



## **CRS Report for Congress**

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

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### **Summary**

The Navy wants to modernize 84 Aegis cruisers and destroyers over a period of more than 20 years at a potential total cost of about \$9.7 billion in today's dollars. The Navy's plan poses several potential issues for Congress, including the Navy's overall vision behind the plan; the schedule, sequence, and scope of the destroyer modernizations, as well as the shipyards to be used for executing them; the strategy for achieving an open architecture combat system on the 84 Aegis ships; and whether to extend the ships' service lives from 35 years to 40 years. Congress's decisions regarding Aegis ship modernizations could affect future Navy ship force levels and capabilities, Navy funding requirements, U.S. shipyards, and makers of Navy ship combat systems. This report will be updated as events warrant.

### **Background**

**Aegis Cruisers and Destroyers.** The Navy's current cruisers and destroyers are called Aegis ships because they are 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. The Aegis ships are multi-mission ships for conducting missions such as anti-air warfare (air defense), ballistic missile defense, 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, 49

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were in service as of the end of FY2006, and the 62nd is scheduled to enter service in late 2010 or early 2011. The Navy currently plans to keep them in service to age 35.

Between 2010/2011, when the 62nd DDG-51 enters service, and 2021, when the first of the 22 remaining CG-47s reaches age 35, the Navy plans to maintain a force of 84 Aegis ships — 22 cruisers and 62 destroyers. These 84 ships equate to about 27%, or more than one-quarter, of the Navy's planned total force of 313 ships.<sup>1</sup> Aegis ships are to account for the majority of the Navy's cruiser-destroyer force into the 2030s, and the last of the 84 ships are to remain in service into the 2040s.

**Major Contractors for Navy Surface Combatants.** The builders of the 84 Aegis ships are General Dynamics' Bath Iron Works (GD/BIW) of Bath, ME (7 CG-47s and 34 DDG-51s), and the Ingalls shipyard of Pascagoula, MS, that forms part of Northrop Grumman Ship Systems (NGSS) (15 CG-47s and 28 DDG-51s). 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.

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. Lockheed's current contract for acting as Aegis system integrator, called the 5197 contract, was awarded in 1998 and will expire on September 30, 2007. 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).<sup>2</sup>

**Purpose of Modernization.** 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 age 35. A second major objective is to make the ships less expensive to operate, maintain, and modernize over the remainder of their lives. The modernization is not intended to extend the ships' expected lives from 35 years to some higher figure, such as 40 years.

**Planned Modernization Work.** The Navy's 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

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<sup>1</sup> 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.

<sup>2</sup> For more on the DDG-1000 and LCS programs program, see CRS Report RL32109, *Navy DDG-1000 (DD(X)) and CG(X) Ship Acquisition Programs: Oversight Issues and Options for Congress*, by Ronald O'Rourke, and CRS Report RL33741, *Navy Littoral Combat Ship (LCS) Program: Oversight Issues and Options for Congress*, by Ronald O'Rourke.

to a more open architecture (OA), meaning, in general terms, an arrangement that uses non-proprietary computers and software. The Navy believes that moving to an Aegis open architecture 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.

**Cost.** The Navy estimates that modernizing the first 8 CG-47s would cost an average of about \$221 million per ship, while modernizing the DDG-51s would cost about \$78 million per ship in today's dollars. Using these figures, the total cost of the 84-ship effort could be about \$9.7 billion in today's dollars. By comparison, the Navy estimates the combined procurement cost of the first three DDG-1000 class destroyers at about \$9.2 billion. **Table 1** shows annual funding for the Aegis ship modernization program.

**Table 1. Funding for Aegis Ship Modernization**  
(millions of then-year dollars)

	FY05	FY06	FY07	FY08
<i>Aegis cruisers</i>				
RDT&EN	0	14.1	7.9	
OPN	0	125.4	233.7	
WPN	0	5.4	18.5	
OMN	0	45.8	98.5	
<i>Cruiser subtotal</i>	<i>0</i>	<i>190.7</i>	<i>358.6</i>	
<i>Aegis destroyers</i>				
SCN	49.8	50.0	0	
OPN	0	3.0	32.2	
OMN	0	10.0	3.9	
<i>Destroyer subtotal</i>	<i>49.8</i>	<i>63.0</i>	<i>36.1</i>	
<b>TOTAL</b>	<b>49.8</b>	<b>253.7</b>	<b>394.7</b>	

**Source:** Table prepared by CRS using U.S. Navy data. **RDT&EN** is the Research, Development, Test and Evaluation, Navy appropriation account; **SCN** is the Shipbuilding and Conversion, Navy account; **OPN** is the Other Procurement, Navy account; **WPN** is the Weapon Procurement, Navy account, and **OMN** is the Operation and Maintenance, Navy account.

**Schedule.** Under the Navy's plan, the oldest cruisers and destroyers would be modernized first, followed by progressively younger ships. Due to the schedule for producing parts of the modernized combat system for the cruisers, three of the first four cruisers would be modernized in two separate shipyard periods, with the HM&E work being done first, and the combat system work done later. Subsequent cruisers, and all the destroyers, would have all modernization work done during a single shipyard period. Total time in the shipyard for each ship would be a year or less.

The cruiser modernizations began in FY2007. The first completely modernized cruiser is to be delivered to the fleet in FY2008. Two more are to be delivered in each of FY2009 and FY2010, and three per year are to be delivered starting in FY2011. Under this schedule, all 22 cruisers would be modernized by FY2016. The Navy wants to fully fund the first destroyer modernization in FY2008 and increase the rate to three ships per year in FY2009. Under this schedule, funding of the destroyer modernizations would

span 22 years. Destroyers would return to service two years after the year in which their modernizations are funded. (The first year would be used to procure the equipment to be installed, the second year to install the equipment at the shipyard.) The first modernized destroyer would be delivered in FY2010, and the last around FY2031.

**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 6 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<sup>3</sup>

**Overall Vision Behind Modernization Plan.** Some industry sources question 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 next-generation cruisers and destroyers, and replace the unmodernized Aegis ships with the accelerated replacement ships.<sup>4</sup>

**Schedule And Sequence For DDG-51 Modernizations.** Some industry sources propose that Navy fund four DDG-51 modernizations per year, rather than three, so that the 62-ship DDG-51 modernization program could be finished years sooner. A 4-per-year rate, these sources argue, would reduce total Navy expenditures considerably by improving economies of scale for the DDG-51 modernizations and by more quickly reducing DDG-51 operating costs. Other industry sources argue that the Navy should begin the DDG-51 modernizations with DDG-51s currently under construction, followed by whatever DDG-51s are scheduled for depot-level maintenance. Still others argue that the Navy should upgrade the combat systems on younger DDG-51s when they come into yards for periodic overhaul and repair work, while modernizing older DDG-51s at the same time.

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<sup>3</sup> This section is 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.

<sup>4</sup> The Navy plans to replace the 22 CG-47s with 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. The DDG(X) is not to be confused with DD(X), the prior name of the new DDG-1000 destroyer, which is not intended as a replacement for either the CG-47s or the DDG-51s.

**Shipyards For DDG-51 Modernizations.** Some industry sources propose allocating all the DDG-51 modernizations to GD/BIW and NGSS, 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 NGSS, these industry sources argue, can be maintained by employing Profit-Related Offers (PROs), 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.<sup>5</sup>

**Aegis Open Architecture.** Some industry sources have expressed concerns about the Navy's plan for moving to an open architecture on the Aegis system, arguing that it will not shift the Aegis ships to a truly open architecture, or do so quickly enough. Related to this, some industry sources have expressed strong interest in, and concerns about, how the Navy will determine who will be the Aegis system integrator after the 5197 contract expires on September 30, 2007. Some industry sources would like the Navy to hold a competition for the system integrator work, and to structure the competition in particular ways, while others have expressed concern that a holding a competition could lead to delays and risks in the Aegis ship modernization program.

Aegis open architecture is viewed as important by the Navy and industry not only because of its potential effect on the Aegis ships, but also because it might become an initial step toward developing a common open-architecture combat system for other Navy surface ships, such as aircraft carriers, amphibious ships, and LCSs. The issue of how to implement open architecture more widely through the surface fleet is reportedly a topic of significant discussion in the Navy.<sup>6</sup> A difference of opinion on the matter was

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<sup>5</sup> 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.

<sup>6</sup> Geoff Fein, "Working Group Focused On Accelerating Open Architecture," *Defense Daily*, Jan. 24, 2007; Geoff Fein, "Navy Needs To Consider If Shipbuilders Should Handle Software Work," *Defense Daily*, Nov. 29, 2006; Geoff Fein, "Surface Ships Need To Follow Submarine SBIR Program For Meeting Fleet Needs," *Defense Daily*, Nov. 28, 2006; Geoff Fein, "Navy Identifies 14 Action Items To Accelerate Open Architecture," *Defense Daily*, Nov. 8, 2006; Christopher J. Castelli, "Navy Leadership Touts Importance of Open Architecture," *Inside the Navy*, Nov. 6, 2006; Geoff Fein, "As Navy Defines Open Architecture, Managing The Process Is Important, SECNAV Says," *Defense Daily*, Nov. 6, 2006; Geoff Fein, "Navy Looking To Include Open Architecture Into All Surface Ship Contracts," *Defense Daily*, Nov. 3, 2006; Christopher P. Cavas, "U.S. Navy Goal: 'Incentivize' Open Architecture," *DefenseNews.com*, Nov. 1, 2006; Geoff Fein, "Open Architecture Systems Will Provide Navy Benefits, But Challenges Ahead," *Defense Daily*, Oct. 10, 2006; Geoff Fein, "Defining Open Architecture For The Surface Fleet,"

(continued...)

reportedly one issue involved in the Navy's January 2007 decision to reassign the admiral who has been in charge of Navy shipbuilding programs.<sup>7</sup> For firms that make (or could make) Navy surface ship combat systems, or parts of them, the financial stakes of the issue are potentially very large. Some of these firms have publicized their recent open-architecture efforts.<sup>8</sup> 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.

**Service Life Extension to 40 Years.** One 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 mitigate a substantial projected shortfall in cruisers and destroyers.<sup>9</sup> On at least one prior occasion (from 1989 to 1993), Navy plans called for keeping surface combatants in operation for 40 years. The feasibility and potential cost of extending the Aegis ships' service lives to 40 years is not yet clear.

## Legislative Activity for FY2008

The proposed FY2008 defense budget will be submitted to Congress on February 5, 2007.

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<sup>6</sup> (...continued)

*Defense Daily*, Sept. 13, 2006; Geoff Fein, "CNO Looks To Speed Up Pace of 'Disappointing' Move To Open Architecture," *Defense Daily*, Sept. 11, 2006; Christopher J. Castelli, "Warner Asks Navy To Review Proprietary Software On Warships," *Inside the Navy*, Sept. 11, 2006; Geoff Fein, "Warner Urges Navy To Establish Panel To Explore Open Architecture," *Defense Daily*, Sept. 11, 2006.

<sup>7</sup> Christopher P. Cavas and Andrew Scutro, "PEO Ships Reassigned: DoD Source," *DefenseNews.com*, Jan. 8, 2007.

<sup>8</sup> See, for example, Geoff Fein, "General Dynamics Gives Navy Unrestricted Rights To LCS Mission Architecture," *Defense Daily*, Jan. 8, 2007; Chris Johnson, "Raytheon Touts Work On Open-Architecture Software For DDG-1000," *Inside the Navy*, Nov. 27, 2006; Geoff Fein, "Lockheed Martin Touts Its Efforts With ARCI As Best Way Ahead For Surface Navy," *Defense Daily*, Oct. 19, 2006; Geoff Fein, "Navy Needs Open Business To Achieve Cost Savings On Ships, General Dynamics Says," *Defense Daily*, Oct. 12, 2006.

<sup>9</sup> For a discussion of this shortfall and options for addressing it, including extending the lives of cruisers and destroyers to 40 years, see CRS Report RL32109, *op. cit.*