

CRS Report for Congress

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Navy DDG-1000 (DD(X)), CG(X), and LCS Ship Acquisition Programs: Oversight Issues and Options for Congress

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Navy DDG-1000 (DD(X)), CG(X), and LCS Ship Acquisition Programs: Oversight Issues and Options for Congress

Summary

The Navy wants to procure three new classes of surface combatants — the DDG-1000 (formerly DD(X)) destroyer, the CG(X) cruiser, and a smaller surface combatant called the Littoral Combat Ship (LCS). The Navy wants to procure 7 DDG-1000s, 19 CG(X)s, and 55 LCSs.

The first two DDG-1000s are to be procured in FY2007, with each ship being split-funded (i.e., incrementally funded) across FY2007 and FY2008. The estimated cost of each ship is \$3,291 million, for a total of \$6,582 million. The FY2007 budget requests \$2,568 million in procurement funding for the two ships. The Navy estimates that the next three DDG-1000s will cost an average of roughly \$2.5 billion each. The Navy wants to procure the first CG(X) in FY2011.

The first LCS was procured in FY2005, three more were procured in FY2006, and the Navy's proposed FY2007 budget requests \$521 million to procure two additional ships. The Navy's FY2007 unfunded requirements list (URL) — its "wish list" of items desired but not included in the FY2007 budget — includes an additional two LCSs for an additional \$520 million.

The DDG-1000/CG(X) and LCS programs raise several oversight issues for Congress, including the affordability of the DDG-1000/CG(X) program and the acquisition strategies for both programs.

FY2007 Defense Appropriations Bill (H.R. 5631). The House Appropriations Committee, in its report (H.Rept. 109-504 of June 16, 2006) on H.R. 5631, recommends approving the Navy's request for FY2007 DDG-1000 procurement funding to fully fund the procurement of one DDG-1000 rather than partially fund the procurement of the first two DDG-1000s. The report recommends approval of the \$521 million requested for procuring two LCSs (page 141) and recommends increasing funding for LCS research and development work by \$12.6 million above the requested amount (pages 239 and 250).

The Senate Appropriations Committee, in its report (S.Rept. 109-292 of July 25, 2006) on H.R. 5631, recommends approving the Navy's request for FY2007 procurement funding for the first two DDG-1000s (page 115), and increasing the Navy's request for FY2007 DDG-1000 research and development funding by a net \$1 million (pages 179 and 186). The report recommends funding the procurement of one LCS (rather than the requested two) in FY2007, and rescinding funding (in Section 8043) for one of the three LCSs procured in FY2006 (pages 114, 115-116, and 230-231). The report recommends increasing the FY2007 request for LCS research and development funding by \$1.8 million (pages 177 and 185).

This report will be updated as events warrant.

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Introduction

Issue for Congress

The Navy wants to procure three new classes of surface combatants — the DDG-1000 (formerly DD(X)) destroyer, the CG(X) cruiser, and a smaller surface combatant called the Littoral Combat Ship (LCS). The Navy wants to procure 7 DDG-1000s, 19 CG(X)s, and 55 LCSs.

The Navy wants to procure the first two DDG-1000s in FY2007, with each ship being split-funded (i.e., incrementally funded) across FY2007 and FY2008. The estimated cost of each ship is \$3,291 million, for a total of \$6,582 million. The two ships have received a total of \$1,010 million in FY2005 and FY2006 advance procurement funding. The FY2007 budget requests an additional \$2,568 million in procurement funding for the two ships. The final \$3,004 million in procurement funding for the two ships is to be requested in FY2008. The Navy wants to procure the first CG(X) in FY2011.

The first LCS was procured in FY2005, three more were procured in FY2006, and the Navy's proposed FY2007 budget requests \$521 million to procure two additional ships. The Navy's FY2007 unfunded requirements list (URL) — its "wish list" of items desired but not included in the FY2007 budget — includes an additional two LCSs for an additional \$520 million.

The issue for Congress is whether to approve, modify, or reject the Navy's proposals for the DDG-1000/CG(X) and LCS programs. Decisions that Congress makes on procurement of surface combatants will significantly affect future Navy capabilities, Navy funding requirements, and the U.S. defense industrial base.

Short CRS Reports on These Programs

Two short CRS reports — CRS Report RS21059, *Navy DDG-1000 (DD(X)) and CG(X) Programs: Background and Issues for Congress*, and CRS Report RS21305, *Navy Littoral Combat Ship (LCS): Background and Issues for Congress*, both by Ronald O'Rourke — provide introductory overviews of the DDG-1000, CG(X), and LCS programs, respectively, for readers seeking short discussions of these programs.

Background

Surface Combatants in the Navy

A Major Component of the Navy. Surface combatants are one of four major types of Navy combat ships, along with aircraft carriers, submarines, and amphibious ships.¹ In descending order of size, surface combatants include battleships, cruisers, destroyers, frigates, corvettes (also called light frigates) and Littoral Combat Ships (LCSs), and patrol craft. The Navy no longer operates battleships. The Navy's surface combatant force in recent decades has consisted largely of cruisers, destroyers, and frigates. The first LCS is scheduled to enter service in 2007.

In recent decades, surface combatants have accounted for 30% to 40% of the Navy's battle force ships. At the end of FY2005, they accounted for about 35% (99 of 282 battle force ships).

Roles, Missions, and Capabilities. From World War II until the 1980s, surface combatants were viewed largely as defensive escorts for protecting other Navy surface ships and commercial cargo ships. During this period, the primary missions of surface combatants were anti-air warfare (AAW) and anti-submarine warfare (ASW), and designs for Navy surface combatant classes were determined in large part by decisions as to whether a given class should emphasize AAW, ASW, or both. Additional but more secondary surface combatant missions during this period included anti-surface warfare (ASuW) and attacking coastal land targets with guns.

The role of Navy surface combatants changed in the 1980s with the advent of three major new systems — the Tomahawk cruise missile, the vertical launch system (VLS), and the Aegis ship combat system. The Tomahawk gave surface combatants an ability to attack enemy targets at ranges comparable to those achievable by carrier-based aircraft. The VLS, which is a battery of vertical missile-launch tubes countersunk into the ship's deck, permitted surface combatants to carry and launch an increased number of Tomahawks (and other missiles). The Aegis system — an integrated ship combat system that includes the sophisticated SPY-1 multifunction phased-array radar — significantly enhanced the AAW capability of surface combatants, giving them more potential for conducting operations independent of aircraft carriers. In the eyes of many observers, these three systems transformed surface combatants from defensive escorts back into significant offensive combatants.

The capabilities of Navy surface combatants are currently being enhanced by new networking systems such as the Cooperative Engagement Capability (CEC) for air-defense operations. Networking systems like these enable surface combatants, other ships, and aircraft to share large amounts of targeting-quality data on a rapid

¹ The Navy's fleet also includes mine warfare and support ships.

and continuous basis, permitting them to engage in what is called network-centric warfare (NCW).²

In coming years, surface combatants are scheduled to take on a growing role as platforms for conducting ballistic missile defense operations.³ The capabilities of surface combatants will also be enhanced in coming years by increased application of networking technology and by the addition of unmanned vehicles,⁴ electromagnetic rail guns, directed-energy weapons such as lasers, and improved equipment for detecting and countering mines. Some of these developments are to be enabled by the application to surface combatants of integrated electric-drive propulsion technology.⁵ As these developments unfold, surface combatants will likely continue to play a significant role in defending both themselves and other friendly surface ships against enemy submarines, surface ships, aircraft, and anti-ship cruise missiles.

Service Lives. For planning purposes, the Navy credits its cruisers and destroyers with 35-year expected service lives (ESLs), its frigates with 30-year ESLs, and its patrol craft with 20-year ESLs. In practice, however, numerous surface combatants in recent years have been decommissioned well before the end of their ESLs for various reasons, including decisions (like the one following the end of the Cold War) to reduce the size of the Navy, shifts in Navy mission requirements that made ships with certain capabilities inappropriate, and high operation and support (O&S) costs that made ships cost-ineffective compared to other approaches for performing their missions. The Navy in recent years has decommissioned numerous cruisers, destroyers, and frigates well before the end of their ESLs.

Current Surface Combatant Force. As of the end of FY2005, the Navy's force of larger surface combatants consisted of 99 ships in three classes:

- 23 Ticonderoga (CG-47) class cruisers;
- 46 Arleigh Burke (DDG-51) class destroyers; and
- 30 Oliver Hazard Perry (FFG-7) class frigates.

The Navy at the end of FY2005 also operated 9 Cyclone (PC-1) class patrol craft.

² For more on CEC and naval NCW in general, see CRS Report RS20557, *Navy Network-Centric Warfare Concept: Key Programs and Issues for Congress*, by Ronald O'Rourke.

³ For more on U.S. missile-defense programs, see CRS Report RL31111, *Missile Defense: The Current Debate*, coordinated by Steven A. Hildreth.

⁴ For more on naval unmanned vehicles, see CRS Report RS21294, *Unmanned Vehicles for U.S. Naval Forces: Background and Issues for Congress*, by Ronald O'Rourke.

⁵ For more on electric-drive technology and its application to Navy ships, see CRS Report RL30622, *Electric-Drive Propulsion for U.S. Navy Ships: Background and Issues for Congress*, by Ronald O'Rourke.

The CG-47s, which have a full load displacement of about 9,500 tons,⁶ are equipped with the Aegis system and are commonly referred to as Aegis cruisers. A total of 27 were procured between FY1978 and FY1988 and entered service between 1983 and 1994. The first five lack VLS and consequently cannot fire Tomahawks; the final 22 are equipped with a 122-tube VLS. The Navy plans to decommission the first five by the end of FY2006. Four of the five were decommissioned by the end of FY2005. The Navy has planned to modernize most or all of the final 22 and keep them in service to age 35.

The DDG-51s, which displace about 9,200 tons,⁷ are equipped with the Aegis system and are sometimes referred to as Aegis destroyers. They are also equipped with a 90- or 96-tube VLS. The first ship was procured in FY1985, and 62 were procured through FY2005. By the end of FY2005, 46 had entered service (the first in 1991) and 16 were in various stages of construction. The Navy wants the three ships procured in FY2005 to be the final ships in the program. The Navy plans to give these ships a mid-life modernization and operate them to age 35.

The FFG-7s, which displace about 4,000 tons, were designed as lower-cost, lower-capability surface combatants for use in lower-threat environments. They lack both the Aegis system and VLS. A total of 51 were procured between FY1973 and FY1984 and entered service between 1977 and 1989. Twenty-one were decommissioned by the end of FY2005. The Navy plans to decommission several more over the next decade. Of the 30 FFG-7s in service at the end of FY2005, 9 were operated as Naval Reserve Force (NRF) ships with crews consisting partly of Navy reservists.

All of these ships have landing pads for operating helicopters, and all but the first 28 DDG-51s have hangars for embarking and supporting 2 helicopters.

The PC-1s, which displace about 330 tons, are high-speed craft that were built to support special operations forces. They have also been used by the Navy and Coast Guard for port-security operations. A total of 13 PC-1s were procured between FY1990 and FY1996 for the Navy and entered service with the Navy between 1993 and 2000. The lead ship, PC-1, was donated to the Philippine Navy and commissioned into service with that navy in March 2004. Four other ships in the class have been loaned to the U.S. Coast Guard. PC-1s in service with the U.S. Navy are classified as local defense and miscellaneous support forces and consequently are not included in the total number of battle force ships in the Navy.

⁶ Full load displacement is the weight of the ship including loads such as fuels and water. Another measure of ship size is light (i.e., empty) ship displacement, which excludes such loads. Full load displacement is the more commonly used measure in general discussions of Navy ships, but light displacement is generally more useful in estimating ship construction costs.

⁷ This is the figure for the 29th and following ships in the class, which are referred to as the Flight IIA ships. The first 28 ships in the class, which are referred to as the Flight I and II ships, were built to a different design that lacked a helicopter hangar and have a full load displacements of about 8,900 tons. Flight IIA ships have a light ship displacement of about 6,950 tons.

Surface Combatant Force-Structure Goal

The Navy in coming years is proposing to maintain a fleet of 313 ships, including 88 cruisers and destroyers — 7 DDG-1000s, 19 CG(X)s, and 62 DDG-51s — and 55 LCSs.⁸ Under this proposal, surface combatants would account for about 46% of the total number of ships in the Navy.

Surface Combatant Industrial Base

Construction Yards. All cruisers, destroyers, and frigates procured since FY1985 have been built at two shipyards — General Dynamics’ Bath Iron Works (GD/BIW) in Bath, ME, and Northrop Grumman’s Ingalls shipyard in Pascagoula, MS, which forms part of Northrop Grumman Ship Systems (NGSS).⁹ Both yards have long histories of building larger surface combatants. Construction of Navy surface combatants in recent years has accounted for virtually all of GD/BIW’s ship-construction work and for a significant share of Ingalls’ ship-construction work.

The Lockheed-led LCS industry team is building its LCSs at Marinette Marine of Marinette, WI, and Bollinger Shipyards of Louisiana and Texas; the GD-led LCS industry team is building its LCSs at Austal USA of Mobile, AL. The Navy’s PC-1 class patrol boats were built at Bollinger Shipyards at Lockport, LA.

Overhaul and Repair Yards. Navy surface combatants are overhauled, repaired, and modernized at GD/BIW, Northrop/Ingalls, other private-sector U.S. shipyards, and government-operated naval shipyards (NSYs).

System Integrators and Supplier Firms. Lockheed Martin and Raytheon are generally considered the two leading Navy surface ship radar makers and combat system integrators. Boeing is another system integrator and maker of Navy surface ship weapons and equipment. The surface combatant industrial and technological base also includes hundreds of additional firms that supply materials and components. The financial health of the supplier firms has been a matter of concern in recent years, particularly since some of them are the sole sources for what they make for Navy surface combatants.¹⁰

⁸ For more on the proposed 313-ship fleet, see CRS Report RL32665, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, by Ronald O’Rourke.

⁹ NGSS also includes the Avondale shipyard near New Orleans and a third facility at Gulfport, MS, from Northrop Grumman’s Ship Systems (NGSS) division. The Navy has not procured any frigates since FY1984, when the last FFG-7 was procured.

¹⁰ The surface combatant industrial base also includes naval architects and engineers who work for shipyards, systems integrators, supplier firms, and independent naval architectural engineering firms, as well as research and development organizations and laboratories in the Navy and at shipyards, system integrators, supplier firms, Federally Funded Research and Development Centers (FFRDCs), and universities and colleges.

Surface Combatant Acquisition Programs

On November 1, 2001, the Navy announced that it was replacing a destroyer-development effort called the DD-21 program, which it had initiated in 1994-1995, with a new Future Surface Combatant Program aimed at developing and acquiring a family of three new classes of surface combatants:

- **a destroyer called DD(X)** for the precision long-range strike and naval gunfire mission,
- **a cruiser called CG(X)** for the missile and air defense mission, and
- **a smaller combatant called the Littoral Combat Ship (LCS)** to counter submarines, small surface attack craft (also called “swarm boats”) and mines in heavily contested littoral (near-shore) areas.

On April 7, 2006, the Navy announced that it had redesignated the DD(X) program as the DDG-1000 program.¹¹

Table 1 shows planned procurement of DDG-1000s, CG(X)s, and LCSs in the FY2007-FY2011 Future Years Defense Plan (FYDP).

Table 1. Planned DDG-1000, CG(X), and LCS Procurement

	FY2007	FY2008	FY2009	FY2010	FY2011
DDG-1000	2		1	1	1
CG(X)					1
LCS	2	3	6	6	6

Source: FY2007-FY2011 Future Years Defense Plan (FYDP).

DDG-1000 (formerly DD(X)) Destroyer

The Navy wants to procure the first two DDG-1000s in FY2007, with each ship being split-funded (i.e., incrementally funded) across FY2007 and FY2008. The estimated cost of each ship is \$3,291 million, for a total of \$6,582 million. The two ships have received a total of \$1,010 million in FY2005 and FY2006 advance procurement funding. The FY2007 budget requests an additional \$2,568 million in procurement funding. The final \$3,004 million in procurement funding for the two ships is to be requested in FY2008.

The Navy estimates that the next three DDG-1000s will cost an average of roughly \$2.5 billion each. Section 123 of the conference report on the FY2006

¹¹ The Navy also confirmed in the April 7, 2006, announcement that the first ship in the class, DDG-1000, is to be named the Zumwalt, in honor of Admiral Elmo R. Zumwalt, the Chief of Naval operations from 1970 to 1974. The decision to name the first ship after Zumwalt was made by the Clinton Administration in July 2000, when the program was still called the DD-21 program.

defense authorization bill (H.R. 1815/P.L. 109-163), limits the cost of the fifth DDG-1000 to \$2.3 billion, plus adjustments for inflation and other factors.

The Navy during the latter months of 2005 took steps to reduce the cost of the lead DDG-1000 by about \$265 million, and follow-on DDG-1000s by about \$214 million each. These steps included reducing the gun magazine capacity of the design from 920 shells to 600 shells. In spite of these actions, the total estimated procurement cost for the first five DDG-1000s (\$14,200 million) has increased about 3.2% from the total shown in the FY2006 budget submitted to Congress in early 2005 (\$13,761 million).

The DDG-1000 destroyer is effectively the successor to the Navy's previously planned DD-21 destroyer and will resemble the DD-21 in terms of mission orientation and ship design. The DDG-1000 would be a multimission ship with an emphasis on land-attack operations that reflects a desire to replace the large-caliber naval gunfire support capability that the Navy lost in 1990-1992, when it removed its four reactivated Iowa-class battleships from service.

The DDG-1000 would have a reduced-size crew (compared to the Navy's current destroyers and cruisers) of about 142 sailors so as to permit reduced operating and support (O&S) costs. The ship would incorporate a significant number of new technologies, including a wave-piercing, tumblehome hull design for reduced signatures, a superstructure made partly of large sections of composite materials rather than steel or aluminum, an integrated electric-drive propulsion system, a total-ship computing system for moving information about the ship, automation technologies for the reduced-sized crew, a dual-band radar, a new kind of VLS, and two copies of a 155mm gun called the Advanced Gun System (AGS).

With a full load displacement of 14,564 tons, the DDG-1000 would be roughly 50% larger than the Navy's current 9,500-ton Aegis cruisers and destroyers, and larger than any Navy destroyer or cruiser since the nuclear-powered cruiser Long Beach (CGN-9), which was procured in FY1957.

The Navy originally envisaged procuring a total of 16 to 24 DDG-1000s. Navy officials subsequently testified in February and March 2005 that they had a requirement for 8 to 12. The Navy's reported new 313-ship plan calls for a total of seven.

Table 2 shows DDG-1000 funding through FY2011.

Since September 30, 2005, the Navy has managed the DDG-1000 program through a series of separate contracts with major DDG-1000 contractors, including NGSS, GD/BIW, Raytheon, and BAE Systems (the maker of the AGS). Under this arrangement, the Navy in effect is acting in at least some respects as the overall system integrator for the program.

Under an earlier DDG-1000 acquisition strategy approved by the Under Secretary of Defense for Acquisition, Technology, and Logistics (USD AT&L) on February 24, 2004, the first DDG-1000 would be built by NGSS, the second would

be built GD/BIW, and contracts for building the first six would be equally divided between NGSS and GD/BIW.

Table 2. DDG-1000/CG(X) Program Funding, FY2002-FY2011
(millions of then-year dollars, rounded to nearest million)

	02	03	04	05	06	07	08	09	10	11	FY0 2- FY11
Research, Development, Test & Evaluation, Navy (RDTEN) account											
DDG-1000	490	895	1002	1120	1068	794	471	369	416	443	7068 ^a
CG(X)	0	0	0	0	60	24	186	328	470	409	1477 ^a
Subtotal RDTEN	490	895	1002	1120	1128	818	657	697	886	852	8545^a
Shipbuilding and Conversion, Navy (SCN) account (including advance procurement)											
DDG-1000 1	0	0	0	220	285	1284	1502	0	0	0	3291 ^d
<i>Construction</i>	0	0	0	0	12 ^b	1271	1502	0	0	0	2785
<i>DD/NRE^c</i>	0	0	0	220	273	13	0	0	0	0	506
DDG-1000 2	0	0	0	84	421	1284	1502	0	0	0	3291 ^d
<i>Construction</i>	0	0	0	0	12 ^b	1271	1502	0	0	0	2785
<i>DD/NRE^c</i>	0	0	0	84	409	13	0	0	0	0	506
DDG-1000 3	0	0	0	0	0	0	51	2556	0	0	2607 ^d
DDG-1000 4	0	0	0	0	0	0	0	51	2650	0	2701 ^d
DDG-1000 5	0	0	0	0	0	0	0	0	51	2259	231 ^d 0
DDG-1000 6+	0	0	0	0	0	0	0	0	0	50	50
CG(X) 1	0	0	0	0	0	0	0	0	0	3235	3235
<i>Construction</i>	0	0	0	0	0	0	0	0	0	2701	2701
<i>DD/NRE^c</i>	0	0	0	0	0	0	0	0	0	534	534
CG(X) 2+	0	0	0	0	0	0	0	0	0	0	0
Subtotal SCN	0	0	0	304	706	2568	3055	2607	2701	5544	17485
TOTAL	490	895	1002	1424	1834	3386	3712	3304	3587	6396	26030

Source: Navy office of Legislative Affairs, March 6, 2006.

- Figures do not include \$1,111.4 million in RDT&E funding provided for DD-21/DD(X)/DDG-1000 program in FY1995-FY2001. Figures also do not include funding for the CG(X) radar in Navy R&D program element (PE) 0604307N. Additional funding required after FY2011. GAO has reported that total DDG-1000/ CG(X) RDT&E costs are roughly \$10 billion.
- Funding for procurement of long lead time materials (forgings) for AGSs for each DDG-1000.
- Detailed design and nonrecurring engineering costs for the class.
- In the FY2006 budget submission, the second DDG-1000 was to be procured in FY2008 rather than FY2007, and the estimated procurement costs of the first five DDG-1000s were \$3,291 million, \$3,061 million, \$2,543 million, \$2,630 million, and \$2,236 million, respectively.

In February 2005, Navy officials announced that they would seek approval from USD AT&L to instead hold a one-time, winner-take-all competition between NGSS and GD/BIW to build all DDG-1000s. On April 20, 2005, the USD AT&L issued a decision memorandum stating that “at this time, I consider it premature to change the shipbuilder portion of the acquisition strategy which I approved on February 24, 2004.” The memorandum agreed to a Navy proposal to separate the system-development and software-development contracts for the DDG-1000 from the detailed-design effort for the DDG-1000. The memorandum said this change “is

projected to result in savings to the Department [of Defense], and helps to ensure that all shipbuilder acquisition strategy options are preserved.”

Several Members of Congress expressed opposition to Navy’s proposal for a winner-take-all competition. Congress included a provision (Section 1019) in the Emergency Supplemental Appropriations Act for 2005 (H.R. 1268/P.L. 109-13 of May 11, 2005) prohibiting a winner-take-all competition. The provision effectively required the participation of at least one additional shipyard in the program but did not specify the share of the program that is to go to the additional shipyard.

On May 25, 2005, the Navy announced that, in light of Section 1019 of P.L. 109-13, it wanted to shift to the currently proposed “dual-lead-ship” acquisition strategy, under which two DDG-1000s would be procured in FY2007, with one to be designed and built by NGSS and the other by GD/BIW. (As mentioned earlier, each ship would be split-funded (i.e., incrementally funded) in FY2007 and FY2008.)

Section 125 of the FY2006 defense authorization act (H.R. 1815/P.L. 109-163) again prohibited the Navy from using a winner-take-all acquisition strategy for procuring its next-generation destroyer. The provision effectively requires the participation of at least one additional shipyard in the program but does not specify the share of the program that is to go to the additional shipyard.

A Defense Acquisition Board (DAB) meeting scheduled for April 29, 2005, to grant the DDG-1000 “Milestone B” approval to proceed was postponed, reportedly because of disagreement between the Navy and CAIG over estimated DDG-1000 procurement costs. The meeting was convened on November 10, 2005, but the DAB did not reach a decision at the meeting. The DAB instead requested more information about the program.

On November 23, 2005, Kenneth Krieg, the USD AT&L, granted Milestone B approval for the DDG-1000, permitting the program to enter the System Development and Demonstration (SDD) phase. Krieg also approved a low rate initial production quantity of eight ships. (The Navy now wants to build seven.) Krieg reportedly approved the Navy’s proposed dual-lead-ship acquisition strategy, and the November 23, 2005, memorandum from Krieg about his decision refers to “the two lead ships.” Krieg’s memorandum states:

On November 10, 2005, I chaired a Defense Acquisition Board (DAB) review of the Navy’s request for Milestone B approval for the DD(X) program. Based on that meeting and subsequent discussions held on November 22, 2005, I approve Milestone B for DD(X) and authorize the program’s entry into the System Development and Demonstration phase of the acquisition process....

I have also separately approved the DD(X) Acquisition Program Baseline and Acquisition Strategy Report (ASR). While there are differences between the OSD Cost Analysis Improvement Group’s cost estimate and the Navy’s cost estimate, I understand the differences and direct the Navy to fund the program to its cost estimate. I direct the Navy to submit, for my approval, an implementation plan for management controls to monitor the major cost estimate differences by January 31, 2006.

The Navy will return for a DAB Program Review before the Navy exercises the contract options for construction of the two lead ships. The Navy will provide an updated ASR and an updated cost assessment prior to this review.

The Navy says it plans to review the acquisition strategy for the third and following ships in the program in late-2006. The Navy has not ruled out the possibility of using competition to determine who will build these ships.

CG(X) Cruiser

The CG(X) is the Navy's planned replacement for the CG-47s. The Navy wants the DDG-1000 hull and DDG-1000 technologies to serve as the basis for the CG(X). Compared to the DDG-1000, the CG(X):

- would be equipped with a more powerful radar that could support missile-defense operations.
- might be equipped with additional missile-launching tubes, and might lack one or both of the DDG-1000s AGSs.
- might be somewhat larger and more expensive to procure.

A Navy long-range shipbuilding plan that the Navy submitted to Congress in May 2003 called for the first CG(X) to be procured in FY2018. The FY2006-FY2011 FYDP accelerated the planned procurement of the lead CG(X) to FY2011. The FY2007-FY2011 FYDP retains FY2011 as the year for lead-ship procurement. **Table 2** shows CG(X) funding through FY2011.

Littoral Combat Ship (LCS)

The LCS is a small, fast surface combatant that uses modular "plug-and-fight" mission packages, including unmanned vehicles (UVs). Rather than being a multimission ship like the Navy's current large surface combatants, the LCS is a focused-mission ship that will be equipped to perform one or two missions at any one time. The ship's mission orientation can be changed by changing out its mission packages. The basic version of the LCS, without any mission packages, is referred to as the LCS sea frame.

The LCS's primary intended missions are countering enemy mines, submarines, and fast attack craft in littoral (near-shore) waters. Secondary missions include intelligence, surveillance, and reconnaissance (ISR); maritime intercept; special operations forces (SOF) support; and logistics support for movement of personnel and supplies. The LCS is also mentioned in connection with the Navy's role in the Global War on Terrorism (GWOT).¹²

¹² For more on the Navy's role in the GWOT, see CRS Report RS22373, *Navy Role in Global War on Terrorism (GWOT) — Background and Issues for Congress*, by Ronald O'Rourke.

The LCS would displace 2,500 to 3,000 tons — about the size of a corvette or Coast Guard cutter. It would have a maximum speed of about 45 knots, compared to about 30 knots for the Navy's current surface combatants. The LCS would have a shallower draft than the Navy's current surface combatants, permitting it to operate in certain coastal waters and visit certain ports that are not accessible to the Navy's current large surface combatants. The LCS would employ automation to achieve a reduced crew size of 40 "core" crew members, not including the additional crew members that would operate the embarked mission modules.

In FY2005, Congress approved the Navy's plan to fund the construction of the first two LCSs using research and development funds rather than shipbuilding funds, funded the first LCS's construction cost, required the second LCS to be built to a different design from the first, prohibited the Navy from requesting funds in FY2006 to build a third LCS, and required all LCSs built after the lead ships of each design to be funded in the Navy's shipbuilding account rather than its research and development account.

In FY2006, Congress funded the procurement of the second, third, and fourth LCSs. (The Navy requested one LCS for FY2006, consistent with Congress's FY2005 action. Congress funded that ship and provided funding for two additional ships.) Congress in FY2006 also established a \$220-million unit procurement cost limit on the fifth and sixth LCSs (the two ships to be procured in FY2007), plus adjustments for inflation and other factors, required an annual report on LCS mission packages, and made procurement of more than four LCSs contingent on the Navy certifying that there exists a stable design for the LCS.

For FY2007, the Navy is requesting \$521 million to procure two additional LCSs. Section 124 of the conference report on the FY2006 defense authorization bill (H.R. 1815/P.L. 109-163), limits the cost of these two ships to \$220 million per ship, plus adjustments for inflation and other factors. The Navy's FY2007 unfunded requirements list (URL) — its "wish list" of items desired but not included in the FY2007 budget — includes an additional two LCSs for an additional \$520 million.

On May 27, 2004, the Navy awarded contracts to teams led by Lockheed Martin and General Dynamics (GD) for final system design of two versions of the LCS, with options for detailed design and construction of up to two LCSs each. The Lockheed team is building the FY2006 LCS and one of the FY2007 ships, while the GD team is building the other two FY2006 ships. The Navy wants to build LCSs to the two teams' initial (i.e., "Flight 0") LCS designs through at least FY2009 before deciding whether to shift to one or two modified Flight 1 designs. Lockheed is building its LCSs at Marinette Marine of Marinette, WI, and Bollinger Shipyards of Louisiana and Texas,¹³ with the first being built by Marinette. GD is building its LCSs at Austal USA of Mobile, AL.¹⁴

¹³ Bollinger operates about 15 shipyards and ship-related facilities in Louisiana and Texas, of which three, located in Lockport, LA, Gretna, LA, and Amelia, LA, are for building new ships.

¹⁴ Austal USA was created in 1999 as a joint venture between Austal Limited of Henderson, (continued...)

The Navy procured the first and second LCSs through the Navy's research and development account rather than the Navy's ship-procurement account. The Navy is procuring LCS mission modules through the Other Procurement, Navy (OPN) account rather than the Navy's ship-procurement account.

Table 3 shows LCS funding through FY2011. The Navy's FY2007 budget submission estimates the total procurement cost of a class of 56 (not 55) LCS sea frames at about \$17.6 billion in then-year dollars. Using figures in **Table 3**, when other LCS program costs are included, the LCS program might have a total acquisition (development plus procurement) cost of more than \$26 billion, or more than \$470 million per ship, in then-year dollars.

Table 3. LCS Program Funding, FY2002-FY2011
(millions of then-year dollars; totals may not add due to rounding)

	03	04	05	06	07	08	09	10	11	Total thru FY11
Research, Development, Test & Evaluation, Navy (RDT&EN) account										
Ship 1 construction (<i>qty</i>)	0	0	206.7 (1)	59.2	8.5	0	0	0	0	274.5
Ship 2 construction (<i>qty</i>)	0	0	16.0	207.1 (1)	55.0	0	0	0	0	278.1
Ships 1 and 2 outfit- ting/post delivery	0	0	0	8.7	36.7	36.8	7.1	0	0	89.3
LCS ship development	35.3	160.1	228.0	86.0	57.0	60.3	43.2	43.9	22.4	736.2
LCS mission package project (<i>qty</i>)	0	0	0	213.0 (3)	162.3 (1)	90.4	82.5	100.1	40.8	689.2 (4)
Subtotal RDT&EN	35.3	160.1	450.8	574.0	319.6	187.6	132.8	144.1	63.2	2067.3
Shipbuilding and Conversion, Navy (SCN) account										
Ships 3-27 construction (<i>qty</i>)	0	0	0	440.0 (2)	520.7 (2)	947.6 (3)	1764.3 (6)	1774.2 (6)	1825.4 (6)	7272.3 (25)
Outfitting & post delivery	0	0	0	0	13	37	70	95	122	337
Subtotal SCN	0	0	0	440.0	533.7	984.6	1834.3	1869.2	1947.4	7609.3
Other Procurement, Navy (OPN) account (for LCS mission packages)										
Subtotal OPN (<i>qty</i>)	0	0	0	40.1 (0)	79.1 (1)	207.6 (3)	652.3 (13)	656.2 (12)	720.2 (15)	2355.5 (44)
Weapons Procurement, Navy (WPN) account										
Subtotal WPN	0	0	0	0	0	12.5	39.1	91.0	134.2	276.8
TOTAL	35.3	160.1	450.8	1054.1	919.3	1355.3	2588.5	2665.6	2743.0	12308.9

Source: Navy Office of Legislative Affairs, March 6 and April 17, 2006.

Table 4 shows projected procurement of DDG-1000s, CG(X)s, LCSs, and DDG(X)s as shown in a Navy 30-year shipbuilding plan dated December 30, 2005.

¹⁴ (...continued)

Western Australia and Bender Shipbuilding & Repair Company of Mobile, AL. The Lockheed LCS team also includes GD/BIW as prime contractor, to provide program management and planning, to provide technical management, and to serve as "LCS system production lead."

The DDG(X), not to be confused with the DD(X), is the Navy's long-term notional projected replacement for today's DDG-51 Aegis destroyers. Note that **Table 4** includes a total of 18 rather than 19 CG(X)s.

Table 4. Projected Procurement Of Surface Combatant

FY	DDG-1000	CG(X) ^b	LCS ^c	DDG(X) ^d
07	2 ^a		2	
08	0 ^a		3	
09	1		6	
10	1		6	
11	1	1	6	
12	1		6	
13	1	1	5	
14		1	6	
15		2	6	
16		1	5	
17		1		
18		2		
19		2		
20		2		
21		2		
22		2		
23		1		1
24				2
25				2
26				2
27				2
28				2
29				2
30			1	2
31			1	2
32			2	2
33			3	2
34			6	2
35			6	2
36			4	2

Source: U.S. Department of the Navy, *Draft Report to Congress on Annual Long-Range Plan for Construction of Naval Vessels for FY 2007*. Table 3 on page 7.

- Each of the two DDG-1000s to be procured in FY2007 is to be split-funded (i.e., incrementally funded) across FY2007 and FY2008.
- The total of 18 rather than 19 CG(X)s in the table is as shown in the draft Navy report.
- Plus one LCS procured in FY2005 and another three procured in FY2006.
- Projected long-term notional replacement for today's DDG-51s.

DDG-1000/CG(X) Oversight Issues for Congress

Accuracy of Navy Cost Estimates

Although the Navy substantially increased estimated DDG-1000 procurement costs between 2004 and 2005, some observers believe the Navy's estimates are still too low. The Cost Analysis Improvement Group (CAIG) within the Office of the Secretary of Defense (OSD) reportedly believed in 2005 that DDG-1000 procurement costs may be 20% to 33% higher than the Navy's estimates.¹⁵ A Congressional Budget Office (CBO) official stated that the CAIG's estimate for the lead ship might be \$4.1 billion, while its estimate for the fifth ship might be \$3.0 billion.¹⁶ CBO itself estimated in 2005 that the lead ship may cost as much as \$4.7 billion, and that the fifth ship may cost \$3.4 billion.¹⁷ **Table 5** summarizes these estimates.

Table 5. Estimated DDG-1000 Unit Procurement Costs
(billions of dollars)

	Navy estimate	Reported CAIG estimate in 2005	CBO estimate in 2005
Lead ship	\$3.3	\$4.1	\$4.7
Fifth ship	\$2.3	\$3.0	\$3.4

Source: U.S. Navy data and July 20, 2005 CBO testimony before Projection Forces Subcommittee of House Armed Services Committee. The CAIG figures shown are from the CBO testimony, which CBO stated are according to an unconfirmed report about the CAIG estimates.

CBO has also questioned the accuracy of the Navy's estimate of the annual operating and support (O&S) cost of a DDG-1000 compared to that of a DDG-51. The Navy estimates that over a 35-year life cycle, a DDG-1000 would cost an average of about \$12 million or \$13 million less per year to operate and support than a DDG-51. CBO estimated in 2005 that the reduction in O&S costs for a DDG-1000 relative to a DDG-51 might range from zero to \$10 million per year.¹⁸

¹⁵ Tony Capaccio, "Destroyer May Cost 33% More Than Navy Budgeted, Pentagon Says," *Bloomberg.net*, May 4, 2005; Christopher P. Cavas, "Rising Costs of DD(X) Threaten U.S. Fleet Plans," *DefenseNews.com*, May 2, 2005; Christopher J. Castelli, "Pentagon Postpones DD(X) DAB Meeting To Resolve Cost Estimates," *Inside the Navy*, May 2, 2005.

¹⁶ Spoken testimony (transcript of hearing) of J. Michael Gilmore, Assistant Director for National Security, Congressional Budget Office, at a July 20, 2005, hearing on the DDG-1000 program before the Projection Forces Subcommittee of the House Armed Services Committee. Gilmore said these figures are from an unconfirmed report about the CAIG estimates.

¹⁷ *Ibid.*

¹⁸ Statement of J. Michael Gilmore, Assistant Director for National Security, Congressional Budget Office, [on] *The Navy's DD(X) Destroyer Program*, in U.S. Congress, House Committee on Armed Services, Subcommittee on Projection Forces, July 19, 2005, p. 5.

Program Affordability and Cost Effectiveness

Procurement Cost Affordability. At the end of a July 19, 2005, hearing on the DDG-1000 program before the Projection Forces Subcommittee of the House Armed Services Committee, DOD and Navy witnesses were asked to provide the subcommittee with their own individual views on the procurement cost figures at which the lead DDG-1000 and a follow-on DDG-1000 (defined as the fifth ship) would become unaffordable. At the beginning of part two of the hearing, which was held on July 20, the chairman of the subcommittee, Representative Roscoe Bartlett, stated that the figures provided by the witnesses ranged from \$4 billion to \$4.5 billion for the lead ship and \$2.5 billion to \$2.9 billion for the fifth ship. As shown in **Table 6**, the 2005 CAIG and CBO estimates discussed earlier are at or above these figures.

Table 6. Views On Maximum Affordable DDG-1000 Cost
(billions of dollars)

	Navy estimate	DOD/Navy 2005 views on maximum affordable cost	Reported CAIG estimate in 2005	CBO estimate in 2005
Lead ship	\$3.3	\$4.0-\$4.5	\$4.1	\$4.7
Fifth ship	\$2.3	\$2.5-\$2.9	\$3.0	\$3.4

Source: U.S. Navy data and transcript of July 20, 2005, hearing before Projection Forces Subcommittee of House Armed Services Committee. See also the source note for the previous table.

The Navy argues that the DDG-1000 is affordable in terms of procurement cost because it is confident in its DDG-1000 procurement cost estimates, which are much less than the maximum-affordable procurement cost figures in **Table 6**. Skeptics could argue that the DDG-1000 is not affordable in terms of procurement cost because the 2005 CAIG and CBO procurement cost estimates for the ship are at or above the maximum-affordable figures in **Table 6**. They could also argue that the Navy's decision to reduce the planned DDG-1000 procurement from an originally envisaged total of 16 to 24 ships to the currently planned total of 7 ships, and the projected long-term shortfall in cruisers and destroyers (see discussion below), are evidence that, in terms of procurement cost, the DDG-1000 is not affordable in the numbers the Navy needs.

Total Life-Cycle Cost Affordability. The Navy argues that, in terms of total life-cycle cost (i.e., procurement plus lifetime O&S cost), the DDG-1000 is more affordable than might appear from looking only at procurement cost, because the ship will have lower lifetime O&S costs than existing Navy cruisers and destroyers. As mentioned above, the Navy estimates that over a 35-year life cycle, a DDG-1000 would cost an average of about \$12 million or \$13 million less per year to operate and support than a DDG-51. Over a 35-year life, this equates to a savings of \$420 million to \$455 million in O&S costs relative to a DDG-51. On this basis, the Navy argues that a force of 10 DDG-51s would have a total 35-year O&S cost \$4.2 billion to \$4.5 billion less than that of force of 10 DDG-51s.

Skeptics could argue that reducing a ship's future O&S costs, though desirable, does not make that ship any more affordable to procure in the budget that funds its procurement. Skeptics could also argue that, in terms of total life-cycle cost, the DDG-1000 is not as affordable as the Navy argues, for the following reasons:

- The Navy's estimated 35-year O&S savings of \$420 million to \$450 million only partially offsets difference between the DDG-1000's higher procurement cost and the procurement cost of a DDG-51 when DDG-51s are procured at a rate of two per year.
- Office of Management and Budget (OMB) Circular A-94¹⁹ and standard business procedures call for future funding flows to be calculated on a present-value basis so as to capture the investment value of money over time. When calculated on this basis, the single-ship 35-year savings figure is reduced by about 46%, to \$226 million to \$242 million, and the 10-ship 35-year savings figure of \$4.5 billion (assuming procurement of one ship per year) is reduced by about 53%, to about \$2.1 billion.²⁰
- The above calculations accept the Navy's estimate that a DDG-1000 would, on a 35-year basis, have an annual O&S cost \$12 million to \$13 million less than that of a DDG-51. As mentioned above, CBO has questioned the accuracy of the Navy's estimate of relative DDG-1000 and DDG-51 O&S costs, and has estimated that the difference might range from zero to \$10 million per year.

Table 7 below compares follow-ship DDG-51 and DDG-1000 total procurement and life-cycle O&S costs using figures from the discussion above. The table uses constant FY2007 dollars, which results in some adjustments to the above figures. As can be seen in the table, on a present-value basis, the combined procurement and 35-year life-cycle O&S cost of the follow-on DDG-1000 is 16% greater than that of the DDG-51 using the Navy's estimates, or 91% to 101% greater using CBO's estimates.

¹⁹ U.S. Office of Management and Budget, *Circular A-94, Guidelines And Discount Rates For Benefit-Cost Analysis of Federal Programs*, available at [<http://www.whitehouse.gov/omb/circulars/a094/a094.pdf>].

²⁰ CRS calculations using the 3.1% real discount rate set forth in **Appendix C** (Revised Jan. 2005) for discounting constant-dollar flows of 30 years or more.

Table 7. Follow-ship DDG-51 and DDG-1000 Costs
(millions of constant FY2007 dollars)

	Constant FY2007 dollars			Present-value calculation		
	Procurement cost	35-year lifecycle O&S cost	Total	Procurement cost	35-year lifecycle O&S cost	Total
Navy Estimate						
Follow-on DDG-51	1,393	2,115	3,508	1,393	1,133	2,526
Follow-on DDG-1000	2,058	1,627	3,685	2,058	871	2,929
DDG-1000 less DDG	665	(488)	177	665	(262)	403
DDG-1000 as % DDG-51	148%	77%	105%	148%	77%	116%
CBO Estimate (with \$10-million annual DDG-1000 O&S cost savings vs. DDG-51)						
Follow-on DDG-51	1,393	1,120	2,513	1,393	600	1,993
Follow-on DDG-1000	3,400	770	4,170	3,400	412	3,812
DDG-1000 less DDG	2,007	(350)	1,657	2,007	(188)	1,819
DDG-1000 as % DDG-51	244%	69%	166%	244%	69%	191%
CBO Estimate (with zero annual DDG-1000 O&S cost savings vs. DDG-51)						
Follow-on DDG-51	1,393	1,120	2,513	1,393	600	1,993
Follow-on DDG-1000	3,400	1,120	4,520	3,400	600	4,000
DDG-1000 less DDG	2,007	0	2,007	2,007	0	2,007
DDG-1000 as % DDG-51	244%	100%	180%	244%	100%	201%

Source: CRS calculations based on Navy and CBO DDG-1000 and DDG-51 cost data and a 3.1% real discount rate, as specified in Appendix C to OMB Circular A-94 for discounting constant-dollar flows of 30 years or more. DDG-51 procurement cost is an average unit cost based on a two-per-year procurement. (For a three-per-year procurement rate, the average unit procurement cost would be \$1,251 million.)

Cost Effectiveness. The Navy argues that the DDG-1000 would be cost effective because the higher procurement cost of the DDG-1000 compared to previous Navy surface combatants would be more than offset by the DDG-1000's numerous and significant improved capabilities.²¹ Skeptics could argue that these capability

²¹ The Navy states that, compared to the DDG-51, these capability improvements include, among other things:

- three-fold improvement in capability against anti-ship cruise missiles, including significantly better radar performance in situations involving near-land radar clutter;
- a 10-fold improvement in overall battle force defense capability, in part because of a 5-fold improvement in networking bandwidth capacity;
- 15% more capability to defend against group attacks by enemy surface craft (i.e., "swarm boats");
- a 50-fold improvement (i.e., reduction) in radar cross-section, which dramatically enhances survivability and reduces by half the total number of missiles that need to be fired in an intercept engagement;
- a 10-fold increase in operating area against mines in shallow-water regions;
- 3 times as much naval surface fire support capability, including an ability to

(continued...)

improvements, though significant, are not worth the ship's cost, particularly if that cost is closer to the CAIG or CBO estimates than to the Navy's estimates, and that if the DDG-1000's most-needed contribution to fleet capabilities is the naval surface fire support capability provided by the ship's two AGSs, then the DDG-1000 represents a very expensive way to add this capability to the fleet.

Projected Long-Term Cruiser-Destroyer Shortfall

The Navy's long-range plan for procuring cruisers and destroyers (see **Table 4**) does not include enough ships to maintain a force of 88 cruisers and destroyers over the long run. If all the cruisers and destroyers in **Table 4** are procured, and if the Navy's plan for procuring two DDG(X)s per year is extended through FY2039, then, as shown in **Table 8**, the cruiser-destroyer force will reach 88 ships in 2016, peak at 95 ships in 2021, fall below 88 ships in 2027, reach a minimum of 62 ships (about 30% below the 88-ship goal) in FY2044-FY2046, and recover somewhat to a steady-state level of 70 ships — about 20% below the 88-ship goal — after 2050.

If, for affordability reasons, no more than one DDG-1000 or CG(X) per year can be procured, and a total of 17 rather than 25 DDG-1000s and CG(X)s are consequently procured, then as shown in **Table 8**, the cruiser-destroyer force will reach 88 ships in 2016, peak at 92 ships in 2020-2021, fall below 88 ships in 2025, reach a minimum of 54 ships (about 39% below the 88-ship goal) in FY2044-FY2046, and recover somewhat to a steady-state level of 70 ships after 2050.

²¹ (...continued)

answer 90% of Marine Corps calls for fire within 5 minutes, permitting the ship to meet stated Marine Corps firepower requirements — a capability otherwise unavailable in the surface fleet — giving the ship a capability roughly equivalent to one-half of an artillery battalion, and permitting a 65% reduction in Marine Corps artillery;

- a ship design that allows underway replenishment of gun shells, creating the equivalent of an almost-infinite ammunition magazine and permitting nearly continuous fire support;

- about 10 times as much electrical capacity available for ship equipment, giving the ship an ability to support future electromagnetic rail guns and high-energy laser weapons; and

- features such as an automated fire-suppression system, peripheral vertical launch system, and integrated fight-through-damage power system that significantly increase ship survivability.

(Source: Points taken from Statement of Admiral Vern Clark, U.S. Navy, Chief of Naval Operations, Before The House Armed Services Committee Projection Forces Subcommittee, July 19th, 2005, and Statement of The Honorable John J. Young, Jr., Assistant Secretary of the Navy (Research, Development and Acquisition), and RADM Charles S. Hamilton, II, Program Executive Officer For Ships, Before the Projection Forces Subcommittee of the House Armed Services Committee on DD(X) Shipbuilding Program, July 19, 2005.)

Table 8. Number of Cruisers and Destroyers, 2007-2050
(figures less than 88 shown in bold)

With 25 DDG-1000s and CG(X)s procured FY07-FY23 (Navy 30-year plan)				With 17 DDG-1000s and CG(X)s procured FY07-FY23 (Procurement limited to 1 DDG-1000 or CG(X) year)			
2007	75	2029	83	2007	75	2029	75
2008	77	2030	79	2008	77	2030	71
2009	80	2031	76	2009	80	2031	68
2010	82	2032	75	2010	82	2032	67
2011	84	2033	73	2011	84	2033	65
2012	84	2034	72	2012	84	2034	64
2013	86	2035	72	2013	86	2035	64
2014	86	2036	70	2014	86	2036	62
2015	87	2037	69	2015	87	2037	61
2016	88	2038	68	2016	88	2038	60
2017	90	2039	66	2017	89	2039	58
2018	91	2040	64	2018	90	2040	56
2019	93	2041	63	2019	91	2041	55
2020	94	2042	63	2020	92	2042	55
2021	95	2043	63	2021	92	2043	55
2022	93	2044	62	2022	90	2044	54
2023	92	2045	62	2023	89	2045	54
2024	90	2046	62	2024	86	2046	54
2025	91	2047	64	2025	86	2047	56
2026	88	2048	64	2026	82	2048	56
2027	86	2049	66	2027	79	2049	58
2028	85	2050	67	2028	77	2050	59

Source: Prepared by CRS using Navy data.

Program Mission Requirements

Although the DDG-1000 is classified as a guided missile destroyer (DDG) rather than a guided missile cruiser (CG), gun cruiser (CA), or guided missile gun cruiser (CAG), the DDG-1000 design, among other things:

- is, at about 14,500 tons full load displacement, about 50% larger than the Aegis cruiser and DDG-51 designs;
- is larger than any cruiser or destroyer that the Navy has procured since the nuclear-powered cruiser Long Beach (CGN-9), which was procured in FY1957;

- has an area-defense anti-air warfare (AAW) capability that in some respects is greater than that of the DDG-51;²²
- has command facilities for a flag-level officer and his command staff — a feature that previously has been installed on cruisers but not destroyers;
- has a vertical launch system (VLS) whose weapon storage volume and weapon weight capacity are between that of the DDG-51 and Aegis cruiser designs;²³ and
- has more gunfire capability than any cruiser the Navy has built since World War II.

In light of these features, the DDG-1000 might be closer to a guided missile gun cruiser (CAG) than a DDG.

The DDG-1000's size and procurement cost do not appear to have been driven by any one technology or payload element, but rather by the ship's total collection of payload elements. These payload elements include, in addition to its above-mentioned AAW system, flag-level command facilities, VLS battery, and gunfire capabilities, the following:

- sonars and other antisubmarine warfare (ASW) systems that are roughly equivalent to that of the DDG-51;²⁴
- a large helicopter flight deck and a hangar and maintenance facilities for two helicopters or one helicopter and three UAVs;

²² The Navy states that radars on the DDG-1000 and DDG-51 are roughly equivalent in terms of dB gain (sensitivity) and target resolution, that the firm track range of the DDG-1000's dual-band radar — the range at which it can maintain firm tracks on targets — is 25% greater for most target types than the firm track range of the DDG-51's SPY-1 radar, that the DDG-1000's radar has much more capability for resisting enemy electronic countermeasures and for detecting targets amidst littoral clutter, that the DDG-1000's AAW combat system would be able to maintain 10 times as many tracks as the DDG-51's Aegis system, and that the two ships can support roughly equal numbers of simultaneous AAW engagements. Given the features of the DDG-1000's AAW system, plus its much-greater C4I/networking bandwidth, the Navy has stated that replacing a DDG-51 with a DDG-1000 in a carrier strike group would increase the strike group's AAW capability by about 20%.

²³ Although the DDG-1000 has 80 VLS cells, compared to 96 on the DDG-51 and 122 on the Aegis cruiser, the DDG-1000's VLS cells are larger. The Mk 41 VLS cells on DDG-51s and Aegis cruisers can fire a missile up to 21 inches in diameter, 21 feet in length, and about 3,000 pounds in weight. The Advanced VLS (AVLS) cells on the DDG-1000 can fire a missile up to 24 inches in diameter, 22 feet in length, and about 4,000 pounds in weight.

²⁴ The Navy states that due to differences in their sonar designs, the DDG-1000 would have more littoral-water ASW capability, while the DDG-51 would have more blue-water ASW capability.

- additional berthing, equipment-stowage space, and mission-planning space for a platoon of 20 special operations forces (SOF) personnel; and
- facilities for embarking and operating two 11-meter boats and four rubber raiding craft (as opposed to two 7-meter boats on the DDG-51).

The payload elements of the DDG-1000 design reflect an Operational Requirements Document (ORD) for the DDG-1000 that was approved by the Joint Staff of DOD in February 2004. Key performance parameters included in this document include having two AGSs that can each fire 10 rounds per minute, for a total of 20 rounds per minute.²⁵ DOD states that

During the restructuring of the DD-21 program into the DD(X) program, the Navy re-evaluated each DD-21 Key Performance Parameter (KPP) to determine the potential for minimizing the size of the ship and ultimately the cost. The Navy made many adjustments and the resulting DD(X) KPPs represent the Navy's minimum requirements. No other known alternative meets all of the DD(X) KPPs and provide the sustained, precision, long-range naval surface fire support that the United States Marine Corps requires.²⁶

Skeptics could argue that, notwithstanding the February 2004 DDG-1000 ORD, GAO reported in December 2005 that the DOD has not yet given final approval to a joint (i.e., inter-service) document on naval surface fire support requirements. The GAO report stated

Since May 2005 when the Marine Corps Combat Development Command submitted a draft requirements document for Joint Staff review, Naval Surface Fire Support requirements have become part of joint fires requirements and are currently being reviewed by DOD. Joint fires include a system of weapons delivered from two or more components — aircraft, ships/submarines, and ground assets — toward a common objective. In order to comply with DOD's new Joint Capabilities Integration and Development System process, the Joint Staff directed the Marine Corps to submit the draft Initial Capabilities Document to determine joint fires requirements in support of expeditionary operations in coastal areas.... The draft document is in the process of being reviewed by subject matter experts within DOD.²⁷

Skeptics could argue that with estimated DDG-1000 procurement costs now much higher than they were in February 2004, and the effect that increased cost appears to have had in reducing planned DDG-1000 procurement, the February 2004 ORD might not reflect a sufficiently up-to-date consideration of how increasing DDG-

²⁵ Statement by The Honorable Kenneth J. Krieg, Under Secretary of Defense (Acquisition, Technology and Logistics), Before the Subcommittee on Projection Forces, House Armed Services Committee, United States House of Representatives, July, 19, 2005, p. 2.

²⁶ *Ibid*, pp. 6-7.

²⁷ Government Accountability Office, *Issues Related to Navy Battleships*, GAO-06-279R, Dec. 13, 2005, pp. 3-4.

1000 capability (and therefore cost) might reduce DDG-1000 numbers and therefore reduce the collective capability of the total DDG-1000 force. In light of the reduction in planned DDG-1000 procurement, skeptics could argue, certain capabilities that might have been viewed as desirable in February 2004 might now be viewed as less desirable because of their role in increasing DDG-1000 unit cost and thereby reducing planned DDG-1000 procurement.

An August 2005 trade press article suggests that growth in DD-21/DDG-1000 requirements (and cost) over time may have been related to the disestablishment of a Navy ship-design board called the Ship Characteristics Improvement Board (SCIB) — an entity that the new Chief of Naval Operations, Admiral Michael Mullen, who became CNO on July 22, 2005, has reestablished (under a new name):

Adm. Michael Mullen, the chief of naval operations, has directed the Navy to re-establish a high-level panel to closely monitor and control the requirements and configurations of new ships in a bid to rein in the skyrocketing cost of new vessel procurement.

Adm. Robert Willard, vice chief of naval operations, is leading the effort as part of a larger undertaking to draw up alternative options for the Navy's current shipbuilding program....

In essence, sources said, Mullen is looking to reconstitute the Ship Characteristics Improvement Board, which eventually became inactive in 2002. For more than 100 years, the Navy has maintained a high-level group of officials to advise service leaders on ship design and configuration. This group, established in 1900 as the General Board has gone through many name changes, including the Ship Characteristics and Improvement Board in the early 1980s and, until 2002, the Ship Characteristics and Improvement Panel.

Navy officials say that the panel's oversight began to wane in the late 1990s, just as the DD-21 program — originally envisioned as a \$750 million replacement for Spruance-class destroyers — took off, before becoming officially inactive in 2002. Requirements during this time were added to the new destroyer program, some of which raised eyebrows in the Navy, such as the need for a flag officer quarters. No other ship in that class has accommodations for an admiral. Still, the DDG-1000 has come to be regarded as a technology carrier for future surface ships and the price tag has ballooned to \$3 billion a copy.

Mullen's goal, spelled out in a July 25 memo to Willard and provided to *InsideDefense.com*, is to put in place a "process that adequately defines warship requirements and manages changes to those requirements (e.g. Ship Characteristics Improvement Board) in a disciplined manner, with cost and configuration control as the paramount considerations."...

A recent RAND study conducted at the request of Mullen's predecessor, retired Adm. Vern Clark, concluded that a key cause for climbing ship costs is the number of requirements tacked on to a program, according to a consultant familiar with the findings of the study, which has not been made public.

"So, what I think Mullen has in the back of his head is, 'I've got to get the requirements process for ships back under control or we're always going to end

up, every time we talk about a new destroyer, with a \$3 billion ship,” said a former senior Navy official.

This senior official, who was in a key Pentagon position as the DD-21 program commenced, said that without a panel overseeing the ship’s configuration and true requirements the new destroyer program became weighed down with capabilities that carried a high price tag.

“In hindsight, we realized that we had put requirements on the ship that no one had really vetted for its cost impact on the ship. For example, it was to operate acoustically silent and risk free in minefields,” said the official. “If the SCIB had existed, this probably would not have happened.”²⁸

Some observers, such as naval analyst Norman Friedman, the author of numerous books on U.S. warship designs, have raised questions about the Navy’s decision to use a tumblehome (i.e., inward-sloping) hull for the DDG-1000. A 2006 magazine article by Friedman, for example,

- raises questions about the implications of a tumblehome hull for the ship’s ability to deal with underwater damage;
- asks whether the Navy knew at the outset of the DDG-1000 design process how much a decision to incorporate a tumblehome hull (and other survivability features) would increase the size of the ship; and
- questions whether the reduced visibility of the tumblehome hull to certain types of radars — the central reason for using a tumblehome hull — will be negated by its visibility to high-frequency (HF) surface wave radars that are now for sale on the international market.

The article, which refers to the DDG-1000 by the previous designation DD(X), states:

In the case of the DD(X), the overriding requirement [in determining the hull design] was to minimise radar cross section — stealth. Much of the hull design was dictated by the attempt to reflect radar pulses away from the radar emitting them, so that radar returns would be minimised. By now the main technique is well known: slope all flat surfaces and eliminate the corner reflector created by the juncture of the hull and water...

If the ship could be stabilized sufficiently [against rolling from side to side], then she would never (or almost never) present any vertical surfaces [to a radar]. In the case of DD(X), stabilization is apparently achieved using ballast tanks. Such tanks in turn demand internal volume deep in the ship. Overall, stealth demands that as much as possible of the overall volume of the ship be buried in her hull, where the shape of the ship can minimise radar returns. That is why, paradoxically, a carefully-designed stealthy ship will be considerably larger — for more internal volume — than a less stealthy and more conventional equivalent. In the case of DD(X), there were also demands for improved survivability. The

²⁸ Jason Sherman, “Mullen To Bring Back Panel To Control Ship Configuration, Cost,” *Inside the Navy*, Aug. 8, 2005.

demand for stealth implied that anti-ship missiles were the most important envisaged threat. They hit above water, so an important survivability feature would be to put as much of the ship's vitals as possible below water — which meant greater demands for underwater volume....

Once the tumblehome hull had been chosen, [the ship's designers] were apparently also constrained to slope the bow back [creating a surface-piercing or ram bow] instead of, as is usual, forward....

There were numerous reasons why [past] naval architects abandoned tumblehome hulls and ram bows. Tumblehome reduces a ship's ability to deal with underwater damage. When a conventional flared (outward-sloping) hull sinks deeper in the water, its waterplane area [the cross-section of the ship where it intersects the plane of the water] increases. It becomes somewhat more stable, and it takes more water to sink it deeper into the water. Because the waterplane area of a tumblehome ship *decreases* as it draws more water, such a ship is easier to sink deeper. Tumblehome also apparently makes a ship less stable, and hence less capable of resisting extreme weather conditions. The larger the ship, the more extreme the weather has to be to make that critical. Critics of DD(X) have concentrated on the danger; defenders have concentrated on how extreme the critical weather condition would be.

In the end, whether the DD(X) hull form is attractive depends on an evaluation of anti-radar stealth as a design driver. About a decade ago, the DD(X) design concept was sold on the basis of a lengthy (and, incidentally, unclassified) analysis, the gist of which was that a heavily-armed surface combatant could play a decisive role in a Korean scenario...

The key analytic point... was that it would be very important for the ship to come reasonably close to enemy shores unobserved. That in turn meant anti-radar stealth. However, it soon came to mean a particular kind of anti-radar performance, against centimetric-wave radars [radars with wavelengths on the order of centimeters] of the sort used by patrol aircraft (the ship would fire [its weapons] from beyond the usual horizons of shore-based radars). As it happens, anti-ship missiles use much the same kinds of radars as patrolling aircraft, so it could be argued that the same anti-radar techniques would be effective in the end-game in which missiles would approach the ship....

Without access to files of the time, it is impossible to say whether those approving the [DDG-1000] project realised that its stealth and survivability characteristics would produce a 14,000 to 17,000 ton destroyer. About the same time that DD(X) characteristics (requirements) were being approved, the decision was taken at [the] Defense Department (not Navy) level that there would be no internal feasibility design. In the past, the feasibility stage had the very useful role of showing those setting requirements what their implications would be. At the very least, the Navy's senior leadership would have been given warning that they would have to justify a drastic jump in destroyer size when they wanted to build DD(X). That jump might well have been considered justified, but on the other hand the leadership might also have asked whether a somewhat less dramatic approach would have been acceptable.

The article continues:

About a decade after the requirements were chosen, with DD(X) well advanced, the situation with regard to stealth may be changing. Shaping is relevant only at relatively short [radar] wavelengths. For about a quarter-century, there has been talk of HF surface wave radars, which operate at wavelengths of about 10 to 200 meters — i.e. at wavelengths the size of a ship. Canada currently operates this type of radar, made by Raytheon, for surveillance of the Grand Banks; another is being tested in the Caribbean. Australia has bought this kind of radar to fill gaps in over-the-horizon radar coverage. Turkey is buying such radars for sale for some years. In 2005 it was reported unofficially that China had bought [a] Russian HF surface wave radar the previous year.

It seems almost certain that HF surface wave radar can defeat any kind of stealth shaping designed primarily to deal with shorter-wave[length] radars. Moreover, [HF surface wave] radars have an inherent maximum range (due to the way they operate) of about 180nm.... At long range [the radar's beam] is not nearly accurate enough to aim a missile. However, we can easily imagine a netted system which would use the long-range [HF surface wave] radar to define a small box within which the target ship would be. A missile with GPS [Global Positioning System] guidance could be flown to that box, ordered to search it....

If the argument given here is realistic, then the considerable sacrifices inherent in the DD(X) design no longer seem nearly as attractive. It can still be argued that a design like the DD(X) is attractive well out to sea, beyond the reach of coastal radars. In that case, however, there may be other signatures which can be exploited. For example, ships proceeding at any speed create massive wakes.... it is clear that the wake produces a radar return very visible from an airplane or, probably, from a space-based radar....

In the end, then, how much is stealth worth? As a way of avoiding detection altogether, probably less than imagined. That leaves the rather important end-game, the hope being that decoys of some sort greatly exceed actual ship radar cross-section. That is probably not a foolish hope, but it does not require the sort of treatment reflected in [the] DD(X).

Now, it may be that the United States typically faces countries which have not had the sense to buy anti-stealth radars (though we would hate to bet on that). In that case, DD(X) may well be effectively invisible to them. So will a lot of less thoroughly stealthy ships.²⁹

Potential oversight questions for Congress include the following:

- **SCIB and DDG-1000 requirements.** Are the DDG-1000's requirements partly a result of inadequate discipline, following the disestablishment of the SCIB, in the Navy's process for setting requirements for new ships? If the SCIB had remained in existence during the DD-21/DDG-1000 design process, which of the DDG-1000's current requirements would have been reduced or eliminated?

²⁹ Norman Friedman, "The New Shape of Ships," *Naval Forces*, No. II, 2006: 56-58, 60, 62-63. Italics as in the original.

- **Tumblehome hull.** How much did the decision to use a tumblehome hull increase the size and cost of the DDG-1000? In the mid-1990s, when design work began on the ship now known as DDG-1000, how well did the Navy understand the relationship between using a tumblehome hull and ship size and cost? What effect does the tumblehome hull have on the DDG-1000's ability to deal with underwater damage? To what degree will HF surface wave radars negate the stealth characteristics of the DDG-1000 design?
- **AGSs.** Since the DDG-1000 is the only ship planned to carry AGSs, and since AGSs are viewed by the Marine Corps as necessary to meet Marine Corps requirements for naval surface fire support capability, should the AGSs be considered the most-critical payload element on the DDG-1000, and certain other payload elements, though desirable, as possibly less critical by comparison?
- **Hangar.** In light of the 167 current or planned helicopter hangar spaces on other Navy surface combatants (2 spaces on each of 22 Aegis cruisers and the final 34 DDG-51s, and at least 1 space on each of 55 LCSs), and the relatively limited number of Navy helicopters available for filling those spaces, how critical is it for the DDG-1000 to have a hangar with spaces for two helicopters? Would it be acceptable for the DDG-1000 instead to have only a helicopter landing platform and an ability to refuel and rearm helicopters, like the first 28 DDG-51s?
- **VLS tubes.** In light of the 8,468 vertical launch system (VLS) missile tubes on the Navy's planned force of 84 VLS-equipped Aegis ships (22 cruisers with 122 tubes each, 28 earlier DDG-51s with 90 tubes each, and 34 later DDG-51s with 96 tubes each), the ability of VLS tubes to store and fire either one 21-inch diameter missile or four smaller-diameter Evolved Sea Sparrow Missiles (ESSMs), the ability in a networked force for a ship to control a missile fired by another ship, and the DDG-1000's key role in providing naval gunfire support with its two AGSs, how critical is it for the DDG-1000 to have 80 enlarged VLS tubes as opposed to a smaller number, such as 64, 48, or 32?
- **Command facilities.** In light of the flag-level command facilities on the 19 Aegis cruisers, as well as additional command facilities on aircraft carriers and planned amphibious assault ships, how critical is it for the DDG-1000 to have flag-level command facilities?
- **SOF support facilities.** In light of SOF support facilities on the Navy's planned force of four converted Trident submarines, or SSGNs (66 or more SOF personnel for each ship),³⁰ support facilities

³⁰ For more on the SSGN program, see CRS Report RS21007, *Navy Trident Submarine* (continued...)

for smaller numbers of SOF on Navy attack submarines (SSNs), and the secondary SOF support role for the Navy's planned force of 55 LCSs, how critical is it for the DDG-1000 to have SOF support facilities?

- **AAW system.** In light of the Aegis area-defense AAW systems on the Navy's planned force of 84 Aegis ships — which, though not as capable in some respects as the DDG-1000's AAW system in littoral operating environments, would still be quite capable, particularly when numbers of Aegis ships are taken into account — how critical is it for the DDG-1000 to have an area-defense-capable AAW system, as opposed to a more modest point-defense AAW system capable of defending only the DDG-1000 itself (which might be closer to the more modest AAW system that was originally envisaged for the DD-21, the precursor to the DDG-1000)?³¹

Dual Ships Strategy And Incremental Funding

As mentioned in the Background section, the Navy's dual lead ships strategy for the DDG-1000 program calls for procuring the first two ships in FY2007 using split funding (i.e., incremental funding) in FY2007 and FY2008.

The Navy argues that the dual lead ships strategy is necessary to help establish a more-level playing field between NGSS and GD/BIW for a potential future competition to build the third ship in the class, and that the Navy must use incremental funding in FY2007 and FY2008 to execute the strategy because fully funding both ships in FY2007 would leave insufficient funding for other FY2007 Navy programs. The Navy argues that delaying the procurement of the second ship to FY2008 would increase the combined cost of the two ships by \$211 million,³² presumably due to added inflation on the second ship, a longer interval at GD/BIW between the end of its DDG-51 construction work and the start of its DDG-1000 construction work, and reduced production efficiencies at supplier firms making components for the two

³⁰ (...continued)

Conversion (SSGN) Program: Background and Issues for Congress, by Ronald O'Rourke.

³¹ Earlier editions of this report also asked the following question:

Gun shell capacity. In light of the DDG-1000 design feature that allows underway replenishment of gun shells, creating the equivalent of an almost-infinite ammunition magazine and permitting nearly continuous fire support, how critical is it for the DDG-1000 to have a total gun shell capacity of 920 shells, as opposed to a smaller number, such as 600?

A December 2005 press states that, as part of an effort to reduce the cost of the DDG-1000, the Navy has reduced the magazine capacity of the design from 920 shells to 600. (Christopher P. Cavas, "U.S. Ship Plan To Cost 20% More," *Defense News*, Dec. 5, 2005: 1, 8.)

³² Geoff Fein, "White House Opposes Plan To Buy One DD(X) In FY '07," *Defense Daily*, June 26, 2006.

ships. Supporters of the dual lead ships strategy could argue that using incremental funding to procure the first two ships is a one-time event, unique to the DDG-1000 program, that does not set a precedent for other defense acquisition programs and consequently does not weaken adherence to the full funding provision that normally prohibits the use of incremental funding in defense procurement.³³ Supporters could argue that the dual lead ships approach helps ensure broader political support for the DDG-1000 program by ensuring that the first ship cannot be funded unless the second ship is funded at the same time.

Skeptics could argue that if procurement of the second ship were deferred to FY2008, the first ship could be fully funded in FY2007 and the second ship could be fully funded in FY2008, avoiding the need for using incremental funding to procure the ships. They could argue that the Navy's proposed use of incremental funding to procure the first two ships would weaken adherence to the full funding policy because the Navy cannot guarantee that others would not use it as a precedent to justify using incremental funding for other programs. Skeptics could argue that if the Navy believes strongly in the benefits of procuring both ships in FY2007, it should have proposed fully funding them in FY2007, with necessary offsets in other FY2007 Navy programs. Skeptics could argue that the potential benefits of establishing a more-level playing field between NGSS and GD/BIW are not worth the risks of attempting to build both ships at the same time. They could argue that the Navy's proposal departs from the traditional approach of having a time interval between the first and second ships in a shipbuilding program, so that problems discovered in building the first ship can be avoided in building the second, and that attempting to build two lead ships at the same time could stress Navy program-management capabilities and possibly cause problems at supplier firms that need to provide identical components simultaneously to both shipyards. Potential problems in these areas, skeptics could argue, could lead to cost increases that would offset the \$211 million in savings that the Navy estimates from procuring the second ship in FY2007.

Contract Strategy And System Integration

As mentioned in the Background section, the Navy since September 30, 2005, has managed the DDG-1000 program through a series of separate contracts with major DDG-1000 program contractors, and consequently is acting in at least some respects as the overall system integrator for the program. This approach represents, to some degree, a turn away from the trend in recent years under which the services have transferred the overall system-integrator role to industry, and a return, to some degree, to an earlier acquisition approach under which the services acted as the overall system integrators. The Navy's decision to manage the DDG-1000 program this way follows actions begun in the 1990s, consistent with shifting the system-integrator role to industry, to reduce the number of people in the Navy's acquisition commands. Potential oversight questions for Congress include the following:

³³ For more on the full funding policy and incremental funding, see CRS Report RL32776, *Navy Ship Procurement: Alternative Funding Approaches — Background and Options for Congress*, by Ronald O'Rourke, and CRS Report RL31404, *Defense Procurement: Full Funding Policy — Background, Issues, and Options for Congress*, by Ronald O'Rourke and Stephen Daggett.

- Does the Navy retain sufficient in-house acquisition and technical expertise to perform the system-integration functions that the Navy is to perform under its DDG-1000 contracting strategy?
- Does the Navy's contracting strategy for the DDG-1000 program have any implications for how other defense acquisition programs should be pursued?

Acquisition Strategy For Third and Subsequent Ships

As mentioned in the Background section, the Navy's intended acquisition strategy for the third and subsequent DDG-1000s is unclear. The Navy has stated that it intends to review the issue in late-2006. The issue has potentially significant implications for the industrial-base effects of the DDG-1000 program (see discussion below).

Potential Program Implications for Industrial Base

The Navy's 30-year shipbuilding plan (see **Table 4**) calls for procuring an average of about 1.5 DDG-1000s/CG(X)s over the next 17 years. The light-ship displacement of the DDG-1000 (about 12,435 tons) is about 79% greater than that of the DDG-51 Flight IIA design (about 6,950 tons). If shipyard construction work for these two ship classes is roughly proportional to their light-ship displacements, and if the CG(X) is about the same size as the DDG-1000, then procuring an average of 1.5 DDG-1000s/CG(X)s per year might provide an amount of shipyard work equivalent to procuring about 2.7 DDG-51s per year. Splitting this work evenly between GD/BIW and the Ingalls shipyard that forms parts of NGSS might thus provide each yard with the work equivalent of about 1.35 DDG-51s per year.

Supporters of these two yards argued in the 1990s that a total of 3 DDG-51s per year (i.e., an average of 1.5 DDG-51s per year for each yard), in conjunction with other work being performed at the two yards (particularly Ingalls), was the minimum rate needed to maintain the financial health of the two yards.³⁴ Navy officials in recent years have questioned whether this figure is still valid. Building the equivalent of about 2.7 DDG-51s per year equates to about 90% of this rate.

If GD/BIW were to build the second and fourth DDG-1000s, then the rather lengthy interval between GD/BIW's first ship (to be procured in FY2007) and its second ship (to be procured in FY2010) could reduce GD/BIW's ability to efficiently shift production from one ship to the next.

Increasing procurement of cruisers and destroyers to an average rate of about 2.5 ships per year — the steady-state replacement rate for the force of 88 cruisers and destroyers within the Navy's proposed 313-ship fleet — would provide the cruiser-destroyer industrial base with substantially more work than would result under the Navy's 30-year shipbuilding plan.

³⁴ See, for example, CRS Report 94-343, *Navy DDG-51 Destroyer Procurement Rate: Issues and Options for Congress*, by Ronald O'Rourke (out of print, available from author).

Conversely, if affordability considerations limit DDG-1000/CG(X) procurement to one ship per year in FY2011 and subsequent years, the workload for the cruiser-destroyer industrial base in those years would be reduced substantially from levels that would be achieved under the Navy's 30-year plan. Procuring one DDG-1000/CG(X) per year might provide an amount of shipyard work equivalent to procuring about 1.8 DDG-51s per year, and splitting this work evenly between GD/BIW and Ingalls might provide each yard with the work equivalent of about 0.9 DDG-51s per year, which would be equivalent to 60% of the rate cited in the 1990s by supporters of the two shipyards as the minimum needed to maintain the financial health of the two yards.

If the Navy at some point holds a competition between the two yards for the right to build all remaining DDG-1000s, the yard that loses the competition could face a difficult business situation, particularly if that yard is GD/BIW, which is involved as a shipbuilder in no shipbuilding programs other than the DDG-51 and DDG-1000.³⁵ Consequently, if GD/BIW does not build DDG-1000s and does not receive other new ship-construction work, then GD/BIW could experience a significant reduction in workloads, revenues, and employment levels by the end of the decade. Theoretical scenarios for the yard under such circumstances could include closure and liquidation of the yard, the "mothballing" of the yard or some portion of it, or reorienting the yard into one that focuses on other kinds of work, such as building commercial ships, overhauling and modernizing Navy or commercial ships, or fabricating components of Navy or commercial ships that are being built by other yards. Reorienting the yard into one that focuses on other kinds of work, if feasible, could arguably result in workloads, revenues, and employment levels that were significantly reduced from current levels.

If Ingalls were to lose such a competition and other work being done at Ingalls (particularly construction of amphibious ships) does not increase, then Ingalls could similarly experience a reduction in workloads, revenues, and employment levels. The continuation of amphibious-ship construction at Ingalls could make the scenarios of closure and liquidation or mothballing less likely for Ingalls than for GD/BIW, but workloads, revenues, and employment levels could still be reduced from current levels, and the cost of amphibious-ship construction and other work done at Ingalls (such as construction of new Coast Guard cutters) could increase due to reduced spreading of shipyard fixed overhead costs.

LCS Oversight Issues for Congress

Increase In LCS Sea Frame Unit Procurement Cost

Estimated LCS sea frame unit procurement costs as shown in the FY2007 budget submission are substantially greater than figures shown in the FY2006 budget submission. The estimate for the first LCS has increased from \$212.5 million to \$274.5 million, an increase of about 29%. The estimate for the second LCS has increased from \$256.5 million to \$278.1 million, an increase of about 8%. As shown

³⁵ GD/BIW is also the prime contractor for the GD version of the LCS, but the GD version is to be built by the Austal USA shipyard, of Mobile, AL.

in **Table 9**, the estimate for follow-on ships to be procured in FY2009-FY2011, when the LCS program is to reach its maximum annual procurement rate of 6 ships per year, has increased from \$223.3 million in then-year dollars to \$298 million in then-year dollars, an increase of about 33%.

The Navy states that these differences are due mostly to the fact that the figures shown in last year's budget did not include items that are traditionally included in the total budgeted procurement cost of a Navy shipbuilding program, such as Navy program-management costs, an allowance for changes, and escalation (inflation). The absence of these costs from last year's LCS budget submission raises potential oversight issues for Congress, including the following:

- Why were these costs excluded from the LCS budget submission in last year's budget? Was this an oversight? If so, how could such an oversight occur, and why did it occur on the LCS program but not other programs? Was anyone held accountable for this oversight, and if so, how? If this was not an oversight, then what was the reason?
- Do LCS procurement costs as presented in the FY2007 budget submission now include all costs that, under traditional budgeting practices, should be included in LCS procurement costs? If not, how many other costs are still unacknowledged? Have personnel or resources from other Navy programs been used for the LCS program in any way? If so, have the costs of these personnel or resources been fully charged to the LCS program and fully reflected in LCS program costs shown in the FY2007 budget submission?
- What is the likelihood that the Navy in future budget submissions will substantially increase procurement cost estimates for other Navy shipbuilding programs to account for costs that were excluded from previous budgets? Does the Navy believe there is no substantial risk of penalty for submitting to Congress a budget presentation for a shipbuilding program that, for whatever reason, significantly underestimates procurement costs?

Table 9. LCS Sea Frame Unit Procurement Costs
(Costs in millions of then-year dollars)

	FY07	FY08	FY09	FY10	FY11	FY09-11
<i>FY2006 budget submission</i>						
Procurement cost	542.4	779.7	1,127.2	1,112.3	1,110.3	3,349.8
Number of ships	2	3	5	5	5	15
Unit procurement cost	271.2	259.9	225.4	222.5	222.1	223.3
<i>FY2007 budget submission</i>						
Procurement cost	520.7	947.6	1,764.3	1,774.2	1,825.4	5,363.9
Number of ships	2	3	6	6	6	18
Unit procurement cost	260.4	315.9	294.1	295.7	304.2	298.0
% change in unit procurement cost, FY07 compared to FY06	(4%)	21%	30%	33%	37%	33%

Source: Prepared by CRS using Navy data from FY2006 and FY2007 Navy budget submissions.

Cost Cap On Fifth and Sixth LCSs

Navy officials have stated to CRS that the fifth and sixth LCSs will meet the legislated cost cap of \$220 million per ship because the hands-on construction cost of the ships, when adjusted for inflation, fall within the \$220-million figure.³⁶ The Navy's explanation suggests that the Navy is interpreting the LCS cost cap as something that applies to the hands-on construction cost of the ship, rather than to the larger procurement cost of the ship as it appears in the budget, which includes costs for other items, such as Navy program-management costs and allowance for changes. The LCS cost cap (Sec. 124 of H.R. 1815/P.L. 109-163) refers to "the total amount obligated or expended for procurement of the fifth and sixth vessels...." Potential oversight questions for Congress include the following:

- Does the Navy's apparent interpretation of the meaning of the LCS cost cap mean that the Navy will interpret cost caps on other Navy shipbuilding programs the same way, so as to exclude budgeted procurement costs other than the actual hands-on construction costs of the ships?
- Is the Navy's apparent interpretation of the LCS cost cap consistent with how the Navy interpreted past legislated cost caps on ships such as the Seawolf-class submarines and the aircraft carrier CVN-77?

³⁶ Source: Information paper provided to CRS by Navy Office of Legislative Affairs, Apr. 3, 2006.

Total Program Acquisition Cost

Although this CRS report estimates that a 55-ship LCS program might have a total acquisition cost of more than \$26 billion, the potential total acquisition cost of the LCS program is uncertain. Supporters could argue that total program acquisition cost will become clearer as the Navy works through the details of the program. Critics could argue that a major acquisition program like the LCS program should not proceed at full pace until its potential total costs are better understood.

Acquisition Strategy

The Navy's acquisition strategy for the LCS program remains unclear in terms of the following:

- the date when procurement will shift from the current Flight 0 designs to one or two modified Flight 1 designs;
- the future division of work between the Lockheed-led and General-dynamics led LCS teams, and how this division will be determined; and
- whether the Navy at some point will decide to downselect to only one industry team.

Observers have also expressed concern about the degree of coordination between procurement of LCS sea frames and development and procurement of LCS mission packages.

Mission Modules Funded in OPN Account

As mentioned in the Background section, the Navy plans to procure LCS mission modules through the Other Procurement, Navy (OPN) appropriation account rather than the Navy's ship-procurement account. The OPN account, as its name suggests, is a large, "grab-bag" appropriation account for procuring a wide variety of items, many of them miscellaneous in nature.

Supporters of the Navy's plan can argue that it is consistent with the traditional practice of procuring ship weapons (e.g., missiles and gun shells) through the Weapon Procurement, Navy (WPN) appropriation account or the Procurement of Ammunition, Navy and Marine Corps (PANMC) appropriation account rather than the ship-procurement account. LCS mission modules, they could argue, are the payload of the LCS, just as missiles and gun shells are the payload of other types of surface combatants, and should therefore be funded outside the ship-procurement account.

Those skeptical of the Navy's plan to fund LCS mission modules through the OPN account could argue that the LCS mission modules are not comparable to missiles and gun shells. Missiles and gun shells, they could argue, are expendable items that are procured for use by various classes of ships while the LCS mission modules will incorporate sensors as well as weapons, are not intended to be

expendable in the way that missiles and gun shells are, and are to be used largely, if not exclusively, by LCSs, making them intrinsic to the LCS program. In light of this, they could argue, it would be more consistent to fund LCS mission modules in the ship-procurement account rather than the OPN account.

Potential oversight questions for Congress include the following:

- Are LCS mission modules analogous to missiles and gun shells that are procured through the WPN and PANMC appropriation accounts?
- Does the Navy's plan to fund the LCS mission modules through this account effectively obscure a significant portion of the total LCS program acquisition cost by placing them in a part of the Navy's budget where they might be less visible to Congress? If so, was this the Navy's intention?
- Does funding a significant portion of the LCS program's total procurement cost through the OPN account give the LCS program an unfair advantage in the competition for limited ship-procurement funding by making the LCS program, as it appears in the ship-procurement account, look less expensive? If so, was this the Navy's intention?

Options for Congress

DDG-1000/CG(X) Program

Potential options for Congress on the DDG-1000/CG(X) program, some of which could be combined, include the following:

- approve the program as proposed by the Navy;
- use a block-buy contract for DDG-1000s procured during the five-year period FY2007-FY2011;
- defer procurement of the second DDG-1000 to FY2008;
- limit combined DDG-1000/CG(X) procurement to a total of no more than one ship per year;
- procure no more than one or two DDG-1000s for use as technology demonstrators, and supplement the industrial base with other work; and
- start design work now on a lower-cost naval gunfire support ship and/or a lower-cost cruiser-destroyer, and start procuring these ships, rather than additional DDG-1000s or CG(X)s, when these new designs are ready for procurement.

Supporters of the **second option** could argue that it could reduce the total cost of the DDG-1000s procured in FY2007-FY2011 by a few percent. Opponents could argue that it would reduce DOD's flexibility for making adjustments in the shipbuilding plan, and similarly tie the hands of future Congresses — something that Congress traditionally tries to avoid in decisions on discretionary spending — by creating a commitment to procure a certain number DDG-1000s through FY2011.

Regarding the **third option**, the Navy, as discussed in the section on DDG-1000/CG(X) oversight issues, argues that its proposal to procure the first two DDG-1000s together in FY2007 — the dual lead ships strategy — is necessary to help establish a more-level playing field between NGSS and GD/BIW for a potential future competition to build the third ship in the class, and that the Navy must use incremental funding in FY2007 and FY2008 to execute the strategy because fully funding both ships in FY2007 would leave insufficient funding for other FY2007 Navy programs. The Navy argues that delaying the procurement of the second ship to FY2008 would increase the combined cost of the two ships by \$211 million, presumably due to added inflation on the second ship, a longer interval at GD/BIW between the end of its DDG-51 construction work and the start of its DDG-1000 construction work, and reduced production efficiencies at supplier firms making components for the two ships. Supporters of the dual lead ships strategy could argue that using incremental funding to procure the first two ships is a one-time event, unique to the DDG-1000 program, that does not set a precedent for other defense acquisition programs and consequently does not weaken adherence to the full funding provision that normally prohibits the use of incremental funding in defense procurement. Supporters could argue that the dual lead ships approach helps ensure broader political support for the DDG-1000 program by ensuring that the first ship cannot be funded unless the second ship is funded at the same time.

Skeptics could argue that if procurement of the second ship were deferred to FY2008, the first ship could be fully funded in FY2007 and the second ship could be fully funded in FY2008, avoiding the need for using incremental funding to procure the ships. They could argue that incrementally funding the first two ships would weaken adherence to the full funding policy because the Navy cannot guarantee that others would not use it as a precedent to justify using incremental funding for other programs. Skeptics could argue that if the Navy believes strongly in the benefits of procuring both ships in FY2007, it should have proposed fully funding them in FY2007, with necessary offsets in other FY2007 Navy programs. Skeptics could argue that the potential benefits of establishing a more-level playing field between NGSS and GD/BIW are not worth the risks of attempting to build both ships at the same time. They could argue that the Navy's proposal departs from the traditional approach of having a time interval between the first and second ships in a shipbuilding program, so that problems discovered in building the first ship can be avoided in building the second, and that attempting to build two lead ships at the same time could stress Navy program-management capabilities and possibly cause problems at supplier firms that need to provide identical components simultaneously to both shipyards. Potential problems in these areas, skeptics could argue, could lead to cost increases that would offset the \$211 million in savings that the Navy estimates from procuring the second ship in FY2007.

The **fourth option** might be considered as an affordability measure to respond to limits on Navy resources and desires for funding other Navy programs. This option would release DDG-1000/CG(X) procurement funding programmed for FY2011 and future years for application to other Navy programs. It would also increase DDG-1000/CG(X) unit procurement costs due to reduced economies of scale in production, and deepen the projected long-term cruiser-destroyer shortfall.

The **fifth option** might be consistent with a view that the DDG-1000 is not affordable or not cost effective. This option could release DDG-1000 procurement funding for application to other Navy programs. It could also have implications for the shipbuilding industrial base, particularly if the industrial base receives a reduced amount of other work in lieu of additional DDG-1000s, and for the projected long-term cruiser-destroyer shortfall.

The **sixth option** could reduce the average unit procurement cost of planned cruisers and destroyers, permitting a larger number of cruisers and destroyers to be procured for a given amount of funding. Consequently, this option could be pursued as a means of addressing the projected long-term cruiser-destroyer shortfall. It would also likely reduce the average unit capability of the future cruisers and destroyers. Below are discussions of two possibilities for lower-cost ships — a lower-cost naval gunfire support ship, and a lower-cost cruiser-destroyer.

Lower-Cost Gunfire Support Ship. CBO and Robert Work of the Center for Strategic and Budgetary Assessments (CSBA) have both suggested, as a lower-cost naval gunfire support ship, an AGS-equipped version of the basic hull design of the San Antonio (LPD-17) class amphibious landing ship. Such a ship might begin procurement in FY2009, following procurement of a final “regular” LPD-17 amphibious landing ship in FY2008. CBO estimates that an initial AGS-armed LPD-17 might cost about \$1.9 billion, including \$400 million detailed design and nonrecurring engineering costs, and that subsequent ships might cost about \$1.5 billion each.³⁷

Lower-Cost Cruiser-Destroyer. A new-design, lower-cost cruiser-destroyer might:

- start procurement as soon as FY2011, if design work were started now;
- incorporate many of the same technologies now being developed for the DDG-1000 and CG(X);
- employ a modular, “plug-and-fight” approach to some of its weapon systems, like the LCS;
- have a displacement of perhaps around 11,000 tons, which would be about 25% less than the DDG-1000’s displacement of about 14,500

³⁷ See Congressional Budget Office, *Options for the Navy’s Future Fleet*, May 2006, pp. 56-57 (Box 3-1).

tons, about the same size as the nuclear-powered cruisers built for the Navy in the 1970s, and about 1,800 tons larger than the DDG-51;

- cost as much as 25% less to procure than a DDG-1000;
- be similar to the DDG-1000 and CG(X) in terms of using a reduced-size crew reduce annual operation and support costs;
- use a second-generation surface combatant integrated electric-drive propulsion system that is smaller and lighter than the first-generation system to be installed in the first DDG-1000s;³⁸
- carry a payload — a combination of sensors, weapon launchers, weapons, and aircraft — that is smaller than that of the DDG-1000 or CG(X), but still sizeable; and
- be built in one or two variants — an air- and missile-defense version to replace the CG(X), which would preserve CG(X) radar capabilities while reducing other payload elements, and possibly also a surface fire support version to supplement the DDG-1000, which would preserve the DDG-1000's two AGSs while reducing other payload elements.

The Navy in 2002 identified the following ship-design characteristics as items that, if varied, would lead to DDG-1000 concept designs of varying sizes, capabilities, and procurement costs:

- cruising range,
- maximum sustained speed,
- number of Advanced Gun Systems (AGSs) and AGS shells,
- hangar space for helicopters and UAVs,
- undersea warfare systems (i.e., sonars and mine countermeasures systems), and
- numbers and types of boats for special operations forces.

Using these variables, the Navy in 2002 developed notional DDG-1000 concept designs with estimated full load displacements ranging from 12,200 tons to about 16,900 tons. One of the concept designs, with an estimated full load displacement of about 12,700 tons, included 32 Advanced Vertical Launch System (AVLS) cells (rather than the DDG-1000's 80), 2 AGSs (like the DDG-1000), 600 AGS shells (rather than the DDG-1000's 920), a maximum sustained speed a few knots lower than the DDG-1000's, and a helicopter flight deck smaller than the DDG-1000's.

³⁸ The integrated electric-drive system to be installed in the first DDG-1000s uses advanced induction motors. A second-generation system could use smaller and lighter motors and generators that employ permanent magnet or high-temperature superconducting technology. Both of these technologies are currently being developed. For more on these technologies, see CRS Report RL30622, *Electric-Drive Propulsion for U.S. Navy Ships: Background and Issues for Congress*, by Ronald O'Rourke. (July 31, 2000)

Another concept design, with an estimated full load displacement of about 12,200 tons, included 64 AVLS cells, 1 AGS, 450 AGS rounds, a maximum sustained speed a few knots lower than the DDG-1000's, and helicopter flight deck smaller than the DDG-1000's.

The Navy in 2003 developed another set of notional DDG-1000 concept designs with estimated full load displacements ranging from 11,400 tons to 17,500 tons. One of the concept designs, with an estimated full load displacement of 13,400 tons, included 64 AVLS cells, 1 AGS, and 450 AGS rounds. Another concept design, with an estimated full load displacement of 11,400 tons, included 32 AVLS cells, 1 AGS, and 300 AGS rounds.

The 2002 and 2003 notional DDG-1000 concept designs with displacements of less than 14,000 tons appear to have preserved other DDG-1000 features, such as the wave-piercing, tumblehome hull, the integrated electric drive system (though with reduced total power in at least some cases), the total ship computing environment, the autonomic fire-suppression system and other features permitting a reduced-sized crew, the DDG-1000 radar suite, the hull and towed-array sonars, medium-caliber guns for use against surface targets, and a helicopter hangar (though not necessarily as large a hangar as on the DDG-1000).

Reducing payload features a bit more than under the smallest of the 2002 and 2003 notional concept designs might lead to a design with a displacement of about 11,000 tons. The Navy has viewed designs of less than 14,000 tons as unsatisfactory because of their reduced individual capabilities. It is not clear, however, to what degree the Navy's assessment of such designs also takes into account the difference that size (and thus unit procurement cost) can have on the total number of ships that might be procured within available resources, and consequently on future cruiser-destroyer force levels. Total cruiser-destroyer force capability is dependent on both cruiser-destroyer unit capability and the total number of cruisers and destroyers.

Notional Procurement Profiles With Lower-Cost Ships. **Table 10** and **Table 11** show notional procurement profiles incorporating the ships described above. In **Table 10**, an AGS-equipped version of the basic LPD-17 hull design is procured to supplement the Navy's DDG-1000s, and an air- and missile-defense version of the smaller cruiser-destroyer is procured starting in FY2011 in lieu of the CG(X). In **Table 11**, a smaller cruiser-destroyer in two versions — an AGS-equipped version to supplement the Navy's DDG-1000s, and air- and missile-defense version in lieu of the CG(X) — is procured starting in FY2011.

**Table 10. Alternative With LPD (AGS)
And Smaller Cruiser-Destroyer**
(Annual quantities procured, FY2007-FY2021)

	07	08	09	10	11	12	13-21	Total
DDG-1000	2 ^a	0 ^a	1	1				4
LPD (AGS) ^b			1	1	1	2		5
SCD ^c					1		2/year	19

Source: Prepared by CRS.

- a. Each of the two ships to be procured in FY2007 is to be split-funded across FY2007 and FY2008.
b. Basic LPD-17 hull equipped with 2 Advanced Gun Systems (AGSs).
c. Air- and missile-defense version of smaller cruiser-destroyer (SCD), in lieu of CG(X).

Table 11. Alternative With Smaller Cruiser-Destroyer
(Annual quantities procured, FY2007-FY2022)

	07	08	09	10	11	12	13-22	Total
DDG-1000	2 ^a	0 ^a	1	1		1		5
SCD ^b					1		2/year	21 ^b

Source: Prepared by CRS.

- a. Each of the two ships to be procured in FY2007 is to be split-funded across FY2007 and FY2008.
b. Includes 2 AGS-equipped versions of smaller cruiser-destroyer (SCD), for a total (along with 5 DDG-1000s) of 7 AGS-equipped ships, and 19 air- and missile-defense versions, in lieu of CG(X).

Projected Cruiser-Destroyer Shortfall

There are at least five options for addressing the projected long-term shortfall in cruisers and destroyers shown in **Table 8**, some of which can be combined:

- reduce the cruiser-destroyer force-level requirement to something less than 88 ships;
- hold the cruiser-destroyer force at no more than 88 ships starting in 2017 by deactivating up to 7 “excess” cruisers and destroyers and placing them into preservation (i.e., “mothball”) status, and then return these ships to service starting in the 2020s to help keep the cruiser-destroyer force closer 88 ships in subsequent years;
- extend the service lives of existing and/or planned cruisers and destroyers to 40 years;
- add up to 26 additional cruisers and destroyers of the kind currently planned into the shipbuilding budget between now and FY2039; and
- reduce the average unit procurement cost of planned cruisers and destroyers.

Each of these options is discussed below.

Reduce Requirement To Less Than 88 Ships. One option for addressing the projected long-term cruiser-destroyer shortfall would be to reduce the cruiser-destroyer force-level goal to something less than 88 ships. In assessing this option, points that may be considered include the following:

- The Navy in early-2005 proposed maintaining in coming years a fleet of 260 to 325 ships, with the 260-ship total including 67 cruisers and destroyers.³⁹
- A cruiser-destroyer force-level goal of 53 or 70 ships would be consistent with the number of cruisers and destroyers that could be maintained over the long run, assuming the currently planned ship service life of 35 years and a steady-state procurement rate of 1.5 or 2 ships per year.
- If ship service life were extended to 40 years (see discussion of this option below), a cruiser-destroyer force-level goal of 60 or 80 ships would be consistent with a steady-state procurement rate of 1.5 or 2 ships per year.
- Changes that might permit a reduction in the cruiser-destroyer force-level goal include increasing the number of cruisers and destroyers that are forward-homeported in areas such as the Western Pacific, and making greater use of rotational crewing (i.e., “Sea Swap”) and multiple crewing (an average of more than one crew per ship) for maintaining forward deployments of cruisers and destroyers.⁴⁰ The Navy, however, presumably considered and rejected these ideas as part of the analysis that led to its decision to set the force-level goal at 88 ships.

Deactivate “Excess” Ships And Return Them To Service Later. As shown in **Table 8**, the cruiser-destroyer force under Navy plans is projected to exceed 88 ships starting in 2017, and peak in 2021 at 95 ships — 7 ships above the 88-ship figure. Consequently, a second option for addressing the projected long-term cruiser-destroyer shortfall would be to deactivate up to 7 Aegis ships starting in 2017, place them in preservation (mothball) status, and return them to service starting in 2027 so that they would reach the end of their 35-year service lives up to 10 years later than if the ships had remained in service for an unbroken period of 35 years, and thereby keep the cruiser-destroyer force closer to the 88-ship goal during these years.

If, due to affordability considerations, procurement of DDG-1000s and CG(X)s is limited to no more than one ship per year, then, as suggested by the figures in **Table**

³⁹ See CRS Report RL32665, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, by Ronald O’Rourke. As shown in this report, the 325-ship fleet included a total of 92 cruisers and destroyers.

⁴⁰ For more on forward homeporting, rotational crewing, and multiple crewing, see CRS Report RS21338, *Navy Ship Deployments: New Approaches — Background and Issues for Congress*, by Ronald O’Rourke.

8, this option would instead involve deactivating and mothballing up to 4 Aegis ships starting in 2017 and returning them to service starting in 2024, so that they would reach the end of their 35-year service lives up to 7 years later than if the ships had remained in service for an unbroken period of 35 years.

This option could require funding overhauls for the ships entering preservation status.⁴¹ The Navy, however, could select ships for deactivation that would have required routine overhauls to continue in active service, in which case funding the pre-deactivation overhauls might have relatively little net impact on the Navy's budget.

Years later, this option would require funding for reactivating and very possibly modernizing these ships. In between deactivation and reactivation, this option would require some funding (perhaps a relatively limited amount) to look after the ships during the time that they were in preservation status.

Extend Service Lives to 40 Years. A third option for addressing the projected long-term cruiser-destroyer shortfall would be to extend cruiser-destroyer service lives from 35 years to 40 years. As shown in part by comparing the figures in **Table 12** to those in **Table 8**, applying this option to both existing and planned ships would do the following:

- delay the start of the longer-term cruiser-destroyer shortfall by roughly a decade, from 2027 to 2036 under the Navy's 30-year shipbuilding plan, and from 2024 to 2034 if DDG-1000/CG(X) procurement is limited to one per year;
- reduce the maximum size of the shortfall by about 10 ships, from 26 ships to about 16 ships under the Navy's 30-year shipbuilding plan, and from 34 ships to about 24 ships if DDG-1000/CG(X) procurement is limited to one per year;
- increase the number of "excess" ships that could be deactivated and mothballed starting in 2017 and then reactivated at a later point to help keep the force closer to 88 ships; and
- increase the steady-state size of the post-2050 cruiser-destroyer force from 70 ships to 80 ships.

⁴¹ The Navy sometimes overhauls ships before placing them into preservation status, so that they will be in better condition when the Navy reactivates them.

Table 12. Effect Of Extending Service Life To 40 Years

(figures less than 88 shown in **bold**;
figures that differ from those in Table 8 shown in *italics*)

With 25 DDG-1000s and CG(X)s procured FY07-FY23 (Navy 30-year plan)				With 17 DDG-1000s and CG(X)s procured FY07-FY23 (Procurement limited to 1 DDG-1000 or CG(X) year)			
2007	75	2029	<i>102</i>	2007	75	2029	<i>94</i>
2008	77	2030	<i>103</i>	2008	77	2030	<i>95</i>
2009	80	2031	<i>100</i>	2009	80	2031	<i>92</i>
2010	82	2032	<i>98</i>	2010	82	2032	<i>90</i>
2011	84	2033	<i>96</i>	2011	84	2033	<i>88</i>
2012	84	2034	<i>93</i>	2012	84	2034	85
2013	86	2035	<i>89</i>	2013	86	2035	81
2014	86	2036	86	2014	86	2036	78
2015	87	2037	85	2015	87	2037	77
2016	88	2038	83	2016	88	2038	75
2017	90	2039	82	2017	89	2039	74
2018	91	2040	82	2018	90	2040	74
2019	93	2041	80	2019	91	2041	72
2020	94	2042	79	2020	92	2042	71
2021	96	2043	78	2021	93	2043	70
2022	97	2044	76	2022	94	2044	68
2023	98	2045	74	2023	95	2045	66
2024	<i>100</i>	2046	73	2024	96	2046	65
2025	<i>102</i>	2047	73	2025	97	2047	65
2026	<i>103</i>	2048	72	2026	97	2048	65
2027	<i>102</i>	2049	72	2027	95	2049	64
2028	<i>103</i>	2050	72	2028	95	2050	64

Source: Prepared by CRS using Navy data.

The idea of extending the service lives of Navy cruisers and destroyers from 35 years to 40 years is not without precedent. In 1989, for example, the Navy planned to maintain its surface combatant force at the required number in part by keeping surface combatants in service for 40 years rather than 35 years. Under the Navy's 1989 plan, surface combatants would spend the first 20 years of their lives as front-line ships that the Navy then called battle force combatants (BFCs), and the second 20 years of their lives performing less-demanding escort missions that the Navy then called protection-of-shipping (POS) missions. The plan to migrate ships from the more-demanding BFC role to the less-demanding POS role over their 40-year lives, which the Navy called "flexible transition," was intended to reduce the amount of

mid-life modernization work needed to keep the ships mission-effective during their second 20 years of operation.⁴²

Although the Navy in the 1989 planned to keep surface combatants in service for 40 years, it is not clear that such a strategy would be feasible or cost effective today:

- Depending on how intensively they are used in coming years, today's Aegis ships might be worn out in terms of their basic structural or mechanical condition by age 35. (Some observers believe they might be worn out by age 30, which would increase the shortfall shown in **Table 8**.)
- If today's Aegis ships are in good enough structural and mechanical condition to permit operation beyond age 35, experience with past surface combatant designs suggests that the Aegis ships might have insufficient space, weight-carrying ability, or electrical power to accommodate the new sensors and weapons that could be needed at that point to keep them mission-effective beyond age 35.
- The Navy has limited experience operating modern cruisers and destroyers beyond age 35, and thus limited experience with the engineering issues that might arise from attempting to operate such ships to age 40.
- The end of the Cold War has reduced the number of less-demanding escort missions that might be fulfilled cost-effectively by ships that are 36 to 40 years old.

Add Up To 26 Ships To Shipbuilding Plans. A fourth option for addressing the projected-long-term cruiser-destroyer shortfall would be to add more DDG-1000s and/or CG(X)s and/or DDG(X)s into the Navy's long-term shipbuilding plan. If none of the three previous options were employed, then maintaining a force of at least 88 cruisers and destroyers over the long run would require adding up to 26 additional cruisers and destroyers to the plan during the 33-year period FY2007-FY2039, or an average of about 0.8 additional cruisers and destroyers per year. Within a constrained Navy budget, adding these additional ships could make it more difficult for the Navy to fund other needs. For example, assuming an average ship procurement cost of \$2.5 billion, these additional 26 ships would cost an additional \$65 billion to procure, or an average of about \$2 billion in additional procurement funding per year during the 33-year period.

⁴² Source: Navy briefing entitled "Briefing For House Armed Services Committee, Seapower Sub-Committee, 23 February 1989." The Navy gave a similar briefing to the Senate Armed Services Committee on May 2, 1989. The Navy's plan for keeping surface combatants in service for 40 years was part of its overall plan at this time for achieving and maintaining a fleet of about 600 ships. The 600-ship plan at this time included 228 surface combatants, of which 4 were battleships, 120 were BFCs, and 104 were POS ships. The 228-ship figure was a modification of a previous goal, within the planned 600-ship fleet, for a force of 242 surface combatants, including 4 battleships, 137 cruisers and destroyers, and 101 frigates.

Reduce Average Cruiser Destroyer Procurement Costs. A fifth option for addressing the projected long-term cruiser-destroyer shortfall would be to reduce the average unit procurement cost of planned cruisers and destroyers, so that the funding programmed for procuring currently planned cruisers and destroyers could instead procure a larger number of cruisers and destroyers. If none of the four previous options were employed, then maintaining a force of at least 88 ships over the long run would require procuring 84 cruisers and destroyers during the 33-year period FY2007-FY2039, rather than the 58 now planned. If the funding programmed for these 58 ships were instead to be sufficient for procuring 84, the average unit cost of the cruisers and destroyers procured would need to be reduced by 31%. Reducing the average unit procurement cost of planned cruisers and destroyers by 31% (or some percentage approaching 31%) would likely require procuring cruisers and destroyers that were, on average, smaller and less capable than those now in the Navy's long-term shipbuilding plan.

LCS Program

Potential options for Congress on the LCS program, some of which could be combined, include the following:

- approve the program as proposed by the Navy;
- use a block-buy contract for LCSs procured during the five-year period FY2007-FY2011;
- shift procurement of LCS mission packages to the SCN account to make these costs more visible to Congress;
- procure a few LCSs and then evaluate them in exercises before deciding whether to put the LCS into larger-scale series production; and
- terminate the LCS program and invest more in other littoral-warfare improvements.

FY2007 Legislative Activity

DDG-1000/CG(X) Program

FY2007 Defense Authorization Bill (H.R. 5122/S. 2766).

House. The House Armed Services Committee, in its report (H.Rept. 109-452 of May 5, 2006) on H.R. 5122, recommended full procurement funding for the first DDG-1000 and design funding for the second. The committee stated:

The committee does not believe the DD(X) is affordable.... the committee understands there is no prospect of being able to design and build the two lead ships for the \$6.6 billion budgeted....

Originally, the Navy proposed building 32 next generation destroyers, reduced that to 24, then finally to 7 in order to make the program affordable. In such small numbers, the committee struggles to see how the original requirements for the next generation destroyer, for example providing naval surface fire support, can be met.... By reducing the requirements for the DD(X), a smaller, less expensive destroyer could be procured in greater numbers. Because of its expense, the committee does not believe that DD(X) will be procured in sufficient numbers to meet the operational need.... The committee supports the construction of up to two DD(X)s to demonstrate technologies that could be incorporated into future, more affordable, major surface combatants. (Pages 69-70)

Senate. The Senate Armed Services Committee, in its report (S.Rept. 109-254 of May 9, 2006) on S. 2766, recommended approving the Navy's FY2007 funding request for the first two ships. The committee stated:

The committee agrees with the Navy's determination that competition is an underlying benefit of dual sourcing, and that it is critical to meeting the fifth ship cost limitation established for the next generation destroyer program.

The committee is equally concerned with the risk that the dual lead ship strategy adds to the program. The committee is aware that the Navy added \$150.0 million to the second lead ship budget to account for this risk. Nevertheless, the Congressional Budget Office has cited a significantly higher cost estimate for the DD(X) lead ship(s) than currently included in the Navy's budget. It is therefore critical that, in preserving the ability to compete follow-on ships, the Navy does not unduly increase lead ship cost risk and total program cost risk.

The committee understands that the Navy intends to award lead ship contracts following approval by the Defense Acquisition Board (DAB), currently planned for January 2008. The committee urges the DAB to carefully weigh affordability and risk mitigation considerations in arriving at a decision to approve award of the lead ship contracts. The committee directs the Secretary of the Navy to submit a report to the congressional defense committees, 30 days prior to lead ship contract(s) award, on the Navy's competition strategy for DD(X) follow ship procurement. (Page 68)

FY2007 Defense Appropriations Bill (H.R. 5631).

House. The House Appropriations Committee, in its report (H.Rept. 109-504 of June 16, 2006) on H.R. 5631, recommends approving the Navy's request for FY2007 DDG-1000 procurement funding to fully fund the procurement of one DDG-1000 rather than partially fund the procurement of the first two DDG-1000s. The committee's report stated:

For fiscal year 2007, the Committee faces several challenges in recommending appropriations for the Department of Defense and the intelligence community. First, the President's budget proposes an unorthodox approach to funding two major procurement programs, the F-22 fighter of the Air Force and the DD(X) destroyer of the Navy. In both cases, the budget request includes incremental or partial funding, for these two programs....

The use of incremental funding mortgages the future of the procurement budget of the Defense Department in a manner that is not acceptable to the

Committee. In addition, the precedent of incremental funding for these programs could be applied to a variety of other procurements, leading to a loss of budget transparency and reducing the ability to perform oversight. Therefore, the recommendations in this bill include full funding for one DD(X) destroyer and the F-22 fighter program.

Funding of \$2,568,111,000 is recommended to complete full funding of one DD(X) vessel. This is the same level as the funding request for this item, but under the President's budget these funds would have been allocated on an incremental basis against two ships. (Page 4)

The report also states:

The Committee recommends \$2,568,111,000 for the procurement of 1 DD(X) destroyer. The budget requested \$2,568,111,000 to incrementally fund 2 ships, with the balance of funding to be provided in fiscal year 2008. The Committee cannot support such a far-reaching policy change which has implications beyond the Navy's shipbuilding program. Further, the Navy's proposal requires special legislative authority to be executed, and this authority is not included in the House-passed National Defense Authorization Act, 2007 (H.R. 5122). (Page 139)

Senate. The Senate Appropriations Committee, in its report (S.Rept. 109-292 of July 25, 2006) on H.R. 5631, recommends approving the Navy's request for FY2007 procurement funding for the first two DDG-1000s. The report states:

Consistent with the Senate-passed authorization bill and the Navy's current acquisition strategy, the Committee recommendation supports the budget request of \$2,568,111,000 for dual lead ships. The Committee reminds the Navy that this is a unique acquisition strategy and should not be used as a precedent for incrementally funding any future DDG-1000 or any other shipbuilding program. (Page 115)

The report recommends increasing the Navy's request for FY2007 DDG-1000 research and development funding by a net \$1 million (pages 179). This net change is the result of the following recommendations: an \$18-million reduction for "Defer New Start," a \$2-million increase for "Bio/Nano-MEMS [micro-electro-mechanical systems] for defense applications," a \$15-million increase for a permanent magnet motor system, and a \$2-million increase for a floating area network (page 186).

LCS Program

FY2007 Defense Authorization Bill (H.R. 5122/S. 2766).

The House and Senate Armed Services Committees, in their reports (H.Rept. 109-452 of May 5, 2006, and S.Rept. 109-254 of May 9, 2006, respectively) on H.R. 5122/S. 2766, recommended approval of the \$521 million requested for procuring two LCSs, and expressed concerns about the program's acquisition strategy.

House. The House report stated:

The committee is concerned about the uncertainty in the Navy's acquisition strategy for the Littoral Combat Ship (LCS)... How long the Navy intends to continue with two separate designs for these vessels remains unclear. The committee believes that it is also unclear when the Navy will place this program into the discipline of the normal acquisition process with definitive and mature requirements and Director, Operational Test and Evaluation, review before continuing with procurement.... the committee encourages the Navy to develop an acquisition strategy for the long-term that clarifies any ambiguity in the current build profile. The committee further encourages the Navy to downselect to one of the two LCS variants currently in procurement in order to achieve economy of scale, or present a compelling case to the congressional defense committees on why both variants should be procured. (Page 69)

Senate. The Senate report stated:

The construction of lead LCS vessels at two shipyards inherently adds cost risk, which will persist until these ships near completion in 2007 and 2008. The emphasis on cost control would dictate that the Navy pursue competition, commonality, and the results of learning curves to the extent practical in the procurement of this 55 ship class.

The committee views LCS as an important component of the Navy's strategy for conducting the global war on terror, and has supported the Navy's approach to rapidly field this capability. The design and construction of LCS in parallel with development of the mission modules requires heightened management of program risk to ensure affordable, full mission capability of the LCS program. However, the committee is concerned that the affordability appeal of the LCS program is being overtaken by apparent cost growth, and that the rapid ramp up in LCS procurement will compound the issue. The stated emphasis on affordability is obscured by the absence of a clear acquisition strategy to guide strategic program decisions. Additionally, it is unclear that the Navy has assessed the added cost for training, maintenance, configuration management, planning and engineering, and supply support for the two flight 0 ship classes. Further, by virtue of budgeting the costs for procuring the flight 0 LCS vessels in three different appropriations, total costs for the program's start are difficult to discern.

In view of these concerns, the committee directs the Secretary of the Navy to submit a report on the LCS program, no later than December 1, 2006 to the congressional defense committees. The report shall outline the Navy's acquisition strategy for the program, including the competition plan, the flight strategy, and the cost containment strategy for the program; contain a clear representation of all R&D and procurement costs for the total program; and assess the added life cycle costs associated with operation and support for two dissimilar flight 0 LCS designs. (Page 113)

FY2007 Defense Appropriations Bill (H.R. 5631).

House. In its report (H.Rept. 109-504 of June 16, 2006) on H.R. 5631, the House Appropriations Committee recommended approval of the \$521 million requested for procuring two LCSs (page 141). The committee also recommended increasing funding for LCS research and development work by \$12.6 million above the requested amount to fund four additional LCS-related research and development projects (pages 239 and 250).

Senate. The Senate Appropriations Committee, in its report (S.Rept. 109-292 of July 25, 2006) on H.R. 5631, recommends funding the procurement of one LCS (rather than the requested two) in FY2007, and rescinding funding (in Section 8043) for one of the three LCSs procured in FY2006 (pages 114, 115-116, and 230-231). The report states:

The Navy's [earlier LCS] acquisition strategy was to procure four flight 0 ships evenly split between two competing designs and then progress to a single flight 1 design selected while evaluating system performance of the flight 0 ships. In 2005, the Navy proposed expanding the planned purchase of flight 0 ships from four to 15 and to continue production of both designs.

The Defense Appropriations Act, 2006 (Public Law 109-148) appropriated an additional \$440,000,000 in the "Shipbuilding and Conversion, Navy" account to accelerate procurement of the third and fourth LCS flight 0 ships. The additional funding was based upon the Navy's estimated \$220,000,000 unit cost. With the fiscal year 2007 budget submission of \$520,670,000 for the fifth and sixth LCS flight 0 ships, the Navy revealed the LCS unit cost estimate used as a basis for last year's appropriation was exclusive of contract change orders, planning and engineering services, program management support and other costs not included in the ship construction contract. The Congressional Research Service estimates these adjustments would increase the average unit cost of LCS ships about 33 percent, to approximately \$300,000,000. As a result, the Navy is unable to procure both the third and fourth LCS flight 0 ships without the availability of additional funding. The Committee is troubled by this revelation and recommends rescinding the insufficient fiscal year 2006 funds currently allocated to the fourth LCS flight 0 vessel.

The Committee is further troubled by reports that the first two LCS flight 0 ships under construction are exceeding their cost as previously budgeted. In last year's report, the Committee reminded the Navy that "the appeal of the LCS is its relative simplicity of design and low cost." The Committee believes cost growth and design changes are jeopardizing the affordability appeal of LCS. As a result, the Committee believes the fiscal year 2007 budget request is insufficient to procure two ships and recommends \$300,670,000 to fully fund procurement of one LCS seaframe, which is a reduction of \$220,000,000 and one seaframe from the request. The Committee notes that this recommendation puts the Navy on its previously established path of procuring four LCS flight 0 ships by the end of fiscal year 2007. (Pages 115-116)

The report recommends increasing the FY2007 request for LCS research and development funding by \$1.8 million for advanced lightweight metals technology for aluminum-intensive marine structures (pages 177 and 185).