

# Executive Summary Background

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## Changing Course on Navy Shipbuilding: Questions Congress Should Ask Before Funding

*Mackenzie M. Eaglen*

For more than a decade, the U.S. Navy has invested significant time and resources in designing a multipurpose destroyer, the DDG-1000 *Zumwalt*, to provide superior naval surface fire support, area anti-air warfare, and anti-submarine warfare (ASW) in the littorals.

However, during testimony on July 31, 2008, Navy leaders rescinded their support for the President's fiscal year (FY) 2009 budget request for a third DDG-1000 and advocated "truncating" the program. Navy officials insisted that the *Zumwalt* was no longer the best ship for the Navy due to a shifting security environment and a host of emerging weapons capabilities. Instead of procuring seven DDG-1000s, the Navy wants to purchase only three and to procure at least eight additional, upgraded DDG-51 *Arleigh Burke* destroyers.

In the FY 2009 defense appropriations bill, Congress has provided funding to keep both options open for the next Administration. Before making any major decisions about the future of the Navy's major surface combatant fleet in 2010, Congress needs to ask a series of questions that deserve straightforward answers from the Navy.

***Zumwalt vs. Arleigh Burke.*** The DDG-1000 and DDG-51 are both considered multimission destroyers because their different weapons systems make them more suited to different missions. The DDG-51 was designed during the Cold War to provide Aegis-based area air defense to aircraft carrier battle groups against Soviet naval bombers armed

with anti-ship supersonic cruise missiles. The *Arleigh Burke* Flight IIA class carries two helicopters, and its sonar system is designed for littoral and open-ocean ASW operations.

The DDG-1000 is designed to conduct anti-submarine warfare operations in littoral waters, has a significantly smaller radar cross section, and can provide improved naval surface fire support for the Marine Corps. The DDG-1000 also offers the capability to support Special Operations Forces, a full range of rotary-wing aircraft, and a larger class of support boats. It will require 50 percent fewer personnel and generate 78 megawatts of electrical power, compared to the DDG-51's 7.5 megawatts.

These advanced capabilities explain why Chairman of the Joint Chiefs of Staff Admiral Michael Mullen said that the DDG-51 constitutes "moving...back to the 1980's technology."

**Questions Congress Needs to Ask.** Congress needs answers from the Navy to the following eight sets of questions, both to guide its oversight and to inform its funding decisions:

This paper, in its entirety, can be found at:  
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- If the DDG-1000 cannot conduct area air defense, why is it classified as a guided missile destroyer? Could the DDG-1000 be upgraded to employ the Standard Missile? What are the growth potential and cost of the DDG-1000's Dual-Band Radar and combat management system for ballistic missile defense?
- What are the Marine Corps' specific naval surface fire-support requirements? Can they be met sufficiently without the planned seven DDG-1000s?
- Is the Navy's decision-making process being driven mostly by budget restraints or by changes in the threat assessment and requirements?
- If China's military capabilities are such a significant factor in the Navy's decision-making process, why did the Navy avoid discussing China in its recent Maritime Strategy?
- What are the growth potentials of *Zumwalt* and *Arleigh Burke* classes in terms of adding new systems, weapons (e.g., lasers), and combat capabilities?
- What are the design flaws, if any, in hull strength and/or weapon locations?
- What are the life cycle costs of adding new systems and combat capabilities?
- Has the projected timeline for procuring the CG(X), the next generation lead cruiser, slipped

from 2011 to 2015 or later? If so, what is the Navy's specific plan for cruiser procurement, particularly in light of its concern about anti-ship cruise missiles and ballistic missiles?

**The Burden Remains on the Navy's Leadership.** During the long and somewhat turbulent history of the *Zumwalt* program, the Navy has continuously supported the ship while expanding its capabilities and reducing its numbers. After years of justifying its requirements, the Navy has reversed direction and is arguing that its future multimission destroyer is no longer the answer to the threats that the service may face in the future.

Recent testimony by Vice Admiral Barry McCullough and Deputy Assistant Secretary of the Navy for Ship Programs Allison Stiller has raised new questions and left other concerns unanswered. The Navy's leadership has an obligation to provide Congress with full answers to these questions in a timely manner. Before deciding which plan to fund in 2010, Congress should demand the information that it needs to conduct due diligence.

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For more than a decade, the U.S. Navy has invested significant time and resources in designing a multipurpose destroyer, the DDG-1000 *Zumwalt*, to provide superior naval surface fire support, area anti-air warfare, and anti-submarine warfare (ASW) in the littorals.

However, during testimony on July 31, 2008, Navy leaders rescinded their support for the President's fiscal year (FY) 2009 budget request for a third DDG-1000 and advocated "truncating" the program. Navy officials insisted that the *Zumwalt* was no longer the best major surface combatant for the Navy due to a shifting security environment and a host of emerging weapons capabilities. Instead of procuring seven DDG-1000s, the Navy now seeks to purchase only three and to procure at least eight additional, upgraded DDG-51 *Arleigh Burke* destroyers.

The *Zumwalt* class and *Arleigh Burke* class are both considered multimission destroyers because their different weapons systems make them more suited to different missions. The DDG-51 was originally designed to provide Aegis-based area air defense to aircraft carrier battle groups against Soviet naval bombers armed with anti-ship supersonic cruise missiles. The latest version of the *Arleigh Burke* has a reduced radar cross section, and its sonar system is designed for littoral and open-ocean anti-submarine warfare operations. The *Zumwalt* class is designed to conduct anti-submarine warfare operations in littoral waters, has a significantly smaller radar cross section, and can provide improved naval surface fire support for the U.S. Marine Corps.

### Talking Points

- After spending a decade designing and testing the DDG-1000 *Zumwalt* multimission destroyer and testifying to Congress that it was a "warfighting imperative" for the future fleet, Navy leaders have rescinded support for the destroyer.
- Navy officials now recommend that Congress limit *Zumwalt* procurement because of a changing threat environment that requires more "ballistic missile defenses, integrated air and missile defense, and antisubmarine warfare best provided by *Arleigh Burke* DDG-51s."
- The Navy's leadership needs to answer a series of outstanding questions in a timely manner before Congress decides which plan to fund in 2010.
- These questions include, among others, the ability of the *Zumwalt* to employ the Standard Missile, the naval surface fire-support requirements of the Marine Corps, the growth potential of both destroyers, and the Navy's plans for the CG(X) cruiser.

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In the FY 2009 defense appropriations bill, Congress has provided funding to keep both options open for the next Administration. Before making any major decisions about the future of the Navy's major surface combatant fleet in 2010, Congress needs to ask a series of questions that deserve straightforward answers from the Navy.

## A Destroyer for the 21st Century

The U.S. Navy has spent more than a decade making the case for a new generation of major surface combatants. Today, it faces a changing security environment in which challenges range from non-state actors operating fast boats to emerging peer competitors that are deploying a new generation of diesel and nuclear-powered submarines. These challenges exist in the blue waters—the strategic naval battleground of the Cold War—and in the cluttered littorals of the Asia-Pacific and the Persian Gulf.

The result of this analysis, research, and development was the DDG-1000 *Zumwalt*-class destroyer. Originally designated as the DD-21 and then the DD(X), the DDG-1000 is a large multimission destroyer with a displacement of 14,987 tons.<sup>1</sup> It is outfitted with an advanced stealth design, a state-of-the-art Dual-Band Radar suite, a wave-piercing tumblehome hull, and a host of other technologies. With its advanced naval surface fire-support capabilities and anti-submarine warfare and anti-air warfare systems, the *Zumwalt* is well suited to land attack and littoral dominance.

However, the Navy's recent analysis of the altered threat environment and the capabilities required to defeat emerging threats—along with increasing budgetary pressures—caused Navy leaders to reverse course relatively rapidly in July. Officials advised Congress to abandon the *Zumwalt* program after the first two ships are constructed.

Primarily citing unforeseen threats in their argument to stop DDG-1000 procurement and to build

upgraded *Arleigh Burke*-class destroyers, the Navy now asserts that the DDG-1000 is incapable of conducting both area defense anti-air warfare (versus point defense in which the ship defends itself with short-range surface-to-air missiles) and ballistic missile defense (BMD). New threats and the Navy's latest claim that the ship's naval fire-support capability can be replaced by aircraft launching precision bombs and by the U.S. Marine Corps' own fire-support assets have therefore eliminated the need for *Zumwalt*'s advanced naval artillery system.

After the Navy's reversal, the Office of the Secretary of Defense directed the Navy to build a third DDG-1000 in accordance with the President's FY 2009 defense budget request because procuring the ship "will provide stability of the industrial base and continue the development of advanced surface ship technologies such as radar systems, stealth, magnetic and acoustic quieting, and automated damage control."<sup>2</sup> However, after construction of the third *Zumwalt*, the Navy currently intends to order at least eight additional DDG-51 destroyers beginning in FY 2010.<sup>3</sup> Congress has left the door open to build either destroyer in FY 2010 because the Senate defense appropriations bill currently provides advance procurement funding for the fourth DDG-1000 and advance procurement funding for the DDG-51 program.

Congress will ultimately approve funding for major surface combatants to reach the goal of a 313-ship Navy. Before making a final decision to abandon the *Zumwalt* line and resume *Arleigh Burke* construction, Congress needs to ask a series of questions and receive honest and accurate answers from Navy officials. These questions center on the Navy's recent claims about a new threat matrix, the official rationale for discontinuing the *Zumwalt*, and what capabilities are needed to counter the emerging threats. Only after receiving the answers to these questions will Members of Congress have the necessary information to make a decision that will shape the fleet for the next 50 years.

1. Ronald O'Rourke, "Navy DD(X) and LCS Ship Acquisition Programs: Oversight Issues and Options for Congress," Congressional Research Service *Report for Congress*, updated October 28, 2004, pp. 9–10, at [http://digital.library.unt.edu/govdocs/crs//data/2004/upl-meta-crs-6395/RL32109\\_2004Oct28.pdf](http://digital.library.unt.edu/govdocs/crs//data/2004/upl-meta-crs-6395/RL32109_2004Oct28.pdf) (September 23, 2008).
2. Jerry Harkavy, "Navy to Seek Third DDG-1000," *Navy Times*, October 14, 2007, at [http://www.navytimes.com/news/2008/08/ap\\_ddg\\_1000\\_081808](http://www.navytimes.com/news/2008/08/ap_ddg_1000_081808) (September 23, 2008).
3. Cassandra Newell, "USN Reinstates Third Zumwalt Destroyer," *Jane's Defence Weekly*, August 27, 2008, p. 8.



## DDG-1000: A “Warfighting Imperative”

The origins of the DDG-1000 span more than a decade.

- In 1994 and 1995, the Navy initiated the DD-21 land-attack destroyer program with a plan to procure 32 ships.<sup>4</sup>
- By 2001, with costs continuing to rise, the Navy reclassified the ship as a multimission destroyer—the DD(X)—and reduced the planned procurement from 24 ships to 16 ships.
- On November 1, 2001, the program was again reclassified as a multimission guided-missile destroyer.
- After budget guidance from the Office of the Secretary of Defense in 2005, the Navy again downsized its procurement plan, with officials testifying to a requirement of eight to 12 ships.<sup>5</sup>
- Finally, in 2006, in conjunction with the Navy’s announcement of its 313-ship plan, the program was renamed the DDG-1000 with a planned procurement of only seven ships.<sup>6</sup>

Navy officials have made the case for the DDG-1000 program on numerous occasions, but none was more dynamic than Chief of Naval Operations Admiral Vern Clark’s testimony on July 19, 2005, before the Projection Forces Subcommittee of the House Armed Services Committee. Admiral Clark testified that the “DD(X) is the right ship to build now to meet Navy requirements in air, surface, and

subsurface warfare, as well as also meeting U.S. Marine Corps and land combat fire support requirements ashore.” The *Zumwalt* is “absolutely essential,” a “U.S. Navy warfighting imperative,” and “absolutely critical for its independent value in the global war on terror and the potential major conflicts [the United States] may face into the 2030 timeframe.”<sup>7</sup>

During the same hearing, Assistant Secretary of the Navy for Research, Development, and Acquisition John Young and Rear Admiral Charles Hamilton, Program Executive Office for Ships, further articulated the Navy’s case by arguing that the Navy needed the DDG-1000 because it provides multiple improvements over current capabilities, including a “10-fold improvement in battle-force defense, a 50-fold improvement in stealth, a 10-fold increase in operating area against shallow water mines, a three-fold increase in volume fire support for forces ashore, and a power system and architecture needed for future high-energy weapons.”<sup>8</sup>

As recently as March of this year, the Navy continued to insist on the need for the DDG-1000 program. Vice Admiral Barry McCullough, Deputy Chief of Naval Operations, and Allison Stiller, Deputy Assistant Secretary of the Navy for Ship Programs, testified before the House Subcommittee on Seapower and Expeditionary Forces that the *Zumwalt* would “provide independent forward presence and deterrence and operate as an integral part of joint and combined forces.”<sup>9</sup>

4. Ronald O’Rourke, “Navy DDG-1000 and DDG-51 Destroyer Programs: Background, Oversight Issues, and Options for Congress,” Congressional Research Service *Report for Congress*, updated September 5, 2008.
5. Ronald O’Rourke, “Navy DD(X), CG(X), and LCS Ship Acquisition Programs: Oversight Issues and Options for Congress,” *Congressional Research Service*, updated June 24, 2005, p. 17, at [http://digital.library.unt.edu/govdocs/crs//data/2005/upl-meta-crs-6753/RL32109\\_2005Jun24.pdf](http://digital.library.unt.edu/govdocs/crs//data/2005/upl-meta-crs-6753/RL32109_2005Jun24.pdf) (September 23, 2008).
6. Robert Work, “Know When to Hold ’Em, When to Fold ’Em: Thinking About Navy Plans for the Future Surface Battle Line,” Center for Strategic and Budgetary Assessments, March 7, 2007, at [http://www.csbaonline.org/4Publications/PubLibrary/B.20070307.\\_Know\\_When\\_to\\_Hold/B.20070307.\\_Know\\_When\\_to\\_Hold.pdf](http://www.csbaonline.org/4Publications/PubLibrary/B.20070307._Know_When_to_Hold/B.20070307._Know_When_to_Hold.pdf) (September 23, 2008).
7. Admiral Vern Clark, “Plans and Programs for the DD(X) Next-Generation Multi-Mission Surface Combatant Ship,” testimony before the Subcommittee on Projection Forces, Committee on Armed Services, U.S. House of Representatives, July 19, 2005, at <http://www.armedservices.house.gov/comdocs/schedules/CNO7-19-05.pdf> (September 23, 2008).
8. John J. Young, Jr., and Rear Admiral Charles S. Hamilton II, “Plans and Programs for the DD(X) Next-Generation Multi-Mission Surface Combatant Ship,” testimony before the Subcommittee on Projection Forces, Committee on Armed Services, U.S. House of Representatives, July 19, 2005, at <http://www.armedservices.house.gov/comdocs/schedules/Young-Hamilton7-19-05.pdf> (September 23, 2008).
9. Vice Admiral Barry McCullough and Allison Stiller, “Navy Force Structure and Shipbuilding,” statement before the Subcommittee on Seapower and Expeditionary Forces, Committee on Armed Services, U.S. House of Representatives, March 14, 2008, at [http://www.armedservices.house.gov/pdfs/SPEF031408/McCullough\\_Stiller\\_Testimony031408.pdf](http://www.armedservices.house.gov/pdfs/SPEF031408/McCullough_Stiller_Testimony031408.pdf) (September 23, 2008).

## A New Threat Environment

Yet in a relatively short time, Navy leaders have changed their assessment of the requirement for the DDG-1000, which they had argued was central to the future fleet. On July 31, 2008, Vice Admiral McCullough and Deputy Assistant Secretary Stiller again testified before the Subcommittee on Seapower and Expeditionary Forces, but this time they argued that the DDG-1000 program should be cancelled or “truncated” after the first two ships are built. Citing the need to “prioritize relevant combat capability” and “things that have happened in the near recent past that have significantly changed the way we view the threat,” Admiral McCullough began by describing the Navy’s new perception of the threat environment:

Rapidly evolving traditional and asymmetric threats continue to pose increasing challenges to Combatant Commanders. State actors and non-state actors who, in the past, have only posed limited threats in the littoral are expanding their reach beyond their own shores with improved capabilities in blue water submarine operations, advanced anti-ship cruise missiles and ballistic missiles. A number of countries who historically have only possessed regional military capabilities are investing in their Navy to extend their reach and influence as they compete in global markets. Our Navy will need to outpace other Navies in the blue water ocean environment as they extend their reach. This will require us to continue to improve our blue water anti-submarine and anti-ballistic missile capabilities in order to counter improving anti-access strategies.<sup>10</sup>

He then detailed three changes in the threat environment that have forced the Navy to recalculate its needs:

There are three specific areas. One is with the increased proliferation of ballistic missiles that provide anti-access challenges to our forces today globally, not only the high-end threat posed by potential adversaries in the Pacific, but lesser included capabilities in the Arabian Gulf region, in Northeast Asia, and the ability that that—or the proliferation into that threat globally...

The second piece is when you see high-tech threat capability that’s usually resident in a nation state come off the beach in a conflict against a non-state actor and strike a warship and do significant damages to it, it’s where is that capability going to go next, with what potential non-state actor. And that happened in the Eastern Med in 2006. And...there are nations that are developing quiet diesel submarine technology and putting it into blue water to challenge where we operate. And we need improved capability against the open-ocean deep water quiet diesel submarine threat.

And that’s where we see the capability that has come rapidly left from where it was projected. I don’t think anybody ever envisioned Hezbollah being able to launch a C-802, and they did that quite well.<sup>11</sup>

Admiral McCullough then outlined why the DDG-1000 is no longer the best option for the U.S. Navy:

[T]he DDG-1000 cannot perform area air defense; specifically, it cannot successfully employ the Standard Missile-2 (SM-2), SM-3, or SM-6 and is incapable of conducting Ballistic Missile Defense. Although superior in littoral ASW, the DDG-1000 lower power sonar design is less effective in the blue water than DDG-51 capability. DDG-1000’s Advanced

10. Vice Admiral Barry McCullough and Allison Stiller, “Surface Combatant Requirements and Acquisition Structures,” statement before the Subcommittee on Seapower and Expeditionary Forces, Committee on Armed Services, U.S. House of Representatives, July 31, 2008, p. 3, at [http://www.armedservices.house.gov/pdfs/SPEF073108/McCullough\\_Stiller\\_Testimony073108.pdf](http://www.armedservices.house.gov/pdfs/SPEF073108/McCullough_Stiller_Testimony073108.pdf) (September 23, 2008).

11. Vice Admiral Barry McCullough, in hearing, *Navy Destroyer Acquisition Programs*, transcript from LexisNexis, Subcommittee on Seapower and Expeditionary Forces, Committee on Armed Services, U.S. House of Representatives, 110th Cong., 2nd Sess., July 31, 2008, p. 21.

Gun System (AGS) design provides enhanced Naval Fires Support capability in the littorals with increased survivability. However, with the accelerated advancement of precision munitions and targeting, excess fires capacity already exists from tactical aviation and organic USMC fires.<sup>12</sup>

Finally, Admiral McCullough also noted that “[c]ombatant commanders continue to request more surface ships and increased naval presence to expand cooperation with new partners in Africa, the Black Sea, the Baltic region, and the Indian Ocean and maintain our relationships with our allies and friends.”<sup>13</sup>

In this evolving threat environment, and recognizing that the DDG-1000 was incapable of meeting the Navy’s new requirements, Admiral McCullough recommended that Congress instead fund additional DDG-51 *Arleigh Burke*-class destroyers. He testified that “[t]he demand from combatant commanders is for ballistic missile defenses, integrated air and missile defense, and antisubmarine warfare best provided by DDG 51s and not the surface fire support optimized in DDG 1000.”<sup>14</sup>

### **Zumwalt vs. Arleigh Burke**

There is a clear contradiction between what Navy leaders have previously stated about the operational value of the *Zumwalt* and what was said on July 31, 2008. A comparison of the combat systems and capabilities of the *Zumwalt* and *Arleigh Burke* provides a clearer picture of their relative strengths and weaknesses.

The DDG-1000 and DDG-51 are both considered multimission destroyers because their differ-

ent weapons systems make them more suited to different missions. The DDG-51 was designed during the Cold War to provide Aegis-based area air defense to aircraft carrier battle groups against Soviet naval bombers armed with anti-ship supersonic cruise missiles.<sup>15</sup> The *Arleigh Burke* destroyers are armed with a single five-inch (127 mm) gun for surface fire support, and Flight IIA, the latest version of the DDG-51, has a vertical launching system with 96 cells. Further, the DDG-51 has stealth features that offer a reduced radar cross section compared to previous destroyer classes.<sup>16</sup> The *Arleigh Burke* Flight IIA class carries two helicopters, and its sonar system is designed for littoral and open-ocean ASW operations.

The DDG-1000 has two 155 mm Advanced Gun Systems that provide improved naval surface fire support and a vertical launching system of 80 cells. The DDG-1000’s tumblehome hull and single-sloped superstructure—built partially of radar-absorbent materials—provide a significantly smaller radar cross section compared to other Navy vessels, making the DDG-1000 a stealthy ship.<sup>17</sup> The *Zumwalt* class is designed to carry up to two helicopters, or one helicopter and one unmanned aerial vehicle,<sup>18</sup> and to conduct anti-submarine warfare operations in littoral waters. The DDG-1000 offers the capability to support Special Operations Forces, a full range of rotary-wing aircraft, and a larger class of support boats. It will require 50 percent fewer personnel and generate 78 megawatts (MW) of electrical power, compared to the DDG-51’s 7.5 MW. These advanced capabilities explain why Chairman of the Joint Chiefs of Staff Admiral Michael Mullen

12. McCullough and Stiller, “Surface Combatant Requirements and Acquisition Structures,” p. 5.

13. *Ibid.*, p. 4.

14. McCullough, in hearing, *Navy Destroyer Acquisition Programs*, p. 5.

15. Norman Friedman, *U.S. Destroyers: An Illustrated Design History*, revised ed. (Annapolis, Md.: U.S. Naval Institute Press, 2004), pp. 391–392.

16. Norman Polmar, *The Naval Institute Guide to the Ships and Aircraft of the U.S. Fleet*, 18th ed. (Annapolis, Md.: Naval Institute Press, 2005), p. 151.

17. Young and Hamilton, “Plans and Programs for the DD(X)”; Polmar, *The Naval Institute Guide to the Ships and Aircraft of the U.S. Fleet*; and O’Rourke, “Navy DDG-1000 and DDG-51 Destroyer Programs.”

18. Eric Wertheim, *The Naval Institute Guide to Combat Fleets of the World: Their Ships, Aircraft, and Systems*, 15th ed. (Annapolis, Md.: Naval Institute Press, 2007), p. 906, and Friedman, *U.S. Destroyers*, p. 449.

said that the DDG-51 constitutes “moving...back to the 1980’s technology.”<sup>19</sup>

**Radar Systems and Area-Wide Anti-Air Warfare Capability.** The DDG-51’s main radar system is the SPY-1D passive phased-array radar, which is the main element of the Aegis combat management and fire-control system. DDG-51 Flight IIA is equipped with the SPY-1D(V) version of the radar, which is designed for littoral warfare to detect and engage small-sized sea-skimming anti-ship cruise missiles in clutter conditions caused by interference from coastal land or electronic jamming.<sup>20</sup> The SPY-1 radar of the *Ticonderoga*-class cruisers and the *Arleigh Burke* class can detect, identify, and track more than 200 contacts at an estimated range of up to 370 km.<sup>21</sup> SPY-1 can simultaneously track SM-2 missiles and their intended targets, directing the missiles through command guidance against up to 20 different targets.<sup>22</sup>

One limitation of Aegis is that it must illuminate each target with a dedicated target illuminator during the terminal phase of interception by an SM-2 missile.<sup>23</sup> The *Arleigh Burke* class has only three target illuminators, and the *Ticonderoga*-class has four. Thus, even though each target illuminator can quickly change to a new target after the previous target has been successfully

intercepted, the *Arleigh Burke* can simultaneously engage only three targets. The SPY-1D(V) radar of the *Arleigh Burke* Flight IIA should be capable of guiding the new SM-6 missile.

The *Zumwalt* uses the advanced Dual-Band Radar suite, which is an integrated advanced radar system built around two active phased-array radar systems: the SPY-3 Multifunction Radar (MFR) and the S-band Volume Search Radar (VSR). The Dual-Band Radar suite greatly improves the ship’s ability to track a range of signatures in both blue-water and cluttered littoral environments.<sup>24</sup>

The SPY-3 MFR is the DDG-1000’s primary air-defense fire-control radar. It can perform area air defense to protect other ships in a naval task force and conduct short-range air defense. The SPY-3 is an X-band medium-range radar with a maximum range against air targets of about 150–167 km.<sup>25</sup> The SPY-3 will thus be able to engage “low-observable”<sup>26</sup> air targets, such as sea-skimming anti-ship cruise missiles,<sup>27</sup> unmanned aerial vehicles, and aircraft. Within the 150–167 km envelope, the SPY-3 will be able to fire and guide missiles to their targets, including the Evolved Sea Sparrow Missile, which has a range of 45 km,<sup>28</sup> and the SM-2 Block IIIB, which can engage sea-skimming cruise missiles at ranges of up to 167 km.<sup>29</sup> The Dual-Band Radar can

19. Admiral Mike Mullen, quoted in Ronald O’Rourke, “Navy DDG-1000 Destroyer Program: Background, Oversight Issues, and Options for Congress,” Congressional Research Service Report for Congress, updated July 15, 2008, p. 2.
20. Norman Friedman, *The Naval Institute Guide to World Naval Weapon Systems*, 5th ed. (Annapolis: Md.: U.S. Naval Institute Press, 2006), p. 317.
21. Polmar, *The Naval Institute Guide to the Ships and Aircraft of the U.S. Fleet*, p. 552; Friedman, *The Naval Institute Guide to World Naval Weapon Systems*, pp. 316 and 597; and Duncan Lennox, ed., *Jane’s Strategic Weapon Systems*, 48th ed. (Coulson, U.K.: Jane’s Information Group, 2008), p. 356. The “volume-scan instrumented range” of the Aegis SPY-1 radar has been reported to be 324 kilometers (175 nautical miles). See Friedman, *The Naval Institute Guide to World Naval Weapon Systems*, p. 316.
22. Polmar, *The Naval Institute Guide to the Ships and Aircraft of the U.S. Fleet*, p. 553.
23. Friedman, *The Naval Institute Guide to World Naval Weapon Systems*, p. 595.
24. O’Rourke, “Navy DDG-1000 and DDG-51 Destroyer Programs,” updated September 5, 2008.
25. Wertheim, *The Naval Institute Guide to Combat Fleets of the World*, p. 878.
26. Friedman, *The Naval Institute Guide to World Naval Weapon Systems*, p. 317.
27. Polmar, *The Naval Institute Guide to the Ships and Aircraft of the U.S. Fleet*, p. 551, and Wertheim, *The Naval Institute Guide to Combat Fleets of the World*, p. 878.
28. Lennox, *Jane’s Strategic Weapon Systems*, p. 354.
29. Wertheim, *The Naval Institute Guide to Combat Fleets of the World*, p. 873, and Polmar, *The Naval Institute Guide to the Ships and Aircraft of the U.S. Fleet*, p. 526.



illuminate targets and guide the SM-2 Block IIIB, but the *Zumwalt's* combat direction system apparently must be modified to fire the SM-2.<sup>30</sup>

The S-band VSR provides effective long-range surveillance, detection, and tracking of air contacts up to 370 km.<sup>31</sup> It can detect, identify, and track over-the-horizon air and surface targets; conduct air traffic control duties of hundreds of air contacts; and “provide cuing for the SPY-3 MFR,” sending target information to the SPY-3 radar.<sup>32</sup> The VSR, as it tracks both SM-2s and their intended air targets, could possibly give command guidance to Standard Missiles through flight updates via data link to the SM-2’s inertial and command midcourse guidance system, like the Aegis SPY-1 radar. A senior Raytheon official seemed to confirm this assessment when talking about the *Zumwalt's* combat management system: “Our [combat system] design has the SM-2 using the same link as used in all the other ships.... The Volume Search radar is essentially the same as the SPY-1D” Aegis radar used in all

current DDGs and cruisers.<sup>33</sup>

With the necessary modifications, the DDG-1000’s Dual-Band Radar could also guide the new SM-6 Extended Range Active Missile,<sup>34</sup> intended to replace the SM-2,<sup>35</sup> through command guidance flight updates sent directly to the SM-6 by the VSR.

**Ballistic Missile Defense.** The *Arleigh Burke*-class destroyers, particularly Flight IIA, were not designed to conduct ballistic missile defense. The BMD upgrades to the SPY-1D(V) radar were considered by the Ballistic Missile Defense Organization after it was developed for littoral waters operations against low-observable sea-skimming cruise missiles,<sup>36</sup> the same air defense role for which the DDG-1000’s SPY-3 was originally designed.<sup>37</sup> There have also been plans to fit the Flight IIA destroyers with the more advanced SPY-1E active phased-array radar, which has greater ability to detect and engage ballistic missiles due to its greater sensitivity and ability to locate low-signature targets under clut-

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30. U.S. Department of Defense, “R-1 Line Item No. 104: Exhibit R-2a, RDT&E Budget Item Justification,” February 2007, p. 4, at <http://www.dtic.mil/descriptivesum/Y2008/Navy/0604366N.pdf> (September 23, 2008).
31. The VSR is based on Lockheed Martin’s experimental SPY-2 radar, better known as the SPY-1E radar, an active phased-array radar designed to replace the SPY-1 radar of the *Ticonderoga*-class cruisers and *Arleigh Burke*-class destroyers. See Friedman, *The Naval Institute Guide to World Naval Weapon Systems*, pp. 317 and 318, and Wertheim, *The Naval Institute Guide to Combat Fleets of the World*, p. 878.
32. Polmar, *The Naval Institute Guide to the Ships and Aircraft of the U.S. Fleet*, p. 552, and GlobalSecurity.org, “Volume Search Radar,” April 27, 2005, at <http://www.globalsecurity.org/military/systems/ship/systems/vsr.htm> (September 23, 2008).
33. Dan Smith, quoted in Christopher P. Cavas, “Troubled DDG 1000 Faces Shipyard Problems,” *Navy Times*, September 16, 2008, at [http://www.navytimes.com/news/2008/09/navy\\_zumwalt\\_091508w](http://www.navytimes.com/news/2008/09/navy_zumwalt_091508w) (September 25, 2008).
34. The SM-6 Extended Range Active Missile (ERAM) is a version of the SM-2 that uses the active radar seeker from the Advanced Medium Range Air-to-Air Missile (AMRAAM). Using its active radar seeker, the missile guides itself to the air target in the terminal phase of interception without needing a fire-control radar to illuminate the target. The SM-6 has a reported maximum range of more than 350 km (probably 370 km) and is designed to shoot down supersonic anti-ship cruise missiles, aircraft, helicopters, unmanned aerial vehicles (UAVs), and cruise missiles flying overland beyond the ship’s fire control radar. Through CEC and command guidance by the VSR, an SM-6 launched from a DDG-1000 could be directed toward a target, and the missile’s active radar seeker would control the terminal phase of interception. A later version of the SM-6 will be able to engage short-range ballistic missiles (SRBMs). See Wertheim, *The Naval Institute Guide to Combat Fleets of the World*, p. 873; Lennox, *Jane’s Strategic Weapon Systems*, p. 356; Friedman, *The Naval Institute Guide to World Naval Weapon Systems*, pp. 597–598; and Polmar, *The Naval Institute Guide to the Ships and Aircraft of the U.S. Fleet*, p. 512.
35. Christopher P. Cavas, “Will DDG-1000 Produce Any Ships at All?” *Defense News*, September 15, 2008, p. 8.
36. Friedman, *The Naval Institute Guide to World Naval Weapon Systems*, p. 317.
37. GlobalSecurity.org, “AN/SPY-3 Multi-Function Radar (MFR),” April 27, 2005, at <http://www.globalsecurity.org/military/systems/ship/systems/mfr.htm> (September 23, 2008).

ter.<sup>38</sup> Reportedly, SPY-1 radars have tracked ballistic missiles at distances exceeding 1,000 km.<sup>39</sup>

The ballistic missile defense weapon of the Aegis system is the SM-3. It would seem that several of the *Arleigh Burke*-class destroyers are being upgraded for theater ballistic missile defense with the capability to fire the SM-3 and with BMD-capable upgraded versions of the Aegis weapon system like the Baseline 7 version.<sup>40</sup> The SM-3 Block 1 is designed to intercept short-range and medium-range ballistic missiles in midcourse. It has a GPS-assisted inertial navigation system and a range of approximately 1,200 km. Intercepts beyond 370 km would require using the network-centric warfare Cooperative Engagement Capability to receive targeting coordinates from other platforms.<sup>41</sup> The SM-3's fourth stage is the Lightweight Exoatmospheric Projectile Kinetic Warhead, which intercepts the ballistic missile.<sup>42</sup>

**Sonar and the Anti-Submarine Warfare Mission.** The two warships' anti-submarine warfare capabilities diverge along their main mission priorities. The DDG-1000's sonar system offers a more capable system for the littorals, while the DDG-51's works more effectively in blue waters. The *Arleigh Burke* Flight IIA is fitted with a very capable sonar suite for littoral and blue-water ASW operations. One component is the SQS-53C(V)1 hull-mounted sonar, which seems to be an adaptation of the original system designed to operate in both littoral

waters and blue waters, as it is integrated with the Kingfisher high-frequency mine-avoidance sonar. The SQS-53C can reportedly detect targets at considerable ranges in shallow waters. Operating like a phased-array radar, the SQS-53C sonar can send out acoustic beams in different directions, allowing it to track multiple sonar contacts simultaneously. SQS-53C appears capable of reaching detection ranges in ocean waters of up to about 100 km (the second convergence zone).<sup>43</sup>

The DDG-1000's sonar suite consists of low-frequency bow sonar, the new Multi-Function Towed Array, the new Lightweight Broadband Variable Depth Sonar, and the dipping sonar of the destroyer's anti-submarine warfare helicopter.<sup>44</sup> The Lightweight Broadband Variable Depth Sonar, which functions at medium and high frequencies, is better suited to the acoustically cluttered littoral waters, particularly against slow submarines and sea mines in shallow waters. It has a limited detection range of about 28 km.<sup>45</sup> The Multi-Function Towed Array can operate at high, medium, and low frequencies.<sup>46</sup>

Yet the Navy has also been funding Tsunami, an alternative sonar suite for the DDG-1000. According to L3 Communications, Tsunami can replicate the performance of the *Arleigh Burke*'s SQS-53 bow sonar in blue waters, although it is claimed to operate more effectively in the littoral waters.<sup>47</sup> L3 claims that Tsunami is a "green sonar" because its

38. Friedman, *The Naval Institute Guide to World Naval Weapon Systems*, p. 317; Polmar, *The Naval Institute Guide to the Ships and Aircraft of the U.S. Fleet*, p. 553; and Wertheim, *The Naval Institute Guide to Combat Fleets of the World*, p. 908.

39. Lennox, *Jane's Strategic Weapon Systems*, pp. 359 and 360.

40. Wertheim, *The Naval Institute Guide to Combat Fleets of the World*, p. 908, and Friedman, *The Naval Institute Guide to World Naval Weapon Systems*, p. 597.

41. Wertheim, *The Naval Institute Guide to Combat Fleets of the World*, p. 873; Lennox, *Jane's Strategic Weapon Systems*, pp. 359 and 360; and Friedman, *The Naval Institute Guide to World Naval Weapon Systems*, p. 597.

42. Lennox, *Jane's Strategic Weapon Systems*, p. 359.

43. Wertheim, *The Naval Institute Guide to Combat Fleets of the World*, p. 907; Polmar, *The Naval Institute Guide to the Ships and Aircraft of the U.S. Fleet*, p. 147; and Friedman, *The Naval Institute Guide to World Naval Weapon Systems*, p. 672.

44. Friedman, *U.S. Destroyers*, p. 448, and Friedman, *The Naval Institute Guide to World Naval Weapon Systems*, p. 674.

45. Friedman, *The Naval Institute Guide to World Naval Weapon Systems*, p. 674.; Anthony J. Watts, ed., *Jane's Underwater Warfare Systems 2004–2005*, 16th ed. (Coulsdon, U.K.: Jane's Information Group, 2004), p. 152; and Anthony J. Watts, ed., *Jane's Underwater Warfare Systems 2002–2003*, 14th ed. (Coulsdon, U.K.: Jane's Information Group, 2002), p. 141.

46. Wertheim, *The Naval Institute Guide to Combat Fleets of the World*, p. 880.

47. Friedman, *The Naval Institute Guide to World Naval Weapon Systems*, pp. 677–678.

acoustic transmissions will not negatively affect marine life such as dolphins and whales.<sup>48</sup>

Tsunami's blue-water capability would apparently be complemented by the sonar suite's variable depth sonar, which seems to be derived from the Low-Frequency Active Towed Sonar. It can detect submarines beyond the first convergence zone (48 km).<sup>49</sup> This low-frequency active sonar technology was originally developed to detect very quiet Soviet submarines in blue waters at long distances using active pinging instead of passive detection. Used together, the DDG-1000's sonar suite and the towed array could triangulate and locate a submarine target faster than the *Arleigh Burke* Flight IIA class, which lacks a towed array.<sup>50</sup> However, the Navy's testimony on July 31 suggests that a towed-array sonar would likely be included in the follow-on DDG-51s that it plans to procure.<sup>51</sup>

**Naval Surface Fire Support.** The *Zumwalt* class will be equipped with a 155 mm Advanced Gun System, the most powerful and accurate long-range naval artillery system in the Navy. It can fire shells farther and faster (10–12 rounds per minute) and on different trajectories so that multiple shells strike a target simultaneously. An AGS shell can carry 24 pounds of explosives, compared to only eight pounds of explosives in a shell fired from the *Arleigh Burke's* Mk 45.<sup>52</sup> The AGS can fire the GPS-guided Long Range Land Attack Projectile, which

reportedly has a maximum range of approximately 60 nautical miles (111 km).<sup>53</sup> A single 155 mm AGS can replace an entire U.S. Marine Corps battery of 155 mm guns.<sup>54</sup> The Advanced Gun System can fire several types of munitions, including shells fitted with the anti-armor Sense and Destroy Armor submunition and an anti-ship warhead with a range of 30 nautical miles (55.5 km) against fast-moving vessels.<sup>55</sup>

In contrast, the DDG-51's single Mk 45, a single five-inch (127 mm) gun, has a maximum range of 23.7 km and fires smaller and less capable shells. Although it can fire 16–20 rounds per minute, it cannot fire precision-strike munitions, such as the Sense and Destroy Armor shells. The Extended Range Guided Munition, a long-range munition planned for the gun, was cancelled, leaving the gun system without a future long-range precision strike capability.<sup>56</sup>

**Additional Capabilities.** The state-of-the-art Advanced Integrated Electronic Warfare System, or SLY-2(V), which was being developed for Aegis cruisers and destroyers and the DDG-1000, was cancelled because of delays and cost overruns, leaving no alternative except for installing a modernized legacy system.<sup>57</sup> The Advanced Integrated Electronic Warfare System has an open architecture design that would assign and use the ship's countermeasures automatically after detecting, comparing,

48. Watts, *Jane's Underwater Warfare Systems 2004–2005*, p. 156.

49. Friedman, *The Naval Institute Guide to World Naval Weapon Systems*, p. 678; Watts, *Jane's Underwater Warfare Systems 2004–2005*, pp. 153 and 156; and Watts, *Jane's Underwater Warfare Systems 2002–2003*, p. 142.

50. O'Rourke, "Navy DDG-1000 and DDG-51 Destroyer Programs," September 5, 2008.

51. *Ibid.*

52. *Ibid.*, p. 77.

53. *Ibid.* It has also been reported that the Long Range Land Attack Projectile would have a maximum range of 100 nautical miles (185 km) with a circular error probable (CEP) of 5–10 meters. See Wertheim, *The Naval Institute Guide to Combat Fleets of the World*, p. 875; Friedman, *The Naval Institute Guide to World Naval Weapon Systems*, p. 486; and E. R. Hooton, ed., *Jane's Naval Weapon Systems*, 40th ed. (Coulsdon, U.K.: Jane's Information Group, 2004), pp. 690–691.

54. Wertheim, *The Naval Institute Guide to Combat Fleets of the World*, p. 875, and Friedman, *The Naval Institute Guide to World Naval Weapon Systems*, p. 486.

55. Polmar, *The Naval Institute Guide to the Ships and Aircraft of the U.S. Fleet*, p. 491; Wertheim, *The Naval Institute Guide to Combat Fleets of the World*, p. 875; and Hooton, *Jane's Naval Weapon Systems*, p. 691.

56. It would have had a maximum range of 63 nautical miles (117 km) and a CEP of 10–20 meters. Wertheim, *The Naval Institute Guide to Combat Fleets of the World*, p. 875.

57. *Ibid.*, p. 879, and Polmar, *The Naval Institute Guide to the Ships and Aircraft of the U.S. Fleet*, p. 542.

and identifying sources of hostile electronic warfare emissions.<sup>58</sup> Without this system, the aging and soon-to-be-obsolete SLQ-32 Electronic Warfare system is being installed in the *Arleigh Burke* Flight IIA class, although, hopefully, the SLY-2(V) will be brought back given the absence of any advanced alternative to the Advanced Integrated Electronic Warfare System.<sup>59</sup>

Both the *Zumwalt* and *Arleigh Burke* Flight IIA classes lack a dedicated anti-ship missile capability. There is no provision in the DDG-1000 to mount the two quadruple launchers of the Harpoon anti-ship cruise missile. As a cost-saving measure, the *Arleigh Burke* Flight IIA class is not fitted with Harpoon missile launch canisters, but they could be mounted if needed.<sup>60</sup>

### Questions Congress Needs to Ask

Both destroyers are incredibly capable ships and essential to the fleet. Given the decade-long research and development effort and the more than \$10 billion investment in the DDG-1000, Congress should carefully examine the Navy's case for essentially halting the program after the third ship before deciding which class of major surface combatant to fund in the FY 2010 defense budget.

Specifically, Congress needs answers from the Navy to the following eight sets of questions, both to guide its oversight and to inform this significant funding decision.

**QUESTION #1: If the DDG-1000 cannot conduct area air defense, why is it classified as a guided missile destroyer? Could the DDG-1000 be upgraded to employ the Standard Missile? What is the growth potential and cost of the DDG-1000's Dual-Band Radar and combat management system for ballistic missile defense?**

Admiral McCullough testified on July 31 that the "DDG-1000 cannot perform area air defense, specifically, it cannot successfully employ the Standard Missile 2 (SM-2), SM-3, or SM-6 and is incapable of conducting Ballistic Missile Defense" and that "[m]odifying the DDG 1000s to support these [missile defense] missions is unaffordable, from the Navy's standpoint."<sup>61</sup> Considering the multimission guided-missile classification of the DDG-1000, this claim is suspect or not well explained. If the *Zumwalt* is incapable of deploying the SM-2, it should be classified as a general-purpose destroyer (DD), not a guided missile destroyer (DDG). However, not only did the Navy reclassify it as a DDG in 2001, but between 2002 and 2008, senior officials consistently included the SM-2 missile in their briefing slides, leading observers to conclude that the weapon would be included in the ship's arsenal.<sup>62</sup>

Additionally, according to a Raytheon spokesman, the "*Zumwalt* mission equipment was designed to accommodate the SM-2 family of missiles and is therefore easily scalable to accommodate the SM-3 and SM-6."<sup>63</sup> This appears to contradict Admiral McCullough's insistence that the DDG-1000 is a "ship which meets the requirements for which it was designed" but is incapable of performing area-wide anti-air warfare and ballistic missile defense.

While the Navy says that the DDG-1000 is unable to support the Standard Missile and that such an upgrade is unaffordable, officials are ignoring a spiral development program already underway that could make this feasible. Buried in the Navy's FY 2009 budget estimate is a Research, Development, Test and Evaluation program classified as "Standard Missile Improvement" that aims to "[d]efine DD(X) functionality/interface requirements and engineering changes needed to make

58. Polmar, *The Naval Institute Guide to the Ships and Aircraft of the U.S. Fleet*, p. 542.

59. Wertheim, *The Naval Institute Guide to Combat Fleets of the World*, pp. 908 and 879, and Friedman, *The Naval Institute Guide to World Naval Weapon Systems*, p. 406.

60. Wertheim, *The Naval Institute Guide to Combat Fleets of the World*, p. 908.

61. McCullough, in hearing, *Navy Destroyer Acquisition Programs*, p. 7.

62. O'Rourke, "Navy DDG-1000 and DDG-51 Destroyer Programs," September 5, 2008, p. 28.

63. "Defense Watch," *Defense Daily*, September 2, 2008, at <http://www.defensedaily.com/publications/dd/3811.html> (September 23, 2008; subscription required).



SM-2 [Block] IIIB compatible with the ship combat system.”<sup>64</sup> According to the document:

Development is expected to conclude by FY10 for the P3I [pre-planned product improvement] and SM-2 IIIB ICWI [Interrupted Continuous Wave Illumination]. Production representative missiles will be built between FY10 and FY12 for the 21 missiles that the DDG-1000 require for Developmental Test and Operational Test (DT&OT) in FY12 and FY13. SM2 IIIB will have dual use on AEGIS Cruisers/Destroyers and DDG-1000.<sup>65</sup>

This program received \$7.7 million in funding in FY 2007 and \$24.2 million in FY 2008.

Congress should seek clarification about the Navy’s goals for this missile improvement program and whether or not the *Zumwalt* could support the Standard Missile.

**QUESTION #2: What are the Marine Corps’ specific naval surface fire-support requirements? Can they be met sufficiently without the planned seven DDG-1000s?**

The Navy insists that it has both “excess capacity in naval surface fires that the DDG-1000 was predominately designed for” and “the capacity to support the Marine Corps’ surface fires requirements.”<sup>66</sup> Paul Francis of the Government Accountability Office (GAO) testified, “I was very much struck by Admiral McCullough’s comment that the current fire support capabilities were sufficient to meet the need, yet three years ago that

didn’t appear to be the case, and that was the basis for the ship.”<sup>67</sup> Although the *Zumwalt* is a multi-mission DDG, one of its primary missions—and thus principal justifications—was naval surface fire support.

After investing so much in this program, the Navy should document why this primary capability of the *Zumwalt* is not needed. If Admiral McCullough’s statements are accurate, they must be further qualified by the Marine Corps’ assessment of its naval surface fire-support requirements. A GAO report from 2006 described the Navy and Marine Corps’ collaboration on naval surface fire-support requirements:

Although the Marine Corps further defined its needs for naval surface fire support over the last 10 years, it only recently reached agreement with the Navy on a new set of requirements through the Joint Capabilities Integration and Development System, a joint process for establishing requirements. This process resulted in the *Joint Fires in Support of Expeditionary Operations in the Littorals Initial Capabilities Document*, which incorporated and validated the Marine Corps’s requirements for naval surface fire support. These requirements are based on the concept of expeditionary operations that the service has been developing since 1992.<sup>68</sup>

The report also addressed how the DDG-1000’s capabilities were incorporated into the naval surface fire-support mission: “Despite the new capabilities promised by the Extended Range Munition and *Zum-*

64. U.S. Department of the Navy, *Fiscal Year (FY) 2009 Budget Estimates: Justification of Estimates—Research, Development, Test and Evaluation*, Navy Budget Activity 5, February 2008, p. 416, at [http://www.finance.hq.navy.mil/FMB/09PRES/RDTEN\\_BA5\\_book.pdf](http://www.finance.hq.navy.mil/FMB/09PRES/RDTEN_BA5_book.pdf) (September 23, 2008).

65. *Ibid.*, p. 417. While the DDG-1000’s SPY-3 radar could be improved with ICWI technology, this might not be possible for the new Aegis SPY-1D(V) radar being fitted to the latest *Arleigh Burke* Flight IIA destroyers. ICWI is a missile guidance technology that is available for active phased-array radars such as the Dutch APAR. The APAR radar fitted with ICWI technology can illuminate 16 air contacts to guide Evolved Sea Sparrow Missiles and SM-2s simultaneously to their intended targets while guiding another 16 surface-to-air missiles to new targets through missile uplinks. Thus, it can simultaneously guide 32 missiles. See Wertheim, *The Naval Institute Guide to Combat Fleets of the World*, p. 493, and Friedman, *The Naval Institute Guide to World Naval Weapon Systems*, pp. 265–266.

66. McCullough, in hearing, *Navy Destroyer Acquisition Programs*, p. 15.

67. Paul Francis, in hearing, *Navy Destroyer Acquisition Programs*, p. 30.

68. U.S. Government Accountability Office, *Defense Acquisitions: Challenges Remain in Developing Capabilities for Naval Surface Fire Support*, GAO–07–115, November 2006, p. 7, at <http://www.gao.gov/new.items/d07115.pdf> (September 23, 2008).

walt class destroyer, needs for naval surface fire support exceed projected capabilities.”<sup>69</sup> The GAO’s conclusion was based on the assumption that seven DDG-1000s would be built. Undoubtedly, its finding concerning needs and capabilities would be even more relevant if just two or three DDG-1000s are built.

During his testimony, Admiral McCullough revealed that “[t]he Navy–Marine Corps team has initiated an in-depth review to look at how surface fire capability fits into the littoral combat ship.”<sup>70</sup> Recent reports indicate that the Office of the Secretary of Defense has directed the services to conduct a joint expeditionary fires analysis of alternatives before the Defense Acquisition Executive Review in June 2009.<sup>71</sup> The debate over the shape of the future surface combatant fleet must not be allowed to proceed without an understanding of the full findings of this study by Congress. Because the Navy and Marine Corps have often been at odds over naval surface fire-support requirements, no final decision should be made regarding DDG-1000 without first determining whether the two services are in fact in agreement on fire support.

**QUESTION #3: Is the Navy’s decision-making process being driven mostly by budget restraints or by changes in the threat assessment and requirements?**

The Navy maintains that its decision is based on “the requirement and a threat” and that the DDG-1000 was not unaffordable, but rather that the resources needed to upgrade the ship to meet the requirements necessary for area-wide anti-air warfare and ballistic missile defense were unaffordable. However, Congress should consider the case of spiral development upgrades and conduct its own cost-benefit analysis.

For example, Congress has already funded a spiral development program for FY 2007 and FY 2008 that would allow the ship to be upgraded to fire the SM-2. Spiral development could also provide the necessary modifications to enable the DDG-1000 to fire the SM-3 for ballistic missile defense. A Raytheon spokesman confirmed that “in February 2008, a detailed technical paper was presented showing a clear path to the integration of the SM-3 missile into DDG-1000 with only minor changes due to the open architecture flexibility built into the DDG-1000.”<sup>72</sup>

To analyze this question further, Congress needs to know whether the Marine Corps’ leadership believes that the fire-support requirements are sufficient without the *Zumwalt*. If the Marine Corps maintains that eight to 12 ships (the number the Navy supported in testimony in 2005) are needed to meet its naval surface fire-support requirements, it would appear that budget considerations are driving the Navy’s decision not to procure additional DDG-1000s.

Congress should learn exactly how much upgrading the *Zumwalt*’s capabilities would cost. The Navy has many competing priorities within its limited budget, but difficult decisions must be made. Congress will undoubtedly help to determine whether this is a financial opportunity worth pursuing.

**QUESTION #4: If China’s military capabilities are such a significant factor in the Navy’s decision-making process, why did the Navy avoid discussing China in its recent Maritime Strategy?**

It is appropriate and past time for Navy leaders to acknowledge in public testimony, plans, and strategies that the Chinese navy is rapidly modernizing into a force capable of seriously challenging the U.S. Navy in short-duration, high-intensity wars.<sup>73</sup> This

69. *Ibid.*, p. 3.

70. McCullough, in hearing, *Navy Destroyer Acquisition Programs*, p. 7.

71. Zachary M. Peterson, “Navy, Marine Corps to Study Naval Surface Fire Support Requirement Gaps,” *Inside the Navy*, September 22, 2008.

72. O’Rourke, “Navy DDG-1000 and DDG-51 Destroyer Programs,” September 5, 2008.

73. See James J. Shinn and Major General Phillip Breedlove, “China: Recent Security Developments,” statement before the Committee on Armed Services, U.S. House of Representatives, June 25, 2008, at [http://armedservices.house.gov/pdfs/FC062508/Shinn\\_Breedlove\\_Testimony062508.pdf](http://armedservices.house.gov/pdfs/FC062508/Shinn_Breedlove_Testimony062508.pdf) (September 23, 2008), and Ronald O’Rourke, “China Naval Modernization: Implications for U.S. Navy Capabilities—Background and Issues for Congress,” Congressional Research Service Report for Congress, updated August 11, 2008, at [http://assets.opencrs.com/rpts/RL33153\\_20080811.pdf](http://assets.opencrs.com/rpts/RL33153_20080811.pdf) (September 23, 2008).

is especially true given Chinese efforts to build a force capable of temporarily denying U.S. conventional forces access to key areas.<sup>74</sup>

The Office of the Secretary of Defense has recognized this, both in the 2006 *Quadrennial Defense Review* and in various annual reports to Congress on the military power of the People's Republic of China.<sup>75</sup> Why, then, has the Navy—the service at the forefront of U.S. efforts to hedge against China's rise—been unwilling to discuss the growing military competition from China publicly?

**QUESTION #5: What are the growth potentials of the Zumwalt and Arleigh Burke classes in terms of adding new systems, weapons (e.g., lasers), and combat capabilities?**

A ship's growth potential is often a function of the volume available, weight-carrying capacity, center of gravity (and stability), and the power-generation capacity of the propulsion system. Congress should conduct its own independent comparison of both ship classes when deciding which ship is most needed for the future fleet.

The *Arleigh Burke*-class destroyers and *Ticonderoga*-class cruisers suffer from a significant growth hindrance: limited space.<sup>76</sup> The DDG-51 gas turbines are linked to the propeller shafts, which occupy valuable space below deck. The DDG-1000's all-electric drive and Integrated Power System generates and distributes electricity more efficiently throughout the ship. Its gas turbines are

linked directly to a power generator, which is linked by cable to a motor. The use of cables to distribute power takes less space, and the gas turbines do not need to be aligned with the propeller shafts.<sup>77</sup>

Furthermore, installation of the new SPY-1E radar could affect the stability of the upgraded *Arleigh Burkes* because the radar's phased-array panels weigh more than the panels of the earlier SPY-1 radar, which it will replace. While the SPY-1E's weight is concentrated more in the panels, freeing more space below deck,<sup>78</sup> this greater weight would be added to the ship's superstructure. Combined with the DDG-51's relatively narrow hull width and short length, this could cause stability problems, particularly when sailing in rough weather.<sup>79</sup>

In turn, the DDG-1000 design's longer and broader hull may provide better performance at certain speeds, reduced seaway resistance, and less fuel consumption.<sup>80</sup> Because of its larger size and volume capacity, the *Zumwalt* class could potentially accommodate more systems without compromising the ship's stability.

The DDG-1000 can generate more electrical power (78 MW)<sup>81</sup> than the DDG-51, which would enable it to power cutting-edge weapons systems such as lasers and rail guns. The *Arleigh Burke* lacks this capability because of its limited power-generation capacity. In terms of growth potential for ballistic missile defense and for anti-air defense, the DDG-1000 has no equal in the fleet. The DDG-

74. Roger Cliff, Mark Bures, Michael S. Chase, Derek Eaton, and Kevin L. Pollpeter, *Entering the Dragon's Lair: Chinese Antiaccess Strategies and Their Implications for the United States*, RAND Corporation, 2007, p. 18, at [http://www.rand.org/pubs/monographs/2007/RAND\\_MG524.pdf](http://www.rand.org/pubs/monographs/2007/RAND_MG524.pdf) (September 23, 2008).

75. See U.S. Department of Defense, *Quadrennial Defense Review Report*, February 6, 2006, at <http://www.defenselink.mil/qdr/report/Report20060203.pdf> (September 23, 2008), and *Military Power of the People's Republic of China 2008*, March 2008, at [http://www.defenselink.mil/pubs/pdfs/China\\_Military\\_Report\\_08.pdf](http://www.defenselink.mil/pubs/pdfs/China_Military_Report_08.pdf) (September 23, 2008).

76. Friedman, *U.S. Destroyers*, pp. 396, 424–425, and 447.

77. Polmar, *The Naval Institute Guide to the Ships and Aircraft of the U.S. Fleet*, p. 145.

78. Friedman, *The Naval Institute Guide to World Naval Weapon Systems*, p. 317.

79. Design stability problems with the *Arleigh Burke* Flight IIA-class that resulted from adding more systems and weight required applying corrective measures to the USS *Pinckney* (DDG-91) and its follow-on sister ships. On each destroyer, 50 tons of ballast was added to port to compensate for the helicopter hangar and two WLD-1(V)1 mine-hunting vehicles and hoist installed on the starboard side. See Wertheim, *The Naval Institute Guide to Combat Fleets of the World*, p. 907.

80. Friedman, *U.S. Destroyers*, p. 426, and P. J. Gates, *Surface Warships: An Introduction to Design Principles* (London: Brassey's Defence Publishers, 1987), p. 55.

81. Wertheim, *The Naval Institute Guide to Combat Fleets of the World*, p. 906.

1000's power-generation capacity is more than adequate to power a solid-state laser weapon system for ballistic missile defense.

In the future, one of the *Zumwalt's* two Advanced Gun Systems could be replaced with a solid-state laser weapon to shoot down ballistic missiles and air threats such as cruise missiles. In contrast to the SM-3 missile, a solid-state laser could intercept<sup>82</sup> several anti-ship maneuverable ballistic missile warheads attacking simultaneously.<sup>83</sup> Moreover, the Navy's experimental Sea Lite Beam Director laser has demonstrated that a laser weapon can function as a ballistic missile defense and air defense sensor to "passively track and image missiles in flight."<sup>84</sup>

A laser weapon mounted on the DDG-1000 could revolutionize ballistic missile defense and air defense warfare by providing immediate (at the speed of light) and accurate interception of targets and precise tracking and imaging of ballistic missiles and air contacts. The operational qualities of a laser weapon in the *Zumwalt* destroyers would complement the ballistic missile defense and air defense capabilities of the Aegis cruisers and destroyers well into the 21st century.

In addition to its growth potential in accommodating electromagnetic rail guns and laser weapons, the DDG-1000's Mk 57 Peripheral Vertical Launch System was designed to accommodate future land-attack and SAM missiles larger and wider than the current Tomahawk and Standard Missiles. A single

cell of the Mk 57 launch system could also carry four Standard Missiles in a quad-pack due to the cell's greater size (28 inches wide).<sup>85</sup> This is a design capability that the *Arleigh Burke's* Mk 41 vertical launching system does not have.

**QUESTION #6: What are the design flaws, if any, in hull strength and/or weapons locations?**

Congress should ask the Navy whether the *Arleigh Burke's* hull stress problems, which have led to structural damage,<sup>86</sup> can be remedied with simple, small changes in the ship's design, or whether it is a design flaw that would inevitably appear after intense use.

Congress should also seek to learn how much it will cost to fix these problems throughout the life cycle of the DDG-51s. Congress has received conflicting data between 2005 and 2008 that have created confusion about the true operating and support costs, particularly if the DDG-51 operating and support costs are modified with future changes in this ship. Conversely, Congress should ask whether the DDG-1000's Peripheral Vertical Launch System is a potential death sentence for the ship if any of the missile cells, installed alongside the hull of the destroyer instead of in a central main battery as in the *Arleigh Burke*, is hit by an enemy supersonic sea-skimming anti-ship cruise missile. Also, in light of the Navy's argument that the *Arleigh Burkes* are better suited for ballistic missile defense, Congress should ask if the Mk 41 VLS central mis-

82. William Matthews, "Weapon of the Future: After Decades, Laser Technology Supporters Say Future Is About to Arrive," *Defense News*, September 15, 2008, p. 24.

83. BMD versions of the Standard Missile (SM-3 and SM-6) may not be able to guarantee interception of the new types of anti-ship maneuverable reentry vehicles (RVs), such as RVs from Chinese DF-21B (CSS-5), DF-21C, and DF-15B (CSS-6) intermediate-range ballistic missiles; RVs from the Russian SS-26 SRBM, which can maneuver at 30 g in the terminal phase; and the RV from the Russian SS-21 SRBM, which can maneuver at 10 g in its terminal phase. See Lennox, *Jane's Strategic Weapon Systems*, pp. 25, 24, 123, and 140. See also Christopher P. Cavas, "Missile Threat Helped Drive DDG Cut," *Defense News*, August 4, 2008, p. 8, and Wendell Minnick, "China Seeks Anti-Ship Ballistic Missile," *Defense News*, September 15, 2008, p. 16.

84. "The inherently precise pointing of the [Sea Lite Beam Director laser] and its ability to track very high speed targets make it an ideal platform for capturing in-flight imagery." The laser was reportedly used "as a sensor platform for tracking and imaging" several theater missile defense missiles in tests. Federation of American Scientists, "Mid-Infrared Advanced Chemical Laser (MIRACL)," updated March 21, 1998, at <http://www.fas.org/spp/military/program/asat/miracl.htm> (September 23, 2008).

85. Friedman, *The Naval Institute Guide to World Naval Weapon Systems*, pp. 601, 600; Polmar, *The Naval Institute Guide to the Ships and Aircraft of the U.S. Fleet*, p. 145.

86. "Report: DDG-51 Class Buckling Under Stress," *Navy Times*, October 14, 2007, at [http://www.navytimes.com/news/2007/10/navy\\_ddgs\\_buckling\\_071011w](http://www.navytimes.com/news/2007/10/navy_ddgs_buckling_071011w) (September 23, 2008).



sile battery of this class is the best design option when facing anti-ship ballistic missiles that could target the missile battery with electro-optic seekers, which could cause, if hit, the mass destruction of all its missiles and the loss of the ship.<sup>87</sup>

**QUESTION #7: What are the life-cycle costs of adding new systems and combat capabilities?**

Congress should ask what the potential operating and support costs would be for a further modified DDG-51 compared to the DDG-1000. If the Navy chooses to purchase the DDG-51 Flight IIA design, its estimated life-cycle operating and support costs, including maintenance and manpower, would exceed the DDG-1000's costs by \$3.9 million annually.

However, it has also been suggested that a modified version of the *Arleigh Burke* could achieve substantial cost savings through further crew reductions, addition of electric-drive equipment, and installation of a near-surface bow bulb, which would reduce fuel consumption by nearly 4 percent. This could reduce the *Arleigh Burke*'s annual operating and support costs by as much as \$2.5 million below the *Zumwalt*'s costs.

**QUESTION #8: Has the projected timeline for procuring the CG(X), the next generation lead cruiser, slipped from 2011 to 2015 or even later? If so, what is the Navy's specific plan for cruiser procurement, particularly in light of its concern about anti-ship cruise missiles and ballistic missiles?**

The Navy had planned to purchase the first CG(X) in 2011, but a recent report indicates that this date may slip to around 2017.<sup>88</sup> There have been some indications that the DDG-1000 hull, originally planned to be the basis of the CG(X) design, was not optimal to support either the CG(X)'s radar suite or a smaller version of the CVN-78 *Ford*-class nuclear reactor.<sup>89</sup>

These unanticipated design constraints may be a leading reason why the CG(X) procurement date has slipped, but the Navy's secrecy about the future cruiser program has left most observers unclear about the state of the program.<sup>90</sup> If the CG(X) is indeed the next-generation cruiser that can meet the new and emerging anti-air warfare and ballistic missile defense requirements, more clarity for Congress on the direction and timeline of the CG(X) program is warranted, even if additional DDG-51s are needed to fill the projected capabilities gap in the coming years.

**The Burden Remains on the Navy's Leadership**

During the long and somewhat turbulent history of the *Zumwalt* program, the Navy has continuously supported the ship while expanding its capabilities and reducing its numbers. After years of justifying its requirements, the Navy has reversed direction and is arguing that its future multimission destroyer is no longer the answer to the threats the service may face in the future.

The recent testimony by Admiral McCullough and Deputy Assistant Secretary Stiller has raised new questions and left other concerns unanswered. The Navy's leadership has an obligation to provide Congress with full answers to these questions in a timely manner. Before deciding which plan to fund in 2010, Congress should demand the appropriate information to conduct its due diligence.

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87. See Polmar, *The Naval Institute Guide to the Ships and Aircraft of the U.S. Fleet*, p. 145; Lennox, *Jane's Strategic Weapon Systems*, p. 122.

88. Katherine McIntire Peters, "Navy's Top Officer Sees Lessons in Shipbuilding Program Failures," *Government Executive*, September 24, 2008, at [http://www.govexec.com/story\\_page.cfm?articleid=41049&dcn=todays\\_most\\_popular](http://www.govexec.com/story_page.cfm?articleid=41049&dcn=todays_most_popular) (September 29, 2008).

89. O'Rourke, "Navy DDG-1000 and DDG-51 Destroyer Programs," p. 14.

90. Christopher P. Cavas, "U.S. Navy CG(X) Off-Limits at Conference," *Defense News*, June 23, 2008, at <http://www.defensenews.com/story.php?i=3595373> (September 23, 2008).