



Navy Aegis Cruiser and Destroyer Modernization: Background and Issues for Congress

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Summary

The Navy has begun a program modernize its 84 existing Aegis cruisers and destroyers over a period of more than 20 years. The program's estimated total cost is about \$16.6 billion in constant FY2010 dollars. The Navy's proposed FY2010 budget requests \$674.8 million in funding Aegis ship modernization. The modernizations are intended to ensure that the ships can be operated cost-effectively throughout their entire 35-year intended service lives. The program poses several potential oversight issues for Congress, including the issue of which shipyards should perform the work, and how the modernization program fits into the Navy's larger plans for the future of its surface combatant force.

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Introduction

The Navy has begun a program modernize its 84 existing Aegis cruisers and destroyers over a period of more than 20 years. The program's estimated total cost is about \$16.6 billion in constant FY2010 dollars. The Navy's proposed FY2010 budget requests \$674.8 million in funding Aegis ship modernization. The modernizations are intended to ensure that the ships can be operated cost-effectively throughout their entire 35-year intended service lives. The program poses several potential oversight issues for Congress, including the issue of which shipyards should perform the work, and how the modernization program fits into the Navy's larger plans for the future of its surface combatant force.

Background

Aegis Cruisers and Destroyers

The Navy's existing cruisers and destroyers are called Aegis ships because they are all equipped with the Aegis combat system—an integrated combination of sensors, weapons, computers, software, and display systems that was named for the mythological shield carried by Zeus. Aegis cruisers and destroyers are multi-mission platforms capable of conducting missions such as air defense (which the Navy calls anti-air warfare), ballistic missile defense (BMD), anti-submarine warfare, anti-surface warfare, naval surface fire support for forces ashore, and Tomahawk cruise missile strikes.

The Navy's Aegis ships include Ticonderoga (CG-47) class cruisers and Arleigh Burke (DDG-51) class destroyers. A total of 27 CG-47s were procured for the Navy between FY1978 and FY1988; the ships entered service between 1983 and 1994. The first five, which were built to an earlier technical standard, were judged by the Navy to be too expensive to modernize and were removed from service in 2004-2005. The Navy plans to keep the remaining 22 ships in service to age 35.

A total of 62 DDG-51s were procured for the Navy between FY1985 and FY2005; the first entered service in 1991, 54 were in service as of the end of FY2008, and the 62nd is scheduled to enter service in 2011. The Navy until recently had planned to keep them in service to age 35, but is now considering extending their service lives to 40 years.

Although procurement of DDG-51s ended in FY2005, the Navy now wants to restart DDG-51 procurement. Under the Navy's plan, the first DDG-51 to be procured under the restart, which would be the 63rd DDG-51 overall, would be procured in FY2010 and would enter service in 2016 or 2017. The resumption of DDG-51 procurement is discussed in detail in another CRS report.¹

The 84 in-service or under construction Aegis ships funded in FY2005 and prior years equate to about 27% of the Navy's planned total force of 313 ships.² (Additional DDG-51s funded in

¹ CRS Report RL32109, *Navy DDG-51 and DDG-1000 Destroyer Programs: Background and Issues for Congress*, by Ronald O'Rourke.

² For more on the Navy's planned 313-ship fleet, see CRS Report RL32665, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, by Ronald O'Rourke.

FY2010 and subsequent years will increase this percentage.) The last of the 84 ships funded in FY2005 and prior years are to remain in service into the 2040s.

Aegis Ship Industrial Base

Construction Shipyards

The builders of the Navy's Aegis ships are General Dynamics' Bath Iron Works (GD/BIW) of Bath, ME, and the Ingalls shipyard of Pascagoula, MS, that forms part of Northrop Grumman Shipbuilding (NGSB). Of the 84 in-service or under construction Aegis ships funded in FY2005 and prior years, GD/BIW built or is building 41 (7 cruisers and 34 destroyers), and Ingalls built or is building 43 (15 cruisers and 28 destroyers). Building surface combatants is GD/BIW's primary business. Ingalls builds both surface combatants and large-deck amphibious assault ships.

Overhaul and Repair Shipyards

Several U.S. shipyards maintain and repair Aegis ships, with much of the work done under multi-ship/multi-option (MSMO) contracts. Under a MSMO contract, a shipyard is responsible for conducting depot-level maintenance work on several ships in a class.

Combat System Manufacturers

The primary contractor for the Aegis system is Lockheed Martin's Maritime Systems & Sensors division of Moorestown, NJ. Lockheed and the firms that previously owned the Moorestown facility have been the primary Aegis contractor since the 1970s. Other makers of Navy surface ship combat systems include Raytheon, the maker of, among other things, the combat system for the Navy's new DDG-1000 class destroyers, and General Dynamics, the maker of the combat system for the General Dynamics version of the Littoral Combat Ship (LCS).³ Although Lockheed is the primary contractor for the Aegis system, Raytheon has a share of the system.

Purpose of Aegis Ship Modernization Effort

A primary objective of the Aegis ship modernization effort is to improve the ships' combat capabilities so that the ships will remain mission-effective to the end of their intended service lives. A second major objective is to make the ships less expensive to operate, maintain, and modernize over the remainder of their lives. The modernization itself is not intended to extend the ships' expected lives from 35 years to some higher figure, such as 40 years. Additional maintenance work would be needed to extend the ships' lives to 40 years or some other higher figure.

³ For more on the DDG-1000 and LCS programs program, see CRS Report RL32109, *Navy DDG-51 and DDG-1000 Destroyer Programs: Background and Issues for Congress*, by Ronald O'Rourke, and CRS Report RL33741, *Navy Littoral Combat Ship (LCS) Program: Background, Oversight Issues, and Options for Congress*, by Ronald O'Rourke.

Planned Modernization Work

The Navy's Aegis ship modernization plan includes modernization of the ships' basic hull, mechanical, and electrical (HM&E) equipment, and modernization of their combat systems. In both areas, the Navy plans to install new systems or components that are more capable than the ones they are to replace. Some of the planned changes are intended to permit the ships to be operated with a smaller crew, thereby reducing their annual operation and support (O&S) costs. Planned changes to the ships' combat systems are intended to, among other things, begin shifting their Aegis computers and software to a more open architecture (OA), meaning, in general terms, an arrangement that uses non-proprietary computers and software. The Navy believes that moving Aegis to an OA design will permit the Aegis system to be updated over the remainder of the ships' lives more easily and less expensively, using contributions from a variety of firms.

In August 2008, it was reported that the Navy had decided to expand the scope of the DDG-51 modernization program to include the installation of a BMD capability, so that all DDG-51s would eventually be BMD-capable, and that the Navy had not committed to similarly expanding the scope of the CG-47 modernization program due to financial constraints.⁴ Equipping all DDG-51s with a BMD capability would significantly expand the previous program of record for sea-based BMD platforms, which called for a total of 18 Aegis ships (3 CG-47s and 15 DDG-51s) to be BMD-capable.⁵

Cost

In constant FY2010 dollars, the Navy estimates the average cost of each cruiser modernization at about \$220 million per ship, and the average cost of each destroyer modernization at about \$190 million per ship.⁶ On this basis, a program for modernizing 22 cruisers and 62 destroyers would have a total estimated cost of about \$16.6 billion in constant FY2010 dollars.

FY2010 Funding Request

As shown in **Table 1**, the Navy's proposed FY2010 budget requests \$674.8 million in funding Aegis ship modernization. The funding is for:

- the fourth and fifth cruiser modernization shipyard availabilities,
- long lead-time procurement of equipment for the modernization of three cruisers,
- the first and second destroyer modernization shipyard availabilities, and
- long lead-time procurement of equipment for the backfit modernization of three destroyers, including hardware and software to upgrade the ballistic missile defense capability of one destroyer.⁷

⁴ Otto Kreisher, "BMD Boost," *Seapower*, August 2008: 12-14.

⁵ For more on sea-based BMD programs, see CRS Report RL33745, *Sea-Based Ballistic Missile Defense—Background and Issues for Congress*, by Ronald O'Rourke.

⁶ Source: Telephone conversation with Navy Office of Legislative Affairs, May 29, 2009.

⁷ Department of the Navy, *Highlights of the Department of the Navy FY 2010 Budget*, May 2009, pp. 5-4 and 5-5.

Table 1. FY2008-FY2010 Funding for Aegis Ship Modernization

Dollars figures in millions

Item	FY2008	FY2009	FY2010 (request)
Cruiser modernization			
Ship quantity	1	2	2
OPN ^a	216.0	165.2	315.3
WPN ^b	23.4	30.0	51.2
RDT&EN ^c	4.6	4.7	4.7
OMN ^d	98.5	109.9	114.7
Subtotal cruiser funding	342.5	309.8	485.9
Destroyer modernization			
Quantity	0	0	2
OPN ^e	52.7	165.0	142.3
RDT&EN ^f	0	0	3.7
OMN ^g	12.0	2.0	2.0
OMN ^h	8.8	37.7	40.9
Subtotal destroyer funding	73.5	204.7	188.9
TOTAL cruiser and destroyer funding	416.0	514.5	674.8

Source: Navy briefings to CRS and CBO on Aegis cruiser and destroyer modernization, June 10, 2009.

Notes: OPN is Other Procurement, Navy account; WPN is Weapon Procurement, Navy account, RDT&EN is Research, Development, Test and Evaluation, Navy account, OMN is Operations and Maintenance, Navy account.

- a. OPN, P-I book, line 15, CG Modernization, 0204162N/0960.
- b. WPN, P-I book, line 33, CG Modernization, 0204221N/4223.
- c. RDT&EN, R-I book, line 113, Ship Contract Design, PE0604567N/Project 1803.
- d. OMN, 1B5B, CG Modernization, 0204221N.
- e. OPN, P-I book, line 6, DDG Modernization, 0204228N/0900.
- f. RDE&EN, R-I book, line 113, Ship Contract Design, PE0604567N/Project 1803.
- g. OMN, 1B2B, DDG Modernization, 0702228N.
- h. OMN, 1B5B, DDG Modernization, 0204222N.

Schedule

Under the Navy's plan, the oldest cruisers and destroyers would be modernized first, followed by progressively younger ships. In general, the Navy wants to divide the modernization work for each ship into two shipyard periods—one for HM&E work, the other for combat system work. An exception was the first cruiser to be modernized (Bunker Hill [CG-52]), which received a combined HM&E and combat system modernization that began in February 2008 and was completed in February 2009. The Navy states that the ship's modernization was completed on time and within budget. The Navy plans to deliver two more fully modernized cruisers in

FY2009 and FY2010, one more in FY2011, and three per year starting in FY2012, until all 22 cruisers are modernized.⁸

The Navy wants each destroyer to receive its combat system modernization two years after its HM&E modernization. The Navy wants to begin the first two destroyer HM&E modernizations in FY2010, three more in FY2011, and two more in FY2012. The Navy wants to begin the first destroyer combat system modernization in FY2012.⁹

Shipyards Performing The Work

The Navy plans to use competitively awarded MSMO contracts for executing the Aegis modernizations. Under the Navy's plan, all U.S. shipyards would be eligible to compete for the contracts. Navy policy calls for modernizations lasting longer than six months to be competed on a coast-wide basis, meaning that competitions would be open to all yards located along the same coast where the Aegis ships in question are homeported.

Potential Issues for Congress

Cost Impact of BMD Addition

One potential oversight issue for Congress concerns cost impact of the Navy's decision in 2008 to expand the scope of the DDG-51 modernization program to include the installation of a BMD capability on every DDG-51 being modernized. How did this decision affect the total estimated cost of the Aegis modernization program? Was funding for other Navy programs reduced to finance this decision, and if so, how were these other programs affected by the funding reduction?

Overall Vision Behind Program¹⁰

Some industry sources have questioned the Navy's logic behind the Aegis ship modernization program, arguing that the Navy lacks a sufficiently thought-through overall vision—a desired end-point—for the surface combatant force, and that in the absence of such a vision, the Navy is planning to spend money on Aegis ship modernizations in a scattershot manner, without knowing whether this will lead to the best-possible future surface fleet for the Navy. These sources argue that, before spending money on Aegis ship modernizations, the Navy should develop a more fully considered overall vision for the future of the surface fleet that looks at the surface force and the Navy as a whole as parts of a larger network of defense capabilities involving other U.S. military forces. One potential alternative to the Navy's plan would be to forego some or all of the Aegis ship modernizations, accelerate the planned procurement of new cruisers and destroyers, and replace the unmodernized Aegis ships with the accelerated replacement ships.¹¹

⁸ Navy briefing to CRS and Congressional Budget Office (CBO) on cruiser modernization program, June 10, 2009.

⁹ Navy briefing to CRS and Congressional Budget Office (CBO) on cruiser modernization program, June 10, 2009.

¹⁰ This issue, and most of the subsequent potential issues for Congress, are based in part on CRS interviews conducted in January 2007 with several major defense firms that have an interest in the Aegis ship modernization program.

¹¹ The Navy plans to replace the 22 CG-47s with 19 CG(X) cruisers to be procured between FY2011 and FY2023, and the 62 DDG-51s with a comparable number of DDG(X) destroyers, the first of which would be procured in FY2023. (continued...)

Shipyards For DDG-51 Modernizations

Some industry sources propose allocating all the DDG-51 modernizations to GD/BIW and NGSB, with each firm receiving one-half of the ships. These sources argue that this would reduce the cost of the DDG-51 modernizations by permitting the two firms to achieve sustained learning-curve benefits in the program, and also support the shipbuilding industrial base by providing additional work to the two yards that have built all Navy cruisers and destroyers procured in recent years. Competitive pressure on GD/BIW and NGSB, these industry sources argue, can be maintained by using Profit Related to Offer (PRO) bidding, under which the two yards would bid prices for performing the modernizations allocated to them, with the lower bid winning a higher profit margin.

Scope of DDG-51 Modernizations

Some industry sources have suggested expanding the scope of the DDG-51 modernizations in various ways to further increase the ships' capabilities or further reduce their crew sizes and operating costs. One proposal would add some electric-drive propulsion equipment to the ships' existing mechanical-drive propulsion systems to more fully interconnect the mechanical-drive components, which could reduce the ships' fuel use and create other operational advantages.¹²

Service Life Extension to 40 Years

Another potential option for the Aegis ship modernization program would be to expand its scope to include work that would be needed to extend the service lives of the Aegis ships from 35 years to a higher number, such as 40 years. Extending the Aegis ships' service lives to 40 years could permit the Navy to maintain higher numbers of cruisers and destroyers in future years. The Navy's report on its FY2009 30-year shipbuilding plan, submitted to Congress in early February 2008, incorporates a new assumption that the service lives of all 62 Aegis destroyers will be extended from 35 years to 40 years.¹³ Subsequent to the submission of this report, however, a Navy official was quoted as stating that the Navy had not yet officially approved the idea of extending the service lives of those ships.¹⁴

Aegis Open Architecture

Some observers have expressed concerns about the Navy's plan for moving to an open architecture (OA) on the Aegis system, arguing that it will not shift the Aegis ships to a truly open architecture, or do so quickly enough.¹⁵ For firms that make Navy surface ship combat systems,

(...continued)

The DDG(X) is not to be confused with DD(X), the prior name of the DDG-1000 destroyer (which is not intended as a replacement for either the CG-47s or the DDG-51s). For more on the CG(X) program, see CRS Report RL34179, *Navy CG(X) Cruiser Program: Background, Oversight Issues, and Options for Congress*, by Ronald O'Rourke.

¹² For more on this proposal, see CRS Report RL33360, *Navy Ship Propulsion Technologies: Options for Reducing Oil Use—Background for Congress*, by Ronald O'Rourke.

¹³ U.S Navy, *Report to Congress on Annual Long-Range Plan for Construction of Naval Vessels for FY 2009*, p. 9.

¹⁴ Zachary M. Peterson, "Destroyer Extension Part of 313-Ship Plan," *NavyTimes.com*, February 11, 2008.

¹⁵ See, for example, Dan Taylor, "Roughhead: Navy Could Be Implementing Open Architecture Faster," *Inside the* (continued...)

or parts of them, the issue of how to implement open architecture on Aegis ships and other Navy surface ships has potentially very large business implications. Potential candidates for the basis of an eventual common open-architecture combat system for Navy surface ships include (but are not necessarily limited to) a modularized version of Lockheed's Aegis system, Raytheon's Total Ship Computing Environment Infrastructure, or TSCEI (the core of the combat system being developed for the DDG-1000 destroyers), and the Core Mission System developed by General Dynamics and Northrop for the General Dynamics version of the LCS. The Senate Armed Services Committee's report on the FY2008 defense authorization bill directed the Navy to report to Congress quarterly on the Navy's plan and progress in implementing OA.¹⁶ The Navy submitted the first such report in February 2008; subsequent reports have followed at three-month intervals.

On September 22, 2008, Raytheon filed a protest with the Government Accountability Office (GAO) for lack of competition in the Navy's plan to award a sole-source contract to Lockheed for modernizing the Aegis combat systems on the fleet's cruisers and destroyers.¹⁷ On December 22, 2008, GAO denied Raytheon's protest.¹⁸

Legislative Activity for FY2010

FY2010 Defense Authorization Bill (H.R. 2647/S. 1390)

House

The House Armed Services Committee, in its report (H.Rept. 111-166 of June 18, 2009) on H.R. 2647, recommends approving the Navy's FY2010 request for \$315.3 million in OPN funding for Aegis cruiser modernization and \$142.3 million in OPN funding for Aegis destroyer modernization (page 77, lines 015 and 006, respectively).

Senate

Division D of S. 1390 as reported by the Senate Armed Services Committee (S.Rept. 111-35 of July 2, 2009) presents the detailed line-item funding tables that in previous years have been

(...continued)

Navy, September 29, 2008. See also Dan Taylor, "Report: All Cruisers, Destroyers To Have Open Architecture by 2025," *Inside the Navy*, September 8, 2005; and Geoff Fein, "Navy OA Report To Congress Shows Service Making Gains Across The Enterprise," *Defense Daily*, September 5, 2008.

¹⁶ S.Rept. 110-77 of June 5, 2007 on S. 1547, pp. 272-273.

¹⁷ August Cole, "Raytheon Files Protest On Aegis Work," *Wall Street Journal*, September 24, 2008: B3; Geoff Fein, "As A Measure if Last Resort, Raytheon Files Protest Over Lack of Aegis Competition," *Defense Daily*, September 25, 2008: 2-3; Rebekah Gordon, "Raytheon Protests Sole-Source Award For Aegis Modernization," *Inside the Navy*, September 29, 2008.

¹⁸ Zachary M. Peterson, with additional reporting by Rebekah Gordon, "GAO Denies Raytheon Protest of Aegis Contract Awards to Lockheed," *DefenseAlert—Daily News (InsideDefense.com)*, December 24, 2008; Bettina H. Chavanne, "Raytheon Loses Protest Bid On Aegis Modernization Contract," *Aerospace Daily & Defense Report*, January 6, 2009: 6; Geoff Fein, "Navy's Decision To Sole-Source Aegis Work Was 'Unobjectionable,' GAO Says," *Defense Daily*, January 12, 2009: 6.

included in the Senate Armed Services Committee's report on the defense authorization bill. Division D recommends approving the Navy's FY2010 request for \$315.3 million in OPN funding for Aegis cruiser modernization and \$142.3 million in OPN funding for Aegis destroyer modernization (page 621, line 015, and page 620, line 006, of the printed bill, respectively).

The committee's report states:

The budget request included \$11.4 million in Other Procurement, Navy (OPN), for firefighting equipment, but included no funding to expand the application of "smart valves" for firefighting systems to support the DDG-51 modernization program.

The Navy developed smart valve technology as part of the DDG-1000 autonomic fire suppression system (AFSS). These systems support reducing crew sizes because they can automatically reconfigure a ship's firefighting system to route around damaged sections of piping without human intervention.

The current DDG-51 modernization program is upgrading various systems on the DDGs, including the hull, mechanical and electrical systems. If the Navy were to make appropriate engineering changes, this smart valve technology could be backfit to the DDG-51 during this modernization period, and provide the opportunity to reduce crew sizes.

Therefore, the committee recommends an increase of \$4.0 million in OPN for expanding the application of smart valve technology. (Page 23 of the report; see also page 620, line 007 of the printed bill)

FY2010 DOD Appropriations Bill (H.R. 3326)

House

The House Appropriations Committee, in its report (H.Rept. 111-230 of July 24, 2009) on H.R. 3326, recommends reducing by \$1.2 million the Navy's FY2010 request for \$315.3 million in OPN funding for Aegis cruiser modernization for "Properly price SPQ-9B radar," and recommends reducing by \$30.9 million the Navy's FY2010 request for \$142.3 million in OPN funding for Aegis destroyer modernization for "Modernization equipment ahead of need" (page 173, lines 015 and 006, respectively).

Senate

The Senate Appropriations Committee, in its report (S.Rept. 111-74 of September 10, 2009) on H.R. 3326, recommends approving the Navy's FY2010 request for \$315.3 million in OPN funding for Aegis cruiser modernization, and recommends increasing by \$3.1 million the Navy's FY2010 request for \$142.3 million in OPN funding for Aegis destroyer modernization for "Smart Valve Automatic Fire Suppression System" (page 115, line 15, and page 122, line 006, respectively).

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