



Navy CG(X) Cruiser Program: Background, Oversight Issues, and Options for Congress

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Summary

The Navy in recent years has been developing technologies and studying design options for a planned new cruiser called the CG(X). The Navy has wanted to procure CG(X)s as replacements for its 22 Ticonderoga (CG-47) class Aegis cruisers, which are projected to reach their retirement age of 35 years between 2021 and 2029. The Navy has wanted the CG(X) to be a highly capable ship, particularly in the areas of anti-air warfare (AAW) and ballistic missile defense (BMD).

The Navy's FY2009 budget called for procuring the first CG(X) in FY2011. Beginning in late-2008, however, it was reported that the Navy had decided to defer the procurement of the first CG(X) by several years, to about FY2017. Consistent with these press reports, on April 6, 2009, Secretary of Defense Robert Gates announced—as part of a series of decisions concerning the Department of Defense's (DOD's) proposed FY2010 defense budget—a decision to “delay the CG-X next generation cruiser program to revisit both the requirements and acquisition strategy” for the program. The Navy's proposed FY2010 budget deferred procurement of the first CG(X) beyond FY2015 and requested \$340 million in research and development funding for the CG(X) program.

Section 1012 of the FY2008 defense authorization act (H.R. 4986/P.L. 110-181 of January 28, 2008) makes it U.S. policy to construct the major combatant ships of the Navy, including the CG(X), with integrated nuclear power systems, unless the Secretary of Defense submits a notification to Congress that the inclusion of an integrated nuclear power system is not in the national interest. The Navy has studied nuclear power as a design option for the CG(X), but has not yet announced whether it would prefer to build the CG(X) as a nuclear-powered ship.

A November 2009 press report on a recent Navy “Hull/Radar” study suggested the Navy might want to procure in coming years a modified destroyer featuring a new radar. Given constraints on future Navy budgets, it might be difficult for the Navy to finance, more or less simultaneously, the development and procurement of both a modified destroyer and the CG(X). Potential oversight questions for Congress arising from this report include the following: Does the Navy now want to terminate the CG(X) program and procure instead a modified DDG-51 destroyer or a modified DDG-1000 destroyer? If so, would the Navy's Hull/Radar Study constitute an adequate analytical basis for such a change in Navy cruiser and destroyer procurement plans? How would a modified destroyer compare with the CG(X) in terms of costs, technical risks, and capabilities?

Section 125 of the conference report (H.Rept. 111-288 of October 7, 2009) on the FY2010 defense authorization act (H.R. 2647/P.L. 111-84 of October 28, 2009) prohibits the obligation and expenditure of funds for the construction or advanced procurement of materials for surface combatants (including cruisers) procured after FY2011 until certain conditions are met, and requires DOD to submit certain reports.

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Introduction

The Navy in recent years has been developing technologies and studying design options for a planned new cruiser called the CG(X).¹ The Navy has wanted to procure CG(X)s as replacements for its 22 Ticonderoga (CG-47) class Aegis cruisers, which are projected to reach their retirement age of 35 years between 2021 and 2029. The Navy has wanted the CG(X) to be a highly capable ship, particularly in the areas of anti-air warfare (AAW) and ballistic missile defense (BMD).

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A November 2009 press report on a recent Navy “Hull/Radar” study suggested the Navy might want to procure in coming years a modified destroyer featuring a new radar.⁴ Given constraints on future Navy budgets, it might be difficult for the Navy to finance, more or less simultaneously,

¹ In the designation CG(X), C means cruiser, G means guided missile, and (X) means that the ship's design has not yet been determined. For a U.S. Navy surface combatant, the use of the G in the designation means that the ship is equipped with an area-defense anti-air warfare (AAW)—an air-defense system whose range is sufficient to defend not only the ship itself (called point defense), but other ships in the areas as well (called area defense).

² Zachary M. Peterson, “Navy Awards Technology Company \$128 Million Contract For CG(X) Work,” *Inside the Navy*, October 27, 2008. Another press report (Katherine McIntire Peters, “Navy's Top Officer Sees Lessons in Shipbuilding Program Failures,” *GovernmentExecutive.com*, September 24, 2008) quoted Admiral Gary Roughead, the Chief of Naval Operations, as saying: “What we will be able to do is take the technology from the DDG-1000, the capability and capacity that [will be achieved] as we build more DDG-51s, and [bring those] together around 2017 in a replacement ship for our cruisers.” (Material in brackets in the press report.) Another press report (Zachary M. Peterson, “Part One of Overdue CG(X) AOA Sent to OSD, Second Part Coming Soon,” *Inside the Navy*, September 29, 2008) quoted Vice Admiral Barry McCullough, the Deputy Chief of Naval Operations for Integration of Capabilities and Resources, as saying that the Navy did not budget for a CG(X) hull in its proposal for the Navy's budget under the FY2010-FY2015 Future Years Defense Plan (FYDP) to be submitted to Congress in early 2009.

An earlier report (Christopher P. Cavas, “DDG 1000 Destroyer Program Facing Major Cuts,” *DefenseNews.com*, July 14, 2008) stated that the CG(X) would be delayed until FY2015 or later. See also Geoff Fein, “Navy Likely To Change CG(X)'s Procurement Schedule, Official Says,” *Defense Daily*, June 24, 2008; Rebekah Gordon, “Navy Agrees CG(X) By FY-11 Won't Happen But Reveals Little Else,” *Inside the Navy*, June 30, 2008.

³ Source: Opening remarks of Secretary of Defense Robert Gates at an April 6, 2009, news conference on DOD decisions relating to DOD's proposed FY2010 defense budget.

⁴ Christopher P. Cavas, “Next-Generation U.S. Warship Could Be Taking Shape,” *Defense News*, November 2, 2009: 18, 20.

the development and procurement of both a modified destroyer and the CG(X). Potential oversight questions for Congress arising from this report include the following: Does the Navy now want to terminate the CG(X) program and procure instead a modified DDG-51 destroyer or a modified DDG-1000 destroyer? If so, would the Navy's Hull/Radar Study constitute an adequate analytical basis for such a change in Navy cruiser and destroyer procurement plans? How would a modified destroyer compare with the CG(X) in terms of costs, technical risks, and capabilities?

Background

Context for CG(X) Program

The context for the CG(X) program includes concerns about the affordability of the Navy's shipbuilding program, the emergence of the Navy's new BMD mission, interest among some in Congress in having the CG(X) be nuclear-powered, and concerns for the surface combatant industrial base. Each of these is discussed briefly below.

Affordability of Navy Shipbuilding Program

The Navy currently faces challenges in being able to afford all the ships in its shipbuilding program.⁵ Because the designs of most of the ships in the Navy's shipbuilding program for the next several years are already determined, the CG(X) is one of the Navy's relatively few remaining opportunities to use a new ship design to manage the overall cost of the shipbuilding program.

Navy Mission of Ballistic Missile Defense

BMD has emerged in recent years as a significant new mission for the Navy. Navy surface ships in coming years may face a threat from anti-ship ballistic missiles (ASBMs)—theater-range ballistic missiles (TBMs) equipped with maneuvering re-entry vehicles (MaRVs) that are capable of hitting moving ships at sea—a kind of threat the Navy has not previously faced.⁶ Navy BMD capabilities could also be used to defend allied or friendly ports, airfields, cities, or forces ashore against enemy TBMs, or to defend the United States against enemy intercontinental ballistic missiles (ICBMs).⁷ The Navy's desire for the CG(X) to be a high-capability BMD platform is a principal reason why the Navy has wanted the CG(X) to carry a radar that is larger and more powerful than the SPY-1 radar on the Navy's current Aegis cruisers and destroyers. The size, weight, energy requirements, and cooling requirements of this radar may help set a lower limit for the size and cost of the CG(X).

⁵ For more on the prospective affordability of the Navy's shipbuilding program, see CRS Report RL32665, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, by Ronald O'Rourke.

⁶ For a discussion of potential MaRV-equipped TBMs capable of hitting moving ships at sea, see CRS Report RL33153, *China Naval Modernization: Implications for U.S. Navy Capabilities—Background and Issues for Congress*, by Ronald O'Rourke.

⁷ For further discussion of the Navy's BMD program, CRS Report RL33745, *Sea-Based Ballistic Missile Defense—Background and Issues for Congress*, by Ronald O'Rourke.

Interest in Nuclear Power for Surface Ships

Representatives Gene Taylor and Roscoe Bartlett, the chairman and ranking member, respectively, of the Seapower and Expeditionary Forces subcommittee of the House Armed Services Committee, strongly support expanding the use of nuclear power to a wider array of Navy surface ships, beginning with the CG(X).⁸ Representative John Murtha, the chairman of the Defense subcommittee of the House Appropriations Committee, has referred to the CG(X) as a nuclear-powered ship.⁹ As mentioned earlier, Section 1012 of the FY2008 defense authorization act (H.R. 4986/P.L. 110-181 of January 28, 2008) makes it U.S. policy to construct the major combatant ships of the Navy, including the CG(X), with integrated nuclear power systems, unless the Secretary of Defense submits a notification to Congress that the inclusion of an integrated nuclear power system is not in the national interest. The conference report on P.L. 110-181 contained extensive report language relating to Section 1012 (see **Appendix**). The issue of nuclear power for Navy surface ships is discussed in more detail in another CRS report.¹⁰

Concern for Surface Combatant Industrial Base

All cruisers, destroyers, and frigates procured by the Navy since FY1985 have been built by either General Dynamics' Bath Iron Works (GD/BIW) in Bath, ME, or the Ingalls shipyard in Pascagoula, MS, that forms part of Northrop Grumman Ship Shipbuilding (NGSB).¹¹ The financial health of shipyards that build ships for the Navy, including these two yards, has been a matter of concern at various points since the early 1990s, when the rate of Navy shipbuilding was reduced following the end of the Cold War. The surface combatant industrial base also includes hundreds of additional firms that supply materials and components, and the financial health of some of these firms has been a matter of concern in recent years, particularly because some of them are the sole sources for what they make for Navy surface combatants.

CG(X) Program in Brief

Announcement of CG(X) Program

The CG(X) program was announced on November 1, 2001, when the Navy stated that it was launching a Future Surface Combatant Program aimed at acquiring a family of next-generation surface combatants. This new family of surface combatants, the Navy stated, would include three new classes of ships:¹²

⁸ See, for example, the remarks of Representatives Taylor and Bartlett at the March 14, 2008, hearing before the Seapower and Expeditionary Forces subcommittee on the Navy's FY2009 shipbuilding program.

⁹ See, for example, Ashley Roque, "Murtha, Young Press Navy on Shipbuilding Plan, Look To Alter 2009 Budget," *CongressNow*, February 27, 2008.

¹⁰ CRS Report RL33946, *Navy Nuclear-Powered Surface Ships: Background, Issues, and Options for Congress*, by Ronald O'Rourke.

¹¹ NGSB also includes the Avondale shipyard near New Orleans, LA, Newport News Shipbuilding of Newport News, VA, and a composite-manufacturing facility at Gulfport, MS.

¹² The Future Surface Combatant Program replaced an earlier Navy surface combatant acquisition effort, begun in the mid-1990s, called the Surface Combatant for the 21st Century (SC-21) program. The SC-21 program encompassed a planned destroyer called DD-21 and a planned cruiser called CG-21. When the Navy announced the Future Surface Combatant Program in 2001, development work on the DD-21 had been underway for several years, but the start of (continued...)

- **a destroyer called the DD(X)**—later renamed the DDG-1000 or Zumwalt class—for the precision long-range strike and naval gunfire mission,¹³
- **a cruiser called the CG(X)** for the air defense and ballistic missile defense mission, and
- **a smaller combatant called the Littoral Combat Ship (LCS)** to counter submarines, small surface attack craft, and mines in heavily contested littoral (near-shore) areas.¹⁴

CG(X)s to Replace CG-47s

The Navy wants to procure CG(X)s as replacements for its 22 Ticonderoga (CG-47) class Aegis cruisers, which are projected to reach their retirement age of 35 years between 2021 and 2029.¹⁵

Planned CG(X) Procurement Schedule

The FY2009-FY2013 Future Years Defense Plan (FYDP) submitted to Congress in February 2008 called for procuring the first CG(X) in FY2011 and the second in FY2013. The FY2009-FY2038 Navy 30-year shipbuilding plan submitted to Congress in February 2008 called for building 17 more CG(X)s between FY2014 and FY2023, including two CG(X)s per year for the seven-year period FY2015-FY2021. As mentioned earlier, procurement of the first CG(X) has been deferred to about FY2017. As also mentioned earlier, the Navy reportedly is considering reducing the planned number of CG(X)s from 19 to eight, and procuring those ships at a rate of one ship every three years.

CG(X) Mission Orientation

The Navy's Aegis cruisers are highly capable multi-mission ships with an emphasis on air defense (which the Navy calls anti-air warfare, or AAW) and, as a more recent addition, BMD. The Navy has wanted the CG(X) to be a highly capable multi-mission ship with an emphasis on AAW and BMD.

(...continued)

development work on the CG-21 was still years in the future. The DD(X) program, now called the DDG-1000 or Zumwalt-class program, is essentially a restructured continuation of the DD-21 program. The CG(X) might be considered the successor, in planning terms, of the 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 the DDG-1000 and CG(X).

¹³ For more on the DDG-1000 program, see CRS Report RL32109, *Navy DDG-51 and DDG-1000 Destroyer Programs: Background and Issues for Congress*, by Ronald O'Rourke.

¹⁴ For more on the LCS program, see CRS Report RL33741, *Navy Littoral Combat Ship (LCS) Program: Background, Issues, and Options for Congress*, by Ronald O'Rourke.

¹⁵ CG-47s are equipped with the Aegis combat system and are therefore referred to as Aegis cruisers. A total of 27 CG-47s were procured for the Navy between FY1978 and FY1988; the ships entered service between 1983 and 1994. The first five, which were built to an earlier technical standard, were judged by the Navy to be too expensive to modernize and were removed from service in 2004-2005. The Navy is currently modernizing the remaining 22 to maintain their mission effectiveness to age 35; for more information, see CRS Report RS22595, *Navy Aegis Cruiser and Destroyer Modernization: Background and Issues for Congress*, by Ronald O'Rourke.

FY2010 CG(X) Program Funding

The Navy's proposed FY2010 budget requested \$340.0 million in research and development funding for the CG(X) program. Of this total, \$190.0 million is for developing the CG(X)'s new radar (called the Air and Missile Defense Radar, or AMDR), and \$150.0 million is for research and development work on the ship in general.

Potential CG(X) Design Features

As mentioned earlier, the Navy has not yet announced a preferred design concept for the CG(X). Observers have expected the CG(X) to feature a radar, called the Air and Missile Defense Radar (AMDR), that is larger and more powerful than the SPY-1 radar on the Navy's current Aegis cruisers and destroyers or the dual-band radar that is to be carried by the DDG-1000. The Navy testified in 2007 that the power requirement of the CG(X) combat system, including the new radar, could be about 30 or 31 megawatts, compared with about 5 megawatts for the Aegis combat system.¹⁶ The CG(X) radar's greater power would be intended, among other things, to give the CG(X) more capability for BMD operations than Navy's Aegis cruisers and destroyers (or the DDG-1000, for which BMD is not an intended mission).

Observers have expected the CG(X) to feature more missile-launch tubes than the DDG-1000 (which has 80), and possibly more than the Navy's current Aegis destroyers (90 or 96 each) or Aegis cruisers (122 each). The CG(X) might be equipped with only one 155mm Advanced Gun System (AGS), or none at all, compared with two AGSs on the DDG-1000, two five-inch (127mm) guns on the Navy's Aegis cruisers, and one five-inch gun on the Navy's Aegis destroyers.

CG(X) Analysis of Alternatives (AOA)

The Navy assessed CG(X) design options, including the option of nuclear power, in a study called the CG(X) Analysis of Alternatives (AOA), known more formally as the Maritime Air and Missile Defense of Joint Forces (MAMDJF) AOA. The CG(X) AOA was begun in mid-2006 and completed at the end of 2007. As of November 2009, the results of the CG(X) AOA have not been publicly released. Below are some press reports regarding the CG(X) AOA.

May 2009 Navy Testimony

The Navy testified on May 15, 2009, that:

The Maritime Air and Missile Defense of Joint Forces (MAMDJF) Initial Capabilities Document (ICD) was validated by the Joint Requirements Oversight Council (JROC) in May 2006.

The results of the Navy's Analysis of Alternatives (AoA) for the Maritime Air and Missile Defense of Joint Forces capability are currently within the Navy staffing process. Resulting requirements definition and acquisition plans, including schedule options and associated risks, are being evaluated in preparation for CG(X) Milestone A. This process includes

¹⁶ Source: Spoken testimony of Navy officials to the Seapower and Expeditionary Forces Subcommittee of the House Armed Services Committee, March 1, 2007.

recognition of the requirement of the FY 2008 National Defense Authorization Act, that all major combatant vessels of the United States Navy strike forces be constructed with an integrated nuclear power plant, unless the Secretary of Defense determines this not to be in the best interest of the United States.

Vital research and development efforts are in progress for the Air and Missile Defense Radar which paces the ship platform development. Engineering development and integration efforts include systems engineering, analysis, computer program development, interface design, engineering development models, technical documentation, and system testing are in process to ensure a fully functional CG(X) system design.¹⁷

Original Preference for CG(X) Design Based on DDG-1000

The Navy originally intended to use DDG-1000 hull design as the basis for the CG(X) design.¹⁸ The potential for reusing the DDG-1000 hull design for the CG(X) was one of the Navy's arguments for moving ahead with the DDG-1000 program. It no longer appears, however, that reusing the DDG-1000 hull design is the Navy's preferred approach for the CG(X).¹⁹

¹⁷ Statement of the Honorable Sean J. Stackley, Assistant Secretary of the Navy, (Research, Development and Acquisition), and Vice Admiral Bernard J. McCullough, Deputy Chief of Naval Operations for Integration of Capabilities and Resources, Before the Subcommittee on Seapower and Expeditionary Forces of the House Armed Services Committee [Hearing] on Navy Force Structure and Shipbuilding, May 15, 2009, pp. 8-9.

¹⁸ For example, at an April 5, 2006, hearing, a Navy admiral in charge of shipbuilding programs, when asked what percentage of the CG(X) design would be common to that of the DDG-1000, stated that:

[W]e haven't defined CG(X) in a way to give you a crisp answer to that question, because there are variations in weapons systems and sensors to go with that. But we're operating under the belief that the hull will fundamentally be—the hull mechanical and electrical piece of CG(X) will be the same, identical as DD(X). So the infrastructure that supports radar and communications gear into the integrated deckhouse would be the same fundamental structure and layout. I believe to accommodate the kinds of technologies CG(X) is thinking about arraying, you'd probably get 60 to 70 percent of the DD(X) hull and integrated (inaudible) common between DD(X) and CG(X), with the variation being in that last 35 percent for weapons and that sort of [thing]....

The big difference [between CG(X) and DDG-1000] will likely [be] the size of the arrays for the radars; the numbers of communication apertures in the integrated deckhouse; a little bit of variation in the CIC [Combat Information Center—in other words, the] command and control center; [and] likely some variation in how many launchers of missiles you have versus the guns.

(Source: Transcript of spoken testimony of Rear Admiral Charles Hamilton II, Program Executive Officer For Ships, Naval Sea Systems Command, before the Projection Forces Subcommittee of House Armed Services Committee, April 5, 2006. The inaudible comment may have been a reference to the DDG-1000's integrated electric-drive propulsion system. Between the two paragraphs quoted above, the questioner (Representative Gene Taylor) asked: "So the big difference [between CG(X) and DDG-1000] will be what?")

¹⁹ A July 2, 2008, letter from John Young, the Department of Defense (DOD) acquisition executive (the Under Secretary of Defense for Acquisition, Technology and Logistics) to Representative Gene Taylor, the chairman of the Seapower and Expeditionary Forces subcommittee of the House Armed Services Committee, stated: "I agree that the Navy's preliminary design analysis for the next-generation cruiser indicates that, for the most capable radar suites under consideration [for the CG(X)], the DDG-1000 [hull design] cannot support the radar." In addition, it is not clear that the DDG-1000 can accommodate one-half of the twin-reactor plant that the Navy has designed for its new Gerald R. Ford (CVN-78) class nuclear-powered aircraft carriers. If the DDG-1000 hull cannot accommodate one-half of the Ford-class plant, then the Navy might face a choice of either designing a new hull for the CG(X) that can accommodate one-half of the Ford-class plant or designing a new reactor plant that can fit into the DDG-1000 hull.

July 2007 Press Report on AOA

A July 23, 2007, defense trade press report stated that analysts conducting the CG(X) AOA were considering dividing the CG(X) program into two groups of ships—14 smaller, conventionally powered CG(X)s based on the 14,500-ton DDG-1000 hull design for AAW operations, and 5 larger, nuclear-powered CGN(X)s,²⁰ displacing 23,000 tons to 25,000 tons each, for BMD operations. The report stated:

Under pressure from the U.S. Navy to develop a new cruiser based on the DDG 1000 Zumwalt-class hull form, and from Congress to incorporate nuclear power, a group of analysts working on the next big surface combatant may recommend two different ships to form the CG(X) program.

One ship would be a 14,000-ton derivative of the DDG 1000, an “escort cruiser,” to protect aircraft carrier strike groups. The vessel would keep the tumblehome hull of the DDG 1000²¹ and its gas turbine power plant.

The other new cruiser would be a much larger, 25,000-ton nuclear-powered ship with a more conventional flared bow, optimized for the ballistic missile defense (BMD) mission.

In all, five large CGN(X) ships and 14 escort cruisers would be built to fulfill the cruiser requirement in the Navy’s 30-year, 313-ship plan, which calls for replacing today’s CG 47 Ticonderoga-class Aegis cruisers and adding a specially designed sea-based missile defense force....

The analysis group is said to be firm in its recommendation for the smaller escort cruiser. Details are less developed on the nuclear-powered variant, sources said.

The article also stated:

The anti-missile cruiser also wouldn’t require the high level of stealth provided by the Zumwalt’s tumblehome hull, analysts said, since the ship would be radiating its radars to search for missiles. Returning to a more conventional, flared-bow hull form would free designers from worries about overloading the untried tumblehome hull.

“There will be great reluctance to use the wave-piercing tumblehome hull form for the larger ship,” said one experience[d] naval engineer. He noted the DDG 1000 stealth requirement is necessary for the ship’s ability to operate in waters near coastlines, but that the open-ocean region where a BMD ship would operate “means you don’t need to go to the extremes of the tumblehome form.”

Splitting the CG(X) into two designs also makes political sense, sources said.

“There’s a concern that the DDG hull has stability problems and doesn’t have growth margin,” said a congressional source. A nuclear-powered option, the source said, also would placate Congress, and “a cash-strapped Navy wouldn’t be fully committed to a nuclear ship....

²⁰ If the ship is nuclear-powered, its designation would become CGN(X), with the “N” standing for nuclear power.

²¹ A tumblehome hull slopes inward as it rises up from the waterline. A tumblehome hull is thought to be less visible to enemy radars than a conventional flared hull, which slopes outward as it rises up from the waterline, creating a corner reflector between the water and the hull that can strongly reflect enemy radar beams.

The nuclear ship also would need to be larger than the DDG 1000. In separate statements, Navy officials have been hinting that a 20,000-ton-plus ship could be in the works.

Sources said early analyses of the CGN(X) showed a 25,000-ton ship, which the Navy said was too large. More realistic, one source said, would be about 23,000 tons.²²

October 2007 Press Report on AOA

An October 29, 2007, defense trade press report on the CG(X) AOA stated:

A study refining the definition of the future CG(X) cruiser was recently completed and will be vetted by Navy officials in the near future, a top shipbuilding official said here last week.

Rear Adm. Bernard McCullough, the Navy's director of warfare integration (N8F), told *Inside the Navy* on Oct. 24 that the analysis of alternatives (AOA) for the new cruiser recommends "about four" variants.

One of those options calls for splitting the ship program and building two different size hulls for the surface combatant, one based on the DDG-1000 destroyer and one that is larger, he confirmed.

"There's about four options and that's one of the options," McCullough told [*Inside the Navy*] at an expeditionary warfare conference in Panama City, FL.

The analysis—conducted by researchers at the Center for Naval Analyses—will be "briefed out to Navy leadership, starting in about another two weeks," McCullough said....

Further Navy analysis of the AOA will examine the life-cycle and acquisition costs of the options, McCullough said. The Navy's surface warfare directorate will then make a presentation to officials including Navy Secretary Donald Winter, he said.²³

January 2008 Press Report on AOA

A January 21, 2008, defense trade press report on the CG(X) AOA stated:

Navy staff members are in the midst of answering Chief of Naval Operations Adm. Gary Roughead's questions on a lengthy study of options for the configuration of the service's next cruiser, naval officials told *Inside the Navy*.

²² Christopher P. Cavas, "U.S. May Build 25,000-Ton Cruiser, Analysis of Alternatives Sees Nuclear BMD Vessel," *Defense News*, July 23, 2007. The article also stated:

According to sources, the AoA looked at two possible nuclear powerplants based on existing designs: doubling the single-reactor Seawolf SSN 21 submarine plant, and halving two-reactor nuclear carrier plants.

Doubling the 34 megawatts of the Seawolf plant would leave the new ship far short of power requirements—and not even match the 78 megawatts of the Zumwalts.

But halving the 209-megawatt plant of current nuclear carriers would yield a bit more than 100 megawatts, enough juice for power-hungry BMD radars plus an extra measure for the Navy's desired future directed-energy weapons and railguns.

²³ Emelie Rutherford, "Analysis Of Alternatives For Future CG(X) Cruiser Completed," *Inside the Navy*, October 29, 2007.

Rear Adm. Victor Guillory, director of surface warfare (N86), described the analysis of alternatives (AOA) on the future CG(X) as a roughly 500-page document that includes “a collection of options of analysis from various sources” into aspects of the next-generation cruiser.

The CG(X) analysis delivered last year by the Center for Naval Analyses (CNA)—which Navy and industry sources said describes a handful of possible variants for the ship, including a nuclear-powered vessel—is just part of what is now the CG(X) AOA, Guillory told ITN [Inside the Navy] Jan. 15 at the Surface Navy Association’s [SNA’s] annual symposium in Arlington, VA.

Guillory said the current AOA does not include “specific options that this is one version of the ship, this is another version.”

“The options are the next level down,” he said. “So, what are all the potential propulsion options for the ship ... Then you look at the combat systems level, you look at the weapons level, you look at the manning level, you look at the shore-infrastructure-support level.”

Roughead “has not made a determination that the analysis satisfies all his questions, so we’re still answering questions,” Guillory said. A lot of those questions don’t require CNA’s input, because they are questions Navy staff has to answer, he added.

“There may be questions related to some other aspect of [the] Navy,” Guillory said. “For instance, how will CG(X) impact our replenishment ships? Do we need more oilers? That’s not necessarily a CG(X) question, but it is a Navy question.”

Vice Adm. Bernard McCullough, deputy chief of naval operations for integration of capabilities and resources, said there has been one briefing session on the CG(X) AOA with Roughead in recent weeks.

“We’re briefing the study report to CNO,” McCullough told ITN on Jan. 16 in a brief interview at the SNA conference. “We’ve had one session with him; I imagine it will take a couple more.”

McCullough added one would expect the service chief to have questions on an investment of the magnitude of the new cruiser.

The report also stated:

Guillory said Navy staff will continue to answer Roughead’s questions on the AOA “until further notice ... until we satisfy all of his questions.”

“There’s no timetable for when he has to be satisfied, he can continue to ask me questions forever,” Guillory said. “At some point, then, they will be passed over to the secretary of the Navy, the secretariat side, for their approval and then forwarding on to [the Office of the Secretary of Defense], who ultimately is the receiver of the analysis of alternatives.”

Guillory said the AOA is “a lot to read,” and that it is his responsibility “to make that discussion palatable at every level” for Roughead.

While parts of the AOA are made up of the CNA’s analysis, Guillory said the document also includes work by Naval Sea Systems Command and other entities such as laboratories.

“There are a lot of sources of information that [go] into this body of work,” he said.

Nuclear power is one of many options for the CG(X) propulsion system, with other alternatives including steam, sail, marine gas turbine and diesel, Guillory said.

“And then every aspect of that, not only how much it costs to build one but then to maintain one,” he said. “Does it take more people for a nuclear ship than it does for a gas turbine ship, what’s the life-cycle cost of that.”...

Roughead told SNA conference attendees on Jan. 15 that nuclear power is being weighed for the CG(X).

“I believe as we look to the future and you look at CG(X), to go down that path and not be examining nuclear power, given what that power can produce for us operationally, but also looking at the realities of the future, we have to take that into account and put that into our calculus,” Roughead said.

“As we look to the future we have to be considering it,” the CNO added. “If you look around the country there are a lot of other people that are considering nuclear power as well.”²⁴

September 2008 Press Report on AOA

A September 29, 2008, press report states:

The first part of the closely held and long overdue analysis of alternatives for the Navy’s next-generation cruiser, CG(X), was submitted recently to senior Pentagon leaders and the second part will be submitted in the next few months, according to the Navy’s top programmer.

The first part of the study, which examined radar sensitivity analysis, the number of missiles the ship needs to carry and what various hull forms would work for these requirements, was submitted to the Office of the Secretary of Defense earlier this month, Vice Adm. Barry McCullough told *Inside the Navy* in an interview last week. The second part, which addresses the propulsion system, remains under review by Navy Secretary Donald Winter and Chief of Naval Operations Adm. Gary Roughead, he added.

“The secretary and the CNO continue to review the studies and I would hope in the next couple of months we would come to the resolution on which alternative of the many included in the study the Navy will choose,” McCullough explained.

“That will include the initial radar capability, missile capacity, hull type and propulsion type, so we would have a recommended material solution,” he added.

The surface combatant, tailored for integrated air and missile defense, is intended to replace the CG-47 class cruiser. The Navy’s analysis of alternatives for the new cruiser was supposed to be completed in fiscal year 2007, but that deadline slid because service leaders said more time was needed to review requirements.

The Navy did not budget a CG(X) hull in its current program objective memorandum 2010 (POM-10), submitted to OSD last month and currently under review, McCullough said last week.

²⁴ Emelie Rutherford, “Navy Staff Answering CNO’s Questions On Next-Gen Cruiser Analysis,” *Inside the Navy*, January 21, 2008.

Originally, the Navy wanted to build the first new cruiser in FY-11, but recently service leaders have acknowledged that date is no longer feasible to reach.

“We don’t see [CG(X)] commencing within the current [budget plans through FY-15],” McCullough said last week. “It’s got to do with technology development of both the radars and propulsion; and to get the risk to moderate or below we don’t see how we can bring all those things together within” POM-10.²⁵

October 2008 Press Report on AOA

An October 27, 2008, press report states that:

a study that will inform the Navy’s requirements for the [CG(X)] remains under close wraps with senior Navy and Pentagon leadership....

The Navy’s analysis of alternatives for the new cruiser was supposed to be completed in fiscal year 2007, but that deadline slid because service leaders said more time was needed to review requirements....

The first part of the CG(X) study, which examined radar sensitivity analysis, the number of missiles the ship needs to carry and what various hull forms would work for these requirements, was submitted to the Office of the Secretary of Defense in September, [Vice Admiral Barry] McCullough told [*Inside the Navy*]. The second part, which addresses the propulsion system, remains under review by Navy Secretary Donald Winter and Chief of Naval Operations Adm. Gary Roughead, he added. Navy spokesman Lt. Clay Doss confirmed the status of the document had not changed at press time (Oct. 24).

“The secretary and the CNO continue to review the studies and I would hope in the next couple of months we would come to the resolution on which alternative of the many included in the study the Navy will choose,” McCullough explained.

“That will include the initial radar capability, missile capacity, hull type and propulsion type, so we would have a recommended material solution,” he added.²⁶

November 2008 Press Report on AOA

A November 2008 magazine article states that:

At this time two [CG(X)] designs are being proposed—6 small [ships] and 13 large ships. The former could be an improved [Arleigh Burke] DDG-51 [class destroyer] with a [hull] plug inserted for additional vertical-launch missile cells. The number of hulls being mentioned may indicate that the restarted DDG-51 program could become the CG(X)....

The proposed 13 large ships would be of a new design. Originally, these were to make use of the ten-year-plus, \$13 billion-plus investment in developing the DDG-1000 design. But the tumblehome hull shape of the DDG-1000 has been rejected for the large cruisers while Congress has directed that the ships have nuclear propulsion. A rough [procurement cost]

²⁵ Zachary M. Peterson, “Part One of Overdue CG(X) AOA Sent to OSD; Second Part Coming Soon,” *Inside the Navy*, September 29, 2008.

²⁶ Zachary M. Peterson, “Navy Awards Technology Company \$128 Million Contract For CG(X) Work,” *Inside the Navy*, October 27, 2008.

estimate of almost \$9 billion for [a nuclear-powered version of] the lead ship has been mentioned....²⁷

Another November 2008 Press Report on AOA

A November 17, 2008, press report states that:

The first half of the tightly-held CG(X) next-generation cruiser analysis of alternatives remains under review by senior Office of the Secretary of Defense officials, Navy leaders tell *Inside the Navy [ITN]*....

The finished portion of the AoA addresses what type of radar the Navy will require on its future surface combatant. Service officials have stressed the importance of determining the radar type before moving ahead with deciding what the best hull type and propulsion system are for the new cruiser.

The radar is a “very significant driver” of the hull requirement, Navy Secretary Donald Winter told reporters aboard his plane Nov. 8 returning to Washington after the commissioning ceremony for LCS-1 [the Navy’s first Littoral Combat Ship] in Milwaukee, WI.

When the decision will be made remains uncertain.

“I wish I did, but I really don’t know” when a decision about the radar on CG(X) will be made, Allison Stiller, deputy assistant secretary of the Navy (research, development and acquisition) for ships, told *ITN* in an interview last week.

“CG(X) is very important and the most important part of it is the radar,” Stiller noted. “Then you figure out the ship you’re going to host the radar on.”

“All options” are open for the hull type, she said, but the “critical piece” is the radar technology.

“I don’t know if it’ll be an existing hull form or a new hull form,” Stiller said.²⁸

August 2009 GAO Letter Report

An August 2009 Government Accountability Office (GAO) letter report on the CG(X) AOA stated:

In the CG(X) Analysis of Alternatives, the Navy identified six ship design concepts. These concepts include developing new designs as well as making modifications to previous hulls. For example, two concepts are based upon making modifications to the DDG 1000 Zumwalt-class destroyer and another concept is based upon making modifications to the DDG 51 Arleigh Burke-class destroyer. The ship design concepts vary in both capability, including the sensitivity of the radar and number of missile cells, and propulsion system. The variability is based on whether the concept uses a previous hull or is a new design. The Navy

²⁷ Norman Polmar, “Still Adrift,” *U.S. Naval Institute Proceedings*, November 2008: 88.

²⁸ Zachary M. Peterson, “CG(X) Study Remains Under Wraps, Radar Requirement Being Reviewed,” *Inside the Navy*, November 17, 2008.

analyzed two new cruiser design concepts, one with a conventional propulsion system and one with a nuclear propulsion system. Both included the most sensitive radar and highest number of missile cells of all the concepts.

The sensitivity of the radar on each ship design drives the ability of that ship to address threats that cause capability gaps for joint forces. The Navy developed a minimum performance standard that each alternative would need to meet to address the gap. As the radar sensitivity level increases, the capability gaps against these threats diminish because the radar's ability to meet the performance standards improves.²⁹

November 2009 Press Report About Destroyer Hull/Radar Study

A November 2, 2009, press report states (see especially the portions in **bold**):

The shape of the U.S. Navy's next large combatant surface ship could be coming closer into view, but a key study group working on the question isn't quite ready to present its findings.

One issue, however, does seem decided: Support for a very large, nuclear-powered cruiser to carry and power a new ballistic missile defense (BMD) radar may have evaporated, largely due to its extravagant price tag.

Work on the Hull/Radar Study began in late spring. The effort, carried out under the office of the chief of naval operations (OP-NAV), was meant to determine the maximum BMD capability that could be put into a destroyer hull.

Concurrent with that analysis, the Navy has tasked industry with developing concept studies for a new radar for the ships, called the Air and Missile Defense Radar (AMDR). Northrop Grumman, Lockheed Martin and Raytheon are the prime contenders.

The Hull/Radar Study is one of several efforts initiated earlier this year by the Navy to examine alternatives for the next big warship, latterly called the Future Surface Combatant and, before that, the CG(X) cruiser. The studies, including efforts by the Johns Hopkins Advanced Physics Laboratory and the Massachusetts Institute of Technology's Lincoln Laboratory, are looking at ways to meet the Navy's requirements for sea-based ballistic missile defense, as well as traditional surface warships roles including defense of carrier and expeditionary strike groups.

But the Hull/Radar Study has, according to sources, become the centerpiece of Chief of Naval Operations Adm. Gary Roughead's effort to choose a capable and affordable ship to meet the Navy's needs. Those same sources also caution about an internal Pentagon debate over the various studies.

The Hull/Radar Study has, said one source, been viewed by the Navy as the "decisional study" for the question of the next surface combatant.

But staffers working for Ashton Carter, the Pentagon's top weapon buyer, reportedly "believe the right answer will be from the sum of all the studies," the source said.

²⁹ Government Accountability Office, *Defense Acquisitions: Additional Analysis Needed to Capture Cost Differences Between Conventional and Nuclear Propulsion for Navy's Future Cruiser*, GAO-09-886R, August 7, 2009, p. 1. GAO states that this letter report is an unclassified summary of a classified GAO report on the CG(X) AOA.

Work on the AMDR, the source added, largely is being done under directives laid out by John Young, whom Carter replaced in April.

The issue could be put to the test soon. Over the past three weeks, Navy officials have been briefing key parties on Capitol Hill and in industry on the state of the Hull/Radar Study. No timetable has been revealed for completion of the study, but one Pentagon source said Oct. 30, “it’s real close.” The issues at stake are complex.

The costs to design and develop a new hull are high, and Naval Sea Systems Command is working to base future ships on as few hull designs as possible. Hull choices on which to build the new ship are the DDG 51 destroyer hull developed in the 1980s, and the DDG 1000 hull designed over the past decade for the new Zumwalt-class destroyers.

The basic DDG 51 hull is just over 500 feet long and 67 feet wide, while the DDG 1000 hull is 600 feet long with a beam of 81 feet. The characteristics of the DDG 51 hull are well understood, while the tumblehome hull of the DDG 1000, meant to slice through waves rather than ride over them, has stirred controversy in some quarters. No similar hull has been constructed, and some engineers worry about potential stability problems, although Navy designers maintain steadfastly that extensive computer and test-tank modeling has shown no stability concerns.

Radar To Combat Missiles

The new radar is meant to form the basis for the next-generation combat system, intended from the outset to combat ballistic missiles.

Northrop Grumman, Lockheed Martin and Raytheon each were awarded \$9.9 million contracts on June 26 to conduct concept studies for the AMDR, but those agreements expire in December. For the work’s next phase, the Navy on Oct. 26 posted a notice of its intent to solicit up to three technology development contracts for the AMDR.

The notice, posted on the Federal Business Opportunities Web site, calls the effort a “full and open competition,” but Navy and industry sources said the three original contractors would likely each receive a request for proposal for the new contract.

The new radar system is a dual-band radar system, including S-band and X-band radars and their Radar Suite Controller (RSC). The S-band AMDR-S is to provide volume search, tracking, BMD discrimination and missile communications. The AMDR-X will provide horizon search, precision tracking, missile communication and terminal illumination.

The new solicitation announced Oct. 26 will cover the RSC and the AMDR-S radar.

The Hull/Radar Study’s decision to move away from the big, nuclear cruiser—dubbed CGNX—was based on a reassessment of the threat, said one source briefed by the Navy.

“They can’t afford it, nor do they think they need it,” the Capitol Hill source said. “They don’t think the scenarios on which the big cruiser was the answer are realistic.” Those scenarios, the source said, envisioned “very large-sized raids of incoming missiles,” a threat now considered less likely.

The potential price tag for such a ship—which would be the biggest surface warship built by the U.S. Navy since World War II—is also exceptionally daunting, with unofficial estimates running as high as \$7 billion a copy, or nearly the price of an aircraft carrier.

The study so far is “strictly an analytical effort,” the source said, with “no conclusions or recommendations yet.” As to which hull would get the go-ahead nod, another source reported the study concluded that the “DDG 51 couldn’t provide the power and cooling” capacity for a large and sensitive radar.

But the Capitol Hill source said that “both ships are equally in the running, although I think they’re steering themselves toward the DDG 51. It’s cheaper and no less capable in a number of dimensions—detection, intercept ca-pability, combat system. And it’s considered less technically risky.”³⁰

Oversight Issues for Congress

Modified Destroyer in Lieu of CG(X)?

The above-cited November 2009 press report on a the recent Navy “Hull/Radar” study suggests the Navy might want to procure in coming years a modified destroyer featuring a new radar. Given constraints on future Navy budgets, it might be difficult for the Navy to finance, more or less simultaneously, the development and procurement of both a modified destroyer and the CG(X). Potential oversight questions for Congress arising from this report include the following:

- Does the Navy now want to terminate the CG(X) program and procure instead a modified DDG-51 destroyer or a modified DDG-1000 destroyer?
- If so, would the Navy’s Hull/Radar Study constitute an adequate analytical basis for such a change in Navy cruiser and destroyer procurement plans?
- How would a modified destroyer compare with the CG(X) in terms of costs, technical risks, and capabilities?

Prospects For Eight-Ship Program With One Ship Every Three Years

It was reported in February 2009 that the Navy was considering the option of reducing the CG(X) program to eight ships and procuring the ships at a rate of one ship every three years.³¹ Assuming the first CG(X) is procured in FY2017, the eighth ship under such a profile would be procured in FY2038 and would enter service around 2044.

A potential oversight issue for Congress are the potential prospects for completing eight-ship program procured at a rate of one ship every three years. Skeptics might argue that there are at least three reasons why such a program with such a profile might not be pursued to completion:

- the 22-year period (FY2017-FY2038) over which the ships would be procured is a long-enough period of time that Navy spending priorities could change before all eight ships are procured;

³⁰ Christopher P. Cavas, “Next-Generation U.S. Warship Could Be Taking Shape,” *Defense News*, November 2, 2009: 18, 20. CRS has highlighted certain sections in **bold**.

³¹ Christopher P. Cavas, “U.S. May Cut 52 Ships From Plan,” *Defense News*, February 16, 2009: 1, 12.

- a procurement rate of one ship every three years could reduce production learning-curve benefits in the program, making the later ships in the program more expensive than they would be if the ships were procured more closely together; and
- a procurement rate of one ship every three years would mean that the last few ships in the program would enter service decades after the retirement of the Aegis cruisers that the ships are intended to replace, and potentially decades after the appearance of ASBMs and other threats that the ships are intended to counter.

If the CG(X) program were stopped before completion due to one or more of the above reasons, or other reasons, a follow-on oversight issue for Congress is whether the Navy could take whatever destroyer it might be procuring at that time and evolve that ship into a ship capable of performing at least some of the CG(X)'s intended missions—a so-called “CG(X) lite.”³²

Nuclear Power

A major issue for the CG(X) program is whether some or all CG(X)s should be nuclear-powered. As mentioned in the “Background” section, the chairman and ranking member of the Seapower and Expeditionary Forces subcommittee of the House Armed Services Committee strongly support making the CG(X) a nuclear-powered ship, and the chairman of the Defense subcommittee of the House Appropriations Committee has referred to the CG(X) as a nuclear-powered ship. As also mentioned earlier, Section 1012 of the FY2008 defense authorization act (H.R. 4986/P.L. 110-181 of January 28, 2008) makes it U.S. policy to construct the major combatant ships of the Navy, including the CG(X), with integrated nuclear power systems, unless the Secretary of Defense submits a notification to Congress that the inclusion of an integrated nuclear power system in a given class of ship is not in the national interest. The conference report on P.L. 110-181 contained extensive report language relating to Section 1012 (see **Appendix**).

The Navy reported to Congress in January 2007 that equipping a notional ship broadly like the CG(X) with a nuclear power plant instead of a conventional (i.e., fossil-fuel) power plant would, other things held equal, increase the unit procurement cost of follow-on ships in the class by about \$600 million to \$700 million in constant FY2007 dollars. The report concluded that if oil prices in coming years are high, much or all of the increase in unit procurement cost could be offset over the ship's service life by avoided fossil-fuel costs.

A nuclear-powered CG(X) would be more capable than a corresponding conventionally powered version because of the mobility advantages of nuclear propulsion, which include, for example, the ability to make long-distance transits at high speeds in response to distant contingencies without need for refueling. Navy officials have also stated that a nuclear power plant might be appropriate for the CG(X) in light of the high energy requirements of the CG(X)'s powerful BMD-capable radar.³³

³² For further discussion, see CRS Report RL32109, *Navy DDG-51 and DDG-1000 Destroyer Programs: Background and Issues for Congress*, by Ronald O'Rourke.

³³ See, for example, the comments of Rear Admiral Kevin McCoy at a June 25, 2007, conference in Arlington, VA, sponsored by the American Society of Naval Engineers (ASNE). A news article reporting McCoy's remarks stated in part:

McCoy has cautioned that the [Navy's] alternate propulsion study [submitted to Congress in (continued...)]

The August 2009 GAO letter report on the CG(X) AOA stated:

The draft cost analysis [in the CG(X) AOA]—which has not yet been approved within the Navy—includes a life-cycle cost estimate and a break-even analysis. The Navy estimated the life-cycle costs for 19 nuclear cruisers and 19 conventional cruisers using the 2007 price of crude oil. Then, in the break-even analysis, the Navy calculated the price of crude oil at which the cost of 19 nuclear cruisers equals the cost of 19 conventional cruisers. Using this analysis, the Navy determined that if oil prices behaved similarly to the past 35 years, the nuclear cruisers would be cheaper than the conventional cruisers. The Navy’s analysis does not include: (1) present value analysis to adequately account for the decreasing time value of money, (2) alternative scenarios for the future price of oil, and (3) an examination of how a less efficient conventional propulsion system would affect its cost estimates. By incorporating present value analysis, as required by Department of Defense guidance, and future oil projections from the Department of Energy’s Energy Information Administration, we found that the life-cycle cost of the conventional cruisers would be less than the nuclear cruisers. This demonstrates the sensitivity of the cost estimates to different assumptions, underscoring the need for more rigorous analysis before reaching conclusions about the alternatives.

Recommendations for Executive Action

We recommend that the Secretary of Defense require that the Navy (1) before finalizing Phase 2 of the Maritime Air and Missile Defense of Joint Forces Analysis of Alternatives, include present value analysis, alternative fuel scenarios, and analysis on the effect that a less efficient conventional propulsion system has on the cost estimates and (2) include present value analysis and alternative fuel scenarios in any future analyses of the trade-off between conventional and nuclear propulsion.

Agency Comments

The Department of Defense provided us with restricted comments on our report. In its comments, the department agreed with the recommended actions. However, it disagreed with several of GAO’s underlying analyses.³⁴

The earlier-cited November 2009 press report on the Navy’s recent Hull/Radar study (see “November 2009 Press Report About Destroyer Hull/Radar Study”) stated that support within the Navy for a nuclear-powered CG(X) “may have evaporated, largely due to its extravagant price tag.”

(...continued)

January 2007] is not a specific recommendation for using nuclear propulsion for the CG(X) cruisers, which are intended to perform missile defense.

“Really the issue I’ll tell you is not so much about the power plant but it’s about the mission,” McCoy said June 25. “And if you think the mission is sitting off a hostile coast looking for a BMD type mission for one-beam cycles on the big high-powered radar, we’re talking the radar is costing in the 30 megawatts range. Then alternatives like nuclear power start to come in.”

(Emelie Rutherford, “Despite Hill Pressure, Navy Noncommittal On Nuclear Power For CG(X),” *Inside the Navy*, July 2, 2007.)

³⁴ Government Accountability Office, *Defense Acquisitions: Additional Analysis Needed to Capture Cost Differences Between Conventional and Nuclear Propulsion for Navy’s Future Cruiser*, GAO-09-886R, August 7, 2009, p. 2. GAO states that this letter report is an unclassified summary of a classified GAO report on the CG(X) AOA.

For more on the issue of nuclear power for Navy surface ships, see CRS Report RL33946, *Navy Nuclear-Powered Surface Ships: Background, Issues, and Options for Congress*, by Ronald O'Rourke.

Technical Risk

The CG(X) is to use many new technologies being developed for the DDG-1000. The Navy is now working to retire the technical risks associated with these technologies, so that they will be ready for installation on the two lead DDG-1000s, which were procured in FY2007.³⁵ A potential key technical risk specific to the CG(X) program concerns its powerful new BMD-capable radar. The need to reduce technical risk in the CG(X) radar may be one reason why the Navy reportedly plans to defer procurement of the lead CG(X) from FY2011 to FY2017. A November 29, 2007, press article reported that Rear Admiral Alan Hicks, the director of the Aegis ballistic missile defense (BMD) program, "cautioned" that:

the Navy shouldn't attempt to go with a radically advanced radar for CG (X), at least not initially. Rather, he said, it might be wiser to go with incremental upgrades, steadily improving radar technology on the future cruiser that will take shape in the next decade, just as the existing Aegis system on cruisers and destroyers today has been upgraded steadily over two decades.

"Lots of people want to build this incredible radar," Hicks said. On the one hand, he sees that as a valid eventual goal. But "I do believe you need to get there in a stepped function. Jumping to a radar that is three generations ahead in one leap is going to be terribly challenging, and may drive costs" skyward, imperiling the need to make CG (X) affordable, he said. "So we need to be very careful how we get a risk-reduction package to get to that cruiser," perhaps by using existing radar technology as a base to help reduce that development risk, he said, pointing to the success of the Aegis modernization program.³⁶

Hull Design

In addition to the issue of nuclear power, another ship-design issue for the CG(X) is whether the ship should use the DDG-1000's tumblehome hull or some other hull. Potential alternative hulls include existing hulls such as the DDG-51 hull and the LPD-17 amphibious ship hull, both of which are conventional flared hulls, or a new flared hull design.

A tumblehome hull, with its reduced radar detectability, is viewed as useful for accomplishing the DDG-1000's mission of using its 155mm guns to strike targets ashore—a mission that could require the DDG-1000 to operate fairly close to enemy shore-based radars. Some observers believe that a hull with reduced detectability is less critical for the CG(X), because the CG(X)'s AAW and BMD missions might not require it to approach enemy shores as closely, and because the energy radiating from the ship's powerful BMD-capable radar will in any event provide enemy sensors with an indication of the ship's location. Other observers might argue that even if a ship's location is known, a hull with reduced detectability can improve the ship's ability to

³⁵ For more on technical risks in the DDG-1000 program, see CRS Report RL32109, *Navy DDG-51 and DDG-1000 Destroyer Programs: Background and Issues for Congress*, op cit.

³⁶ Dave Ahearn, "Large Number of Aegis Ships Would Be Needed To Shield Europe: Admiral," *Defense Daily*, November 29, 2007.

evade (or to use decoys to confuse) the homing devices in enemy anti-ship cruise missile and torpedoes, or the fusing mechanisms in enemy mines.

Even if the CG(X) does not require the reduced radar detectability of a tumblehome hull, reusing the DDG-1000's tumblehome hull for the CG(X) might still have economic advantages in terms of avoiding the cost of designing a new hull (which could easily be in the hundreds of millions of dollars) and taking advantage of production learning-curve efficiencies achieved from earlier construction of DDG-1000s. Designing a new hull would incur hull-design costs and sacrifice the opportunity to take advantage of DDG-1000 production learning-curve benefits. On the other hand, a new-design hull might more easily accommodate the power plant and combat system desired for the CG(X), and be designed with the latest features for reducing its production cost.

One option for making the CG(X) a nuclear-powered ship would be to equip it with one-half of the new twin-reactor plant that the Navy has designed for its new Ford (CVN-78) class aircraft carriers.³⁷ Reusing the Ford-class reactor plant would avoid the costs of developing a new reactor plant for the CG(X)—a cost that could exceed \$1 billion.³⁸ As mentioned earlier, the DDG-1000 hull (or an enlarged version of the DDG-51 hull) might be too small to easily accommodate one-half of a Ford-class plant, at least not without making changes to the plant. Using one-half of the Ford-class plant without making changes to it might require designing a new hull that is larger than the DDG-1000 hull. If so, then using one-half of the Ford-class plant would pose a tradeoff between avoided reactor plant design costs and additional hull-design costs.

Unit Affordability vs. Unit Capability

Issues such as the question of nuclear power and the ship's hull design form part of a more general potential general oversight issue for Congress concerning whether the Navy has achieved the best balance in the CG(X) design between unit affordability and unit capability. As mentioned in the "Background" section, the CG(X) is one of the Navy's relatively few remaining opportunities to use a new ship design to manage the overall cost of the Navy's shipbuilding program. Navy officials are aware of this, but they also want the CG(X) to be capable of performing certain intended missions, including the BMD mission that drives the need for the CG(X) to carry a large and powerful new radar. Navy officials are seeking a design solution for the CG(X) that represents the best balance between unit affordability and unit capability. Achieving such a balance is a long-standing challenge in ship design.

Concerns about the potential affordability of the CG(X) have been reinforced by the experience with DDG-1000, which turned out to be much more expensive than originally envisaged. The Navy originally planned a total of 16 to 24 DDG-1000s and a sustaining procurement rate of two DDG-1000s per year. Due in part to the ship's cost, this was reduced to a total of 7 DDG-1000s to be procured at a rate of about one ship per year. Subsequently, on July 31, 2008, Navy officials testified that the service wants to stop DDG-1000 procurement ships and restart DDG-51 procurement. Affordability considerations may have played a role in the Navy's decision.³⁹

³⁷ For more on the Ford-class program, see CRS Report RS20643, *Navy Ford (CVN-78) Class Aircraft Carrier Program: Background and Issues for Congress*, by Ronald O'Rourke.

³⁸ The estimated development cost of the Ford-class plant is roughly \$1.5 billion.

³⁹ For a discussion, see CRS Report RL32109, *Navy DDG-51 and DDG-1000 Destroyer Programs: Background and Issues for Congress*, op cit.

A dual-design solution for the CG(X) program, such as the one reportedly considered in the CG(X) AOA (see “Background” section), is one possible strategy for striking a balance between affordability and capability in the CG(X) program. A dual-design solution could permit the Navy and Congress to respond to changes in the strategic or budgetary environment by altering the numbers of smaller and larger CG(X)s to be procured.⁴⁰

BMD Impact on CG(X) Numbers and Schedule

An additional potential oversight issue for Congress concerns the possible effect of the BMD mission on the required number of CG(X)s and the schedule for procuring CG(X)s. The currently planned total of 19 CG(X)s reflects, in part, certain assumptions about the Navy’s future role in U.S. BMD operations. The Navy’s future in U.S. BMD operations, however, has not yet been fully defined. It is possible that as the role becomes better defined, the total required number of CG(X)s could change.⁴¹ A related question is whether the schedule for procuring CG(X)s is properly aligned with foreign-country ballistic missile development programs. A 2005 defense trade press report, for example, states that “navy officials project” that China could field TBMs capable of hitting moving ships at sea by about 2015.⁴²

Industrial-Base Implications

The question of whether some or all CG(X)s should be nuclear-powered has significant potential implications for the surface combatant industrial base because the two shipyards that have built all the Navy’s cruisers and destroyers in recent years—GD/BIW and the Ingalls yard that forms part of NGSB—are not licensed to build nuclear-powered ships.⁴³

⁴⁰ A dual-design solution might also be viewed as reminiscent of the so-called high-low mix approach that was adopted in the 1970s and 1980s for the procurement of Navy surface combatants and Air Force fighters. The high-low mix approach involved procuring a mix of more-capable, more-expensive platforms (the “high” end of the mix) and less-capable, less-expensive platforms (the “low” end). In the 1970s and 1980s, the Navy procured nuclear-powered cruisers and Aegis cruisers as its high-end ships and Spruance (DD-963) class destroyers and Oliver Hazard Perry (FFG-7) class frigates as its low-end ships. The Air Force procured F-15s as its high-end fighters and F-16s as its low-end fighters. The Air Force today might be viewed as again implementing a high-low mix approach through its planned procurement of a combination of high-end F-22 fighters and more-affordable F-35 Joint Strike Fighters (JSFs). The capability ratio of a 23,000-ton, nuclear-powered CG(X) relative to that of a 14,000-ton, conventionally powered CG(X) might not necessarily be the same as that of the 1970s/1980s high-end surface combatants relative to the 1970s/1980s low-end surface combatants, or of the F-15 relative to the F-16, or of the F-22 relative to the F-35. The merits of the high-low mix approach as a strategy for balancing unit capability against unit affordability have been debated on and off for years.

⁴¹ For more on this issue, see CRS Report RL33745, *Sea-Based Ballistic Missile Defense—Background and Issues for Congress*, by Ronald O'Rourke.

⁴² Yihong Chang and Andrew Koch, “Is China Building A Carrier?” *Jane’s Defence Weekly*, August 17, 2005. The article states that “navy officials project [that such missiles] could be capable of targeting US warships from sometime around 2015.” A 2007 press report states that another observer believes that a MARV-equipped version of China’s CSS-6 TBM may be close to initial operational status. (Bill Gertz, “Inside the Ring,” *Washington Times*, July 20, 2007: 6. [Item entitled “New Chinese Missiles”]. The article stated that it was reporting information from forthcoming report on China’s military from the International Assessment and Strategy Center authored by Richard Fisher.)

⁴³ GD/BIW has never built nuclear-powered ships, and has never been licensed to do so. The Ingalls yard within NGSS built nuclear-powered submarines until the early 1970s but is no longer licensed to build nuclear-powered ships. (Ingalls built 12 nuclear-powered submarines, the last being the *Parche* [SSN-683], which was procured in FY1968, entered service in 1974, and retired in 2005. Ingalls also overhauled or refueled 11 nuclear-powered submarines. Ingalls’s nuclear facility was decommissioned in 1980.)

The only two U.S. shipyards currently licensed to build nuclear-powered ships for the Navy are Newport News Shipbuilding of Newport News, VA, a part of NGSB, which builds nuclear-powered surface ships and submarines, and General Dynamics' Electric Boat Division (GD/EB) of Groton, CT, and Quonset Point, RI, which builds nuclear-powered submarines. These two yards have built every nuclear-powered ship procured for the Navy since FY1969.

There are at least three potential approaches for building nuclear-powered CG(X)s:

- Build them at Newport News, with GD/EB possibly contributing to the construction of the ships' nuclear portions.
- License GD/BIW and/or Ingalls to build nuclear-powered ships, and then build the CG(X)s at those yards.
- Build the nuclear portions of the CG(X)s at Newport News and/or GD/EB, the non-nuclear portions at GD/BIW and/or Ingalls, and perform final assembly, integration, and test work for the ships at either
 - Newport News and/or
GD/EB, or
 - GD/BIW and/or Ingalls.

These options have significant potential implications for workloads and employment levels at each of these shipyards.

On the question of what would be needed to license Ingalls and/or GD/BIW to build nuclear-powered ships, the director of Naval Reactors (NR)—the office in charge of the Navy's nuclear propulsion program—testified in March 2007 that:

Just the basics of what it takes to have a nuclear-certified yard, to build one from scratch, or even if one existed once upon a time as it did at Pascagoula, and we shut it down, first and foremost you have to have the facilities to do that. What that includes, and I have just some notes here, but such things as you have to have the docks and the dry-docks and the pier capability to support nuclear ships, whatever that would entail. You would have to have lifting and handling equipment, cranes, that type of thing; construction facilities to build the special nuclear components, and to store those components and protect them in the way that would be required.

The construction facilities would be necessary for handling fuel and doing the fueling operations that would be necessary on the ship—those types of things. And then the second piece is, and probably the harder piece other than just kind of the brick-and-mortar type, is building the structures, the organizations in place to do that work, for instance, nuclear testing, specialized nuclear engineering, nuclear production work. If you look, for instance, at Northrop Grumman Newport News, right now, just to give you a perspective of the people you are talking about in those departments, it is on the order of 769 people in nuclear engineering; 308 people in the major lines of control department; 225 in nuclear quality assurance; and then almost 2,500 people who do nuclear production work. So all of those would have to be, you would have to find that workforce, certify and qualify them, to be able to do that.⁴⁴

⁴⁴ Spoken testimony of Admiral Kirkland Donald before the Seapower and Expeditionary Forces Subcommittee of the House Armed Services Committee, March 1, 2007.

The director of NR testified that Newport News and GD/EB “have sufficient capacity to accommodate nuclear-powered surface ship construction, and therefore there is no need to make the substantial investment in time and dollars necessary to generate additional excess capacity.”⁴⁵ In light of this, the Navy testified, only the first and third options above are “viable.”⁴⁶ The director of NR testified that:

my view of this is we have some additional capacity at both Electric Boat and at Northrop Grumman Newport News. My primary concern is if we are serious about building another nuclear-powered warship, a new class of warship, cost is obviously going to be some degree of concern, and certainly this additional costs, which would be—and I don’t have a number to give you right now, but I think you can see it would be substantial to do it even if you could. It probably doesn’t help our case to move down the path toward building another nuclear-powered case, when we have the capability existing already in those existing yards.⁴⁷

With regard to the third option of building the nuclear portions of the ships at Newport News and/or GD/EB, and the non-nuclear portions at Ingalls and/or GD/BIW, the Navy testified that the “[I]ocation of final ship erection would require additional analysis.” One Navy official, however, expressed a potential preference for performing final assembly, integration, and test work at Newport News or GD/EB, stating that:

we are building warships in modular sections now. So if we were going to [ask], “Could you assemble this [ship], could you build modules of this ship in different yards and put it together in a nuclear-certified yard?”, the answer is yes, definitely, and we do that today with the Virginia Class [submarine program]. As you know, we are barging modules of [that type of] submarine up and down the coast.

What I would want is, and sort of following along with what [NR director] Admiral [Kirkland] Donald said, you would want the delivering yard to be the yard where the reactor plant was built, tooled, and tested, because they have the expertise to run through all of that nuclear work and test and certify the ship and take it out on sea trials.

But the modules of the non-reactor plant, which is the rest of the ship, could be built theoretically at other yards and barged or transported in other fashion to the delivering shipyard. If I had to do it ideally, that is where I would probably start talking to my industry partners, because although we have six [large] shipyards [for building large navy ships], it is really two corporations [that own them], and those two corporations each own what is now a surface combatant shipyard and they each own a nuclear-capable shipyard. I would say if we were going to go do this, we would sit down with them and say, you know, from a corporation standpoint, what would be the best work flow? What would be the best place to construct modules? And how would you do the final assembly and testing of a nuclear-powered warship?⁴⁸

⁴⁵ Statement of Admiral Kirkland H. Donald, U.S. Navy, Director, Naval Nuclear Propulsion Program, before the House Armed Services Committee Seapower and Expeditionary Forces Subcommittee on Nuclear Propulsion For Surface Ships, 1 March 2007, p. 13.

⁴⁶ Source: Statement of The Honorable Dr. Delores M. Etter, Assistant Secretary of the Navy (Research, Development and Acquisition), et al., before the Seapower and Expeditionary Forces Subcommittee of the House Armed Services Committee on Integrated Nuclear Power Systems for Future Naval Surface Combatants, March 1, 2007, p. 7.

⁴⁷ Spoken testimony of Admiral Kirkland Donald before the Seapower and Expeditionary Forces Subcommittee of the House Armed Services Committee, March 1, 2007.

⁴⁸ Spoken testimony of Vice Admiral Paul E. Sullivan, Commander, Naval Sea Systems Command, to the Seapower and Expeditionary Forces Subcommittee of the House Armed Services Committee, March 1, 2007.

For further discussion of the issue, see CRS Report RL33946, *Navy Nuclear-Powered Surface Ships: Background, Issues, and Options for Congress*, by Ronald O'Rourke.

Visibility of CG(X) Research and Development Costs

Another potential oversight issue for Congress is whether CG(X) research and development costs are sufficiently visible in Navy budget-justification documents. CG(X) research and development costs are currently found in the Research, Development, Test and Evaluation, Navy (RDTEN) appropriation account in:

- Program Element (PE) PE0204201N (CG[X]); and
- Project 3186 (Air and Missile Defense Radar) of PE0604501N (Advanced Above Water Sensors).

The entry for PE0204201N in the FY2010 budget-justification book for the RDTEN account states that this PE is “a newly established PE for all CG (X) Research and Development” and that this PE “encompasses all CG (X) Projects.” These statements could mislead readers into overlooking Project 3186 in PE0604501N, which accounts for the majority (\$190 million) of the \$340 million requested in FY2010 for work relating to the CG(X). The 11-page entry on PE0204201N mentions Project 3186 on PE0604501N twice in tables that summarize “other program funding,” but does not explain that this project funds the development of the AMDR.⁴⁹

Options for Congress

Potential options for Congress for the CG(X) program, some of which could be combined, include but are not limited to the following:

- direct the Navy to make it more clear in RDTEN account budget-justification documents that PE0204201N does not contain all CG(X)-related research and development funding because it does not include funding for development of the AMDR;
- institute increased requirements for the Navy to report to Congress on the goals and status of the CG(X) program;
- request independent analyses of the CG(X) program by the Government Accountability Office (GAO) or the Congressional Budget Office (CBO);

⁴⁹ The AMDR is intended not solely for the CG(X), but potentially for future destroyers as well. In this sense, Project 3186 is not strictly for the CG(X) program. Even so, Navy briefing materials on the Navy's proposed FY2010 budget include the \$190 million for Project 3186 in the total amount requested for CG(X) research and development (see, for example, the briefing slide entitled “R&D Investment” in the Navy briefing entitled “Department of the Navy FY 2010 President's Budget, 18 May 2009, Rear Admiral J.T. Blake, Deputy Assistant Secretary of the Navy for Budget”), and May 2009 Navy testimony on Navy shipbuilding programs states, in the section on the CG(X) program, that “The FY 2010 President's Budget requests \$190 million for the Air and Missile Defense Radar development and \$150 million to continue maturation of the CG(X) design based on the preferred alternative selected.” (Statement of the Honorable Sean J. Stackley, Assistant Secretary of the Navy, (Research, Development and Acquisition), and Vice Admiral Bernard J. McCullough, Deputy Chief of Naval Operations for Integration of Capabilities and Resources, Before the Subcommittee on Seapower and Expeditionary Forces of the House Armed Services Committee [Hearing] on Navy Force Structure and Shipbuilding, May 15, 2009, p. 9)

- modify the CG(X) program's proposed FY2010 research and development funding request;
- pass legislation, or include report language, on questions such as the following:
 - a potential target procurement cost of the CG(X), or
 - other aspects of the CG(X) acquisition strategy, such as the use of competition in the awarding of construction contracts for the ships;
- defer or reject the CG(X) program in favor of potential alternatives, such as a service-life extension program (SLEP) for the Navy's 22 Aegis cruisers that would include a more robust upgrading of the ships' AAW and BMD capabilities than currently planned.⁵⁰

Legislative Activity in 2009

FY2010 Funding Request

The Navy's proposed FY2010 budget requested \$340.0 million in research and development funding for the CG(X) program. Of this total, \$190.0 million is for developing the CG(X)'s new radar (called the Air and Missile Defense Radar, or AMDR) and \$150.0 million is for research and development work on the ship in general. The \$190 million for the AMDR is Project 3186 (Air and Missile Defense Radar) of PE0604501N (Advanced Above Water Sensors). The \$150 million for the CG(X) in general is PE0204201N (CG[X]).

FY2010 Defense Authorization Act (H.R. 2647/P.L. 111-84)

House

The House Armed Services Committee, in its report (H.Rept. 111-166 of June 18, 2009) on H.R. 2647, recommends approving the Navy's FY2010 research and development funding requests for

⁵⁰ An October 2006 journal article by two retired Navy admirals (including a former Vice Chief of Naval Operations) proposed modernizing and extending the service lives of the Navy's Aegis cruisers and destroyers through a service life extension program (SLEP). Robert J. Natter and Donald Pilling, "Achieving the Right Mix," *U.S. Naval Institute Proceedings*, October 2006: 14-16. The authors state that five to eight Aegis ships per year might be modernized under such a program, at a cost of about \$300 million to \$500 million per ship. The article suggests that the program could be a part of a scenario in which constraints on Navy shipbuilding funding limit, for a time at least, procurement of DDG-1000s and CG(X)s to combined rate of one per year. The article provides no figures on the service lives of the Aegis ships before or after the extension, so it is unclear whether the authors are proposing to extend their lives from 35 years (or some lower figure) to 40 years (or some other figure).

Whether it would be feasible or cost effective today to extend the lives of the Aegis cruisers is unclear. Depending on how intensively they are used in coming years, the Aegis cruisers might be worn out in terms of their basic structural or mechanical condition by age 35. (Some observers believe they might be worn out by age 30.) If the Aegis cruisers are in good enough structural and mechanical condition to permit operation beyond age 35, experience with past surface combatant designs suggests that the ships might have insufficient space, weight-carrying ability, or electrical power to accommodate the new sensors and weapons that could be needed at that point to keep them mission-effective beyond age 35. The Navy has limited experience operating modern cruisers and destroyers beyond age 35, and thus limited experience with the engineering issues that might arise from attempting to operate such ships to age 40.

PE0604501N (Advanced Above Water Sensors) and PE0204201N (CG[X]) (page 168, line 105, and page 170, line 134). The report states:

The committee supports the ongoing efforts to develop the next generation cruiser. The committee believes that the next generation cruiser must meet the challenge of emerging ballistic missile technology and that an integrated nuclear power system is required to achieve maximum capability of the vessel. (Page 72)

The report also states:

The committee supports Navy research efforts to develop a radar system for the next generation cruiser (CGN(X)). The committee understands that ongoing analysis to determine radar sensitivity, power requirements, physical structure, and weight will dictate the size of the hull necessary for the vessel.

Therefore the committee supports accelerated development of the combat system along with efforts to begin detailed design and construction of the vessel.

The committee remains committed to the direction of section 1012 of the National Defense Authorization Act for Fiscal Year 2008 (Public Law 110–181), which requires the use of an integrated nuclear propulsion system for the CGN(X). (Page 75)

Senate

Division D of the FY2010 defense authorization bill (S. 1390) as reported by the Senate Armed Services Committee (S.Rept. 111-35 of July 2, 2009) presents the detailed line-item funding tables that in previous years have been included in the Senate Armed Services Committee's report on the defense authorization bill. Division D recommends increasing the Navy's funding request for PE0604501N (Advanced Above Water Sensors) by \$50 million, with additional funding to be used for "mobile maritime sensor technology development" (page 677, line 105 of the printed bill), and recommends approving the Navy's funding request for PE0204201N (CG[X]) (page 678, line 134). The committee's report states:

The budget request included \$190.0 million in PE 64501N for development efforts in support of a next-generation cruiser, CG(X). CG(X) is planned to be the replacement for the CG–47 class cruiser, with primary missions including air and missile defense. The Navy's last long-range shipbuilding plan proposed to procure the first ship of the CG(X) program in 2011. That schedule was clearly too optimistic.

Part of the delay came from questions about the CG(X) Analysis of Alternatives (AoA), called the Maritime Air and Missile Defense of Joint Forces (MAMDJF) AoA. One problem has been that demanding threat requirements have led to very demanding sensor requirements, some of which could only be fit on a cruiser-size vessel by achieving major technology breakthroughs.

Another cause of the delay was that, as the committee understands it, the Secretary of the Navy was asking questions about potential contributions of off-board, networked sensors and why the MAMDJF vessel had to be self-sufficient for target acquisition and tracking.

The committee recognizes that there are at least two other platforms within DOD inventories that could provide the basis for developing a more robust off-board sensor augmentation. Such an incremental development approach might not require that the Navy make such heroic technology improvements in surface combatant radar technology. These are the

Navy's own programs to develop a Cobra Judy replacement vessel, and the Missile Defense Agency's Sea-Based X-Band radar.

A mobile maritime sensor could improve upon the performance of either of these radars by making more modest technology improvements that could provide requisite capability for radars that would be less risky, cheaper to acquire and operate, and potentially available sooner than sensors that must provide equivalent performance from within the relatively constrained confines of a surface combatant.

The committee recommends an increase of \$50.0 million to: (1) develop a radar architecture that would provide full field of view; (2) design of a partial array prototype; (3) develop, build, and test components of such an array; and (4) fabricate and test a partial array prototype. Information resulting from such an effort could provide valuable information upon which to base informed decisions about the best way to support the maritime air and missile defense mission. (Pages 67-68)

Section 113 of S. 1390 would prohibit the obligation and expenditure of funds for the construction or advanced procurement of materials for surface combatants (including cruisers) procured after FY2011 until certain conditions are met, and would require DOD to submit certain reports. The text of Section 113 is as follows:

SEC. 113. PROCUREMENT PROGRAMS FOR FUTURE NAVAL SURFACE COMBATANTS.

(a) Limitation on Availability of Funds Pending Reports About Surface Combatant Shipbuilding Programs- The Secretary of the Navy may not obligate or expend funds for the construction of, or advanced procurement of materials for, a surface combatant to be constructed after fiscal year 2011 until the Secretary has submitted to Congress each of the following:

(1) An acquisition strategy for such surface combatants that has been approved by the Department of Defense.

(2) The results of reviews by the Joint Requirements Oversight Council for an Acquisition Category I program that supports the need for an acquisition strategy to procure surface combatants after fiscal year 2011.

(3) A verification by an independent review panel convened by the Secretary of Defense that, in evaluating the shipbuilding program concerned, the Secretary of the Navy considered each of the following:

(A) Modeling and simulation, including war gaming conclusions regarding combat effectiveness for the selected ship platforms as compared to other reasonable alternative approaches.

(B) Assessments of platform operational availability.

(C) Life cycle costs from vessel manning levels to accomplish missions.

(4) An intelligence analysis reflecting a coordinated threat assessment of the Defense Intelligence Agency that provides the basis for deriving the mix of platforms in the shipbuilding program concerned when compared with the surface combatants in the 2009 shipbuilding plan.

(5) The differences in cost and schedule arising from the need to accommodate new sensors and weapons in future surface combatants to counter the future threats referred to in paragraph (4) when compared with the cost and schedule arising from the need to accommodate sensors and weapons on surface combatants as contemplated by the 2009 shipbuilding plan for the vessels concerned.

(6) A verification by the commanders of the combatant commands that the shipbuilding program for the vessels concerned would be preferable to the surface combatants included in the 2009 shipbuilding plan for the vessels concerned in meeting all of their future mission requirements.

(7) A joint review by the Navy and the Missile Defense Agency setting forth additional requirements for investment in Aegis ballistic missile defense (BMD) beyond the number of DDG-51 and CG-47 vessels planned to be equipped for this mission area in the budget of the President for fiscal year 2010 (as submitted to Congress pursuant to section 1105 of title 31, United States Code).

(b) Future Surface Combatant Acquisition Strategy- Not later than the date upon which President submits to Congress the budget for fiscal year 2012 (as so submitted), the Secretary of the Navy shall submit to the congressional defense committees a plan to provide for full and open competition on the combat systems for surface combatants proposed in the future-years defense program submitted to Congress under section 221 of title 10, United States Code, together with such budget. The plan shall include specifics on the intent of the Navy to satisfy criteria described in subsection (a) and evaluate applicable technologies during the request for proposal and selection process.

(c) Naval Surface Fire Support- Not later than 120 days after the enactment of this Act, the Secretary of the Navy shall submit to the congressional defense committees an update to the March 2006 Report to Congress on Naval Surface Fire Support. The update shall identify how the Department of Defense intends to address any shortfalls between required naval surface fire support capability and the plan of the Navy to provide that capability. The update shall include addenda by the Chief of Naval Operations and Commandant of the Marine Corps, as was the case in the 2006 report.

(d) Technology Roadmap for Future Surface Combatants and Fleet Modernization-

(1) IN GENERAL- Not later than 120 days after the date of the enactment of this Act, the Secretary of the Navy shall develop a plan to incorporate into surface combatants constructed after 2011, and into fleet modernization programs, the technologies developed for the DDG-1000 destroyer and the DDG-51 and CG-47 Aegis ships, including the following:

(A) For the DDG-1000 destroyer—

(i) combat system;

(ii) multi-function and dual-band radars;

(iii) hull, mechanical and electrical systems achieving significant manpower savings; and

(iv) integrated electric propulsion technologies.

(B) For the DDG-51 and CG-47 Aegis ships—

(i) combat system, including missile defense capability;

- (ii) hull, mechanical and electrical systems achieving manpower savings; and
 - (iii) anti-submarine warfare sensor systems designed for operating in open ocean areas.
- (2) SCOPE OF PLAN- The plan required by paragraph (1) shall include sufficient detail for systems and subsystems to ensure that the plan—
- (A) avoids redundant development for common functions;
 - (B) reflects implementation of Navy plans for achieving an open architecture for all naval surface combat systems; and
 - (C) fosters full and open competition.
- (e) Definition- In this section:
- (1) The term `2009 shipbuilding plan' means the 30-year shipbuilding plan submitted to Congress pursuant to section 231, title 10, United States Code, together with the budget of the President for fiscal year 2009 (as submitted to Congress pursuant to section 1105 of title 31, United States Code).
 - (2) The term `surface combatant' means a cruiser, a destroyer, or any naval vessel under a program currently designated as a future surface combatant program.

Regarding this section, the committee's report states:

The committee recommends a provision that would prevent the Navy from obligating any funds for building surface combatants after 2011 until the Navy conducts particular analyses, and completes certain tasks that should be required at the beginning of major defense acquisition programs (MDAP).

For at least the past couple of years, the Navy's strategy for modernizing the major surface combatants in the fleet has been in upheaval. The Navy was adamant that the next generation cruiser had to begin construction in the 2011-2012 timeframe. After 15 years of consistent, unequivocal support of the uniformed Navy for the fire support requirement, and for the DDG-1000 destroyer that was intended to meet that requirement (i.e., gun fire support for Marine Corps or Army forces ashore), the Navy leadership, in the middle of last year, decided that they should truncate the DDG-1000 destroyer program and buy DDG51 destroyers instead.

The Defense Department has announced that the Navy will complete construction of the three DDG-1000 vessels and will build three DDG-51 destroyers, one in fiscal year 2010 and two in fiscal year 2011. Beyond that, the plan is less well defined, and includes building only a notional "future surface combatant," with requirements, capabilities, and costs to be determined.

Notwithstanding Navy protests to the contrary, this was mainly due to the Navy's affordability concerns. The committee notes with no little irony that this sudden change of heart on the DDG-1000 program is at odds with its own consistent testimony that "stability" in the shipbuilding programs is fundamental to controlling costs and protecting the industrial base.

The Navy claims the change of heart on the DDG-1000 program was related to an emerging need for additional missile defense capability that would be provided by DDG-51s and is

being requested by the combatant commanders, and would be used to protect carrier battle groups against new threats.

The committee certainly believes that the services should have the ability to change course as the long-term situation dictates. However, since we are talking about the long-term and hundreds of billions of dollars of development and production costs for MDAPs, the committee believes that the Defense Department should exercise greater rigor in making sure such course corrections are made with full understanding of the alternatives and the implications of such decisions, rather than relying on inputs from a handful of individuals. The committee has only to look at the decision-making behind the major course correction in Navy shipbuilding that yielded the Littoral Combat Ship (LCS) to be concerned by that prospect.

Before deciding on a course of action regarding acquisition of surface combatants after 2011, we collectively have time to perform the due diligence that should be and must be performed at the beginning of any MDAP. That is what this section will ensure.

In addition, in order to deter any delaying action on conducting and completing the activities required by this section before 2011, the committee directs that the Secretary of the Navy obligate no more than 50 percent of the funds authorized for fiscal year 2010 in PE 24201N, CG(X), until the Navy submits a plan for implementing the requirements of this section to the congressional defense committees. (Pages 13-14; emphasis added)

Section 1012 of S. 1390 would repeal Section 1012 of the FY2008 defense authorization act (H.R. 4986/P.L. 110-181 of January 28, 2008). The committee's report states:

The committee recommends a provision [Section 1012] that would repeal section 1012 of the National Defense Authorization Act for Fiscal Year 2008 (P.L. 110-181).

Section 1012 of the National Defense Authorization Act for Fiscal Year 2008 (P.L. 110-181), as amended by section 1015 of the Duncan Hunter National Defense Authorization Act for Fiscal Year 2009 (P.L. 110-417), would require that all new classes of surface combatants and all new amphibious assault ships larger than 15,000 deadweight ton light ship displacement have integrated nuclear power systems, unless the Secretary of Defense determines that the inclusion of an integrated nuclear power system in such vessel is not in the national interest.

The committee believes that the Navy is already having too much difficulty in achieving the goal of a 313-ship fleet without adding a substantial increment to the acquisition price of a significant portion of the fleet. Moreover, current acquisition law and the Weapon System Acquisition Reform Act of 2009 (P.L. 111-23) emphasize the need to start acquisition programs on a sure footing as a central mechanism by which the Department of Defense (DOD) can get control of cost growth and schedule slippage on major defense acquisition programs. Therefore, Congress should be loathe to dictate a particular outcome of a requirements process before the Department has conducted the normal requirements review.

The committee expects that the Navy will continue to evaluate the integrated nuclear power alternative for any new class of major surface combatants, but would prefer that any Navy requirements analysis not be skewed toward a particular outcome. (Page 170)

Conference

The conference report (H.Rept. 111-288 of October 7, 2009) on H.R. 2647/P.L. 111-84 of October 28, 2009, authorizes an increase of \$15 million to the Navy's funding request for PE0604501N

(Advanced Above Water Sensors), with the additional funding to be used for “mobile maritime sensor technology development” (page 1004, line 105), and a decrease of \$40 million to the Navy’s funding request for PE0204201N (CG[X]), with the reduction being for “program delay.” (Page 1006, line 134)

Section 125 prohibits the obligation and expenditure of funds for the construction or advanced procurement of materials for surface combatants (including cruisers) procured after FY2011 until certain conditions are met, and requires DOD to submit certain reports. The text of Section 125 is as follows:

SEC. 125. PROCUREMENT PROGRAMS FOR FUTURE NAVAL SURFACE COMBATANTS.

(a) LIMITATION ON AVAILABILITY OF FUNDS PENDING REPORTS ABOUT SURFACE COMBATANT SHIPBUILDING PROGRAMS.—The Secretary of the Navy may not obligate or expend funds for the construction of, or advanced procurement of materials for, a surface combatant to be constructed after fiscal year 2011 until the Secretary has submitted to Congress each of the following:

(1) An acquisition strategy for such surface combatants that has been approved by the Under Secretary of Defense for Acquisition, Technology, and Logistics.

(2) Certification that the Joint Requirements Oversight Council—

(A) has been briefed on the acquisition strategy to procure such surface combatants; and

(B) has concurred that such strategy is the best preferred approach to deliver required capabilities to address future threats, as reflected in the latest assessment by the defense intelligence community.

(3) A verification by, and conclusions of, an independent review panel that, in evaluating the program or programs concerned, the Secretary of the Navy considered each of the following:

(A) Modeling and simulation, including war gaming conclusions regarding combat effectiveness for the selected ship platforms as compared to other reasonable alternative approaches.

(B) Assessments of platform operational availability.

(C) Life cycle costs, including vessel manning levels, to accomplish missions.

(D) The differences in cost and schedule arising from the need to accommodate new sensors and weapons in surface combatants to be constructed after fiscal year 2011 to counter the future threats referred to in paragraph (2), when compared with the cost and schedule arising from the need to accommodate sensors and weapons on surface combatants as contemplated by the 2009 shipbuilding plan for the vessels concerned.

(4) The conclusions of a joint review by the Secretary of the Navy and the Director of the Missile Defense Agency setting forth additional requirements for investment in Aegis ballistic missile defense beyond the number of DDG-51 and CG-47 vessels planned to be equipped for this mission area in the budget of the President for fiscal year 2010 (as submitted to Congress pursuant to section 1105 of title 31, United States Code).

(b) **FUTURE SURFACE COMBATANT ACQUISITION STRATEGY.**—Not later than the date upon which the President submits to Congress the budget for fiscal year 2012 (as so submitted), the Secretary of the Navy shall submit to the congressional defense committees an update to the open architecture report to Congress that reflects the Navy’s combat systems acquisition plans for the surface combatants to be procured in fiscal year 2012 and fiscal years thereafter.

(c) **NAVAL SURFACE FIRE SUPPORT.**—Not later than 120 days after the enactment of this Act, the Secretary of the Navy shall submit to the congressional defense committees an update to the March 2006 Report to Congress on Naval Surface Fire Support. The update shall identify how the Department of Defense intends to address any shortfalls between required naval surface fire support capability and the plan of the Navy to provide that capability. The update shall include addenda by the Chief of Naval Operations and Commandant of the Marine Corps, as was the case in the 2006 report.

(d) **TECHNOLOGY ROADMAP FOR FUTURE SURFACE COMBATANTS AND FLEET MODERNIZATION.**—

(1) **IN GENERAL.**—Not later than 120 days after the date of the enactment of this Act, the Secretary of the Navy shall develop a plan to incorporate into surface combatants constructed after 2011, and into fleet modernization programs, the technologies developed for the DDG–1000 destroyer and the DDG–51 and CG–47 Aegis ships, including technologies and systems designed to achieve significant manpower savings.

(2) **SCOPE OF PLAN.**—The plan required by paragraph (1) shall include sufficient detail for systems and subsystems to ensure that the plan—

(A) avoids redundant development for common functions;

(B) reflects implementation of Navy plans for achieving an open architecture for all naval surface combat systems; and

(C) fosters competition.

(e) **DEFINITIONS.**—In this section:

(1) The term “2009 shipbuilding plan” means the 30-year shipbuilding plan submitted to Congress pursuant to section 231, title 10, United States Code, together with the budget of the President for fiscal year 2009 (as submitted to Congress pursuant to section 1105 of title 31, United States Code).

(2) The term “surface combatant” means a cruiser, a destroyer, or any naval vessel, excluding Littoral Combat Ships, under a program currently designated as a future surface combatant program.

Regarding Section 125, the conference report states that “the conferees agree to direct that the Secretary submit the plan for implementing the requirements of this section to the congressional defense committees at the same time as the President submits the budget request for fiscal year 2011.” (Page 680)

Regarding Section 1012 of S. 1390 (see discussion above), the conference report states:

Repeal of policy relating to the major combatant vessels of the United States Navy

The Senate amendment contained a provision (sec. 1012) that would repeal section 1012 of the National Defense Authorization Act for Fiscal Year 2008 (Public Law 110-181). Section 1012, as amended, would require that all new classes of surface combatants and all new amphibious assault ships larger than 15,000 deadweight ton light ship displacement have integrated nuclear power systems, unless the Secretary of Defense determines that the inclusion of an integrated nuclear power system in such vessel is not in the national interest.

The House bill contained no similar provision.

The Senate recesses. (Page 822)

FY2010 DOD Appropriations Bill (H.R. 3326)

House

The House Appropriations Committee, in its report (H.Rept. 111-230 of July 24, 2009) on H.R. 3326, recommends increasing the Navy's funding request for PE0604501N (Advanced Above Water Sensors) by \$23 million, with the additional funding to be used for "Common Digital Sensor Architecture" (\$3 million), "Submarine Navigation Decision Aids" (\$5 million), and "Program Increase – Advanced Sensor Development" (\$15 million) (page 257, line 105). The report recommends reducing the Navy's funding request for PE0204201N (CG[X]) by \$40 million for "Program delay" (page 258, line 134).

Senate

The Senate Appropriations Committee, in its report (S.Rept. 111-74 of September 10, 2009) on H.R. 3326, recommends approving the Navy's funding request for PE0604501N (Advanced Above Water Sensors), and reducing the Navy's funding request for PE0204201N (CG[X]) by \$64 million, of which \$24 million is for "Propulsion development ahead of material solution decision" and \$40 million is for "Unjustified request" (page 177, line 105 and page 184, line 134).

FY2009 Supplemental Appropriations Act (H.R. 2346/P.L. 111-32)

Senate

Section 308 of H.R. 2346 as passed by the Senate would rescind, among other things, \$270.26 million in FY2009 funding for the Research, Development, Test and Evaluation, Navy (RDT&EN) appropriation account. This provision is also present in S. 1054 as reported by the Senate Appropriations Committee. The committee's report on S. 1054 (S.Rept. 111-20 of May 14, 2009, page 55) states that the \$270.26 million includes a rescission of \$100 million in FY2009 funding for the CG(X) program.

House

Section 10012 of H.R. 2346 as passed by the House would rescind, among other things, \$30.51 million in FY2009 RDT&EN funding and \$5 million in FY2008 RDT&EN funding, but the House Appropriation Committee's report on H.R. 2346 (H.Rept. 111-105 of May 12, 2009, page

32) states that these rescissions are for fuel and for a classified program, respectively, rather than for the CG(X) program.

Conference

Section 309 of the conference report (H.Rept. 111-151 of June 12, 2009) on H.R. 2346/P.L. 111-32 of June 24, 2009, includes a rescission of \$73.6 million in FY2009 research and development funding for the CG(X) program. (Page 106)

Appendix. FY2008 Defense Authorization Act Bill and Report Language

The FY2008 defense authorization bill was first reported by the House and Senate Armed Services Committees as H.R. 1585 and S. 1547, respectively. The president vetoed H.R. 1585 on December 28, 2007, citing to objections unrelated to the matters discussed in this CRS report. H.R. 1585 was succeeded by H.R. 4986, a bill that modified certain provisions of H.R. 1585 as to take into account the president's objections. H.R. 4986 was signed into law as P.L. 110-181 on January 28, 2008. For the parts of H.R. 4986 that are the same as H.R. 1585, including the matters discussed in this CRS report, the conference report on H.R. 1585 (H.Rept. 110-477 of December 6, 2008 in effect serves as the conference report for H.R. 4986.

House Report

The House Armed Services Committee, in its report (H.Rept. 110-146 of May 11, 2007) on H.R. 1585 stated the following:

The committee believes that the mobility, endurance, and electric power generation capability of nuclear powered warships is essential to the next generation of Navy cruisers. The Navy's report to Congress on alternative propulsion methods for surface combatants and amphibious warfare ships, required by section 130 of the National Defense Authorization Act for Fiscal Year 2006 (P.L. 109-163), indicated that the total lifecycle cost for medium-sized nuclear surface combatants is equivalent to conventionally powered ships. The committee notes that this study only compared acquisition and maintenance costs and did not analyze the increased speed and endurance capability of nuclear powered vessels.

The committee believes that the primary escort vessels for the Navy's fleet of aircraft carriers should have the same speed and endurance capability as the aircraft carrier. The committee also notes that surface combatants with nuclear propulsion systems would be more capable during independent operations because there would be no need for underway fuel replenishment. (Page 387)

Conference Report

Section 1012 of the conference report (H.Rept. 110-477 of December 6, 2007) on H.R. 1585 stated:

SEC. 1012. POLICY RELATING TO MAJOR COMBATANT VESSELS OF THE STRIKE FORCES OF THE UNITED STATES NAVY.

(a) INTEGRATED NUCLEAR POWER SYSTEMS.—It is the policy of the United States to construct the major combatant vessels of the strike forces of the United States Navy, including all new classes of such vessels, with integrated nuclear power systems.

(b) REQUIREMENT TO REQUEST NUCLEAR VESSELS.—If a request is submitted to Congress in the budget for a fiscal year for construction of a new class of major combatant vessel for the strike forces of the United States, the request shall be for such a vessel with an integrated nuclear power system, unless the Secretary of Defense submits with the request a notification to Congress that the inclusion of an integrated nuclear power system in such vessel is not in the national interest.

(c) DEFINITIONS.—In this section:

(1) MAJOR COMBATANT VESSELS OF THE STRIKE FORCES OF THE UNITED STATES NAVY.—The term “major combatant vessels of the strike forces of the United States Navy” means the following:

(A) Submarines.

(B) Aircraft carriers.

(C) Cruisers, battleships, or other large surface combatants whose primary mission includes protection of carrier strike groups, expeditionary strike groups, and vessels comprising a sea base.

(2) INTEGRATED NUCLEAR POWER SYSTEM.—The term “integrated nuclear power system” means a ship engineering system that uses a naval nuclear reactor as its energy source and generates sufficient electric energy to provide power to the ship’s electrical loads, including its combat systems and propulsion motors.

(3) BUDGET.—The term “budget” means the budget that is submitted to Congress by the President under section 1105(a) of title 31, United States Code.

Regarding Section 1012, the conference report stated:

The Navy’s next opportunity to apply this guidance will be the next generation cruiser, or “CG(X)”. Under the current future-years defense program (FYDP), the Navy plans to award the construction contract for CG(X) in fiscal year 2011. Under this provision, the next cruiser would be identified as “CGN(X)” to designate the ship as nuclear powered. Under the Navy’s normal shipbuilding schedule for the two programs that already have nuclear power systems (aircraft carriers and submarines), the Navy seeks authorization and appropriations for long lead time nuclear components for ships 2 years prior to full authorization and appropriation for construction.

The conferees recognize that the milestone decision for the Navy’s CG(X) is only months away. After that milestone decision, the Navy and its contractors will begin a significant design effort, and, in that process, will be making significant tradeoff decisions and discarding major options (such as propulsion alternatives). This is the normal process for the Navy and the Department of Defense (DOD) to make choices that will lead to producing a contract design that will be the basis for awarding the construction contract for the lead ship in 2011.

In order for the Navy to live by the spirit of this guidance, the conferees agree that:

(1) the Navy would be required to proceed through the contract design phase of the program with a comprehensive effort to design a CGN(X) independent of the outcome of decisions that the Navy regarding any preferred propulsion system for the next generation cruiser;

(2) if the Navy intends to maintain the schedule in the current FYDP and award a vessel in fiscal year 2011, the Navy would need to request advance procurement for nuclear components in the fiscal year 2009 budget request; and

(3) the Navy must consider options for:

- (a) maintaining the segment of the industrial base that currently produces the conventionally powered destroyer and amphibious forces of the Navy;
- (b) certifying yards which comprise that segment of the industrial base to build nuclear-powered vessels; or
- (c) seeking other alternatives for building non-nuclear ships in the future if the Navy is only building nuclear-powered surface combatant ships for some period of time as it builds CGN(X) vessels; and
- (d) identifying sources of funds to pay for the additional near-term costs of the integrated nuclear power system, either from offsets within the Navy's budget, from elsewhere within the Department's resources, or from gaining additional funds for DOD overall.

The conferees recognize that these considerations will require significant additional near-term investment by the Navy. Some in the Navy have asserted that, despite such added investment, the Navy would not be ready to award a shipbuilding contract for a CGN(X) in fiscal year 2011 as in the current FYDP.

Section 128 of the John Warner National Defense Authorization Act for Fiscal Year 2007 (P.L. 109-364) required that the Navy include nuclear power in its Analysis of Alternatives (AOA) for the CG(X) propulsion system. The conferees are aware that the CG(X) AOA is nearing completion, in which case the Navy should have some indications of what it will require to design and construct a CGN(X) class.

Accordingly, the conferees direct the Secretary of the Navy to submit a report to the congressional defense committees with the budget request for fiscal year 2009 providing the following information:

- (1) the set of next generation cruiser characteristics, such as displacement and manning, which would be affected by the requirement for including an integrated nuclear power system;
- (2) the Navy's estimate for additional costs to develop, design, and construct a CGN(X) to fill the requirement for the next generation cruiser, and the optimal phasing of those costs in order to deliver CGN(X) most affordably;
- (3) the Navy's assessment of any effects on the delivery schedule for the first ship of the next generation cruiser class that would be associated with shifting the design to incorporate an integrated nuclear propulsion system, options for reducing or eliminating those schedule effects, and alternatives for meeting next generation cruiser requirements during any intervening period if the cruiser's full operational capability were delayed;
- (4) the Navy's estimate for the cost associated with certifying those shipyards that currently produce conventionally powered surface combatants, to be capable of constructing and integrating a nuclear-powered combatant;
- (5) any other potential effects on the Navy's 30-year shipbuilding plan as a result of implementing these factors;
- (6) such other considerations that would need to be addressed in parallel with design and construction of a CGN(X) class, including any unique test and training facilities, facilities and infrastructure requirements for potential CGN(X) homeports, and environmental assessments that may require long-term coordination and planning; and

(7) an assessment of the highest risk areas associated with meeting this requirement, and the Navy's alternatives for mitigating such risk. (Pages 984-986)

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