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

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

Summary

The Navy is currently developing technologies and studying design options for a planned new cruiser called the CG(X). Navy plans call for procuring the first CG(X) in FY2011, at an estimated cost of about $3.2 billion, and 18 more CG(X)s in subsequent years. If the CG(X) is equipped with a nuclear power plant, which is an option currently being considered by the Navy, then advance procurement funding for the first CG(X) could appear in the FY2009 Navy budget to be submitted to Congress in early 2008. The Navy requested $118 million in FY2008 research and development funding for the CG(X) program.

The Navy is pursuing the CG(X) program in a context that includes concerns about the affordability of the Navy's shipbuilding program, the emergence of the Navy's new ballistic missile defense (BMD) mission, interest on the House Armed Services Committee in having the CG(X) be nuclear-powered, and concerns for the surface combatant industrial base.

The 19 planned CG(X)s are intended to replace the Navy's 22 existing Ticonderoga (CG-47) class Aegis cruisers. The Navy wants the CG(X) to be a highly capable multi-mission ship with an emphasis on air defense and ballistic missile defense (BMD). The Navy is currently assessing CG(X) design options, including the option of nuclear power, in a study called the CG(X) Analysis of Alternatives (AOA) that is to be completed by the end of 2007.

Although the CG(X) AOA is examining a range of design options for the CG(X), the Navy has publicly stated that it prefers a CG(X) design based on the conventionally powered DDG-1000 destroyer hull design. On July 23, 2007, it was reported in the defense trade press that analysts conducting the CG(X) AOA are 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, and 5 larger, nuclear-powered CG(X)s, displacing 23,000 tons to 25,000 tons each.

The CG(X) raises several potential oversight issues for Congress, including the balance in the CG(X) design between unit affordability and unit capability; the accuracy of the Navy's cost estimate for the CG(X); technical risk in the CG(X) program; whether some or all CG(X)s should be nuclear-powered; what kind of hull design the CG(X) should use; the potential impact of the BMD mission on the number of CG(X)s to be procured and the schedule for procuring them; the industrial-base implications of the CG(X) program; and whether the shared-production arrangement for the DDG-1000 should be extended into the CG(X) program.

Congress has several near-term and longer-term options for the CG(X) program. This report will be updated as events warrant.

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Introduction

The Navy is currently developing technologies and studying design options for a planned new cruiser called the CG(X).[1] The Navy wants the CG(X) to be a highly capable multi-mission ship with an emphasis on air defense and ballistic missile defense (BMD). Because the designs of most of the ships in the Navy's shipbuilding program 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 program, the affordability of which is a matter of concern.

Navy plans call for procuring the first CG(X) in FY2011, at an estimated cost of about $3.2 billion, and 18 more CG(X)s in subsequent years. If the CG(X) is equipped with a nuclear power plant, which is an option currently being considered by the Navy, then advance procurement funding for the first CG(X) could appear in the FY2009 Navy budget to be submitted to Congress in early 2008. The Navy requested $118 million in FY2008 research and development funding for the CG(X) program.

The issue for Congress is whether to approve, reject, or modify the Navy's plans for the CG(X) program. Congress's decisions on this issue could affect Navy capabilities and funding requirements, U.S. BMD capabilities, and the U.S. shipbuilding industrial base.

For congressional action on the CG(X) for FY2008, see the "Legislative Activity" section at the end of this report.

This report supercedes an earlier CRS report on the CG(X).[2]

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[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 surface ship, the term *guided missile* means the that ship is equipped with 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] CRS Report RS22559, *Navy CG(X) Cruiser Design Options: Background and Oversight Issues for Congress*, by Ronald O'Rourke.

Background

Context for CG(X) Program

The Navy is pursuing the CG(X) program in a context that includes the following:

- concerns about the affordability of the Navy's shipbuilding program,
- the emergence of the Navy's new BMD mission,
- interest on the House Armed Services Committee in having the CG(X) be nuclear-powered, and
- concerns for the surface combatant industrial base.

Affordability of Navy Shipbuilding Program. The Navy currently faces challenges in being able to afford all the ships in its shipbuilding program, particularly in FY2011 and subsequent years — when the Navy wants to begin procuring CG(X)s. The Congressional Budget Office (CBO) estimates that the Navy's shipbuilding program will cost roughly one-third more than the Navy estimates.[3] Because the designs of most of the ships in the Navy's shipbuilding program 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 program.

New 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 theater-range ballistic missiles (TBMs) equipped with maneuvering re-entry vehicles (MaRVs) that are capable of hitting moving ships at sea — a kind of theat the Navy has not previously faced.[4] 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).[5] The Navy's desire for the CG(X) to be a high-capability BMD platform is a principal reason why the Navy wants 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).

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[3] 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.

[4] 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.

[5] For further discussion of the Navy's BMD program, see 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).[6] The Senate Armed Services Committee and the Defense subcommittees of the House and Senate Appropriations Committees have not expressed a view either way on the issue of nuclear power for the CG(X). The issue of nuclear power for Navy surface ships is discussed in more detail in another CRS report.[7]

Concern for Surface Combatant Industrial Base. All cruisers, destroyers, and frigates procured by the Navy since FY1985 have been built at either one of two shipyards — General Dynamics' Bath Iron Works (GD/BIW) in Bath, ME, and the Ingalls shipyard in Pascagoula, MS, that forms part of Northrop Grumman Ship Systems (NGSS).[8] 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. The financial health of the supplier firms has also 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:[9]

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[6] See, for example, the remarks of Representatives Taylor and Bartlett at the March 1, 2007, hearing before the Seapower and Expeditionary Forces subcommittee on nuclear power for future Navy surface ships.

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

[8] NGSS also includes the Avondale shipyard near New Orleans, LA, and a composite-manufacturing facility at Gulfport, MS.

[9] 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 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

(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,[10]

- **a cruiser called the CG(X)** for the air defense and ballistic missile mission, and

- **a smaller combatant called the Littoral Combat Ship (LCS)** to counter submarines, small surface attack craft, and mines in heavily contested littoral (near-shore) areas.[11]

CG(X)s to Replace CG-47s. The Navy wants to procure 19 CG(X)s as replacements for its 22 existing Ticonderoga (CG-47) class Aegis cruisers, which are projected to reach their retirement age of 35 years between 2021 and 2029.[12] The 19 CG(X)s would form part of a planned force of 88 cruisers and destroyers within the Navy's planned total fleet of 313 ships.[13]

Planned CG(X) Procurement Schedule. The FY2008-FY2013 Future Years Defense Plan (FYDP) calls for procuring the first CG(X) in FY2011 and the second in FY2013. The Navy's 30-year (FY2008-FY2037) shipbuilding plan calls 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.

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[9] (...continued)
development work on the DDG-1000 and CG(X).

[10] For more on the DD(X) program, now called the DDG-1000 program, see CRS Report RL32109, *Navy DDG-1000 (DD(X)) Destroyer Program: Background, Oversight Issues, and Options for Congress*, by Ronald O'Rourke.

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

[12] 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.

[13] The 88 cruisers and destroyers would include 19 CG(X)s, 7 DDG-1000s, and 62 older Arleigh Burke (DDG-51) class Aegis destroyers. For more on the proposed 313-ship fleet, see CRS Report RL32665, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, by Ronald O'Rourke. DDG-51s are equipped with the Aegis combat system and are therefore referred to as Aegis destroyers. A total of 62 DDG-51s were procured between FY1985 and FY2005. The first entered service in 1991. By the end of FY2006, 49 had entered service and the remaining 13 were in various stages of construction, with the final ships scheduled to be delivered in 2010 or 2011. The Navy plans to modernize the DDG-51s to maintain their mission effectiveness to age 35; see CRS Report RS22595, op cit.

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 similarly wants the CG(X) to be a highly capable multi-mission ship with an emphasis on AAW and BMD.

Potential CG(X) Design Features. Although many design features of the CG(X) have not been determined, it is expected that the CG(X) will incorporate many basic technologies developed for the DDG-1000, including technologies permitting a crew that is significantly smaller in number than the crews of current cruisers and destroyers.

The CG(X) is expected to feature a radar 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 has testified 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.[14] The CG(X) radar's greater power is 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 a principal mission).

The CG(X) is expected 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) may be equipped with only one 155mm Advanced Gun System (AGS), or none at all, compared with two AGSs on the DDG-51, two five-inch (127mm) guns on the Navy's Aegis cruisers, and one five-inch gun on the Navy's Aegis destroyers. In September 2007, it was reported that the Navy wants to equip the CG(X) with an electromagnetic rail gun (EMRG) capable of firing projectiles as far as 250 miles — several times the distance possible with conventional (i.e., chemically powered) guns.[15]

CG(X) Analysis of Alternatives (AOA). The Navy is currently assessing 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 Navy initiated this AOA in early 2006 and plans to complete it by the end of 2007.

Stated Preference for CG(X) Design Based on DDG-1000. Although the CG(X) AOA is examining a range of design options for the CG(X), the Navy has publicly stated that it prefers a CG(X) design based on the conventionally powered DDG-1000 hull design. The potential for using the DDG-1000 hull design as the

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

[15] Zachary M. Peterson, "U.S. Navy Wants EM Railgun On New Cruiser," *Defense News*, September 10, 2007. According to the report, the EMRG, which is currently in development, might enter service between 2020 and 2025.

basis for the CG(X) was one of the Navy's arguments for moving ahead with the DDG-1000 program. 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 the following:

> [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.[16]

July 2007 Press Report on Potential Dual-Design Solution. Little information on the CG(X) AOA has come to light. On July 23, 2007, however, it was reported in the defense trade press that analysts conducting the CG(X) AOA are 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,[17] 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 1000[18] and its gas turbine power plant.

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[16] 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?"

[17] If the ship is nuclear-powered, its designation would become CGN(X), with the "N" standing for nuclear power.

[18] 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

(continued...)

> 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....
>
> 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.[19]

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[18] (...continued)
the hull that can strongly reflect enemy radar beams.

[19] 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.

(continued...)

CG(X) Program Funding. **Table 1** shows CG(X) funding through FY2013. As shown in the table, the Navy requested $118 million in FY2008 research and development funding for the program. The $3,235-million procurement cost shown in the table for the first CG(X) is a notional "placeholder" figure, pending the outcome of the AOA, that appears broadly consistent with the cost of a CG(X) design based on the DDG-1000 hull design.

Table 1. CG(X) Program Funding, FY2005-FY2013
(millions of then-year dollars, rounded to nearest million)

	05	06	07	08	09	10	11	12	13	Total thru FY13
Research, Development, Test and Evaluation, Navy (RDTEN) account[a]										
	0	48	15	118	233	380	450	519	529	2292
Shipbuilding and Conversion, Navy (SCN) account										
CG(X) 1	0	0	0	0	0	0	3235	0	0	3235
CG(X) 2	0	0	0	0	0	0	0	0	3064	3064
TOTAL	**0**	**48**	**15**	**118**	**233**	**380**	**3685**	**519**	**3593**	**8591**

Source: Navy Office of Legislative Affairs, March 28, 2007.

a. Does not include RDTEN funding for CG(X) radar in PE 0604501N. FY2006 funding includes $30 million congressional add.

Oversight Issues for Congress

Unit Affordability vs. Unit Capability

One potential oversight issue for Congress, particularly when the results of the CG(X) AOA are reported to Congress, is 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

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[19] (...continued)

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.

balance between unit affordability and unit capability. Achieving such a balance is a classic ship-design challenge.

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.

A dual-design solution for the CG(X) program, such as the one reportedly being 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.[20]

Accuracy of Navy Cost Estimate

CBO believes that the Navy is substantially underestimating DDG-1000 procurement costs[21] and consequently is also substantially underestimating CG(X) procurement costs. CBO believes the first CG(X) would cost about 88% more than the Navy's "placeholder" estimate, and that the average unit cost for all 19 CG(X)s would be about 67% more than the Navy's placeholder estimate for the second CG(X). CBO's also believes that its own cost estimates for the CG(X) may be prove to be too low. CBO testified in July 2007 on its cost estimate for the CG(X):

> CBO assumed that a CG(X) would use the same hull, and cost about the same, as a DDG-1000. The Navy's estimates for the 2011 and 2013 cruisers are

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[20] 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- to 25,000-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.

[21] Statement of J. Michael Gilmore, Assistant Director for National Security, and Eric J. Labs, Senior Analyst, [on] The Navy's 2008 Shipbuilding Plan and Key Ship Programs, before the Subcommittee on Seapower and Expeditionary Forces, Committee on Armed Services, U.S. House of Representatives, July 24, 2007, pp. 14-16.

> based on the same assumption; thus, it expects those ships to cost $2.6 billion and $2.4 billion [in constant 2008 dollars], respectively. However, the Navy is currently conducting an analysis of alternatives to determine what capabilities the CG(X) will have. A version using the DDG-1000's hull and technology is only one option being considered; the Navy says it is also studying versions of the ship that would be larger and more capable, including using nuclear propulsion. (There does not appear to be a design smaller than the DDG-1000 under consideration.) Any design larger than the DDG-1000 is likely to be substantially more expensive than that ship. Using the same method as for its estimate of DDG-1000 costs, CBO estimated that the lead CG(X) would cost $4.9 billion and that the class would average about $4.0 billion per ship....
>
> CBO's estimate for the cost of the CG(X) may be optimistic, however. The last time the Navy reused a hull design for a new class of surface combatants was in the 1970s, when it built Spruance class destroyers and Ticonderoga class cruisers, which had the same hull but were designed for different missions. The Spruance class consisted of general-purpose destroyers intended to escort other Navy ships in wartime and designed particularly for antisubmarine warfare. The Ticonderoga class cruisers incorporated the Aegis antiair combat system, the SPY-1 radar, and surface-to-air missiles to counter threats to carrier battle groups from Soviet naval aviation. Reflecting its more complex combat systems, the lead Ticonderoga cost 60 percent more per thousand tons than the lead Spruance, notwithstanding their many common hull and mechanical systems.[22]

CBO also testified in July 2007 that:

> The relatively simple design of the LCS and the large cost increases that have occurred in the [LCS] program suggest that the Navy may also have trouble meeting its cost targets for the larger, much more complex surface combatants in its shipbuilding plan, such as the DDG-1000 and the CG(X).[23]

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.[24]

A potential key technical risk specific to the CG(X) program concerns its powerful new BMD-capable radar. Delays in the development of this radar could lead to delays in the construction of a CG(X) procured in FY2011.

Nuclear Power

A major ship-design issue for the CG(X) program is whether some or all CG(X)s should be nuclear-powered. As mentioned earlier, the chairman and ranking

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[22] Ibid, p. 16.

[23] Ibid, p. 18.

[24] For more on technical risks in the DDG-1000 program, see CRS Report RL32109, op cit.

member of the Seapower and Expeditionary Forces subcommittee of the House Armed Services Committee strongly support making the CG(X) a nuclear-powered ship.

The Navy reported to Congress in January 2007 that equipping a ship like the CG(X) with a nuclear power plant instead of a conventional (i.e., fossil-fuel) power plant would 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.[25]

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.

Other Ship Design Features

Hull Design. In addition to the above issue of nuclear power, another ship-design issue is whether the CG(X) 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.

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[25] 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 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.)

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 shores. Some observers believe that a hull with reduced delectability 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.

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.[26] 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.[27] The DDG-1000 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.

Kinetic Energy Interceptor (KEI). Another ship design issue is whether the CG(X) should incorporate missile-launch tubes that are large enough to accommodate the Kinetic Energy Interceptor (KEI), a new BMD interceptor now in development that could be used as a ground-based BMD interceptor and perhaps subsequently as a sea-based BMD interceptor. Under current DOD plans, the land-based version of the KEI could become available use in 2014.[28]

The KEI is reportedly about 40 inches in diameter and almost 39 feet in length, which makes it much larger than other missiles currently fired by Navy surface

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[26] For more on the Ford-class program, see CRS Report RS20643, *Navy Ford (CVN-78) Class (CVN-21) Aircraft Carrier Program: Background and Issues for Congress*, by Ronald O'Rourke.

[27] The estimated development cost of the Ford-class plant is roughly $1.5 billion.

[28] For more on the KEI, see Government Accountability Office, *Defense Acquisitions[:] Assessments of Selected Weapon Programs*, March 2007 (GAO-07-406SP), pp. 97-98.

combatants. The largest missile currently fired by Navy surface combatants is the Tomahawk land attack cruise missile, which is 21 inches in diameter and about 21 feet in length. The Navy's current BMD missile — the Standard Missile 3 (SM-3) — is currently smaller than the Tomahawk. Current Navy plans call for enlarging the SM-3 to a "Block II/IIA" configuration that would be comparable in size to the Tomahawk.

The KEI's first-stage rocket engine would be hotter-burning than the first-stage engines of other missiles currently fired from Navy surface combatants. This could require the KEI to be "cold-launched" from a surface ship — that is, popped out of the launch tube and then ignited in mid-air — rather than hot-launched directly from the missile-launch tube, like other missiles currently fired from Navy surface combatants. The Navy has long used the cold-launch technique for launching nuclear-armed ballistic missiles from submerged ballistic missile submarines (SSBNs).

As discussed in another CRS report, potential platforms for basing the KEI at sea include the CG(X), Aegis cruisers or destroyers refitted with KEI-compatible launch tubes, SSBNs, or a non-combat DOD ship (perhaps based on a commercial-ship hull) or floating platform.[29]

Proponents of designing the CG(X) with missile-launch tubes large enough for the KEI could argue that doing so would preserve the option of arming the CG(X) with the KEI, should DOD decide on that course, that arming the CG(X) with the KEI would be consistent with the ship's BMD mission, and that KEI-sized missile-launch tubes could also be used for launching other large missiles that the Navy or DOD in the future might wish to develop and launch from the CG(X). Skeptics of designing the CG(X) with KEI-compatible launch tubes could argue that DOD has not decided whether to base the KEI at sea, that there are options other than the CG(X) for basing the KEI at sea, that the CG(X) will be armed with the SM-3 for BMD operations, and that designing the CG(X) with KEI-compatible launch tubes could require enlarging the ship (which could increase its cost) or, alternatively, reducing other CG(X) design features (which could reduce the CG(X)'s capabilities in other areas).

The July 2007 trade press article on the CG(X) AOA that reported on the Navy's consideration of a dual-design solution for the CG(X) also stated that the AOA:

> will recommend dropping the Kinetic Energy Interceptor (KEI) from the CG(X) program....
>
> The KEI is much larger than the SM-3 Standard missile developed by Raytheon to arm Navy cruisers and destroyers for the BMD role. The 40-inch diameter KEI is nearly 39 feet long, while the 21-inch diameter SM-3 stands just over 21 feet tall. Both missiles use a kinetic energy warhead, intended to ram an enemy missile.

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[29] See CRS Report RL33745, *Sea-Based Ballistic Missile Defense — Background and Issues for Congress*, by Ronald O'Rourke.

> Sources said a missile launch tube for a KEI would need to be so large it would take the place of six SM-3 launch cells.
>
> "That's a poor exchange ratio," said one naval analyst familiar with the AoA.[30]

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.[31]

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 — about three years before the first CG(X) is scheduled to enter service.[32] Given the time needed to develop the CG(X)'s new radar, it might not be possible to accelerate the procurement of the first CG(X) from FY2011 to an earlier year. Once CG(X) procurement were to begin however, it might be possible to accelerate the procurement dates of later ships in the program, so as to get more of the ships in service sooner. Issues to address for this option would include industry capacity and available financial resources. Based on past procurement rates for Aegis cruisers and destroyers, industry capacity might not pose a significant constraint to accelerated CG(X) procurement. On the other hand, accelerating procurement of CG(X)s to earlier years could, in a situation of constrained Navy funding, leave less funding available in those years for meeting other Navy needs.

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

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[30] Christopher P. Cavas, "U.S. May Build 25,000-Ton Cruiser, Analysis of Alternatives Sees Nuclear BMD Vessel," *Defense News*, July 23, 2007.

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

[32] 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.)

the two shipyards that have built all the Navy's cruisers and destroyers in recent years — GD/EB and NGSS — are not licensed to build nuclear-powered ships.[33]

The only two U.S. shipyards currently licensed to build nuclear-powered ships for the Navy are Northrop Grumman Newport News (NGNN) of Newport News, VA, 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 NGNN, with GD/EB possibly contributing to the construction of the ships' nuclear portions.
- License GD/IW and/or NGSS 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 NGNN and/or GD/EB, the non-nuclear portions at GD/BIW and/or NGSS, and perform final assembly, integration, and test work for the ships at either
  - NGNN and/or GD/EB, or
  - GD/BIW and/or NGSS.

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 NGSS and/or GD/BIW to build nuclear-powered ships, the director of NR 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

[33] 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.)

> 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.[34]

The director of NR testified that NGNN and GD/BIW "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."[35] In light of this, the Navy testified, only the first and third options above are "viable."[36] 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.[37]

With regard to the third option of building the nuclear portions of the ships at NGNN and/or GD/EB, and the non-nuclear portions at NGSS and/or GD/BIW, the Navy testified that the "[l]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 NGNN 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.

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

[35] 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.

[36] 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.

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

> 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?[38]

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.

Shared Production

NGSS and GD/BIW have agreed on a shared-production arrangement for building DDG-1000s. Under this arrangement, certain parts of each ship will be built by NGSS, certain other parts of each ship will be built by GD/BIW, and the remaining parts of each ship would be built by the yard that does final-assembly work on that ship. The arrangement is somewhat analogous to the joint-production arrangement currently in place for the Virginia-class submarine program.

If the CG(X) design is derived from the DDG-1000 design, supporters of the DDG-1000 shared-production arrangement might argue that it would make sense to extend the arrangement into the CG(X) program. If so, then one potential question for Congress is whether a shared-production arrangement that makes sense for the DDG-1000 program would also make sense for the CG(X) program. A shared-production arrangement can help preserve production learning-curve benefits in a program like the DDG-1000, where a limited number of ships (seven) are to be produced by two shipyards under a relatively low government procurement rate of about one ship per year (i.e., an average of about one-half of a ship per year for each yard). In a program like the CG(X), where a larger number of ships (19) are to be produced at a sustained government procurement rate of two ships per year (i.e., an average of one ship year for each of the two yards), a shared-production arrangement might not be as necessary to preserve production learning-curve benefits, and could limit the degree to which the Navy could use competition between the yards to restrain CG(X) procurement costs.

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[38] 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.

Options for Congress

Potential Near-Term Options

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

- approve the CG(X) program as proposed by the Navy;
- 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 GAO or CBO;
- modify the CG(X) program's proposed research and development funding request;
- pass legislation, or include report language, on questions such as the following:
  - whether the CG(X) should be nuclear-powered,
  - a potential target procurement cost of the CG(X),
  - whether CG(X)s should be built under a shared-production arrangement or some other arrangement, or
  - other aspects of the CG(X) acquisition strategy, such as the use of competition in the awarding of construction contracts for the ships; and
- 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.

With regard to the last of these options, an October 2006 journal article by a 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). [39] The idea of extending the service lives of Navy cruisers and destroyers is not without precedent: between

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[39] 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).

1989 and 1993, the Navy planned to keep its surface combatants in operation for 40 years rather than 35.[40] Whether it would be feasible or cost effective today to extend the lives of Navy the Navy's Aegis cruisers and destroyers is unclear, given changes in certain circumstances since 1989-1993.[41]

Potential Longer-Term Options

Potential longer-term options for Congress for the CG(X) program, some of which could be combined, and some of which overlap with options for the DDG-1000 program, include but are not limited to the following:

- use a block-buy contract or a multiyear procurement (MYP) arrangement for procuring CG(X)s in future years;
- procure more than 19 CG(X)s, or accelerate procurement of follow-on CG(X)s to earlier years;
- defer procurement of the first CG(X) beyond FY2011 to permit additional time for development of the CG(X)'s radar, or additional time for procurement of DDG-1000s prior to commencement of CG(X) procurement;

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[40] Under a Navy plan proposed in 1989, surface combatants would spend the first 20 years of their lives as front-line ships that the Navy then called battle force combatants (BFCs), and the second 20 years of their lives performing less-demanding escort missions that the Navy then called protection-of-shipping (POS) missions. The plan to migrate ships from the more-demanding BFC role to the less-demanding POS role over their 40-year lives, which the Navy called "flexible transition," was intended to reduce the amount of mid-life modernization work needed to keep the ships mission-effective during their second 20 years of operation. (Source: Navy briefing entitled "Briefing For House Armed Services Committee, Seapower Sub-Committee, 23 February 1989." The Navy gave a similar briefing to the Senate Armed Services Committee on May 2, 1989.) The Navy proposed a similar plan in 1993 for maintaining a force of about 80 "unrestricted" (i.e., more capable) ships and about 40 "restricted" (i.e., less capable) ships operating over 40-year lives. (Source: Navy briefing on 21st century destroyer study, provided by the Navy to CRS in June 1993, slides 61 and 62.)

[41] Depending on how intensively they are used in coming years, today's Aegis ships 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 today's Aegis ships are in good enough structural and mechanical condition to permit operation beyond age 35, experience with past surface combatant designs suggests that the Aegis 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. The end of the Cold War has also reduced the number of less demanding escort missions that might be fulfilled cost-effectively by ships that are 36 to 40 years old.

- as an annual affordability measure, limit DDG-1000/CG(X) procurement to a combined total of no more than one ship per year;[42] and

- as total-program affordability measure, limit DDG-1000/CG(X) procurement to a combined total of 12 ships (one for each of 12 planned carrier strike groups [CSGs]).

Legislative Activity for FY2008

FY2008 Defense Authorization Bill (H.R. 1585/S. 1547)

FY2008 Funding Request. The Navy requested $118 million in FY2008 research and development funding for the CG(X) program. This $118 million is included within $621.5 million that the Navy requested for a line item (i.e., program element) in the Navy's research and development account called "SC-21 Total Ship System Engineering" (PE0604300N, the 100th line item in the account). This line item includes research and development funding for both the DDG-1000 and CG(X) programs. SC-21 means surface combatant for the 21st Century and refers to the Navy's pre-November 2001 SC-21 program to develop a destroyer called the DD-21 (now called the DDG-1000) and an eventual cruiser called the CG-21 (now called CG(X)).

House. The House Armed Services Committee, in its report (H.Rept. 110-146 of May 11, 2007) on H.R 1585, recommended increasing the Navy's $621.5-million funding request for research and development on the DDG-1000 and CG(X) programs by $9 million for work on a permanent magnet motor (page 179).

The House-passed version of the FY2008 defense authorization bill (H.R. 1585) contains a provision (Section 1012) that would make it U.S. policy to build cruisers and other large surface combatants, as well as submarines and aircraft carriers, with nuclear power unless the Secretary of Defense notifies Congress that nuclear power for a given class of ship would not be in the national interest. The provision states:

> 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

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[42] Although this option could reduce annual DDG-1000/CG(X) procurement costs, it could increase total DDG-1000/CG(X) procurement costs because of the reduced economies of scale from limiting production to one ship per year.

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.

The committee's report states the following in regard to Section 1012:

This section would require that all new ship classes of submarines, cruisers, and aircraft carriers be built with nuclear power systems unless the Secretary of Defense notifies the committee that it is not in the national interest to do so.

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 (Public Law 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)

Senate. The Senate Armed Services Committee, in its report (S.Rept. 110-77 of June 5, 2007) on S. 1547, recommended increasing the Navy's $621.5-million funding request for research and development on the DDG-1000 and CG(X)

programs by $15 million for work on a permanent magnet motor ($9 million) and an advanced wireless encryption module ($6 million). (Page 187)

FY2008 Defense Appropriations Bill (H.R. 3222)

House. The House Appropriations Committee, in its report (H.Rept. 110-279 of July 30, 2007) on H.R. 3222, recommended increasing the Navy's $621.5-million funding request for research and development on the DDG-1000 and CG(X) programs by $8 million for work on a floating area network (FAN) littoral sensor grid ($5 million), SmartLink planar scanner antenna modernization ($2 million), and a wireless maritime inspection system ($1 million). (Page 338)

The report stated the following regarding the Kinetic Energy Interceptor (KEI):

> The Committee has included $372,853,000 for the Kinetic Energy Interceptor (KEI) program, an increase of $145,354,000 above the budget request. In the fiscal year 2008 request, the Missile Defense Agency (MDA) reduced the planned funding by $178,009,000 to $227,499,000. Additionally, the MDA drastically descoped the program. Even though the KEI program has met each knowledge point while remaining on schedule and on budget, it has been used as an offset on numerous occasions for other more high risk programs. As originally conceived, the KEI mission is as a boost phase defense weapon with mobile capability on land and sea. In the current request, the KEI has been descoped to a booster program aimed at replacing the Ground-based Midcourse Interceptor. The Committee disagrees with this change and has provided additional funding in an effort to accelerate this much-needed capability. (Pages 383-384)

Senate. The Senate Appropriations Committee, in its report (S.Rept. 110-155 of September 14, 2007) on H.R. 3222, recommended increasing the Navy's $621.5 million funding request for research and development on the DDG-1000 and CG(X) programs by $16 million for work on a permanent magnet motor ($9 million), an advanced wireless encryption module ($3 million), and bio/nano MEMS (micro-electro mechanical systems) for defense applications ($4 million). (Page 227)

The report stated the following regarding the KEI:

> According to the budget justification materials, KEI has three objectives: "(1) to develop a midcourse interceptor capable of replacing the current fixed Ground-based interceptor (GBI) when the deployed GBIs become obsolete; (2) to develop this interceptor so that it could be strategically deployed as an additional midcourse capability with mobile land- or sea-based launchers; and (3) to assume the boost- and ascent-phase intercept mission within the Ballistic Missile Defense System (BMDS) if the Airborne Laser (ABL) fails to meet its performance objectives." The Committee believes that these objectives are premature, that existing systems can achieve the same goals, and that the missile is not suitable for Navy platforms....
>
> The Committee is concerned that MDA is developing KEI as a replacement for the GBI's prematurely since the GBI's are still under development, the fielded GBI's undergo continuous upgrades and retrofits, and the GBI's still have to undergo significant testing. Furthermore, additional midcourse capability can

be achieved with upgrading current mobile systems, such as Theater High Altitude Area Defense (THAAD). In addition, a study is currently underway on sea-basing the KEI, including an examination of Navy platforms suitable for hosting the large KEI. The Committee has not been informed that any current or future Navy ship will be outfitted with the KEI, and it appears that there are few, if any, viable platforms. Therefore, the Committee recommends a reduction of $30,000,000 for the KEI program. (Page 268)