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

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Summary

The Arleigh Burke (DDG-51) class destroyer program is one of the longest-running shipbuilding programs in Navy history. The Navy began procuring DDG-51s, also known as Aegis destroyers, in FY1985, and a total of 92 have been procured through FY2023, including three in FY2023. 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. (The Navy did not procure any DDG-51s in FY2006-FY2009. Instead, the Navy in FY2007-FY2009 procured three Zumwalt [DDG-1000] class destroyers. The Navy plans no further procurement of DDG-1000s.)

The Navy's proposed FY2024 budget requests the procurement of two more DDG-51s in FY2024. The Navy's FY2024 five-year (FY2024-FY2028) shipbuilding plan includes 10 DDG-51s, to be procured at a rate of two ships per year.

As part of its FY2023 budget submission, the Navy requested authority for using a multiyear procurement (MYP) contract for DDG-51s scheduled for procurement in FY2023-FY2027. Congress, as part of its action on the Navy's proposed FY2023 budget, approved this request. Four previous MYP contracts for the DDG-51 program covered DDG-51s procured in FY1998-FY2001, FY2002-FY2005, FY2013-FY2017, and FY2018-FY2022.

The first DDG-51 entered service in 1991, and a total of 72 have been delivered as of March 2023. The DDG-51 design has been updated multiple times over the years; the version currently being procured, called the Flight III DDG-51 design, incorporates a new and more capable radar called the SPY-6 radar.

DDG-51s currently cost about \$2.2 billion each to procure. The budget estimates the combined procurement cost of the two DDG-51s requested for procurement in FY2024 at \$4,432.8 million (i.e., about \$4.4 billion). The two ships have received \$233.6 million in prior-year Economic Order Quantity (EOQ) funding, which is a kind of advance procurement (AP) funding that can occur under an MYP contract. The Navy's proposed FY2024 budget requests the remaining \$4,199.2 million needed to complete the two ships' estimated combined procurement cost. The Navy's proposed FY2024 budget also requests \$284.0 million in EOQ funding for DDG-51s to be procured under the FY2023-FY2027 MYP contract, and \$225.9 million in cost-to-complete funding to cover cost growth on DDG-51s procured in prior fiscal years.

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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 92 have been procured through FY2023, including three in FY2023. The Navy's FY2024 budget requests the procurement of two DDG-51s in FY2024.

Potential issues for Congress for the DDG-51 program in FY2024 include 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

LSC Force Level as of End of FY2022

As of the end of FY2022, the Navy's LSC force included 90 ships, including 17 Ticonderoga (CG-47) class cruisers,² 72 DDG-51s, and one Zumwalt (DDG-1000) class destroyer.

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.

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). Of the remaining 22, five were retired in FY2022, leaving 17 in service at the end of FY22.

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.³

Successor Force-Level Goal to Replace 355-ship Goal of 2016

The Navy and the Department of Defense (DOD) have been working since 2019 to develop a successor for the 355-ship force-level goal. The Navy's FY2023 30-year (FY2023-FY2052) shipbuilding plan, released on April 20, 2022, includes a table summarizing the results of studies that have been conducted on the successor force-level goal. These studies outline potential future fleets with 63 to 96 LCSs.⁴

DDG-51 Program

Overview

The DDG-51 program was initiated in the late 1970s.⁵ It 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. The first DDG-51 was procured FY1985, and a total of 92 have been procured through FY2023, including three in FY2023. 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. The Navy did not procure any DDG-51s in FY2006-FY2009. Instead, the Navy in FY2007-FY2009 procured three Zumwalt [DDG-1000] class destroyers, which are discussed later in this report.

The first DDG-51 entered service in 1991, and a total of 72 have been delivered as of March 2023. The remaining 20 DDG-51s are in various stages of construction. Earlier DDG-51s, known as the Flight I/II DDG-51s, generally have an estimated service life (ESL) of 35 years, meaning that retirement of these ships could begin in the late 2020s. An exception to the 35-year ESL for the Flight I/II DDG-51s is the very first ship in the class—DDG-51 itself—which has been certified for a 40-year life. Additional Flight I/II DDG-51s might eventually receive similar certifications, depending on their condition and Navy mission needs. Later DDG-51s, known as the Flight IIA and Flight III DDG-51s, have an estimated service life of 40 years.

DDG-51s (**Figure 1** and **Figure 2**) 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 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

³ For additional discussion, see CRS Report RL32665, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, by Ronald O'Rourke.

⁴ For additional discussion, see CRS Report RL32665, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, by Ronald O'Rourke.

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.

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

Figure I. DDG-51 Class Destroyer



Source: Cropped version of photograph at Huntington Ingalls Industries, “Delbert Black (DDG 119) Completes Builder’s Trials,” February 26, 2020, accessed November 17, 2021, at <https://newsroom.huntingtoningalls.com/file/delbert-black-ddg119-builders-trials>.

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 current Flight III DDG-51 design, which incorporates a new and more capable radar called the SPY-6 radar (previously known as the Air and Missile Defense Radar, or 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.

Multiyear Procurement (MYP)

As part of its FY2023 budget submission, the Navy requested authority for using a multiyear procurement (MYP) contract for DDG-51s scheduled for procurement in FY2023-FY2027.⁷

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.

⁷ For more on MYP contracting, see CRS Report R41909, *Multiyear Procurement (MYP) and Block Buy Contracting in Defense Acquisition: Background and Issues for Congress*, by Ronald O’Rourke.

Congress, as part of its action on the Navy’s proposed FY2023 budget, approved this request.⁸ Four previous MYP contracts for the DDG-51 program covered DDG-51s procured in FY1998-FY2001, FY2002-FY2005, FY2013-FY2017, and FY2018-FY2022.

Figure 2. DDG-51 Class Destroyer



Source: Cropped version of undated photograph of USS *Jason Dunham* (DDG-109) at “Bath Iron Works,” accessed November 17, 2021, at <https://www.gd.com/our-businesses/marine-systems/bath-iron-works>.

Shipbuilders, Combat System Lead, and Radar Maker

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.⁹

⁸ See Section 125 of the FY2023 National Defense Authorization Act (NDAA) (H.R. 7776/P.L. 117-263 of December 23, 2022) and Section 8010 of the FY2023 DOD Appropriations Act, (Division C of H.R. 2617/P.L. 117-328 of December 29, 2022).

⁹ See CRS Report 94-343, *Navy DDG-51 Destroyer Procurement Rate: Issues and Options for Congress*, by Ronald

FY2024 Procurement Funding Request

The Navy's proposed FY2024 budget requests the procurement of two more DDG-51s in FY2024. The budget estimates the combined procurement cost of the two ships at \$4,432.8 million (i.e., about \$4.4 billion). The two ships have received \$233.6 million in prior-year Economic Order Quantity (EOQ) funding, which is a kind of advance procurement (AP) funding that can occur under an MYP contract. The Navy's proposed FY2024 budget requests the remaining \$4,199.2 million needed to complete the two ships' estimated combined procurement cost. The Navy's proposed FY2024 budget also requests \$284.0 million in EOQ funding for DDG-51s to be procured under the FY2023-FY2027 MYP contract, and \$225.9 million in cost-to-complete funding to cover cost growth on DDG-51s procured in prior fiscal years.

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 would 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

As noted in the **Appendix**, the DDG-1000 program's originally scheduled date for achieving Initial Operating Capability (IOC) was FY2015. The date for achieving IOC, however, has been repeatedly delayed. In February 2022, it was reported that the date had been delayed from September 2021 to December 2021, but that the December 2021 date was not achieved, and that the Navy was reevaluating the timeline for achieving IOC.¹³

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).

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 Pricely 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 Audrey Decker, "Zumwalt's Initial Operational Capability Delayed Again," *Inside Defense*, February 25, 2022.

To further optimize the three ships for conducting surface strike missions, the Navy reportedly plans to remove their AGSs and associated below-deck equipment and replace them with large-diameter vertical launch tubes capable of storing and firing the Navy's new hypersonic Conventional Prompt Strike (CPS) missile, with a goal of having the first CPS-equipped DDG-1000 class ship ready for testing by 2025. Each DDG-1000 class ship reportedly is to be equipped with four of the large-diameter tubes, with each tube capable of holding three CPS missiles, for a total of 12 CPS missiles per ship.¹⁴

The Navy reportedly also wants to replace some of the combat system equipment on the three ships with equipment more similar to, and interoperable with, combat system equipment on other U.S. Navy surface combatants. The Navy refers to this as the Zumwalt Enterprise Upgrade Solution (ZEUS).¹⁵

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 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

¹⁴ See, for example, Mallory Shelbourne, "Navy Planning for December 2025 Hypersonic Missile Test off USS Zumwalt," *USNI News*, February 1, 2023; Kyle Mizokami, "The Navy's Stealth Destroyers Are Getting a Serious Upgrade: 12 Hypersonic Missiles Each," *Popular Mechanics*, December 1, 2022; Sam LaGrone, "Navy Details Hypersonic Missile Plan for Zumwalt Destroyers, Virginia Submarines," *USNI News*, November 3, 2022; Sam LaGrone, "HII Set to Install First Hypersonic Missiles on USS Zumwalt, USS Michael Monsoor During Repair Period," *USNI News*, August 12, 2022; Sam LaGrone, "Latest Zumwalt Hypersonic Missile Installation Plan Calls For Removing Gun Mounts," *USNI News*, March 16, 2022; Joseph Trevithick, "The Navy's Stealth Destroyers Will Have Their Deck Guns Replaced With Hypersonic Missiles," *The Drive*, November 2, 2021; 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; Jason Sherman, "Navy to Rip Out DDG-1000 Advanced Gun System Mounts to Make Room for Hypersonic Weapons," *Inside Defense*, May 26, 2021; Sam LaGrone, "CNO: Hypersonic Weapons at Sea to Premiere on Zumwalt Destroyers in 2025," *USNI News*, April 28, 2021; David B. Larter, "What Should Become of the Zumwalt Class? The US Navy Has Some Big Ideas," *Defense News*, March 25, 2021; Joseph Trevithick, "Navy Wants Triple-Packed Hypersonic Missile Modules On Its Stealthy Zumwalt Destroyers," *The Drive*, March 19, 2021; Paul McLeary, "Exclusive:] Eying China. CNO Plans Hypersonics & Lasers On Zumwalt Destroyers," *Breaking Defense*, February 26, 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.

¹⁵ See, for example, Kyle Mizokami, "The Navy's Stealth Destroyers Are Getting a Serious Upgrade: 12 Hypersonic Missiles Each," *Popular Mechanics*, December 1, 2022; Mallory Shelbourne, "Navy Exploring 'Surface Strike' Upgrades for Zumwalt Destroyers," *USNI News*, November 28, 2022; Justin Katz, "Navy Eyeing 'ZEUS,' an Upgrade Program for the Zumwalt Destroyers," *Breaking Defense*, November 22, 2022.

SPY-6 radar 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 SPY-6.

The surface combatant construction industrial base also includes hundreds of additional firms that supply materials and components. 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

Future LSC Force-Level Goal

One issue for Congress for the DDG-51 concerns the future LSC force-level goal. As noted above, studies conducted on the Navy's next force-level goal outline potential future fleets with 63 to 96 LCSs. Reducing the LSC force-level goal from the current required figure of 104 ships to a smaller number—particularly a number closer to 63 ships—could affect issues such as when to retire older LCSs and how many new LCSs to procure each year. An August 1, 2022, press report stated

In little more than five months, the shape of America's future Navy fleet changed. Between February and July, U.S. Navy leadership went from advocating for a modest fleet of 60 cruisers and destroyers to supporting a more robust vision of 96 large surface combatants by 2045.

Nobody really knows what, exactly, pushed the Navy to favoring large combatants—a rating traditionally comprised of high-value cruisers and destroyers. Neither the U.S. Department of Defense, the Secretary of the Navy, nor America's Chief of Naval Operations, Admiral Mike Gilday, has offered taxpayers any real detail on what spurred the Navy, after years of fretting over the relevance of large surface combatants, to redirect at least \$70 billion in future funding towards building bigger ships.

The shift was abrupt. In February, at the annual WEST 2022 conference in San Diego, Gilday sketched out a future fleet of 60 large and 50 small combatants, breaking from the traditional 355-ship fleet goal of maintaining a 2:1 ratio of large combatants (cruisers and destroyers) to small vessels (frigates and Littoral Combat Ships). Last month, Gilday changed his tune, releasing a "2022 Navigation Plan," aiming for a fleet of 96 large combatants by 2045.

Both targets are out of step with the 30-year shipbuilding plan detailed in April's "Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for Fiscal Year 2023," which suggested to Congress that the Navy was intent upon fielding a fleet of between 70 to 80 large surface combatants by 2045....

Given the public reporting to date, it is tough to tell what, exactly, is driving the Navy's sudden interest in large surface combatants. Industry press has been less than dogged in its efforts to understand the dramatic—if not unprecedented—oscillation in the U.S. Navy's demand for large surface combatants.

That failure is unfortunate, as America's public and policymaker communities need clarity more than ever....

While the Navy's growing appetite for large surface combatants—whatever they might turn out to be—is welcome news for the large surface combatant industrial base, the Navy's inability to fix on a consistent plan is a public relations and strategic disaster....

With no viable strategic or tactical justification forthcoming from Navy leadership, the Navy's free-form approach to the future of the surface fleet does little more than bemuse rivals and irk everybody else. The Navy has little room to make sudden whipsaw changes.

After repeated operational fiascoes, the U.S. Navy has little credibility right now, and an unexplained strategic change leaves pro-Navy advocates confused, and an already impatient Congress frustrated....

The embrace of big ships in Gilday's new force structure turns distributed lethality on its head. Rather than working to grow the small-surface combatant fleet and using those vessels to smear sensors and shooters all over the sea, the surface Navy is, with DDG(X), re-inventing the battleship and, apparently, returning to the traditional World War II-era battle group, leaving distributed lethality for crew-less things.

That's fine. But, as originally articulated, the Distributed Maritime Operations concept was set to push the fleet towards a 2:1 ratio of smaller crewed ships to bigger crewed surface combatants. If the mechanics behind Distributed Maritime Operations are shifting to feed the Navy's craving for larger vessels, that shift—particularly if it is sacrificing smaller crewed vessels for robots— is worth a bit of public discussion.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.

(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.

Shipbuilding Industrial-Base Capacity and DDG-51 Procurement Rate

Another issue for Congress concerns the shipbuilding industrial base's capacity for building DDG-51s, and the impact this could have on the DDG-51 procurement rate, specifically on the

¹⁶ Craig Hooper, "Battleships Are Back! Navy Abruptly Boosts DDG/CG Building Targets For 2045," *Forbes*, August 1, 2022.

question of whether to procure two or three DDG-51s per year. A March 21, 2023, press report stated:

The Navy is keeping a two-ship-per-year cadence for its destroyer line because that's a realistic goal for industry to work toward, according to the Pentagon's top budget officer.

Despite Congress' push for the Navy to start buying three Arleigh Burke-class Flight III destroyers per year, the Fiscal Year 2024 budget request unveiled last week showed the service buying two destroyers. That's because U.S. shipyards are not yet able to build two destroyers per year, let alone three, Mike McCord said last week.

"I'm not hating on DDGs – my only point was that last year Congress added a third and the reason we didn't budget for three is, again, we don't see the yards being able to produce three a year. We don't see them being able to produce two a year. And that's just data. It's not what we wish to be true. But everybody's struggling with skilled labor. Everybody's struggling with supply chain. So it's not getting better very fast from the data that I've seen – whether with submarines or DDGs. So two a year seems to be a reasonable place," McCord told USNI News at the McAleese Conference.

During the [FY2024] budget rollout last week, McCord said industry is currently building 1.5 destroyers per year, a number Chief of Naval Operations Adm. Mike Gilday has also cited when arguing that the shipyards have limited capacity.

McCord also argued that asking for more destroyers than industry can build takes away leverage from the Navy to negotiate with shipbuilders on price.

"If you keep sort of placing orders for things faster than they can be delivered, it's good for the books, the balance sheets of the companies. But are you really, as the buyer, are you in the best place you'd like to be with any leverage or are you actually short of leverage when, you produce on time or you don't produce on time. It doesn't matter to me – I'm going to keep writing you checks," McCord told USNI News.

The comptroller said both he and Susanna Blume, the director of the Cost Assessment and Program Evaluation (CAPE) Office of the Secretary of Defense, don't think putting more funding toward an extra destroyer is a wise use of resources that will help shipbuilders deliver it to the Navy quicker.

"It's just sort of piling up in the orders book and we're still going to have the same problems of the yards producing faster until we get through the supply chain and the workforce issues," McCord said. "It is not to say that we would not be interest[ed] in a more robust production world where in having three DDGs or moving to three submarines, but it doesn't seem to be ... realistic."

General Dynamics Bath Iron Works, one of the yards that build the destroyers, has spent the last several years digging through a backlog of work at its Maine yard that the COVID-19 pandemic exacerbated. HII's Ingalls Shipbuilding, the other yard that builds the Arleigh Burke destroyers, has performed better. Ingalls is also winding down the Coast Guard's Legend-class National Security Cutter production line, which could open up more capacity at its yard in Pascagoula, Miss.

A spokeswoman for Ingalls Shipbuilding told USNI New in a statement that the yard is ready to support building three destroyers per year should the Navy go this route.

"Our shipbuilders will position to support whatever destroyer cadence the Navy needs and we have started by building, testing and taking the first Flight III ship to sea, which will be delivered later this year. We are a committed partner to not only our customers but to our network of nearly 1,200 suppliers as well. Together, we can build three DDGs a year if that is what the Navy and our country need," Kimberly Aguiard said in a statement.

A spokesperson for Bath Iron Works told USNI News that it's "working to aggressively recover schedule" at the shipyard.

“We support the call for a consistent demand signal that gives shipyards and suppliers the predictability to make major investments in workforce and facilities, both to expand destroyer production and to ensure that capability remains intact well into the future,” David Hench said in a statement. “Those capital investments are currently underway in Bath, and we are confident there will be significant schedule improvement so we can meet the Navy’s expectations by the time construction begins on the anticipated multi-year contract.”

Lawmakers have urged the Navy to work toward buying three destroyers per year and added a third destroyer on top of the Navy’s request for two in FY 2023. Congress also included a provision in the FY 2023 policy bill that would allow the Navy to ink a multi-year procurement deal for as many as 15 Flight III destroyers. If the multi-year procurement contracts are for fewer than 15 destroyers, the Navy must include at least one “pre-priced option” so it has the opportunity to buy 15 ships, according to the bill language.¹⁷

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 have been an oversight focus for the defense committees. DON’s prepared statement for the April 26, 2022, hearing on DON investment programs before the Seapower subcommittee of the Senate Armed Services Committee states

The Navy is committed to a smooth and successful transition from DDG 51 to DDG(X) starting around FY 2030.¹⁸ The transition will preserve the critical shipbuilding and supplier industrial base by executing a collaborative design process with current DDG 51 shipyards and transitioning to a proven limited competition model between these shipyards at the right point in ship construction.¹⁹

The Navy’s FY2024 budget submission states that “early DDG(X) production transition will overlap DDG 51 FLT III production ensuring stability in the Large Surface Combatant industrial base.”²⁰

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.

¹⁷ Mallory Shelbourne, “OSD Comptroller Says U.S. Shipyards Can’t Build 3 Destroyers a Year,” *USNI News*, March 21 (updated March 22), 2023.

¹⁸ Under the Navy’s proposed FY2024 budget, procurement of the first DDG(X) has been deferred from FY2030 to FY2032.

¹⁹ Statement of Frederick J. Stefany, Principal Civilian Deputy, Assistant Secretary of the Navy (Research, Development and Acquisition), Performing the Duties of the Assistant Secretary of the Navy (Research, Development and Acquisition), and Vice Admiral Scott Conn, Deputy Chief of Naval Operations, Warfighting Requirements and Capabilities (OPNAV N9), and Lieutenant General Karsten S. Heckl, Deputy Commandant, Combat Development and Integration, Commanding General, Marine Corps Combat Development Command, before the Subcommittee on Seapower of the Senate Armed Services Committee on Department of the Navy Fiscal Year 2023 Budget Request for Seapower, April 26, 2022, PDF page 10 of 37.

²⁰ *Department of Defense Fiscal Year (FY) 2024 Budget Estimates, Navy, Justification Book, Volume 2 of 5, Research, Development, Test & Evaluation, Navy*, March 2023, p. 453.

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 2022 Government Accountability Office (GAO) report assessing selected DOD acquisition programs stated the following in its assessment of the Flight III DDG-51:

Current Status

Construction on the lead Flight III ship—DDG 125—is on schedule to deliver in April 2023, but the schedule leaves minimal time to address unexpected issues identified during sea trials or operational testing to meet its August 2024 initial capability date, according to program officials. Contractor performance reports show that the first two Flight III ships saw cost growth since construction began. Both ships are above target costs due to first time build challenges and ongoing impacts of COVID-19, per program officials. In October 2021, program officials said DDG 125 was 67 percent complete, and the second Flight III ship—DDG 126—was 11 percent complete. Program officials report they plan to procure 14 Flight III ships through fiscal year 2022 with additional ships subject to future funding. We previously reported the Navy planned to procure 18 Flight III ships through fiscal year 2025.

The program continues to make progress testing and integrating ship components with AMDR components and Aegis software, but faced technical challenges over the last year. Officials said these challenges resulted in rephasing AMDR testing 9 months later than planned, but did not delay planned ship delivery and have since been resolved. The Navy activated Aegis onboard DDG 125 in December 2021. The program is integrating and testing ship power components with AN/SPY-6(V)1 and Aegis hardware and software at land-based test sites. Flight III ships will also receive a new 400Hz power distribution system after tests on Flight IIA ships showed the initial system did not meet requirements, per program officials. The new system required design updates and retrofitting to areas on Flight III ships, but has been tested on a Flight IIA ship and meets all requirements.

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 stated that it delivered 70 DDG 51 ships with an additional 19 under contract, 14 of which are Flight III ships. Officials said AN/SPY-6(V)1 and electrical plant installations are complete on DDG 125, which is on track to be delivered in April 2023. Land-based integration testing is ongoing and continues to reduce risk to the ship's production schedule, per officials. Program officials said the use of fixed-price incentive contracts with cost ceilings have minimized cost overrun risks to the government.²¹

Regarding the AMDR specifically, the report stated the following:

Technology Maturity, Design Stability, and Production Readiness

AMDR fully matured its critical technologies when the Navy activated AMDR and the Aegis combat system on DDG 125 in December 2021. Following combat system activation, the Navy plans to conduct operational testing on AMDR and Aegis at sea on DDG 125 starting in March 2024.

While AMDR's overall design is stable, previous issues with a critical technology component resulted in significant design changes over the past few years. Specifically, in 2020, the program redesigned the Digital Receiver Exciter (DREX) because it did not meet vibration specifications, according to Navy officials. Program officials stated that the new design met all qualification testing specifications. However, the fourth radar array, which

²¹ Government Accountability Office, *Weapon Systems Annual Assessment[:] Challenges to Fielding Capabilities Faster Persist* GAO-22-105230, June 2022, p. 187.

completed the AMDR unit for DDG 125, was delivered to the shipyard in October 2020, 2 months later than planned due in part to the redesign. In October 2021, program officials stated that tests have shown that the new design is reliable, and they consider DREX issues resolved. Any deficiencies the Navy discovers during testing could result in costly and time-intensive revisions to existing design drawings or retrofitting to already-built radars.

By the end of 2021, the AMDR program delivered the radar arrays for DDG 128 and DDG 129—the third and fourth Flight III ships under construction, respectively. However, program officials stated that they delayed delivery of an array to DDG 129 by a few weeks due to a manufacturing issue. They explained that a microelectronic circuit within the transmit/receive modules in the arrays was not functioning properly and the receiver could become overloaded. Program officials stated that they had to replace some modules in the array and the two arrays that followed it on the production line. While these manufacturing issues delayed delivery of one of the arrays to the shipyard, they ultimately did not affect the DDG Flight III program’s schedule because the shipbuilder was able to install the AMDR shipsets as planned.

Also in 2021, the program addressed a manufacturing issue we reported on last year related to the incorrect adhesive application on Transmit/Receive Integrated Microwave Module components—another critical technology—that caused cost increases and rework. Officials told us this year that Raytheon fixed the issue for future deliveries and offered a warranty on the components.

We updated our Attainment of Production Knowledge table to reflect that we did not assess whether critical manufacturing processes are in statistical control because the AMDR program office stated that there are no critical processes.

Software and Cybersecurity

AMDR used an Agile development approach to complete nine software deliveries that support core radar capabilities. Program officials stated that the 10th software delivery will be the final one for DDG 51 Flight III.

Officials said that AMDR cybersecurity is addressed within the Aegis combat system and cybersecurity testing will not occur until at least 2023.

Other Program Issues

The Navy continues to integrate and test AMDR and Aegis at land-based test sites and these activities supported combat system activation. AMDR program officials stated that, while they experienced some challenges integrating the radar and combat system, the shipbuilder successfully activated the radar and combat system in December 2021, nearly 1 month ahead of its contracted schedule date.

In 2021, the Navy established the Enterprise Air Surveillance Radar (EASR) as a subprogram within AMDR, which is expected to increase the program’s total cost estimate. The Navy designed the AN/SPY-6(V)1 to be a family of radars that are scalable and adaptable across multiple ship programs. Through the EASR subprogram, the Navy is developing two variants of the AN/SPY-6 radar that are planned for installation on CVN 68, CVN 78, LHA 8, LPD 17 Flight II, and FFG 62 class ships. Program officials stated that the updated acquisition program baseline reflecting this change is awaiting final approval and, as of January 2022, a DOD official confirmed that the updated baseline had not yet been approved.

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 is on track to support DDG 125’s schedule. It noted that it successfully completed two phases of testing at the land-based test site and plans to

complete full-array power testing of the radar by the end of fiscal year 2022. The program office also stated that the DDG 51 program successfully activated the Aegis combat system on time on DDG 125. According to the program office, it is in the process of making the two AN/SPY-6 EASR variants major subprograms of the AMDR program, and noted that six EASR radars are in procurement and are on schedule to meet required ship dates. The program office also stated that it began testing the EASR radar with air traffic control systems in 2020 and the Ships Self-Defense System in 2021.²²

Legislative Activity for FY2024

Summary of Congressional Action on FY2024 Funding Request

The Navy's proposed FY2024 budget requests the procurement of two DDG-51s in FY2024. The budget estimates the combined procurement cost of the two ships at \$4,432.8 million (i.e., about \$4.4 billion). The two ships have received \$233.6 million in prior-year Economic Order Quantity (EOQ) funding, which is a kind of advance procurement (AP) funding that can occur under an MYP contract. The Navy's proposed FY2024 budget requests the remaining \$4,199.2 million needed to complete the two ships' estimated combined procurement cost. The Navy's proposed FY2024 budget also requests \$284.0 million in EOQ funding for DDG-51s to be procured under the FY2023-FY2027 MYP contract, and \$225.9 million in cost-to-complete funding to cover cost growth on DDG-51s procured in prior fiscal years.

The Navy's proposed FY2024 budget also requests \$410.4 million in continued procurement funding for the DDG-1000 program. The Navy's FY2024 budget submission states that \$234 million of the \$410.4 million is for modifying the third ship in the program (DDG-1002) during its construction to include large-diameter vertical launch tubes capable of storing and firing the Navy's new hypersonic Conventional Prompt Strike (CPS) missile.²³ (Costs to modify the first two DDG-1000 class ships—DDG-1000 and DDG-1001—for the CPS are budgeted in the Other Procurement, Navy [OPN] appropriation account.)

Table 1 summarizes congressional action on the Navy's FY2024 procurement funding requests for the DDG-51 and DDG-1000 programs.

²² Government Accountability Office, *Weapon Systems Annual Assessment[:] Challenges to Fielding Capabilities Faster Persist* GAO-22-105230, June 2022, p. 160.

²³ Department of Defense, Fiscal Year (FY) 2024 Budget Estimates, Navy Justification Book Volume 1 of 1, Shipbuilding and Conversion, Navy, March 2023, pp. 178-179.

Table I. Congressional Action on FY2024 Funding Request

Millions of dollars, rounded to nearest tenth

	Request	Authorization			Appropriation		
		HASC	SASC	HASC-SASC Agreement	HAC	SAC	HAC-SAC
DDG-51 procurement	4,199.2						
<i>Quantity</i>	(2)						
DDG-51 advance procurement (EOQ AP)	284.0						
DDG-51 cost to complete	225.9						
DDG-1000 procurement	410.4						

Sources: Table prepared by CRS based on Navy’s FY2024 budget submission, committee and conference reports, and explanatory statements on FY2024 National Defense Authorization Act and FY2024 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.

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.²⁴ 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 I51207-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,²⁵ to improve the Navy’s general capabilities for operating in defended littoral

²⁴ 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.

²⁵ 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.²⁶

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 system²⁷ 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 FY2024 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 FY2024 budget submission estimates its procurement cost at \$4,342.4 million.

The first DDG-1000 was commissioned into service on September 7, 2016. Its delivery date was revised multiple times and reportedly was April 2020.²⁸ 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.²⁹ In the Navy's FY2024 budget submission, the delivery dates for the two ships are listed as October 2023 and December 2026, 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:³⁰

²⁶ For more on the CG(X) program, see CRS Report RL34179, *Navy CG(X) Cruiser Program: Background for Congress*, by Ronald O'Rourke.

²⁷ 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.

²⁸ See Aidan Quigley, "Final Delivery of Zumwalt-class Destroyer Monsoor Delayed," *Inside Defense*, January 21, 2021.

²⁹ 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.

³⁰ 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 and a new cruiser called CG-21. When the Navy announced the Future Surface Combatant Program in 2001,

- **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.³¹

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.³²

New Technologies

The DDG-1000 incorporates a significant number of new technologies, including a wave-piercing, tumblehome hull design for reduced detectability,³³ 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,³⁴ 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

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).

³¹ 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.

³² For more on Navy ship names, see CRS Report RS22478, *Navy Ship Names: Background for Congress*, by Ronald O’Rourke.

³³ 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.

³⁴ 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/Ingalls³⁵ 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.³⁶

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.

³⁵ At the time of the events described in this section, HII was owned by Northrop Grumman and was called Northrop Grumman Shipbuilding (NGSB).

³⁶ 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).³⁷

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 submissions, has grown by \$4,816.1 million (i.e., about \$4.8 billion), or 53.6%, since the FY2009 budget (i.e., the budget for the fiscal year in which the third DDG-1000 was procured). Within the increase from the FY2023 figure to the FY2024 figure, the Navy's FY2024 budget submission states \$234 million is for modifying the third ship in the program (DDG-1002) during its construction to include large-diameter vertical launch tubes capable of storing and firing the Navy's new hypersonic Conventional Prompt Strike

³⁷ 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.

(CPS) missile.³⁸ (Costs to modify the first two DDG-1000 class ships—DDG-1000 and DDG-1001—for the CPS are budgeted in the Other Procurement, Navy [OPN] appropriation account.)

Table A-1. Estimated Combined Procurement Cost of DDGs 1000, 1001, and 1002

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%)
FY23	13,378.7	+72.8 (+0.5%)	+4,401.6 (+49.0%)
FY24	13,793.2	+414.5 (+3.1%)	+4,816.1 (+53.6%)

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

Note: The Navy's FY2024 budget submission states \$234 million of the increase shown for FY2024 is for modifying the third ship in the program (DDG-1002) during its construction to include large-diameter vertical launch tubes capable of storing and firing the Navy's new hypersonic Conventional Prompt Strike (CPS) missile. (Costs to modify the first two DDG-1000 class ships—DDG-1000 and DDG-1001—for the CPS are budgeted in the Other Procurement, Navy [OPN] appropriation account.)

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.

The Navy stated in 2014 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

³⁸ Department of Defense, Fiscal Year (FY) 2024 Budget Estimates, Navy Justification Book Volume 1 of 1, Shipbuilding and Conversion, Navy, March 2023, pp. 178-179.

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.³⁹

Technical Risk and Test and Evaluation Issues

January 2022 DOT&E Report

A January 2022 report from DOD's Director, Operational Test and Evaluation (DOT&E)—DOT&E's annual report for FY2021—stated the following regarding the DDG-1000 program:

Test Adequacy

In FY21, the Navy executed three missile exercises on the SDTS [Self-Defense Test Ship] to evaluate the DDG 1000's self-defense capability and validate the DDG 1000 combat system M&S [modeling and simulation] test bed.

Due to shipyard delays and persistent combat systems integration faults affecting multiple warfare areas, the test ship could not support the DDG 1000 IOT&E [Initial Operational Test and Evaluation], initially planned for FY19. The Navy started IOT&E in October 2021, but the Navy must still develop a test strategy for the intended OaS UW [Offensive Anti-Surface Warfare] capability.

The Navy has not planned or funded an adequate ship survivability assessment against underwater threats, to include a demonstration of residual mission capability after such engagements, through a full-ship shock trial. Given the current schedule, this assessment will not be complete prior to initial deployment of a DDG 1000 ship.

The Navy has not yet modeled the ship as built to support an LFT&E [Live Fire Test and Evaluation] assessment, and has yet to verify, validate, and accredit the intended vulnerability M&S needed to evaluate ship survivability against air-delivered threats. Planned shipboard testing will supplement some gaps in the capability of survivability models and support the final survivability assessment.

The Navy plans to start Failure and Recoverability Mode testing on USS Michael Monsoor [DDG-1001] in 1QFY22 [first quarter of FY2022] to evaluate the mission systems' capability to recover from system failures and effectiveness of damage control response. Development delays and required updates to the ship's combat system and auxiliary systems have limited the opportunity to conduct this evaluation. The Navy has scheduled the cyber survivability assessment for 3QFY22 [third quarter of FY2022].

Performance

Effectiveness

Not enough data are yet available to provide a preliminary assessment of DDG 1000 operational effectiveness. The DDG 1000 live missile events using SDTS highlighted performance limitations that may restrict operational effectiveness in the air warfare mission. Final assessment of DDG offensive surface strike effectiveness will be published in a classified report following the completion of the live missile events.

Suitability

³⁹ Source: Navy briefing for CRS and the Congressional Budget Office (CBO) on the DDG-1000 program, April 30, 2014.

Not enough data are yet available to provide a preliminary assessment of DDG 1000 operational suitability.

Survivability

Survivability assessments conducted thus far have not been validated and do not reflect the ship as-built. Consequently, data are insufficient to adequately assess DDG survivability in a contested environment, to include a cyber-contested environment.

Recommendations

The Navy should:

1. Complete IOT&E prior to the first deployment of a DDG 1000 ship.
2. Complete revision of the TEMP [Test and Evaluation master Plan] that includes an adequate test strategy for the delivered OaSUV capability as soon as feasible.
3. Schedule, fund, and execute the four remaining DDG 1000 SDTS tests.
4. Complete development and validate the DDG 1000 combat system test bed, to include debris, missile, radar, and electronic warfare models.
5. Document the risk to the warfighter associated with incomplete component shock qualification and lack of full-ship shock trial.
6. Complete validation of LFT&E M&S for the ship as-built and determine required mitigations to identified limitations.⁴⁰

Regarding the Conventional Prompt Strike (CPS) weapon system—a conventionally armed, boost-glide hypersonic weapon system that the Navy intends to deploy on DDG-1000s—the DOT&E report stated

Test Adequacy

The Army and the Navy will start the Phase 1 flight tests as Joint Flight Campaign events to determine Phase 1 flight performance and mission-relevant limitations of the common components of the hypersonic weapon systems. Collection of joint test data is necessary to identify and leverage common practices, test corridors and infrastructure, test data, and modeling and simulation (M&S) capability across the family of hypersonic weapon systems. The Navy intends to execute Phase 2 operational demonstrations, but limited flight test opportunities pose a risk to demonstrating the required operational capability in support of the fielding of the hypersonic missile system onboard a *Zumwalt*-class surface combatant....

Performance

Effectiveness

Not enough data are yet available to evaluate the CPS effectiveness and lethality required for the CPS program to transition from Phase 1 to Phase 2. Demonstrated capabilities and limitations will be published in a classified Early Fielding Report after the completion of Phase 2 testing.

Suitability

Not enough data are yet available to evaluate the CPS suitability capabilities required for the CPS program to transition from Phase 1 to Phase 2. The program intends to complete

⁴⁰ Department of Defense, Director, Operational Test & Evaluation, *FY2021 Annual Report*, January 2022, p. 147.

an initial Life Cycle Support Plan to address product support and fielding on a *Zumwalt*-class in FY22.⁴¹

June 2022 GAO Report

A June 2022 GAO report assessing selected major DOD weapon acquisition programs stated the following of the DDG-1000 program:

Technology Maturity, Design Stability, Production Readiness

The DDG 1000 program has yet to mature three of its nine original critical technologies as it nears completion of construction of the final ship in 2021. The program is also adding a new weapon system with more immature technologies. According to the program, the Navy intends to mature the three remaining original technologies—*infrared signature*, *volume search radar*, and *total ship computing environment*—during operational testing, conducted in realistic combat conditions. The Navy now plans to complete operational testing for the DDG 1000 in December 2022—a 15-month delay compared to last year’s date. This delay is a result of the Navy’s efforts to support industry workload balance, and the Navy requiring the ship to be elsewhere to support other fleet activities.

Last year, we reported that three critical technologies had been added to the original nine technologies to enable the new offensive surface strike mission. According to the Navy, one of those three—a communication system—has since matured and will be installed in 2023. The second technology—a surface strike missile with a new seeker that was approaching maturity—is no longer planned for this class. The Navy expects the third technology—an intelligence system—to reach maturity by installation in 2024.

In addition to this strike mission, this year, the Navy announced plans to incorporate the Conventional Prompt Strike (CPS) hypersonic weapon system—a separate development effort that we also assess in this report—on the class starting in 2024. CPS has four immature technologies. The program currently has \$15 million in funding to begin CPS incorporation design efforts and finalize requirements, and requested over \$100 million in fiscal year 2022. The Navy plans to install CPS on the DDG 1000 in fiscal year 2024, and on the other ships during their first planned dry docking maintenance periods.

DDG 1000 completed final delivery in April 2020 and is undergoing at-sea testing ahead of planned initial operational capability. According to the Navy, initial operational capability was delayed from December 2021 to December 2022 due to the rescheduling of test events. The DDG 1000 also successfully completed rough-water testing of the ship which, according to the program manager, validated the hull form design in harsh sea states.

The other two ships of the class are facing delays. According to the program manager, DDG 1001’s delivery was delayed until the fourth quarter of fiscal year 2022 due to challenges with developing some needed range testing equipment. Delays also continue for DDG 1002, as delivery of the ship was delayed until November 2021 to resolve deficiencies and create a COVID-19 safe workplace, among other reasons. While the Navy still plans for final delivery of DDG 1002 with its combat systems in 2024, further delays are possible. For example, due to delays and crew habitability concerns, a different contractor will install weapon systems on DDG 1002 than the contractor used on the other two hulls, which could result in some loss of efficiencies gained by the contractor on the other two ships.

Other Program Issues

⁴¹ Department of Defense, Director, Operational Test & Evaluation, *FY2021 Annual Report*, January 2022, p. 141. See also Justin Katz and Andrew Eversden, “Navy’s Problems with the Zumwalt May Be Hurting Its Hypersonic Weapon Efforts,” *Breaking Defense*, January 27, 2022.

According to the program manager, one of the primary engineering efforts to incorporate CPS is to design a launching system that enables a cold launch missile, meaning that the missile is ejected from the ship before its rocket motor ignites. The DDG 1000 class would be the first surface ship that uses cold launch missile technology. Design efforts are also required to remove the existing Advanced Gun System turrets and replace them with the CPS payload launcher system that will house the CPS missiles. The program manager further stated that the funding provided constitutes a fraction of the total expected funding necessary for complete CPS integration. For example, integration of the CPS weapon system across all three ships was estimated in June 2021 at approximately \$900 million. The first live demonstration of a hypersonic weapon from the DDG 1000 is currently scheduled for fiscal year 2025.

Program Office Comments

We provided a draft of this assessment for program office review and comment. The program office provided technical comments, which we incorporated where appropriate. The program office stated that the DDG 1000 completed a key maintenance event and several test events, and was transferred to in-service sustainment in 2021. It added that the DDG 1001 participated in underway test events and fleet exercises, including an aviation test, an integrated fleet exercise, and torpedo defense tests in 2021. Further, it noted that the Navy accepted completion of DDG 1002 from Bath Iron Works in November 2021, and that DDG 1002 departed in January 2022 and arrived at Huntington Ingalls Industries' shipyard for completion of combat systems installation and activation. According to the program office, the Navy commenced engineering design planning to allow for integration of CPS in support of the Zumwalt class being the first platform to field these missiles.⁴²

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.⁴³

⁴² Government Accountability Office, *Weapon Systems Annual Assessment[:] Challenges to Fielding Capabilities Faster Persist* GAO-22-105230, June 2022, p. 166.

⁴³ 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.

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.⁴⁴ Since 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 growth⁴⁵—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.⁴⁶ 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....

⁴⁴ 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.

⁴⁵ 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.

⁴⁶ 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.

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 software modification to provide the volume search capability will be significantly less than the estimated procurement costs for the VSR.⁴⁷

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.⁴⁸ 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."⁴⁹

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.

⁴⁷ 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.

⁴⁸ Source: Undated Navy information paper on CVN-78 cost issues, provided by Navy Office of Legislative Affairs to CRS on March 19, 2012.

⁴⁹ 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.

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 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-1000.⁵⁰

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⁵⁰ Christopher J. Castelli, “Pentagon Approves Key Milestone For Multibillion-Dollar Destroyer,” *Inside the Navy*, November 22, 2010.