Congressional Research Service
Informing the legislative debate since 1914

Navy DDG-51 and DDG-1000 Destroyer Programs: Background and Issues for Congress

Updated June 25, 2021

Congressional Research Service
https://crsreports.congress.gov
RL32109

CRS REPORT
Prepared for Members and
Committees of Congress

Summary

The Navy began procuring Arleigh Burke (DDG-51) class destroyers, also known as Aegis destroyers, in FY1985, and a total of 87 have been procured through FY2021, including two in FY2021. From FY1989 through FY2005, DDG-51s were procured in annual quantities of two to five ships per year. Since FY2010, they have been procured in annual quantities of one to three ships per year.

DDG-51s are being procured in FY2018-FY2022 under a multiyear procurement (MYP) contract that Congress approved as part of its action on the Navy's FY2018 budget. DDG-51s procured in FY2017 and subsequent years are being built to a design called the Flight III design, which incorporates a new and more capable radar called the SPY-6 radar.

The Navy's proposed FY2022 budget requests the procurement of one DDG-51 in FY2022, rather than the two DDG-51s that are called for in FY2022 under the FY2018-FY2022 DDG-51 MYP contract, and that were projected for FY2022 under the Navy's FY2021 budget submission. A key issue for Congress for the DDG-51 program in FY2022 is whether to fund the procurement of one DDG-51, two DDG-51s, or some other number of DDG-51s (such as zero or three).

When procured at a rate of two per year, DDG-51s cost roughly $2.0 billion each. Due to the reduced production economies of scale that would occur at a production rate of one ship per year, the one DDG-51 requested for procurement in FY2022 has an estimated cost of $2,401.7 million (i.e., about $2.4 billion). Under the Navy's proposed FY2022 budget, the one requested DDG-51 would receive $384.9 million in prior-year Economic Order Quantity (EOQ) funding—a type of advance procurement (AP) funding that occurs under an MYP contract. Taking this prior-year EOQ funding into account, the Navy's proposed FY2022 budget requests the remaining $2,016.8 million (i.e., about $2.0 billion) needed to complete the ship's estimated procurement cost of $2,401.7 million. The Navy's proposed FY2022 budget also requests $45.8 million in cost-to-complete funding to pay for cost growth on DDG-51s procured in prior years, bringing the total amount of procurement funding requested for the DDG-51 program to $2,062.5 million (i.e., about $2.1 billion)

Procuring one DDG-51 rather than two DDG-51s in FY2022 would prevent the Navy from fulfilling its obligations in the final year of the FY2018-FY2022 DDG-51 MYP contract. Navy officials state that as a result, the Navy would need to pay a $33 million penalty to the DDG-51 shipbuilders (unless the Navy and the shipbuilders were to reach an agreement to amend the terms of the MYP contract).

Navy officials have stated that requesting procurement of one DDG-51 rather than two DDG-51s was an affordability measure—a means of helping the Navy remain within its budget topline while meeting funding needs for other Navy programs. Procuring a second DDG-51 in FY2022 is the number one item on the Navy's FY2022 Unfunded Priorities List (UPL)—the service's list of programs it would prefer to be funded in FY2022, if additional funding were to become available.

The UPL states that procuring two DDG-51s rather than one DDG-51 in FY2022 would require an additional $1,659.2 million (i.e., about $1.7 billion) in shipbuilding funding. That figure is not the cost of the second DDG-51—the second DDG-51's procurement cost would be roughly $2.0 billion. Adding the second DDG-51, however, would reduce the estimated procurement cost of the first DDG-51 due to the resulting increased production economies of scale. The figure of $1,659.2 million is thus the *net* increase in shipbuilding funding that would be needed to procure two DDG-51s rather than one DDG-51 in FY2022.

Contents

Introduction 1
Background 1
Navy's Force of Large Surface Combatants (LSCs) 1
LSC Definition 1
LSC Force Level as of End of FY2020 2
Current and Potential Future LSC Force-Level Goal 2
Comparison of Surface Combatant Force-Level Goals 2
DDG-51 Program 3
Overview 3
Design Changes 3
Multiyear Procurement (MYP) 4
Shipbuilders, Combat System Lead, and Radar Makers 4
Modernization of In-Service Ships 4
FY2022 Procurement Funding Request 5
DDG-1000 Program 6
Surface Combatant Construction Industrial Base 6
Issues for Congress 7
Number of DDG-51s to Procure in FY2022 7
Future LSC Force-Level Goal 8
Transition of Procurement from DDG-51s to DDG(X)s 10
Potential Impact of COVID-19 Pandemic 10
Cost, Technical, and Schedule Risk in Flight III DDG-51 Effort 11
Legislative Activity for FY2022 13
Summary of Congressional Action on FY2022 Funding Request 13

Figures

Figure 1. DDG-51 Class Destroyer 4

Figure A-1. DDG-1000 Class Destroyer 14

Tables

Table 1. Current and Potential Surface Combatant Force-Level Goals 3
Table 2. Congressional Action on FY2022 Funding Request 13

Table A-1. Estimated Combined Procurement Cost of DDG-1000, DDG-1001, and DDG-2002 19

Appendixes

Appendix. Additional Background Information on DDG-1000 Program 14

Contacts

Author Information 24

Introduction

This report presents background information and potential oversight issues for Congress on the Navy's Arleigh Burke (DDG-51) and Zumwalt (DDG-1000) class destroyer programs. The Navy began procuring DDG-51s, also known as Aegis destroyers, in FY1985, and a total of 87 have been procured through FY2021, including two in FY2021. The Navy procured three DDG-1000 class destroyers in FY2007-FY2009 and plans no further procurement of DDG-1000s.

The Navy's proposed FY2022 budget requests the procurement of one DDG-51 in FY2022, rather than the two DDG-51s that are called for in FY2022 under the FY2018-FY2022 DDG-51 multiyear procurement (MYP) contract, and that were projected for FY2022 under the Navy's FY2021 budget submission. Procuring a second DDG-51 in FY2022 is the number one item on the Navy's FY2022 Unfunded Priorities List (UPL)—the service's list of programs it would prefer to be funded in FY2022, if additional funding were to become available. A key issue for Congress for the DDG-51 program in FY2022 is whether to fund the procurement of one DDG-51, two DDG-51s, or some other number of DDG-51s (such as zero or three).

Other issues for Congress concern the Navy's future force-level goal for large surface combatants (or LSCs, meaning cruisers and destroyers) and how the Navy proposes to transition several years from now from procurement of DDG-51s to procurement of a successor destroyer design now in development called the DDG(X). Decisions that Congress makes on these issues could substantially affect Navy capabilities and funding requirements, and the U.S. shipbuilding industrial base.

For more on the DDG(X) program, see CRS In Focus IF11679, *Navy DDG(X) Next-Generation Destroyer Program: Background and Issues for Congress*, by Ronald O'Rourke.

Background

Navy's Force of Large Surface Combatants (LSCs)

LSC Definition

Decades ago, the Navy's cruisers were considerably larger and more capable than its destroyers. In the years after World War II, however, the Navy's cruiser designs in general became smaller while its destroyer designs in general became larger. As a result, since the 1980s there has been substantial overlap in size and capability of Navy cruisers and destroyers. (The Navy's new Zumwalt [DDG-1000] class destroyers, in fact, are considerably larger than the Navy's cruisers.)

In part for this reason, the Navy now refers to its cruisers and destroyers collectively as *large surface combatants (LSCs)*, and distinguishes these ships from the Navy's *small surface combatants (SSCs)*, the term the Navy now uses to refer collectively to its frigates, Littoral Combat Ships (LCSs), mine warfare ships, and patrol craft. The Navy's annual 30-year shipbuilding plan, for example, groups the Navy's surface combatants into LSCs and SSCs.[1]

[1] The Navy sometimes also uses the term *Cru-Des* (an abbreviation of cruiser-destroyer, pronounced "crew-dez") to refer collectively to its cruisers and destroyers.

LSC Force Level as of End of FY2020

As of the end of FY2020, the Navy's LSC force included 91 ships, including 22 Ticonderoga (CG-47) class cruisers,[2] 68 DDG-51s, and one Zumwalt (DDG-1000) class destroyer.

Current and Potential Future LSC Force-Level Goal

Current LSC Force-Level Goal Within 355-Ship Plan of December 2016

The Navy's current force-level goal, released in December 2016, calls for achieving and maintaining a fleet of 355 ships, including 104 LSCs. The Navy and the Department of Defense (DOD) have been working since 2019 to develop a successor for the 355-ship force-level goal.

December 9, 2020, Document Presented Potential New LSC Force-Level Goal

On December 9, 2020, the Trump Administration released a long-range Navy shipbuilding document that called for a Navy with a more distributed fleet architecture, including 382 to 446 manned ships and 143 to 242 large surface and underwater unmanned vehicles (UVs). Within the total of 382 to 446 manned ships, the document called for a total of 78 to 83 LSCs.

June 17, 2021, Document Presents Potential New LSC Force-Level Goal

On June 17, 2021, the Biden Administration released a long-range Navy shipbuilding document that calls for a Navy with a more distributed fleet architecture, including 321 to 372 manned ships and 77 to 140 large surface and underwater UVs. Within the total of 321 to 372 manned ships, the document calls for a total of 63 to 65 LSCs.[3]

Comparison of Surface Combatant Force-Level Goals

Table 1 compares the current force-level goals for surface combatants (i.e., LSCs, SSCs, and large and medium unmanned surface vehicles [LUSVs] and [MUSVs]) within the 355-ship plan to the potential force-level goals for surface combatants in the June 17, 2021, and December 9, 2020, long-range Navy shipbuilding documents.[4]

[2] A total of 27 CG-47s (CGs 47 through 73) were procured for the Navy between FY1978 and FY1988; the ships entered service between 1983 and 1994. The first five ships in the class (CGs 47 through 51), which were built to an earlier technical standard in certain respects, were judged by the Navy to be too expensive to modernize and were removed from service in 2004-2005, leaving 22 ships in operation (CGs 52 through 73).

[3] For more on the 355-ship force-level goal and the December 9, 2020, and June 17, 2021, long-range Navy shipbuilding documents, see CRS Report RL32665, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, by Ronald O'Rourke.

[4] For more on the Navy's SSC programs, see CRS Report R44972, *Navy Constellation (FFG-62) Class Frigate Program: Background and Issues for Congress*, by Ronald O'Rourke; and CRS Report RL33741, *Navy Littoral Combat Ship (LCS) Program: Background and Issues for Congress*, by Ronald O'Rourke. For more on the LUSV and MUSV programs, see CRS Report R45757, *Navy Large Unmanned Surface and Undersea Vehicles: Background and Issues for Congress*, by Ronald O'Rourke.

Table 1. Current and Potential Surface Combatant Force-Level Goals

	Current force-level goal within 355-ship plan	December 9, 2020, shipbuilding document	June 17, 2021, shipbuilding document
Large surface combatants (LSCs—cruisers and destroyers)	**104**	**73 to 88**	**63 to 65**
Small surface combatants (SSCs—frigates and Littoral Combat Ships)	52	60 to 77	40 to 45
Subtotal: LSCs and SSCs	***156***	***133 to 155***	***103 to 110***
Large and Medium Unmanned Surface Vehicles (LUSVs and MUSVs)	0	119 to 166	59 to 89

Source: Table prepared by CRS based on U.S. Navy data.

DDG-51 Program

Overview

The DDG-51 program was initiated in the late 1970s.[5] The first DDG-51 was procured in FY1985 and entered service in 1991. A total of 87 have been procured through FY2021. From FY1989 through FY2005, DDG-51s were procured at rates of two to five ships per year. Since FY2010, they have been procured at rates of one to three ships per year. (The Navy did not procure any DDG-51s during the period FY2006-FY2009. Instead, the Navy in FY2007-FY2009 procured three Zumwalt [DDG-1000] class destroyers, which are discussed later in this report.) The DDG-51 program is one of the longest-running shipbuilding programs in Navy history, and the DDG-51 class is one of the Navy's numerically largest classes of ships since World War II.

DDG-51s (**Figure 1**) are multi-mission destroyers with an emphasis on air defense (which the Navy refers to as anti-air warfare, or AAW) and blue-water (mid-ocean) operations. DDG-51s, like the Navy's 22 Ticonderoga (CG-47) class cruisers, are equipped with the Aegis combat system, an integrated ship combat system named for the mythological shield that defended Zeus. CG-47s and DDG-51s consequently are often referred to as Aegis cruisers and Aegis destroyers, respectively, or collectively as Aegis ships. The Aegis system has been updated several times over the years. Many DDG-51s (and also some CG-47s) have a capability for conducting ballistic missile defense (BMD) operations.[6]

Design Changes

The DDG-51 design has been modified and updated periodically over the years. The first 28 DDG-51s (DDGs 51 through 78) are called Flight I/II DDG-51s. In FY1994, the Navy shifted DDG-51 procurement to the Flight IIA DDG-51 design, which incorporated certain changes, including the addition of a helicopter hangar. A total of 47 Flight IIA DDG-51s (DDGs 79 through 124 and DDG-127) were procured in FY1994-FY2016. In FY2017, the Navy shifted DDG-51 procurement to the Flight III DDG-51 design, which incorporates a new and more

[5] The program was initiated with the aim of developing a surface combatant to replace older destroyers and cruisers that were projected to retire in the 1990s. The DDG-51 was conceived as an affordable complement to the Navy's Ticonderoga (CG-47) class Aegis cruisers. For an early discussion of the DDG-51 program, see Alva M. Bowen and Ronald O'Rourke, "DDG-51 and the Future Surface Navy," *U.S. Naval Institute Proceedings*, May 1985: 176-189.

[6] For more on Navy BMD programs, see CRS Report RL33745, *Navy Aegis Ballistic Missile Defense (BMD) Program: Background and Issues for Congress*, by Ronald O'Rourke.

capable radar called the SPY-6 radar or the Air and Missile Defense Radar (AMDR), as well as associated changes to the ship's electrical power and cooling systems. DDGs 125 and higher, except for DDG-127 as noted above, are to be Flight III DDG-51s.

Figure 1. DDG-51 Class Destroyer

Source: U.S. Navy file photograph.

Multiyear Procurement (MYP)

As part of its action on the Navy's FY2018 budget, Congress granted the Navy authority to use a multiyear procurement (MYP) contract for DDG-51s planned for procurement in FY2018-FY2022. This is the fourth DDG-51 MYP contract—previous DDG-51 MYP contracts covered DDG-51s procured in FY2013-FY2017, FY2002-FY2005, and FY1998-FY2001.

Shipbuilders, Combat System Lead, and Radar Makers

DDG-51s are built by General Dynamics/Bath Iron Works (GD/BIW) of Bath, ME, and Huntington Ingalls Industries/Ingalls Shipbuilding (HII/Ingalls) of Pascagoula, MS. Lockheed is the lead contractor for the Aegis system installed on all DDG-51s. The SPY-6—the primary radar for the Aegis system on Flight III DDG-51s—is made by Raytheon.

Modernization of In-Service Ships

The Navy is modernizing existing DDG-51s (and some CG-47s) so as to maintain their mission and cost-effectiveness out to the end of their projected service lives. Older CRS reports provide additional historical and background information on the DDG-51 program.[7]

[7] See CRS Report 94-343, *Navy DDG-51 Destroyer Procurement Rate: Issues and Options for Congress*, by Ronald

FY2022 Procurement Funding Request

The Navy's proposed FY2022 budget requests the procurement of one DDG-51 in FY2022, rather than the two DDG-51s that are called for in FY2022 under the FY2018-FY2022 DDG-51 MYP contract, and that were projected for FY2022 under the Navy's FY2021 budget submission. When procured at a rate of two per year, DDG-51s cost roughly $2.0 billion each. Due to the reduced production economies of scale that would occur at a production rate of one ship per year, the one DDG-51 requested for procurement in FY2022 has an estimated cost of $2,401.7 million (i.e., about $2.4 billion).

Under the Navy's proposed FY2022 budget, the one requested DDG-51 would receive $384.9 million in prior-year Economic Order Quantity (EOQ) funding—a type of advance procurement (AP) funding that occurs under an MYP contract.[8] Taking this prior-year EOQ funding into account, the Navy's proposed FY2022 budget requests the remaining $2,016.8 million (i.e., about $2.0 billion) needed to complete the ship's estimated procurement cost of $2,401.7 million. The Navy's proposed FY2022 budget also requests $45.8 million in cost-to-complete funding to pay for cost growth on DDG-51s procured in prior years, bringing the total amount of procurement funding requested for the DDG-51 program to $2,062.5 million (i.e., about $2.1 billion)

Procuring one DDG-51 rather than two DDG-51s in FY2022 would prevent the Navy from fulfilling its obligations in the final year of the FY2018-FY2022 DDG-51 MYP contract. Navy officials state that as a result, the Navy would need to pay a $33 million penalty to the DDG-51 shipbuilders[9] (unless the Navy and the shipbuilders were to reach an agreement to amend the terms of the MYP contract).

Navy officials have stated that requesting procurement of one DDG-51 rather than two DDG-51s was an affordability measure—a means of helping the Navy remain within its budget topline while meeting funding needs for other Navy programs. Procuring a second DDG-51 in FY2022 is the number one item on the Navy's FY2022 Unfunded Priorities List (UPL)—the service's list of programs it would prefer to be funded in FY2022, if additional funding were to become available.

The UPL states that procuring two DDG-51s rather than one DDG-51 in FY2022 would require an additional $1,659.2 million (i.e., about $1.7 billion) in shipbuilding funding. That figure is not the cost of the second DDG-51—the second DDG-51's procurement cost would be roughly $2.0 billion. Adding the second DDG-51, however, would reduce the estimated procurement cost of the first DDG-51 due to the resulting increased production economies of scale. The figure of $1,659.2 million is thus the *net* increase in shipbuilding funding that would be needed to procure two DDG-51s rather than one DDG-51 in FY2022.

O'Rourke (April 25, 1994; out of print and available to congressional clients directly from the author), and CRS Report 80-205, *The Navy's Proposed Arleigh Burke (DDG-51) Class Guided Missile Destroyer Program: A Comparison With An Equal-Cost Force Of Ticonderoga (CG-47) Class Guided Missile Destroyers*, by Ronald O'Rourke (November 21, 1984; out of print and available to congressional clients directly from the author).

[8] For more on EOQ funding with MYP contracts, see CRS Report R41909, *Multiyear Procurement (MYP) and Block Buy Contracting in Defense Acquisition: Background and Issues for Congress*, by Ronald O'Rourke.

[9] See, for example, Christopher P. Cavas, "Updated: Fleet Growth Stymied by Navy Budget Request," *USNI News*, May 28 (updated May 30), 2021.

DDG-1000 Program

As noted earlier, in FY2007-FY2009, during the time when the Navy was not procuring DDG-51s, the Navy instead procured three Zumwalt (DDG-1000) class destroyers. The Navy plans no further procurement of DDG-1000s.

DDG-1000s are multi-mission destroyers with an originally intended emphasis on naval surface fire support (NSFS)[10] and operations in littoral (i.e., near-shore) waters. Consistent with that mission orientation, the ship was designed with two new-design 155mm guns called Advanced Gun Systems (AGSs). The AGSs were to fire a new 155mm, gun-launched, rocket-assisted guided projectile called the Long-Range Land-Attack Projectile (LRLAP, pronounced LUR-lap). In November 2016, however, it was reported that the Navy had decided to stop procuring LRLAP projectiles because the projected unit cost of each projectile had risen to at least $800,000.[11]

In December 2017, it was reported that, due to shifts in the international security environment and resulting shifts in Navy mission needs, the mission orientation of the DDG-1000s will be shifted from an emphasis on NSFS to an emphasis on surface strike, meaning the use of missiles to attack surface ships and perhaps also land targets.[12]

In April and May 2021, it was reported that the Navy plans to remove the AGSs on the three ships and replace them with vertical launch tubes for the Navy's new hypersonic Conventional Prompt Strike (CPS) missile, with a goal of fielding CPSs on a DDG-1000 class ship by 2025.[13]

For additional background information on the DDG-1000 program, see the **Appendix**.

Surface Combatant Construction Industrial Base

All cruisers and destroyers procured since FY1985 have been built at GD/BIW and HII/Ingalls. Both of these shipyards 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 HII/Ingalls' ship-construction work. (HII/Ingalls also builds amphibious ships for the Navy and cutters for the Coast Guard.) Navy surface

[10] NSFS is the use of naval guns to provide fire support for friendly forces operating ashore.

[11] Christopher P. Cavas, "New Warship's Big Guns Have No Bullets," *Defense News*, November 6, 2016; Sam LaGrone, "Navy Planning on Not Buying More LRLAP Rounds for Zumwalt Class," *USNI News*, November 7, 2016; Ben Guarino, "The Navy Called USS Zumwalt A Warship Batman Would Drive. But at $800,000 Per Round, Its Ammo Is Too Pricey to Fire," *Washington Post*, November 8, 2016.

[12] Megan Eckstein, "New Requirements for DDG-1000 Focus on Surface Strike," *USNI News*, December 4, 2017. See also Richard Abott, "Navy Will Focus Zumwalt On Offensive Surface Strike," *Defense Daily*, December 5, 2017; David B. Larter, "The Navy's Stealth Destroyers to Get New Weapons and a New Mission: Killing Ships," *Defense News*, February 15, 2018.

[13] See, for example, Rich Abott, "Navy Plans to Field 12 Hypersonic Missiles on Each Zumwalt Destroyer, Replacing Gun," *Defense Daily*, June 8, 2021; Jason Sherman, "Navy Plans to Pack Each DDG-1000 with 12 Long-Range Hypersonic Strike Missiles," *Inside Defense*, June 8, 2021; Sam LaGrone, "CNO: Hypersonic Weapons at Sea to Premiere on Zumwalt Destroyers in 2025," *USNI News*, April 28, 2021; Jason Sherman, "Navy to Rip Out DDG-1000 Advanced Gun System Mounts to Make Room for Hypersonic Weapons," *Inside Defense*, May 26, 2021. See also Paul McLeary, "Exclusive[:] Eying China, CNO Plans Hypersonics & Lasers On Zumwalt Destroyers," *Breaking Defense*, February 26, 2021; Joseph Trevithick, "Navy Wants Triple-Packed Hypersonic Missile Modules On Its Stealthy Zumwalt Destroyers," *The Drive*, March 19, 2021; David B. Larter, "What Should Become of the Zumwalt Class? The US Navy Has Some Big Ideas," *Defense News*, March 25, 2021.

For more on the CPS program, see CRS Report R41464, *Conventional Prompt Global Strike and Long-Range Ballistic Missiles: Background and Issues*, by Amy F. Woolf.

combatants are overhauled, repaired, and modernized at GD/BIW, HII/Ingalls, and other U.S. shipyards.

Lockheed Martin and Raytheon are generally considered the two leading Navy surface combatant radar makers and combat system integrators. Lockheed is the lead contractor for the DDG-51 combat system (the Aegis system), while Raytheon is the lead contractor for the DDG-1000 combat system, the core of which is called the Total Ship Computing Environment Infrastructure (TSCE-I). Lockheed has a share of the DDG-1000 combat system, and Raytheon has a share of the DDG-51 combat system. Lockheed, Raytheon, and Northrop competed to be the maker of the AMDR to be carried by the Flight III DDG-51. On October 10, 2013, the Navy announced that it had selected Raytheon to be the maker of the AMDR, now called the SPY-6 radar.

The surface combatant construction industrial base also includes hundreds of additional firms that supply materials and components. The financial health of Navy shipbuilding 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. Several Navy-operated laboratories and other facilities support the Aegis system and other aspects of the DDG-51 and DDG-1000 programs.

Issues for Congress

Number of DDG-51s to Procure in FY2022

A key issue for Congress for the DDG-51 program in FY2022 is whether to fund the procurement of one DDG-51, two DDG-51s, or some other number of DDG-51s (such as zero or three).

Supporters of procuring one DDG-51 might argue that in a situation of finite defense resources, funding the procurement of a second DDG-51 could require reducing funding for other Navy or DOD programs by about $1.7 billion, which could reduce Navy or DOD capabilities in other ways; that the Navy's new fleet architecture may result in a reduction in the force-level goal for large surface combatants (as shown in **Table 1**), which would reduce the need for procuring a second DDG-51 in FY2022; that the DDG-51 industrial base (both shipyards and supplier firms) will be adequately supported by their existing backlog of DDG-51s and other Navy shipbuilding work; and that a second DDG-51 can be procured in FY2023 (a year in which the Navy's FY2021 budget submission had called for procuring one DDG-51), which would preserve the procurement of a total of three DDG-51s across the two-year period FY2022-FY2023.

Supporters of procuring two DDG-51s might argue that it would help accelerate the introduction of Flight III DDG-51s, with their SPY-6 radars, into the fleet; that it would improve production economies of scale in the DDG-51 program, avoiding a roughly $400 million increase in the procurement cost of the single DDG-51 requested for procurement in FY2021; that it would more strongly support the DDG-51 industrial base; that the second DDG-51's position at the top of the Navy's FY2022 UPL shows that the second ship is a high-priority item for the Navy to fund with offsetting reductions that Congress might be able to identify in reviewing and marking up DOD's proposed FY2022 budget; and that it would permit the Navy to fulfill its obligations under the DDG-51 MYP contract, which would avoid the $33 million penalty payment to the shipbuilders and avoid setting a precedent of the Navy not fully implementing a shipbuilding MYP contract—a precedent that could impact defense contractor confidence about the likelihood that the Navy (or other parts of DOD) will fully implement future MYP contracts.[14]

[14] See also Richard R. Burgess, "Senators Hammer $1 Billion Loss, Industrial Instability with Navy's Planned 2022

Future LSC Force-Level Goal

Another issue for Congress concerns the future LSC force-level goal. In connection with this issue, it can be noted that the December 9, 2020, and June 17, 2021, long-range Navy shipbuilding documents reflect a Navy desire to shift to a more distributed force architecture that would feature

- a smaller proportion of larger ships (such as large-deck aircraft carriers, cruisers, destroyers, large amphibious ships, and large resupply ships);
- a larger proportion of smaller ships (such as frigates, corvettes, smaller amphibious ships, smaller resupply ships, and perhaps smaller aircraft carriers); and
- a new third tier of large unmanned surface and underwater unmanned vehicles (UVs).

Navy and DOD leaders believe that shifting to a more distributed fleet architecture is

- **operationally necessary**, to respond effectively to the improving maritime anti-access/area-denial (A2/AD) capabilities of other countries, particularly China;
- **technically feasible** as a result of advances in technologies for unmanned vehicles (UVs) and for networking widely distributed maritime forces that include significant numbers of UVs; and
- **affordable**—no more expensive, and possibly less expensive, than the current fleet architecture, for a given aggregate level of Navy capability.[15]

Reducing the LSC force-level goal from 104 manned ships to a smaller number (such as those shown in **Table 1** for the December 9, 2020, and June 17, 2021, long-range Navy shipbuilding documents) could affect issues such as when to retire older LSCs and how many new LSCs to procure each year. A June 23, 2021, press article that presents one observer's perspective regarding the figures in **Table 1** states that the June 17, 2021, long-range Navy shipbuilding document

> telegraphs enormous cuts to America's large surface combatant fleet of cruisers and destroyers. The mild verbiage from the report, saying "that growing the small surface combatant force enables reductions in the quantity of large surface combatants while yielding a more distributed and lethal force," masks a likely brutal downsizing.
>
> The cuts will be deep and potentially rapid. Today, 92 large combatants are in the fleet, but the Navy's longer-term plans suggest the legacy large surface combatant fleet of Ticonderoga Class (CG 47) cruisers, Zumwalt Class (DDG 1000) destroyers and Arleigh Burke Class (DDG 51) destroyers will shrink to a fleet of 63 to 65 large surface vessels over the next 30 years. Amphibious assault vessels (LHA/LHDs and LPDs) and command, support and fast transport ships will be cut as well, and the future small surface combatant fleet of littoral combat ships and frigates is only projected to grow to between 40 and 45 ships from a current fleet of 35.
>
> The cuts are widespread, but one place the axe falls hardest is upon the Navy's large surface combatant fleet. First, the Department of Defense will force the Navy to eliminate the entire 22-hull Ticonderoga Class cruiser fleet. But even that drastic cut is not enough for the Navy

Shipbuilding," *Seapower*, June 22, 2021; Kathleen O'Brien, "Rep. Jared Golden: Warship Cut from Biden's Budget Could Mean Shipyard Layoffs," *Times Record (ME)*, June 21, 2021 (updated June 23, 2021).

[15] For additional discussion about shifting the Navy to a more distributed architecture, see CRS Report RL32665, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, by Ronald O'Rourke.

> to get to the Department of Defense's current projection of 63 to 65 ships. With 88 Arleigh Burkes in service, under construction or already authorized, Arleigh Burke destroyer procurement will likely cease and 27 older Flight I, Flight IA and Flight II Burkes will be ushered out of the fleet.
>
> The only question is just how fast the cuts to the large surface combatants will happen.
>
> If left to normal attrition, most of the 27 older Arleigh Burke Class destroyers, deprived of a few hundred million dollar service-life extension six years ago, will simply age out over the next 30 years. Commissioned between 1991 and 1999, early-Flight Burkes were built with a service life expectation of about 35 years and, since the Navy has been unable to find money to systematically modernize and extend the life of the aging ships, most of the older Arleigh Burke destroyers are set to start decommissioning sometime after 2026.
>
> That would be relatively normal practice. But, in a rush to claw back additional money, lock in savings, and make the proposed cuts permanent, aged Ticonderoga cruisers and older Burkes may well be pulled from service quite quickly—far faster than anyone outside of the Pentagon expects.
>
> What should scare surface warriors is that the administration's proposed 30-year goal of 63 to 65 large combatants can be achieved without procuring a single new hull. And while one of America's two remaining large surface combatant yards may help build Constellation Class (FFG-62) guided missile frigates in the coming years, the Navy's surface combatant industrial base will fall under serious strain without some modest level of large surface combatant procurement.
>
> The end of the Burke production line is in sight. The newer, Flight IIA Burkes were built to have a 40-year service life, and, even with no additional vessel procurements beyond the authorized-but-unnamed "DDG 139," the Navy would only need to give six Burkes, DDGs 79 through 84, a 10-year service life extension to meet the current fleet-size goal.
>
> Those handful of refits would let the Navy show up in in 2051 with about 60 Arleigh Burkes and three DDG 1000s in service, clocking in right at the low end of the Navy's 30-year estimate….
>
> A large surface combatant procurement pause may be inevitable.[16]

Section 121 of the FY2021 National Defense Authorization Act (H.R. 6395/P.L. 116-283 of January 1, 2021) states

> SEC. 121. LIMITATION ON ALTERATION OF THE NAVY FLEET MIX.
>
> (a) LIMITATION.—
>
> (1) IN GENERAL.—The Secretary of the Navy may not deviate from the large surface combatant requirements included in the 2016 Navy Force Structure Assessment until the date on which the Secretary submits to the congressional defense committees the certification under paragraph (2) and the report under subsection (b).
>
> (2) CERTIFICATION.—The certification referred to in paragraph (1) is a certification, in writing, that the Navy can mitigate the reduction in multi-mission large surface combatant requirements, including anti-air and ballistic missile defense capabilities, due to having a reduced number of DDG–51 Destroyers with the advanced AN/SPY–6 radar in the next three decades.

[16] Craig Hooper, "Pentagon Plan Sets Navy Up to Quickly Shed 30% of Cruiser and Destroyer Fleet," *Forbes*, June 23, 2021.

(b) REPORT.—Not later than 90 days after the date of the enactment of this Act, the Secretary of the Navy shall submit to the congressional defense committees a report that includes—

(1) a description of likely detrimental impacts to the large surface combatant industrial base, and a plan to mitigate such impacts, if the fiscal year 2021 future-years defense program is implemented as proposed;

(2) a review of the benefits to the Navy fleet of the new AN/SPY–6 radar to be deployed aboard Flight III variant DDG–51 Destroyers, which are currently under construction, as well as an analysis of impacts to the warfighting capabilities of the fleet should the number of such destroyers be reduced; and

(3) a plan to fully implement section 131 of the National Defense Authorization for Fiscal Year 2020 (Public Law 116–92; 133 Stat. 1237), including subsystem prototyping efforts and funding by fiscal year.

Transition of Procurement from DDG-51s to DDG(X)s

Another issue for Congress concerns how the Navy proposes to transition several years from now from procurement of DDG-51s to procurement of a successor destroyer design now in development called the DDG(X). Navy plans for transitioning from procurement of DDG-51s to procurement of DDG(X)s were an oversight focus for the defense committees in their reviews and markups of the Navy's proposed FY2020 and FY2021 budgets. Decisions regarding the transition to DDG(X) procurement will affect Navy capabilities and funding requirements and the U.S. shipbuilding industrial base. Recent Navy documents have shown the following:

- The Navy's FY2020 budget submission and FY2020 30-year shipbuilding plan projected DDG-51s being procured during the period FY2022-FY2025 in annual quantities of 2-3-3-2, with FY2025 being the final year of DDG-51 procurement and the year that the first DDG(X) would be procured.
- The Navy's FY2021 budget submission projected DDG-51s being procured during the period FY2022-FY2025 in annual quantities of 2-1-2-1, and for DDG-51 procurement to end with the procurement of two final ships that would be procured in either FY2026 (both ships) or FY2026 and FY2027 (one ship each year). Under this budget submission, DDG(X) procurement might begin around FY2028.
- The December 9, 2020, long-range Navy shipbuilding document projected DDG-51s being procured during the period FY2022-FY2026 in annual quantities of 2-2-2-2-2. The document did not specify the final year of DDG-51 procurement, but press reports have suggested that the Navy wants to procure the first DDG(X) around FY2028.

For more on the DDG(X) program, see CRS In Focus IF11679, *Navy DDG(X) Next-Generation Destroyer Program: Background and Issues for Congress*, by Ronald O'Rourke.

Potential Impact of COVID-19 Pandemic

Another issue for Congress concerns the potential impact of the COVID-19 pandemic on the execution of U.S. military shipbuilding programs, including the DDG-51 program. For additional discussion of this issue, see CRS Report RL32665, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, by Ronald O'Rourke.

Cost, Technical, and Schedule Risk in Flight III DDG-51 Effort

Another issue for Congress concerns cost, technical, and schedule risk for the Flight III DDG-51. A June 2021 Government Accountability Office (GAO) report assessing selected DOD acquisition programs stated the following in its assessment of the Flight III DDG-51:

> **Current Status**
>
> Flight III ships include design changes to incorporate the AN/SPY-6(V)1 radar and an upgraded Aegis combat system, both of which the Navy plans to be integrated and tested at a land-based site prior to on-board activation in 2022. Program officials stated that integration and testing with AN/SPY-6(V)1 and Aegis is underway and is expected to be complete prior to Aegis combat system activation on DDG 125 in 2022. However, Aegis and AN/SPY-6(V)1 will be installed on DDG 125 before land-based testing is complete. This limits opportunities to address any issues prior to Aegis activation in 2022.
>
> The program office, in coordination with the Aegis and AMDR programs, is developing an integrated test and evaluation master plan for the ship, AMDR, and Aegis, but the plan has yet to be approved.
>
> Both shipbuilders—new to building Flight III—may face cost and schedule challenges often associated with lead ships, potentially exacerbated by a labor inefficiencies due to COVID-19. DDG 125 is 43 percent complete, as of October 2020, and has experienced some cost growth, but is expected to deliver on schedule in fiscal year 2023, according to officials. However, this schedule leaves limited time for sea trials and operational testing based on a planned August 2024 initial operational capability. Any issues during sea trials and testing would likely delay DDG 125's operational availability. Construction on the second Flight III ship—DDG 126—began in March 2020. The program reported that a recent labor strike could also affect DDG 126 construction efficiency. Since last year, the program reduced its planned Flight III procurement from 22 to 18 ships to align with the Navy's future large surface combatant ships plan.
>
> **Program Office Comments**
>
> We provided a draft of this assessment to the program office for review and comment. The program office provided technical comments, which we incorporated where appropriate. The program office reports that the DDG 51 program has delivered 68 ships, with another 21 ships under contract, and that both shipyards are in serial production and constructing the initial Flight III ships. It stated the Navy is executing a test program to demonstrate Flight III upgrades prior to shipboard activation. The program anticipates that the first Flight III ship is on track for delivery in fiscal year 2023, and will reach initial operational capability in fiscal year 2024.[17]

Regarding the AMDR specifically, the report stated the following:

> **Technology Maturity, Design Stability, and Production Readiness**
>
> AMDR will not demonstrate its critical technologies in a realistic environment until after the Navy integrates AMDR and Aegis on the lead DDG 51 Flight III ship during activation of the Aegis combat system in 2022. Until this occurs, we will continue to disagree that the program's critical technologies are fully mature, despite the program reporting them mature since 2017. The Navy will then test AMDR and Aegis in a realistic, at-sea environment on the lead DDG 51 Flight III ship in 2023. The design remains at risk for further disruption until the Navy completes operational testing in fiscal year 2024. Any deficiencies the Navy discovers during testing could require revisions to existing design

[17] Government Accountability Office, *Weapon Systems Annual Assessment[:] Updated Program Oversight Approach Needed*, GAO-21-222, p. 192.

drawings or retrofitting to already-built radars, likely increasing costs, delaying future radar deliveries, or both.

While AMDR's overall design is currently stable, according to officials, the program redesigned the Digital Receiver Exciter (DREX)—a critical technology component—in 2020 because it did not meet vibration specifications, leading to cost increases. Program officials said the new design met all qualification testing specifications and is easier to manufacture. However, the fourth radar array—which completes the first AMDR unit—was delivered to the shipyard in October 2020, 2 months later than planned due in part to the redesign. To maintain the delivery schedule and offset further delays due to the component redesign, the program delivered the first radar to the lead DDG 51 Flight III ship without the complete set of DREX components installed. Officials said the remaining components will be installed in the radar once it is installed on the ship prior to shipyard testing and activation of the Aegis combat system in 2022.

AMDR has yet to demonstrate statistical control of its critical manufacturing processes despite initiating production in May 2017, an approach inconsistent with leading practices. In 2020, the program experienced a manufacturing issue with a Transmit/Receive Integrated Microwave Module (TRIMM) component—another critical technology—that caused cost increases and rework. A TRIMM component's incorrect adhesive application caused unexpected heat exposure, which could result in premature component failure, demonstrating the risks of these immature manufacturing processes. Officials said the contractor fixed the issue for future deliveries. They added that samples of the weakened TRIMM components were re-tested for confidence that they will not prematurely fail and do not present a significant reduction in operational capability for AMDR on the lead DDG 51 Flight III ship.

Software and Cybersecurity

AMDR has used Agile development to complete eight software deliveries that support core radar capabilities. In 2020, the AMDR program tested new Aegis software at the Pacific Missile Range Facility (PMRF), where the Aegis combat system and an AMDR radar array interfaced and tracked an aircraft, according to officials. The program delivered a radar array to the combat system land-based test site and started integration and testing of AMDR and Aegis at the land-based test site in October 2020. These tests will inform software development and integration of AMDR and Aegis, in development concurrently, in preparation for Aegis combat system activation, planned in January 2022.

In the future, the program plans to integrate an Advanced Distributed Radar (ADR) capability through AMDR and Aegis software upgrades. ADR is expected to add radar enhancements and address future threats to the current system. Officials expect to finalize ADR requirements in fiscal year 2021 and begin software development in 2022, with the plan to deliver a capability after 2024. Program officials reported that software development costs increased due to unanticipated complexity and new system requirements such as ADR, among other things.

Officials said that AMDR cybersecurity is addressed within the Aegis combat system. The Aegis program plans to conduct three cyber exercises in 2021, but complete cybersecurity testing will not occur until at least 2023.

Other Program Issues

Since last year, the Navy reduced the number of radar units from 22 to 20—lowering procurement costs—to better align with the number of DDG 51 Flight III ships planned through 2025.

Program Office Comments

We provided a draft of this assessment to the program office for review and comment. The program office provided technical comments, which we incorporated where appropriate.

The program office stated that the first AMDR was delivered in October 2020, this delivery supported DDG 51 Flight III construction schedule, and AMDR performance exceeded thresholds during testing in a maritime environment at PMRF. The program also stated that while radar testing with Aegis and other components at the combat system land-based test site and PMRF will help decrease risk, complete AMDR testing with the ship is necessary to fully retire risk. Additionally, the program noted that the new DREX component is in production and will be installed in all future arrays. According to the program, the use of an FPI firm target production contract for AMDR procurement minimizes the impact of component price variances.[18]

Legislative Activity for FY2022

Summary of Congressional Action on FY2022 Funding Request

Table 2 summarizes congressional action on the Navy's FY2022 procurement funding requests for the DDG-51 and DDG-1000 programs.

Table 2. Congressional Action on FY2022 Funding Request

Millions of dollars, rounded to nearest tenth

		Authorization			Appropriation		
	Request	HASC	SASC	Conf.	HAC	SAC	Conf.
DDG-51 procurement	2,016.8						
DDG-51 advance procurement (AP)	0.0						
DDG-51 cost to complete	45.8						
DDG-1000 procurement	56.6						

Source: Table prepared by CRS based on Navy's FY2022 budget submission, committee and conference reports, and explanatory statements on FY2022 National Defense Authorization Act and FY2022 DOD Appropriations Act.

Notes: HASC is House Armed Services Committee; **SASC** is Senate armed Services Committee; **HAC** is House Appropriations Committee; **SAC** is Senate Appropriations Committee; **Conf.** is conference agreement.

[18] Government Accountability Office, *Weapon Systems Annual Assessment[:] Updated Program Oversight Approach Needed*, GAO-21-222, p. 165.

Appendix. Additional Background Information on DDG-1000 Program

This appendix presents additional background information on the DDG-1000 program.

Overview

The DDG-1000 program was initiated in the early 1990s.[19] DDG-1000s (**Figure A-1**) are multi-mission destroyers with an originally intended emphasis on naval surface fire support (NSFS) and operations in littoral (i.e., near-shore) waters. (NSFS is the use of naval guns to provide fire support for friendly forces operating ashore.)

Figure A-1. DDG-1000 Class Destroyer

Source: U.S. Navy photo 151207-N-ZZ999-435, posted December 8, 2015, with a caption that reads in part: "The future USS Zumwalt (DDG 1000) is underway for the first time conducting at-sea tests and trials in the Atlantic Ocean Dec. 7, 2015."

DDG-1000s were originally intended to replace, in a technologically more modern form, the large-caliber naval gun fire capability that the Navy lost when it retired its Iowa-class battleships in the early 1990s,[20] to improve the Navy's general capabilities for operating in defended littoral

[19] The program was originally designated DD-21, which meant destroyer for the 21st century. In November 2001, the program was restructured and renamed DD(X), meaning a destroyer whose design was in development. In April 2006, the program's name was changed again, to DDG-1000, meaning a guided missile destroyer with the hull number 1000.

[20] The Navy in the 1980s reactivated and modernized four Iowa (BB-61) class battleships that were originally built during World War II. The ships reentered service between 1982 and 1988 and were removed from service between 1990 and 1992.

waters, and to introduce several new technologies that would be available for use on future Navy ships. The DDG-1000 was also intended to serve as the basis for a planned cruiser called CG(X) that was subsequently canceled.[21]

DDG-1000s are to have reduced-size crews of 175 sailors (147 to operate the ship, plus a 28-person aviation detachment), compared to roughly 300 on the Navy's Aegis destroyers and cruisers, so as to reduce its operating and support (O&S) costs. The DDG-1000 design incorporates a significant number of new technologies, including an integrated electric-drive propulsion system[22] and automation technologies enabling its reduced-sized crew.

With an estimated full load displacement of 15,656 tons, the DDG-1000 design is substantially larger than the Navy's Aegis cruisers and destroyers, which have displacements of up to about 9,700 tons, and are larger than any Navy destroyer or cruiser since the nuclear-powered cruiser *Long Beach* (CGN-9), which was procured in FY1957.

The first two DDG-1000s were procured in FY2007 and split-funded (i.e., funded with two-year incremental funding) in FY2007-FY2008; the Navy's FY2021 budget submission estimates their combined procurement cost at $9,450.8 million. The third DDG-1000 was procured in FY2009 and split-funded in FY2009-FY2010; the Navy's FY2021 budget submission estimates its procurement cost at $3,855.1 million.

The first DDG-1000 was commissioned into service on September 7, 2016. Its delivery date was revised multiple times. In the Navy's FY2021 budget submission, the ship's delivery date was revised to March 2020. The ship's actual delivery date reportedly was April 2020.[23] This created an unusual situation in which a ship was commissioned into service more than three years prior to its delivery date. The delivery dates for the second and third ships have also been revised multiple times.[24] In the Navy's FY2022 budget submission, the delivery dates for the two ships were revised to March 2022 and April 2024, respectively.

Program Origin

The program known today as the DDG-1000 program was announced on November 1, 2001, when the Navy stated that it was replacing a destroyer-development effort called the DD-21 program, which the Navy had initiated in the mid-1990s, with a new Future Surface Combatant Program aimed at developing and acquiring a family of three new classes of surface combatants:[25]

---

[21] For more on the CG(X) program, see CRS Report RL34179, *Navy CG(X) Cruiser Program: Background for Congress*, by Ronald O'Rourke.

[22] For more on integrated electric-drive technology, see CRS Report RL30622, *Electric-Drive Propulsion for U.S. Navy Ships: Background and Issues for Congress*, by Ronald O'Rourke.

[23] See Aidan Quigley, "Final Delivery of Zumwalt-class Destroyer Monsoor Delayed," *Inside Defense*, January 21, 2021.

[24] The revised delivery dates for the three ships reflect Section 121 of the FY2017 National Defense Authorization Act (S. 2943/P.L. 114-328 of December 23, 2016), a provision that establishes standards for determining vessel delivery dates and which also required the Secretary of the Navy to certify that the delivery dates for certain ships, including the three DDG-1000s, had been adjusted in accordance with the provision. The Navy's original plan for the DDG-1000 program was to install certain elements of each DDG-1000's combat system after delivering the ship and commissioning it into service. Section 121 of P.L. 114-328 in effect requires the Navy to defer the delivery date of a DDG-1000 until those elements of the combat system are installed. By the time P.L. 114-328 was enacted, DDG-1000, per the Navy's original plan, had already been commissioned into service without those elements of its combat system.

[25] The DD-21 program was part of a Navy surface combatant acquisition effort begun in the mid-1990s and called the SC-21 (Surface Combatant for the 21st Century) program. The SC-21 program envisaged a new destroyer called DD-21

- **a destroyer called DD(X)** for the precision long-range strike and naval gunfire mission;
- **a cruiser called CG(X)** for the air defense and ballistic missile 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.[26]

On April 7, 2006, the Navy announced that it had redesignated the DD(X) program as the DDG-1000 program. The Navy also confirmed in that announcement that the first ship in the class, DDG-1000, would be named *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.[27]

New Technologies

The DDG-1000 incorporates a significant number of new technologies, including a wave-piercing, tumblehome hull design for reduced detectability,[28] a superstructure on the first two ships, but not the third that is made partly of large sections of composite (i.e., fiberglass-like) materials rather than steel or aluminum, an integrated electric-drive propulsion system,[29] a total-ship computing system for moving information about the ship, automation technologies enabling its reduced-sized crew, a dual-band radar (that was later changed to a single-band radar), a new kind of vertical launch system (VLS) for storing and firing missiles, and two copies of a new 155mm gun called the Advanced Gun System (AGS).

Shipbuilders and Combat System Prime Contractor

GD/BIW is the builder for all three DDG-1000s, with some portions of each ship being built by HII/Ingalls for delivery to GD/BIW. Raytheon is the prime contractor for the DDG-1000's combat system (its collection of sensors, computers, related software, displays, and weapon launchers).

Under a 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 was to have been built by HII/Ingalls, the second ship was to have been built by GD/BIW, and

---

and a new cruiser called CG-21. When the Navy announced the Future Surface Combatant Program in 2001, development work on the DD-21 had been underway for several years, while the start of development work on the CG-21 was still years in the future. The current DDG-1000 destroyer CG(X) cruiser programs can be viewed as the descendants, respectively, of the DD-21 and CG-21. The acronym SC-21 is still used in the Navy's research and development account to designate the line item (i.e., program element) that funds development work on both the DDG-1000 and CG(X).

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

[27] For more on Navy ship names, see CRS Report RS22478, *Navy Ship Names: Background for Congress*, by Ronald O'Rourke.

[28] A tumblehome hull slopes inward, toward the ship's centerline, as it rises up from the waterline, in contrast to a conventional flared hull, which slopes outward as it rises up from the waterline.

[29] For more on integrated electric-drive technology, see CRS Report RL30622, *Electric-Drive Propulsion for U.S. Navy Ships: Background and Issues for Congress*, by Ronald O'Rourke.

contracts for building the first six were to have been equally divided between HII/Ingalls[30] and GD/BIW.

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 HII/Ingalls and GD/BIW to build all DDG-1000s. On April 20, 2005, the USD AT&L issued a decision memorandum deferring this proposal, stating in part, "at this time, I consider it premature to change the shipbuilder portion of the acquisition strategy which I approved on February 24, 2004."

Several Members of Congress also expressed opposition to the Navy's proposal for a winner-take-all competition. Congress included a provision (§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 a "dual-lead-ship" acquisition strategy, under which two DDG-1000s would be procured in FY2007, with one to be designed and built by HII/Ingalls and the other by GD/BIW.

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 again 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.

On November 23, 2005, the USD AT&L granted Milestone B approval for the DDG-1000, permitting the program to enter the System Development and Demonstration (SDD) phase. As part of this decision, the USD AT&L approved the Navy's proposed dual-lead-ship acquisition strategy and a low rate initial production quantity of eight ships (one more than the Navy subsequently planned to procure).

On February 14, 2008, the Navy awarded contract modifications to GD/BIW and HII/Ingalls for the construction of the two lead ships. The awards were modifications to existing contracts that the Navy has with GD/BIW and HII/Ingalls for detailed design and construction of the two lead ships. Under the modified contracts, the line item for the construction of the dual lead ships is treated as a cost plus incentive fee (CPIF) item.

Until July 2007, it was expected that HII/Ingalls would be the final-assembly yard for the first DDG-1000 and that GD/BIW would be the final-assembly yard for the second. On September 25, 2007, the Navy announced that it had decided to build the first DDG-1000 at GD/BIW, and the second at HII/Ingalls.

On January 12, 2009, it was reported that the Navy, HII/Ingalls, and GD/BIW in the fall of 2008 began holding discussions on the idea of having GD/BIW build both the first and second DDG-1000s, in exchange for HII/Ingalls receiving a greater share of the new DDG-51s that would be procured under the Navy's July 2008 proposal to stop DDG-1000 procurement and restart DDG-51 procurement.[31]

On April 8, 2009, it was reported that the Navy had reached an agreement with HII/Ingalls and GD/BIW to shift the second DDG-1000 to GD/BIW, and to have GD/BIW build all three ships.

[30] At the time of the events described in this section, HII was owned by Northrop Grumman and was called Northrop Grumman Shipbuilding (NGSB).

[31] Christopher P. Cavas, "Will Bath Build Second DDG 1000?" *Defense News*, January 12, 2009: 1, 6.

HII/Ingalls will continue to make certain parts of the three ships, notably their composite deckhouses. The agreement to have all three DDG-1000s built at GD/BIW was a condition that Secretary of Defense Robert Gates set forth in an April 6, 2009, news conference on the FY2010 defense budget for his support for continuing with the construction of all three DDG-1000s (rather than proposing the cancellation of the second and third).

Reduction in Procurement to Three Ships

Navy plans for many years called for ending DDG-51 procurement in FY2005, to be followed by procurement of up to 32 DDG-1000s and some number of CG(X)s. In subsequent years, the planned total number of DDG-1000s was reduced to 16 to 24, then to 7, and finally to 3.

At the end of July 2008, in a major reversal of its destroyer procurement plans, the Navy announced that it wanted to end procurement of DDG-1000s and resume procurement of DDG-51s. In explaining this reversal, which came after two DDG-1000s had been procured, the Navy stated that it had reevaluated the future operating environment and determined that its destroyer procurement now needed to emphasize three missions: open-ocean antisubmarine warfare (ASW), countering anti-ship cruise missiles (ASCMs), and countering ballistic missiles. Although the DDG-1000 could perform the first two of these missions and could be modified to perform the third, the Navy concluded that the DDG-51 design could perform these three missions adequately and would be less expensive to procure than the DDG-1000 design.

The Navy's proposal to stop procuring DDG-1000s and resume procuring DDG-51s was presented in the Navy's proposed FY2010 budget, which was submitted to Congress in 2009. Congress, in acting on the Navy's FY2010 budget, approved the idea of ending DDG-1000 procurement and restarting DDG-51 procurement, and procured a third DDG-1000 as the final ship in the class.

In retrospect, the Navy's 2008 reversal in its destroyer procurement plans can be viewed as an early indication of the ending of the post-Cold War era (during which the Navy focused its planning on operating in littoral waters against the land- and sea-based forces of countries such as Iran and North Korea) and the shift in the international security environment to renewed great power competition (during which the Navy is now focusing its planning more on being able to operate in mid-ocean waters against capable naval forces from near-peer competitors such as China and Russia).[32]

Increase in Estimated Procurement Cost

As shown in **Table A-1** below, the estimated combined procurement cost for all three DDG-1000s, as reflected in the Navy's annual budget submission, has grown by $4,328.8 million, or 48.2%, since the FY2009 budget (i.e., the budget for the fiscal year in which the third DDG-1000 was procured).

Some of the cost growth in the earlier years in the table was caused by the truncation of the DDG-1000 program from seven ships to three, which caused some class-wide procurement-rated costs that had been allocated to the fourth through seventh ships in the program to be reallocated to the three remaining ships.

[32] For additional discussion, see CRS Report R43838, *Renewed Great Power Competition: Implications for Defense—Issues for Congress*, by Ronald O'Rourke, and CRS Report RL33153, *China Naval Modernization: Implications for U.S. Navy Capabilities—Background and Issues for Congress*, by Ronald O'Rourke.

Table A-1. Estimated Combined Procurement Cost of DDG-1000, DDG-1001, and DDG-2002

In millions, rounded to nearest tenth, as shown in annual Navy budget submissions

Budget submission	Estimated combined procurement cost (millions of dollars)	Change from prior year's budget submission	Cumulative change from FY2009 budget submission
FY09	8,977.1	—	—
FY10	9,372.5	+395.4 (+4.4%)	+395.4 (+4.4%)
FY11	9,993.3	+620.8 (+6.6%)	+1,016.2 (+11.3%)
FY12	11,308.8	+1,315.5 (+13.2%)	+2,331.7 (+26.0%)
FY13	11,470.1	+161.3 (+1.4%)	+2,493.0 (+27.8%)
FY14	11,618.4	+148.3 (+1.3%)	+2,641.3 (+29.4%)
FY15	12,069.4	+451.0 (+3.9%)	+3,092.3 (+34.4%)
FY16	12,288.7	+219.3 (+1.8%)	+3,311.6 (+36.9%)
FY17	12,738.2	+449.5 (+3.7%)	+3,761.1 (+41.9%)
FY18	12,882.0	+143.8 (+1.1%)	+3,904.0 (+43.5%)
FY19	13,032.2	+150.2 (+1.2%)	+4,055.1 (+45.1%)
FY20	13,195.5	+163.3 (+1.3%)	+4,218.4 (+47.0%)
FY21	13,275.6	+80.1 (+ 0.6%)	+4,298.5 (+47.9%)
FY22	13,305.9	+30.3 (+0.2+%)	+4,328.8 (+48.2%)

Source: Table prepared by CRS based on data in annual Navy budget submissions.

The Navy states that the cost growth shown through FY2015 in the table reflects, among other things, a series of incremental, year-by-year movements away from an earlier Navy cost estimate for the program, and toward a higher estimate developed by the Cost Assessment and Program Evaluation (CAPE) office within the Office of the Secretary of Defense (OSD). As one consequence of a Nunn-McCurdy cost breach experienced by the DDG-1000 program in 2010 (see discussion below), the Navy was directed to fund the DDG-1000 program to CAPE's higher cost estimate for the period FY2011-FY2015, and to the Navy's cost estimate for FY2016 and beyond. The Navy states that it implemented this directive in a year-by-year fashion with each budget submission from FY2010 through FY2015, moving incrementally closer each year through FY2015 to CAPE's higher estimate. The Navy stated in 2014 that even with the cost growth shown in the table, the DDG-1000 program as of the FY2015 budget submission was still about 3% below the program's rebaselined starting point for calculating any new Nunn-McCurdy cost breach on the program.[33]

Technical Risk and Test and Evaluation Issues

June 2021 GAO Report

A June 2021 GAO report assessing selected major DOD weapon acquisition programs stated the following of the DDG-1000 program:

[33] Source: Navy briefing for CRS and the Congressional Budget Office (CBO) on the DDG-1000 program, April 30, 2014.

Technology Maturity, Design Stability, and Production Readiness

The DDG 1000 program continues to have several immature technologies as it approaches the planned conclusion of operational testing in 2021. Four technologies have yet to demonstrate effectiveness on board the ship—the vertical launch system, infrared signature, volume search radar, and total ship computing environment. The Navy expects to mature these technologies as it completes ship construction, certification, and operational testing over the next 2 years. Maturing these technologies throughout the construction and testing process will likely lead to additional cost and schedule delays as the Navy may need to conduct onboard upgrades to facilitate the systems' effectiveness.

To begin to enable the new surface strike mission, the Navy also added three additional immature critical technologies: a communication system, an intelligence system, and an offensive strike missile with an immature seeker technology. In addition, the Navy received $15 million in funding to begin initial integration of a prompt strike (hypersonic) weapon.

As of September 2020, the Navy plans to request $169 million to install its four new systems on at least one or more DDG 1000 ships and would need to request further funding to complete the remaining ships' systems. Though the Navy plans to fully mature these technologies by ship integration, the integration will not occur until several years after the Navy plans to achieve initial operational capability in December 2021. As a result, the DDG 1000 class ships will remain incomplete and incapable of performing their planned mission until at least 2025.

In 2020, the Navy achieved a major milestone with DDG 1000's final delivery—including combat systems activation—in April 2020, but cost growth and schedule delays continue to mount for the third and final ship. Additionally, delivery of DDG 1001 has been delayed again and is now planned for fiscal year 2022. The Navy now plans delivery of DDG 1002 with its combat systems in January 2024—a 16-month delay compared to last year's estimate of September 2022—and further delays are possible given its planned change in delivery approach. The program manager attributed the current delay to a strike at the shipyard and COVID-19-related complications.

Software and Cybersecurity

The Navy now plans to complete software development for the class in fiscal year 2022—a 24-month delay since our 2020 assessment, largely due to overly optimistic development schedules. Although the lead ship was initially delivered in 2016, the program continues to deliver software builds only providing a portion of initially planned automation and to complete programming for the ship's communication systems, as we reported last year. Without the originally planned level of capability and automation, the Navy has had to permanently grow the crew size by 31 sailors, increasing life-cycle costs.

The program expects that a cybersecurity strategy planned for fiscal year 2023 which, along with the remainder of a 2-year regimen of certifications and testing, should demonstrate the full functionality of the ships' systems and their cybersecurity. Our prior work has shown that not focusing on cybersecurity until late in the development cycle or after a system has been deployed is more difficult and costly than designing it in from the beginning. According to the program manager, no cybersecurity issues have been identified to date.

Other Program Issues

For DDG 1002, the Navy changed its delivery plan over the past year. According to the program manager, instead of taking custody of the ship from the builder's yard and completing the combat system at Naval Base San Diego, the Navy is now planning to contract with a private shipyard to install the combat system and will not take delivery or commission DDG 1002 until it is fully complete. The program manager stated that this new approach may result in additional schedule delays; however, it will free up valuable

pier space in Naval Base San Diego and enable the Navy to avoid moving the crew onboard DDG 1002 until it is ready to operate. The program manager identified the change as a response to lessons learned from DDG 1000 and 1001—specifically, that completing combat system activation and final construction is complicated by onboard crew, in part, because access to spaces is more constrained.

Program Office Comments

We provided a draft of this assessment to the program office for review and comment. The program office provided technical comments, which we incorporated where appropriate. The program office stated that it continues to make significant progress in the construction, testing, activation, and sustainment of the Zumwalt class. It added that final delivery of DDG 1000 marked the transition to the next phase of development and integrated at-sea testing. According to the program office, DDG 1000 conducted the class's first live fire test of the vertical launching system in October 2020, and DDG 1000 will continue lead ship developmental and integrated at-sea testing in support of achieving initial operational capability, planned for December 2021. The program office stated that DDG 1001 completed installation of its combat systems in March 2020 and is currently activating its weapons, sensors, and communications systems. Additionally, it noted that construction of DDG 1002 is 97 percent complete, and on a path to delivery following activation of its combat systems.[34]

Procurement Cost Cap

Section 123 of the FY2006 defense authorization act (H.R. 1815/P.L. 109-163 of January 6, 2006) limited the procurement cost of the fifth DDG-1000 to $2.3 billion, plus adjustments for inflation and other factors. Given the truncation of the DDG-1000 program to three ships, this unit procurement cost cap appears moot.

2010 Nunn-McCurdy Breach, Program Restructuring, and Milestone Recertification

On February 1, 2010, the Navy notified Congress that the DDG-1000 program had experienced a critical cost breach under the Nunn-McCurdy provision. The Nunn-McCurdy provision (10 U.S.C. 2433a) requires certain actions to be taken if a major defense acquisition program exceeds (i.e., breaches) certain cost-growth thresholds and is not terminated. Among other things, a program that experiences a cost breach large enough to qualify under the provision as a critical cost breach has its previous acquisition system milestone certification revoked. (In the case of the DDG-1000 program, this was Milestone B.) In addition, for the program to proceed rather than be terminated, DOD must certify certain things, including that the program is essential to national security and that there are no alternatives to the program that will provide acceptable capability to meet the joint military requirement at less cost.[35]

The Navy stated in its February 1, 2010, notification letter that the DDG-1000 program's critical cost breach was a mathematical consequence of the program's truncation to three ships.[36] Since

[34] Government Accountability Office, *Weapon Systems Annual Assessment[:] Updated Program Oversight Approach Needed*, GAO-21-222, p. 171.

[35] For more on the Nunn-McCurdy provision, see CRS Report R41293, *The Nunn-McCurdy Act: Background, Analysis, and Issues for Congress*, by Moshe Schwartz and Charles V. O'Connor.

[36] Source: Letter to congressional offices dated February 1, 2010, from Robert O. Work, Acting Secretary of the Navy, to Representative Ike Skelton, provided to CRS by Navy Office of Legislative Affairs on February 24, 2010.

the DDG-1000 program has roughly $9.3 billion in research and development costs, truncating the program to three ships increased to roughly $3.1 billion the average amount of research and development costs that are included in the average acquisition cost (i.e., average research and development cost plus procurement cost) of each DDG-1000. The resulting increase in program acquisition unit cost (PAUC)—one of two measures used under the Nunn-McCurdy provision for measuring cost growth[37]—was enough to cause a Nunn-McCurdy critical cost breach.

In a June 1, 2010, letter (with attachment) to Congress, Ashton Carter, the DOD acquisition executive (i.e., the Under Secretary of Defense for Acquisition, Technology and Logistics), stated that he had restructured the DDG-1000 program and that he was issuing the certifications required under the Nunn-McCurdy provision for the restructured DDG-1000 program to proceed.[38] The letter stated that the restructuring of the DDG-1000 program included the following:

- A change to the DDG-1000's design affecting its primary radar.
- A change in the program's Initial Operational Capability (IOC) from FY2015 to FY2016.
- A revision to the program's testing and evaluation requirements.

Regarding the change to the ship's design affecting its primary radar, the DDG-1000 originally was to have been equipped with a dual-band radar (DBR) consisting of the Raytheon-built X-band SPY-3 multifunction radar (MFR) and the Lockheed-built S-band SPY-4 Volume Search Radar (VSR). (Raytheon is the prime contractor for the overall DBR.) Both parts of the DBR have been in development for the past several years. An attachment to the June 1, 2010, letter stated that, as a result of the program's restructuring, the ship is now to be equipped with "an upgraded multifunction radar [MFR] and no volume search radar [VSR]." The change eliminates the Lockheed-built S-band SPY-4 VSR from the ship's design. The ship might retain a space and weight reservation that would permit the VSR to be backfitted to the ship at a later point. The Navy states that

> As part of the Nunn-McCurdy certification process, the Volume Search Radar (VSR) hardware was identified as an acceptable opportunity to reduce cost in the program and thus was removed from the current baseline design....
>
> Modifications will be made to the SPY-3 Multi-Function Radar (MFR) with the focus of meeting ship Key Performance Parameters. The MFR modifications will involve software changes to perform a volume search functionality. Shipboard operators will be able to optimize the SPY-3 MFR for either horizon search or volume search. While optimized for volume search, the horizon search capability is limited. Without the VSR, DDG 1000 is still expected to perform local area air defense....
>
> The removal of the VSR will result in an estimated $300 million net total cost savings for the three-ship class. These savings will be used to offset the program cost increase as a result of the truncation of the program to three ships. The estimated cost of the MFR

[37] PAUC is the sum of the program's research and development cost and procurement cost divided by the number of units in the program. The other measure used under the Nunn-McCurdy provision to measure cost growth is average program unit cost (APUC), which is the program's total procurement cost divided by the number of units in the program.

[38] Letter dated June 1, 2010, from Ashton Carter, Under Secretary of Defense (Acquisition, Technology and Logistics) to the Honorable Ike Skelton, with attachment. The letter and attachment were posted on InsideDefense.com (subscription required) on June 2, 2010.

> software modification to provide the volume search capability will be significantly less than the estimated procurement costs for the VSR.[39]

Regarding the figure of $300 million net total cost savings in the above passage, the Navy during 2011 determined that eliminating the SPY-4 VSR from the DDG-1000 increased by $54 million the cost to integrate the dual-band radar into the Navy's new Gerald R. Ford (CVN-78) class aircraft carriers.[40] Subtracting this $54 million cost from the above $300 million savings figure would bring the net total cost savings to about $246 million on a Navy-wide basis.

A July 26, 2010, press report quotes Captain James Syring, the DDG-1000 program manager, as stating the following: "We don't need the S-band radar to meet our requirements [for the DDG-1000]," and "You can meet [the DDG-1000's operational] requirements with [the] X-band [radar] with software modifications."[41]

An attachment to the June 1, 2010, letter stated that the PAUC for the DDG-1000 program had increased 86%, triggering the Nunn-McCurdy critical cost breach, and that the truncation of the program to three ships was responsible for 79 of the 86 percentage points of increase. (The attachment stated that the other seven percentage points of increase are from increases in development costs that are primarily due to increased research and development work content for the program.)

Carter also stated in his June 1, 2010, letter that he had directed that the DDG-1000 program be funded, for the period FY2011-FY2015, to the cost estimate for the program provided by the Cost Assessment and Program Evaluation (CAPE) office (which is a part of the Office of the Secretary of Defense [OSD]), and, for FY2016 and beyond, to the Navy's cost estimate for the program. The program was previously funded to the Navy's cost estimate for all years. Since CAPE's cost estimate for the program is higher than the Navy's cost estimate, funding the program to the CAPE estimate for the period FY2011-FY2015 will increase the cost of the program as it appears in the budget for those years. The letter states that DOD "intends to address the [resulting] FY2011 [funding] shortfall [for the DDG-1000 program] through reprogramming actions."

An attachment to the letter stated that the CAPE in May 2010 estimated the PAUC of the DDG-1000 program (i.e., the sum of the program's research and development costs and procurement costs, divided by the three ships in the program) as $7.4 billion per ship in then-year dollars ($22.1 billion in then-year dollars for all three ships), and the program's average procurement unit cost (APUC), which is the program's total procurement cost divided by the three ships in the program, as $4.3 billion per ship in then-year dollars ($12.8 billion in then-year dollars for all three ships). The attachment stated that these estimates are at a confidence level of about 50%, meaning that the CAPE believes there is a roughly 50% chance that the program can be completed at or under these cost estimates, and a roughly 50% chance that the program will exceed these cost estimates.

An attachment to the letter directed the Navy to "return for a Defense Acquisition Board (DAB) review in the fall 2010 timeframe when the program is ready to seek approval of the new

[39] Source: Undated Navy information paper on DDG-51 program restructuring provided to CRS and CBO by Navy Office of Legislative Affairs on July 19, 2010.

[40] Source: Undated Navy information paper on CVN-78 cost issues, provided by Navy Office of Legislative Affairs to CRS on March 19, 2012.

[41] Cid Standifer, "Volume Radar Contracted For DDG-1000 Could Be Shifted To CVN-79," *Inside the Navy*, July 26, 2010. See also Joseph Trevithick and Tyler Rogoway, "Navy's Troubled Stealth Destroyers May Have Radars Replaced Before Ever Sailing On A Mission," *The Drive*, October 15, 2020.

Milestone B and authorization for production of the DDG-1002 [i.e., the third ship in the program]."

On October 8, 2010, DOD reinstated the DDG-1000 program's Milestone B certification and authorized the Navy to continue production of the first and second DDG-1000s and commence production of the third DDG-1000.[42]

Author Information

Ronald O'Rourke
Specialist in Naval Affairs

Disclaimer

This document was prepared by the Congressional Research Service (CRS). CRS serves as nonpartisan shared staff to congressional committees and Members of Congress. It operates solely at the behest of and under the direction of Congress. Information in a CRS Report should not be relied upon for purposes other than public understanding of information that has been provided by CRS to Members of Congress in connection with CRS's institutional role. CRS Reports, as a work of the United States Government, are not subject to copyright protection in the United States. Any CRS Report may be reproduced and distributed in its entirety without permission from CRS. However, as a CRS Report may include copyrighted images or material from a third party, you may need to obtain the permission of the copyright holder if you wish to copy or otherwise use copyrighted material.

[42] Christopher J. Castelli, "Pentagon Approves Key Milestone For Multibillion-Dollar Destroyer," *Inside the Navy*, November 22, 2010.