed by one boat the following year, and two boats the year after that — a 2-1-2 pattern. Recent Navy testimony to the full House Armed Services Committee suggested that if the procurement rate were increased in a given year to two boats, it would not be best, from a production efficiency point of view, to decrease the rate to a single boat the following year, and then increase it again to two boats the next year, because of the workforce fluctuations such a profile would produce.[11]

This statement may overstate the production-efficiency disadvantages of a 2-1-2 pattern. If two boats were procured in a given year, followed by one boat the next year — a total of three boats in 24 months — the schedule for producing the three boats could be phased so that, for a given stage in the production process, the production rate would be one boat every eight months. A production rate of one boat every eight months might actually help the industrial base make the transition from the current schedule of one boat every twelve months (one boat per year) to one boat every six months (two boats per year). Viewed this way, a 2-1-2 pattern might actually lead to some benefits in production efficiency on the way to a steady rate of two boats per year. As mentioned earlier, the Navy's 30-year SSN procurement plan calls for procuring SSNs in a 1-2-1-2 pattern in FY2029-FY2037.

Potential Approaches For Procuring Additional Boats In FY2008-FY2011

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

Procuring One Additional Boat. One potential approach to fund a single additional boat in FY2008-FY2011 would be to procure the boat in FY2011 using the traditional approach — full funding in FY2011 with advance procurement in FY2009 and FY2010. This option would require

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[11] At a March 1, 2007, hearing before the House Armed Services Committee on the FY2008 Department of the Navy budget request, Representative Taylor asked which additional ships the Navy might want to procure in FY2008, should additional funding be made available for that purpose. In response, Secretary of the Navy Donald Winter stated in part: "If we're going to go to two a year in 2010, we really need to go to two a year for 2010, 2011 and out from there on. We don't want to go to two a year and then back to one a year. I think that would create too much stress into the workforce there." (Source: Transcript of hearing.)

little or no additional procurement funding in FY2008.

A second potential approach would be to procure the boat in FY2010 using the traditional approach — full funding in FY2010 and advance procurement funding in FY2008 and FY2009. This approach could require between $400 million and $500 million in additional advance procurement funding in FY2008. This approach would also preserve an option for adding a second additional boat in FY2011, should Congress decide next year that it wanted to fund a second additional boat in FY2011.

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

Table 8. Some Potential Profiles For Procuring Two Additional Boats

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

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

In the second profile in **Table 8**, the additional boat in FY2009 could be procured with single-year full funding in FY2009, which would not require any additional funding in FY2008. Under this approach, the boat might enter service in FY2017, as opposed to FY2015 for a boat procured in FY2009 that had received traditional advance procurement funding starting in FY2007. Alternatively, the second boat in FY2009 could be procured with a combination of funding in FY2008 and FY2009 (and perhaps also FY2010). Under this approach, the FY2008 funding might be limited to the $400 million to $500 million that would be required for long-leadtime components, and the boat might enter service in FY2016.

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

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

Table 9. Some Potential Profiles For Procuring Three Additional Boats

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

In the first profile in **Table 9**, the additional boat in FY2008 could be procured using either single-year full funding in FY2008, or split funding in FY2008 and FY2009. In either case, the boat might enter service in FY2016, as opposed to FY2014 for a boat procured in FY2008 that had received advance procurement funding starting in FY2006. In the second profile, the additional boat in FY2009 could be procured with single-year full funding in FY2009, or with a combination of funding in FY2008 and FY2009, in which case the FY2008 funding might be limited to the $400 million to $500 million that would be required for long-leadtime components.

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

Current And Projected Virginia-Class Shipbuilding Costs

Table 10 shows unit procurement costs for Virginia-class boats in then-year dollars and constant FY2005 dollars, and the percent cost growth on the earlier boats in the program. Points that can be made in connection with the figures the table include the following:

- The first ship (SSN-774) is considerably more expensive than the others because its procurement cost included much of the detailed design and non-recurring engineering (DD/NRE) costs for the class, as is traditional for a lead ship in a Navy shipbuilding program.

- The large percentage cost growth on the second ship (SSN-775) reflects in part challenges experienced at NGNN in building its first submarine since the Los Angeles (SSN-688) class submarine Cheyenne (SSN-773), which was commissioned in 1996.

- The constant-dollar unit procurement cost is relatively stable for SSNs 778 through 786, suggesting that, for these boats, learning curve benefits have been (or are expected to be) limited, or have been (or are expected to be) offset by other cost increases, or both.

- SSNs 784 through 786 were planned for procurement at a rate of two boats per year in the FY2004 budget, but one boat per year in the FY2008 budget. If these three boats had been planned for the same rate of procurement in both budgets, the percentage increase in their costs in the final column of **Table 10** might be more comparable to the 14.9% figure for SSN-787, which was planned for procurement at a rate of two boats per year in both the FY2004 and FY2008 budgets.

Table 10. Virginia-Class Unit Procurement Costs
(cost figures in millions of dollars)

Hull number	Fiscal year procured	Current estimated procurement cost		% increase in procurement cost compared to cost as shown in	
		Then-year dollars	Constant FY2005 dollars	the budget for the FY in which the boat was procured[a]	an earlier budget where that boat's cost was projected[b]
774	98	3,752.1	4,671.9	11.2	11.2 (FY98)
775	99	2,713.8	3,308.8	23.8	25.2 (FY98)
776	01	2,210.4	2,530.7	9.5	8.2 (FY98)
777	02	2,332.1	2,650.8	2.5	10.1 (FY98)
778	03	2,242.0	2,416.0	2.3	16.8 (FY00)
779	04	2,254.6	2,348.5	4.8	17.3 (FY00)
780	05	2,289.2	2,289.2	2.0	18.9 (FY00)
781	06	2,378.4	2,283.6	0.0	2.5 (FY03)
782	07	2,604.4	2,403.5	0.0	9.7 (FY03)
783	08	2,653.7	2,360.2	n/a	20.0 (FY04)
784	09	2,864.5	2,459.4	n/a	17.9 (FY04)[c]
785	10	2,783.0	2,307.0	n/a	24.8 (FY04)[c]
786	11	2,904.2	2,323.8	n/a	28.8 (FY04)[c]
787	12	2,590.8	2,000.9	n/a	14.9 (FY04)
788	12	2,590.8	2,000.9	n/a	n/a
789	13	2,684.1	2,000.8	n/a	n/a
790	13	2,684.1	2,000.8	n/a	n/a

Source: Prepared by CRS using U.S. Navy data on current estimated procurement costs provided to CRS on March 2, 2007, and SCN account justification books for FY1998-FY2008.

a Percent cost growth calculated from cost for that boat as estimated in the budget in which the boat was procured.

b Percent cost growth calculated from cost for that boat as projected in an earlier budget, shown in parentheses. With the exceptions of SSNs 774 and 775, the earlier budget shown was the first in which the cost of the boat appeared in the SCN account justification book.

c SSNs 784 through 786 were planned for procurement at a rate of two boats per year in the FY2004 budget, but one boat per year in the FY2008 budget. If these three boats had been planned for the same rate of procurement in both budgets, the percentage increase in their costs in the final column of Table 10 might be more comparable to the 14.9% figure for SSN-787, which was planned for procurement at a rate of two boats per year in both the FY2004 and FY2008 budgets.

As mentioned earlier, the Navy says its plan to increase Virginia-class procurement to two per year starting in FY2012 is contingent on being able to reduce the procurement cost of Virginia-class submarines to $2.0 billion each in constant FY2005 dollars, compared to a current cost of about $2.4 billion each in constant FY2005 dollars. As shown in **Table 10**, the Navy projects that it will meet that target.

The Navy says that, in constant FY2005 dollars, about $200 million of the $400 million in sought-after cost reductions would be accomplished simply through the improved economies of scale (e.g., better spreading of shipyard fixed costs and improved learning rates) of producing two submarines per year rather than one per year. The remaining $200 million in sought-after cost reductions, the Navy says, is to be accomplished through changes in the ship's design and in the shipyard production process. The design changes, the Navy says, are scheduled to be ready for boats procured in FY2012. Consequently, the Navy says, the $2.0 billion target cost cannot be fully achieved before FY2012. The Navy says that if improved economies of scale and changes in the ship's design and in the shipyard production process are not sufficient to achieve the $2.0 billion target, it may consider reducing the capabilities of the Virginia class in certain areas until the target is achieved.[12]

Two additional points can be made in connection with the $2.0 billion cost target:

- The Navy has established cost-reduction targets for several of its shipbuilding programs, but the Virginia-class program is apparently the only program that must meet its cost reduction target as an internal Navy condition for retaining all ships of that type in the Navy's shipbuilding program. This raises a potential question regarding the comparative incentives for other shipbuilding programs to meet their cost-reduction goals.

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

Mr. Chairman, distinguished members of the subcommittee, this concludes my testimony. Thank you again for the opportunity to appear before you to discuss these issues. I will be pleased to respond to any questions you might have.

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[12]For more on the Navy's plan for reducing the procurement cost of the Virginia-class design, see William Hilarides, "2 For 4 in 2012, The Virginia-Class Road Ahead," *U.S. Naval Institute Proceedings*, June 2006: 68-69.

Appendix A: SSN Force-Level Goal

The SSN force-level goal has evolved over time. This appendix summarizes the evolution of the goal since the Reagan Administration (1981-1989), and recent debate concerning the appropriateness of the current 48-boat goal.

Previous Administrations

The Reagan Administration's plan for a 600-ship Navy included an objective of achieving and maintaining a force of 100 SSNs. The George H. W. Bush Administration's proposed Base Force plan of 1991-1992 originally called for a Navy of more than 400 ships, including 80 SSNs.[13] In 1992, however, the SSN goal was reduced to about 55 boats as a result of a 1992 Joint Staff force-level requirement study (updated in 1993) that called for a force of 51 to 67 SSNs, including 10 to 12 with Seawolf-level acoustic quieting, by the year 2012.[14]

The Clinton Administration, as part of its 1993 Bottom-Up Review (BUR) of U.S. defense policy, established a goal of maintaining a Navy of about 346 ships, including 45 to 55 SSNs.[15] The Clinton administration's 1997 QDR supported a requirement for a Navy of about 305 ships and established a tentative SSN force-level goal of 50 boats, "contingent on a reevaluation of peacetime operational requirements."[16] The Clinton administration later amended the SSN figure to 55 boats (and therefore a total of about 310 ships).

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

- "that a force structure below 55 SSNs in the 2015 [time frame] and 62 [SSNs] in the 2025 time frame would leave the CINC's [the regional military commanders-in-chief] with insufficient capability to respond to urgent crucial demands without gapping other requirements of higher national interest. Additionally, this force

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

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

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

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

structure [55 SSNs in 2015 and 62 in 2025] would be sufficient to meet the modeled war fighting requirements;"

- "that to counter the technologically pacing threat would require 18 Virginia class SSNs in the 2015 time frame;" and

- "that 68 SSNs in the 2015 [time frame] and 76 [SSNs] in the 2025 time frame would meet all of the CINCs' and national intelligence community's highest operational and collection requirements."[17]

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

George W. Bush Administration

The George W. Bush Administration's report on the 2001 QDR revalidated the amended requirement from the 1997 QDR for a fleet of about 310 ships, including 55 SSNs. In revalidating this and other U.S. military force-structure goals, the report cautioned that as DOD's "transformation effort matures — and as it produces significantly higher output of military value from each element of the force — DOD will explore additional opportunities to restructure and reorganize the Armed Forces."[18]

DOD and the Navy conducted studies on undersea warfare requirements in 2003-2004. One of the Navy studies — an internal Navy study done in 2004 — reportedly recommended reducing the attack submarine force level requirement to as few as 37 boats. The study reportedly recommended homeporting a total of nine attack submarines at Guam and using satellites and unmanned underwater vehicles (UUVs) to perform ISR missions now performed by attack submarines.[19]

In March 2005, the Navy submitted to Congress a report projecting Navy force levels out to FY2035. The report presented two alternatives for FY2035 — a 260-ship fleet including 37 SSNs and 4 SSGNs, and a 325-ship fleet including 41 SSNs and 4 SSGNs.[20]

In May 2005, it was reported that a newly completed DOD study on attack submarine requirements called for maintaining a force of 45 to 50 boats.[21]

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[17]Department of Navy point paper dated Feb. 7, 2000. Reprinted in *Inside the Nav*y, Feb. 14, 2000, p. 5.

[18]U.S. Department of Defense, *Quadrennial Defense Review*, Sept. 2001, p. 23.

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

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

[21]Robert A. Hamilton, "Delegation Calls Report on Sub Needs Encouraging," *The Day (New London, CT)*, (continued...)

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

Debate Over Appropriateness Of Current 48-Boat Goal

Navy View.[22] In support of its position that 48 is the correct number of SSNs to meet future needs, the Navy in 2006 argued the following:

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

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

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

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

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

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

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

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[21](...continued)
May 27, 2005; Jesse Hamilton, "Delegation to Get Details on Sub Report," *Hartford (CT) Courant*, May 26, 2005.

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

requested missions. The theater allocation request process prior to 2004 did not include a priority breakdown. In general, ISR missions have been assigned as Critical or High Priority requirements. Other mission areas have been assigned from High Priority to Routine, based on the relative importance to the theater commander. No allocation is currently requested to support OPLAN or Other mission areas.

Each COCOM has authority to use its allocated SSNs as required to meet current national and theater priorities. The CJCS [Chairman Joint Chiefs of Staff] allocation order to the Submarine Force strictly directs an allotted number of SSN days of presence be provided, capable of meeting each theaters' [sic] taskings. The breakdown of mission priorities into Critical, High Priority, Priority and Routine is predominantly a construct to demonstrate how a COCOM could meet their priorities, given a specific level of SSN presence. It serves as an aid to the CJCS in apportioning limited SSN presence to the various theaters.

The number of SSNs allocated against Critical Missions enabled COCOMs to meet all requirements in 2004 and 2005, and 99% of the requirements in 2006. For High Priority missions, sufficient SSNs were allocated to meet 25%, 50% and 34% of requirements in 2004, 2005, and 2006 respectively. Overall, the number of SSNs forward deployed was sufficient to cover 66%, 61% and 54% of Combatant Commanders' requested SSN mission taskings in 2004, 2005, and 2006 respectively.[23]

Alternative View. Some observers believe that more than 48 SSNs will be needed to meet future needs. One such observer — retired Vice Admiral Albert Konetzni, Jr., a former commander of the U.S. Pacific Fleet submarine force — argued the following in 2006:[24]

- The Navy's SSN force-level analyses called for a force of 48 to 60 SSNs. In this context, a force of 48 SSNs looks more like a sour spot than a sweet spot.
- The Navy's SSN force-level analyses reflect "reverse engineering," in which an SSN force-level number is selected at the outset for affordability reasons, and assumptions used in the force-level study are then adjusted to produce that figure.
- The 1999 JCS study on SSN requirements remains valid today.
- All of the U.S. regional military commanders' requirements for day-to-day forward-deployed SSNs, and not just the 60% or so of those requirements that are being met, are critical.
- In light of the potential size of China's submarine force in 2020, a force of 48 SSNs

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

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

in that year will be insufficient.[25]

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

Appendix B: Submarine Design And Engineering Base

This appendix summarizes recent discussion concerning options for maintaining the submarine design and engineering base.

Recent Concern

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

Navy and industry officials, some Members of Congress, and some other observers are concerned that unless a major submarine-design project is begun soon, the submarine design and engineering base will begin to atrophy through the departure of experienced personnel. Rebuilding an atrophied submarine design and engineering base, Navy and industry officials believe, could be time-consuming, adding time and cost to the task of the next submarine-design effort, whenever it might begin. Concern about this possibility among some Navy and industry officials has been strengthened by the UK's difficulties a few years ago in designing its new Astute-class SSN. The UK submarine design and engineering base atrophied for lack of submarine-design work, and the subsequent Astute-class design effort experienced considerable delays and cost overruns. Submarine designers and engineers from GD/EB were assigned to the Astute-class project to help the UK overcome these problems.[26]

Potential Options

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

- **Expanded Virginia-class modification effort.** The Navy is currently funding certain work to modify the Virginia-class design, in part to reach the Navy's Virginia-class cost-reduction target. The scope of this effort could be expanded to include a greater number and variety of modifications. An expanded modification effort would add to the amount of submarine design and engineering work currently

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

programmed, but by itself might not be sufficient in terms of volume of work or number of skills areas engaged to fully preserve the submarine design and engineering base.

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

- **Diesel-electric submarine for Taiwan.** In April 2001, the Bush Administration announced a proposed arms-sales package for Taiwan that included, among other things, eight diesel-electric submarines.[27] Since foreign countries that build diesel-electric submarines appear reluctant to make their designs available for a program to build such boats for Taiwan, some observers have proposed that the United States develop its own design for this purpose. This option would generate a substantial volume of work and engage many skill areas. Uncertainty over whether and when this project might occur could make it difficult to confidently incorporate it into an integrated schedule of work for preserving the U.S. design and engineering base. Although the project would engage many skill areas, it might not engage all of them. Skills related to the design of nuclear propulsion plants, for example, might not be engaged. In addition, this project might raise concerns regarding the potential for unintended transfer of sensitive U.S. submarine technology — an issue that has been cited by the Navy in the past for not supporting the idea of designing and building diesel-electric submarines in the United States for sale to foreign buyers.[28]

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

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

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

conference version of the bill did not mandate it.

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

RAND Analysis

The Navy has acknowledged the need to devise a strategy to preserve the submarine design and engineering base, and asked the RAND Corporation to study the issue. The RAND report, which is to be published shortly, concludes that accelerating the start of design work on the next SSBN, and carrying out this work as a steady-state effort over several years, could maintain the submarine design and engineering base for several years. An exception, RAND found, relates to designers and engineers employed by about 50 supplier firms that design the submarine components they make for the Navy. The RAND report concluded that accelerating the start of design work of the next SSBN might not help maintain the designers and engineers at some of these firms.[29]

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