Navy Littoral Combat Ship (LCS) Program: Background and Issues for Congress

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Summary

The Littoral Combat Ship (LCS) is a relatively inexpensive Navy surface combatant equipped with modular "plug-and-fight" mission packages. The Navy wants to field a force of 55 LCSs. Twelve LCSs have been funded through FY2012, and the FY2013-FY2017 Future Years Defense Plan (FYDP) calls for procuring 16 more, in annual quantities of 4-4-4-2-2.

The Navy's proposed FY2013 budget requests $1,785.0 million in procurement funding for the four LCSs requested for FY2013. The Navy's proposed budget also requests $102.6 million in procurement funding for LCS mission modules.

There are two very different LCS designs—one developed by an industry team led by Lockheed, and another developed by an industry team that was led by General Dynamics. The Lockheed design is built at the Marinette Marine shipyard at Marinette, WI; the General Dynamics design is built at the Austal USA shipyard at Mobile, AL. LCSs 1, 3, 5, and so on are Marinette Marine-built ships; LCSs 2, 4, 6, and so on are Austal-built ships.

The 20 LCSs procured or scheduled for procurement in FY2010-FY2015—LCSs 5 through 24—are being acquired under a pair of 10-ship block buy contracts. Congress granted the Navy the authority for the block buy contracts in Section 150 of H.R. 3082/P.L. 111-322 of December 22, 2010, and the Navy awarded the block buy contracts to Lockheed and Austal USA on December 29, 2010. The contracts are both fixed-price incentive (FPI) block-buy contracts.

The LCS program has encountered controversy from time to time over the years over various program-related issues. Some observers, citing these issues, potential future Navy operations, and potential future constraints on defense spending, have proposed truncating the number of LCSs to be procured. In response to criticisms of the LCS program, the Navy over the years has acknowledged certain problems and stated that it was taking action to correct them, disputed other arguments made against the program, and maintained its support for the program and for procuring a total of 55 LCSs.

Current issues for Congress concerning the LCS program include the LCS's prospective mission performance and cost-effectiveness, the combat survivability of the LCS, hull cracking and engine problems on LCS-1, and corrosion on LCS-2.

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Introduction

This report provides background information and potential issues for Congress on the Littoral Combat Ship (LCS), a relatively inexpensive Navy surface combatant equipped with modular "plug-and-fight" mission packages. The Navy's proposed FY2013 budget requests funding for the procurement of four LCSs.

Current issues for Congress concerning the LCS program include the LCS's prospective mission performance and cost-effectiveness, the combat survivability of the LCS, hull cracking and engine problems on LCS-1, and corrosion on LCS-2.

Background

The Program in General

The LCS in Brief

The LCS program was announced on November 1, 2001.[1] The LCS is a relatively inexpensive Navy surface combatant that is to be equipped with modular "plug-and-fight" mission packages, including unmanned vehicles (UVs). Rather than being a multimission ship like the Navy's larger surface combatants, the LCS is to be a focused-mission ship, meaning a ship equipped to perform one primary mission at any given time. The ship's mission orientation can be changed by changing out its mission packages. The basic version of the LCS, without any mission packages, is referred to as the LCS sea frame.

The LCS's originally stated primary missions are antisubmarine warfare (ASW), mine countermeasures (MCM), and surface warfare (SUW) against small boats (including so-called "swarm boats"), particularly in littoral (i.e., near-shore) waters. The LCS program includes the development and procurement of ASW, MCM, and SUW mission packages for LCS sea frames. The LCS's permanently built-in gun 57 mm gives it some ability to perform the SUW mission even without an SUW module.

Additional potential missions for the LCS include peacetime engagement and partnership-building operations; intelligence, surveillance, and reconnaissance (ISR) operations; maritime intercept operations; support of special operations forces; and homeland defense operations. An LCS might perform these missions at any time, regardless of its installed mission module,

[1] On November 1, 2001, the Navy announced 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: a destroyer called the DD(X)—later redesignated the DDG-1000—for the precision long-range strike and naval gunfire mission; 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. 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. For more on the CG(X) program, see CRS Report RL34179, *Navy CG(X) Cruiser Program: Background for Congress*, by Ronald O'Rourke.

although an installed mission module might enhance an LCS's ability to perform some of these missions.

The LCS displaces about 3,000 tons, making it about the size of a corvette (i.e., a light frigate) or a Coast Guard cutter. It has a maximum speed of more than 40 knots, compared to something more than 30 knots for the Navy cruisers and destroyers. The LCS has a shallower draft than Navy cruisers and destroyers, permitting it to operate in certain coastal waters and visit certain ports that are not accessible to Navy cruisers and destroyers.

Planned Procurement Quantities

The Navy plans to procure 55 LCS sea frames and 64 LCS mission packages (16 ASW, 24 MCM, and 24 SUW). The Navy's planned force of 55 LCSs would account for 17.5% to 17.7%, or more than one-sixth, of the Navy's planned fleet of about 310-316 ships of all types.[2] **Table 1** shows past and projected annual procurement quantities for LCS sea frames.

Table 1. Past and Projected Annual Procurement Quantities

FY05	FY06	FY07	FY08	FY09	FY10	FY11
1	1	0	0	2	2	2
FY12	***FY13***	***FY14***	***FY15***	***FY16***	***FY17***	
4	*4*	*4*	*4*	*2*	*2*	

Source: Prepared by CRS based on FY2013 Navy budget submission and congressional reports on annual defense authorization and appropriations acts.

Notes: (1) The two ships shown in FY2005 and FY2006 were funded through Navy's research and development account rather than the Navy's shipbuilding account. (2) The figures for FY2006-FY2008 do not include five LCSs (two in FY2006, two in FY2007, and one in FY2008) that were funded in those years but later canceled by the Navy. For details on these five canceled ships, see **Table C-1** in **Appendix C**.

Two LCS Designs

On May 27, 2004, the Navy awarded contracts to two industry teams—one led by Lockheed Martin, the other by General Dynamics (GD)—to design two versions of the LCS, with options for each team to build up to two LCSs each. The LCS designs developed by the two teams are quite different—the Lockheed team's design is based on a steel semi-planing monohull, while the GD team's design is based on an aluminum trimaran hull (see **Figure 1**). The two ships also use different built-in combat systems (i.e., different collections of built-in sensors, computers, software, and tactical displays) that were designed by each industry team. The Navy states that both LCS designs meet the Key Performance Parameters (KPPs) for the LCS program.

[2] For more on the Navy's planned fleet, see CRS Report RL32665, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, by Ronald O'Rourke.

Figure 1. Lockheed LCS Design (Top) and General Dynamics LCS Design (Bottom)

Source: Source: U.S. Navy file photo accessed by CRS at http://www.navy.mil/list_all.asp?id=57917 on January 6, 2010.

Two LCS Shipyards

The Lockheed LCS design is built at the Marinette Marine shipyard at Marinette, WI.[3] The GD LCS design is built at the Austal USA shipyard at Mobile, AL.[4] Odd-numbered LCSs (i.e., LCS-1, LCS-3, LCS-5, and so on) use the Lockheed design; even numbered LCSs (i.e., LCS-2, LCS-4, LCS-6, and so on) use the GD design.

Table 2 shows the construction status of the 12 LCSs funded through FY2012.[5] LCSs 5 through 12 are the first eight LCSs executed under the two LCS block-buy contracts that are described later in this report (see "2010 Dual-Award Acquisition Strategy (Implemented)").

Table 2. Construction Status of LCSs

FY funded	Hull designation	Shipyard	Status
2005	LCS-1	Marinette Marine	**Commissioned into service** November 8, 2008.
2006	LCS-2	Austal USA	**Commissioned into service** January 16, 2010.
2009	LCS-3	Marinette Marine	**Under construction.** Delivery scheduled for June 2012.
	LCS-4	Austal USA	**Under construction.** Delivery scheduled for March 2013.
2010	LCS-5	Marinette Marine	**Under construction.** Delivery scheduled for August 2014.
	LCS-6	Austal USA	**Under construction.** Delivery scheduled for June 2014.
2011	LCS-7	Marinette Marine	**Under construction.** Delivery scheduled for April 2015.
	LCS-8	Austal USA	**Under construction.** Delivery scheduled for October 2014.
2012	LCS-9	Marinette Marine	**Under construction.** Delivery scheduled for February 2016.
	LCS-10	Austal USA	**Under construction.** Delivery scheduled for August 2015.
	LCS-11	Marinette Marine	**Under construction.** Delivery scheduled for August 2016.
	LCS-12	Austal USA	**Under construction.** Delivery scheduled for March 2016.

Source: Prepared by CRS based on FY2013 Navy budget submission.

Notes: This table excludes five LCSs funded in FY2006-FY2008 but later canceled by the Navy; these five canceled LCSs are shown in **Table C-1** in **Appendix C**.

Mission Package Deliveries and Initial Operational Capability (IOC) Dates

As of March 29, 2012, the first two MCM mission modules, the first two SUW mission modules, and the first ASW mission module had been delivered.[6] LCS mission modules are currently

[3] Marinette Marine is a division of the Fincantieri Marine Group, an Italian shipbuilding firm. In 2009, Fincantieri purchased Manitowoc Marine Group, the owner of Marinette Marine and two other shipyards. Lockheed is a minority investor in Marinette Marine.

[4] Austal USA was created in 1999 as a joint venture between Austal Limited of Henderson, Western Australia, and Bender Shipbuilding & Repair Company of Mobile, AL, with Austal Limited as the majority owner.

[5] **Table 2** excludes five LCSs that were funded in FY2006-FY2008 but later canceled by the Navy; these five canceled LCSs are shown in **Table C-1** in **Appendix C**.

[6] Statement of the Honorable Sean J. Stackley, Assistant Secretary of the Navy (Research, Development and Acquisition), and Vice Admiral John Terence Blake, Deputy Chief of Naval Operations for Integration of Capabilities (continued...)

undergoing testing. The Navy states in its FY2013 budget submission that the SUW mission package is scheduled to achieve Initial Operational Capability (IOC) in late FY2013, that the MCM mission package is scheduled to achieve IOC in late FY2014, and that the ASW mission package is scheduled to achieve IOC in late FY2016.[7]

Manning and Deployment Concept

The LCS employs automation to achieve a reduced-sized core crew (i.e., sea frame crew). The program's aim was to achieve a core crew of 40 sailors. Another 35 to 40 additional sailors are to operate the ship's embarked aircraft (about 15 sailors) and mission packages (about 25 sailors), which would make for a total crew of about 75 to 80, compared to more than 200 for the Navy's frigates and about 300 (or more) for the Navy's current cruisers and destroyers.

In July 2012, it was reported that initial experience in operating the first two LCSs has led to a Navy decision to increase the size of the LCS core crew by up to 20 sailors (i.e., an increase of up to 50% over the original aim of a core crew of 40). This would increase the ship's total crew (including aircraft and mission packages) to 95-100. The increase in core crew size reportedly was to be implemented first on LCS-1, starting in July 2012.[8]

The Navy plans to maintain three LCS crews for each two LCSs, and to keep one of those two LCSs continuously underway—a plan Navy officials refer to as "3-2-1." Under the 3-2-1 plan, LCSs are to be deployed for 16 months at a time, and crews are to rotate on and off deployed ships at four-month intervals.[9] The 3-2-1 plan will permit the Navy to maintain a greater percentage of the LCS force in deployed status at any given time than would be possible under the traditional approach of maintaining one crew for each LCS and deploying LCSs for six or seven months at a time. The Navy plans to forward-station up to four LCSs in the Western Pacific at Sinagpore, and up to eight LCSs in the Persian Gulf at Bahrain.

Unit Procurement Cost Cap

LCS sea frames procured in FY2010 and subsequent years are subject to a unit procurement cost cap. The legislative history of the cost cap is as follows:

- The cost cap was originally established by **Section 124 of the FY2006 National Defense Authorization act** (H.R. 1815/P.L. 109-163 of January 6, 2006). Under this provision, the fifth and sixth ships in the class were to cost no more than $220 million each, plus adjustments for inflation and other factors.

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and Resources, and Lieutenant General Richard P. Mills, Deputy Commandant, Combat Development and Integration & Commanding General, Marine Corps Combat Development Command, before the Subcommittee on Seapower and Projection Forces of the House Armed Services Committee [Hearing] on Navy Shipbuilding Acquisition Programs and Budget Requirements of the Navy's Shipbuilding and Construction Plan, March 29, 2012, pp. 8-9.

[7] Department of Defense, *Department of Defense Fiscal Year (FY) 2013 President's Budget Submission, Navy Justification Book Volume 2, Research, Development, Test & Evaluation, Navy Budget Activity 4*, February 2012, page 446 (pdf page 488 of 940), bottom line of schedule chart.

[8] Christopher P. Cavas, "U.S. Navy Boosting LCS Core Crew Up To 50%," *Defense News*, July 2, 2012: 8.

[9] See, for example, Grace Jean, "Buying Two Littoral Combat Ship Designs Saves the Navy $600 Million, Official Says," *NationalDefenseMagazine.org*, January 12, 2011.

- The cost cap was amended by **Section 125 of the FY2008 National Defense Authorization Act** (H.R. 4986/P.L. 110-181 of January 28, 2008). This provision amended the cost cap to $460 million per ship, with no adjustments for inflation, and applied the cap to all LCSs procured in FY2008 and subsequent years.
- The cost cap was amended again by **Section 122 of the FY2009 Duncan Hunter National Defense Authorization Act** (S. 3001/P.L. 110-417 of October 14, 2008). This provision deferred the implementation of the cost cap by two years, applying it to all LCSs procured in FY2010 and subsequent years.
- The cost cap was amended again by **Section 121(c) and (d) of the FY2010 National Defense Authorization Act** (H.R. 2647/P.L. 111-84 of October 28, 2009). The provision adjusted the cost cap to $480 million per ship, excluded certain costs from being counted against the $480 million cap, included provisions for adjusting the $480 million figure over time to take inflation and other events into account, and permitted the Secretary of the Navy to waive the cost cap under certain conditions.[10] The Navy states that after taking inflation into account, the $480 million figure equates, as of December 2010, to $538 million.

Acquisition Cost

The Department of Defense's (DOD's) December 31, 2011, Selected Acquisition Report (SAR) for the LCS program, which was released on March 29, 2012, estimates the total acquisition cost for 55 LCS sea frames at $37,440.5 million (i.e., about $37.4 billion) in then-year dollars. This figure includes $3,457.3 million in research and development costs (including funds for the construction of LCS-1 and LCS-2), $33,746.6 million in procurement costs for LCSs 3 through 55, and $236.6 million in military construction (MilCon) costs. The SAR reports that, in constant FY2010 dollars, these figures become $30,677.5 million, including $3,391.4 million in research and development costs, $27,083.4 million in procurement costs, and $202.7 million in MilCon costs, respectively.[11] These figures are changed only slightly from those reported in the December 31, 2010, SAR for the program.

The December 31, 2011, SAR does not contain estimated acquisition costs for the planned total of 64 LCS mission packages. The SAR for December 31, 2010 stated:

[10] Section 121(d)(1) states that the Secretary of the Navy may waive the cost cap if:

> (A) the Secretary provides supporting data and certifies in writing to the congressional defense committees that—
>
> (i) the total amount obligated or expended for procurement of the vessel-
>
> (I) is in the best interest of the United States; and
>
> (II) is affordable, within the context of the annual naval vessel construction plan required by section 231 of title 10, United States Code; and
>
> (ii) the total amount obligated or expended for procurement of at least one other vessel authorized by subsection (a) has been or is expected to be less than $480,000,000; and
>
> (B) a period of not less than 30 days has expired following the date on which such certification and data are submitted to the congressional defense committees.

[11] Department of Defense, *Selected Acquisition Report (SAR), LCS*, as of December 31, 2011, p. 12.

> On February 18, 2011, USD(AT&L)[12] conducted a Milestone B (MS B) Defense Acquisition Board (DAB) for the seaframe portion of the LCS program. The decision of the DAB was to separate the program into two separate and distinct programs with separate reporting requirements. The Seaframe portion of the program is reported in this SAR as approved at MS B. The Mission Module portion of the program will begin reporting when it receives its Milestone B decision.[13]

Operation and Support (O&S) Cost

DOD's December 31, 2011, SAR for the sea frame portion of the LCS program estimates the total life-cycle operation and support (O&S) cost for 55 sea frames, each operated for 25 years, at $87,089.3 million (i.e., about $87.1 billion) in then-year dollars, or $50,479.0 million in constant FY2010 dollars. Included in this estimate are costs for 83 LCS sea frame crews (i.e., 3 crews for every two ships—see "Manning and Deployment Concept" above) consisting of 40 core crew members each. The SAR estimates the annual O&S cost of a single LCS sea frame at $36.6 million in constant FY2010 dollars.[14] These figures are unchanged from the December 31, 2010, SAR,[15] and do not account for the Navy's decision, reported in July 2012 (see "Manning and Deployment Concept" above), to increase the LCS core crew by up to 20 sailors.

The above estimated life-cycle O&S costs in the SAR do not include life-cycle O&S costs for 64 LCS mission modules and the additional crew members that would be embarked on LCSs to operate them.

The Congressional Budget Office (CBO) estimated O&S costs for LCS sea frames in an April 28, 2010, letter.[16] A February 2010 Government Accountability Office (GAO) report commented on a 2009 Navy estimate of LCS O&S costs.[17]

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[12] The Under Secretary of Defense (Acquisition, Technology, and Logistics)—DOD's acquisition executive.

[13] Department of Defense, *Selected Acquisition Report (SAR), LCS*, as of December 31, 2010, p. 4.

[14] Department of Defense, *Selected Acquisition Report (SAR), LCS*, as of December 31, 2010, p. 37. Dividing the figure of $50,479.0 million by 55 ships and 25 years per ship produces a figure of $36.7 million per ship per year. The SAR states: "The difference between total Operating and Support (O&S) cost and the average annual cost per ship is approximately $145 million of disposal costs for 55 ships. The additional nine million difference is attributable to a small variance in the calculation of the annual cost per hull."

[15] The December 31, 2011, SAR, like the December 31, 2010, SAR, states that the "Source of [the] estimate is the Navy Service Cost Position and the OSD Independent Cost Estimate developed and approved in support of the LCS Seaframe Milestone B decision in February, 2011."

[16] Letter dated April 28, 2010, from Douglas W. Elmendorf, Director, CBO, to the Honorable Jeff Sessions, 8 pp. The full text of the letter is available online at http://www.cbo.gov/ftpdocs/114xx/doc11431/04-28-SessionsLetter.pdf.

[17] The GAO report stated:

> The Navy estimated operating and support costs for LCS seaframes and mission packages in 2009, but the estimates do not fully reflect DOD and GAO best practices for cost estimating and may change due to program uncertainties. GAO's analysis of the Navy's 2009 estimates showed that the operating and support costs for seaframes and mission packages could total $84 billion (in constant fiscal year 2009 dollars) through about 2050. However, the Navy did not follow some best practices for developing an estimate such as (1) analyzing the likelihood that the costs could be greater than estimated, (2) fully assessing how the estimate may change as key assumptions change, and (3) requesting an independent estimate and comparing it with the program estimate. The estimates may also be affected by program uncertainties, such as potential changes to force structure that could alter the number of ships and mission packages required. The costs to operate and support a weapon system can total 70 percent of a system's costs, and the lack of an estimate that fully reflects best practices could limit decision makers' ability to identify the resources that

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Major Program Developments

Growth in Sea Frame Procurement Costs

The Navy originally spoke of building LCS sea frames for about $220 million each in constant FY2005 dollars. Costs for the first few LCSs subsequently more than doubled. For a detailed discussion of cost growth on the first few LCS sea frames from the FY2007 budget through the FY2013 budget, see **Appendix B**.

2007 Program Restructuring and Ship Cancellations

The Navy substantially restructured the LCS program in 2007 in response to significant cost growth and delays in constructing the first LCS sea frames. This restructuring led to the cancellation of four LCSs that were funded in FY2006 and FY2007. A fifth LCS, funded in FY2008, was cancelled in 2008. For details on the 2007 program restructuring and the cancellation of the five LCSs funded in FY2006-FY2008, see **Appendix C**.

2009 Down Select Acquisition Strategy (Not Implemented)

On September 16, 2009, the Navy announced a proposed acquisition strategy under which the Navy would hold a competition to pick a single design to which all LCSs procured in FY2010 and subsequent years would be built (i.e., carry out a design "down select").[18] Section 121(a) and

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> will be needed over the long term to support the planned investment in LCS force structure. With a decision pending in 2010 on which seaframe to buy for the remainder of the program, decision makers could lack critical information to assess the full costs of the alternatives.
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> (Government Accountability Office, *Littoral Combat Ship[:] Actions Needed to Improve Operating Cost Estimates and Mitigate Risks in Implementing New Concepts*, GAO-10-257, February 2010, summary page.)

[18] The winner of the down select would be awarded a contract to build 10 LCSs over the five-year period FY2010-FY2014, at a rate of two ships per year. The Navy would then hold a second competition—open to all bidders other than the shipyard building the 10 LCSs in FY2010-FY2014—to select a second shipyard to build up to five additional LCSs to the same design in FY2012-FY2014 (one ship in FY2012, and two ships per year in FY2013-FY2014). These two shipyards would then compete for contracts to build LCSs procured in FY2015 and subsequent years.

Prior to the Navy's announcement of September 16, 2009, the Navy had announced an acquisition strategy for LCSs to be procured in FY2009 and FY2010. Under this acquisition strategy, the Navy bundled together the two LCSs funded in FY2009 (LCSs 3 and 4) with the three LCSs to be requested for FY2010 into a single, five-ship solicitation. The Navy announced that each LCS industry team would be awarded a contract for one of the FY2009 ships, and that the prices that the two teams bid for both the FY2009 ships and the FY2010 ships would determine the allocation of the three FY2010 ships, with the winning team getting two of the FY2010 ships and the other team getting one FY2010 ship. This strategy was intended to use the carrot of the third FY2010 ship to generate bidding pressure on the two industry teams for both the FY2009 ships and the FY2010 ships.

The Navy stated that the contracts for the two FY2009 ships would be awarded by the end of January 2009. The first contract (for Lockheed Martin, to build LCS-3) was awarded March 23, 2009; the second contract (for General Dynamics, to build LCS-4) was awarded May 1, 2009. The delay in the awarding of the contracts past the end-of-January target date may have been due in part to the challenge the Navy faced in coming to agreement with the industry teams on prices for the two FY2009 ships that would permit the three FY2010 ships to be built within the $460 million LCS unit procurement cost cap. See also Statement of RADM Victor Guillory, U.S. Navy Director of Surface Warfare, and RADM William E. Landay, III, Program Executive Officer Ships, and Ms. E. Anne Sandel, Program Executive Officer Littoral and Mine Warfare, before the Subcommittee on Seapower and Expeditionary Forces of the House (continued...)

(b) of the FY2010 National Defense Authorization Act (H.R. 2647/P.L. 111-84 of October 28, 2009) provided the Navy authority to implement this down select strategy. The Navy's down select decision was expected to be announced by December 14, 2010, the date when the two LCS bidders' bid prices would expire.[19] The down select strategy was not implemented; it was superseded in late December 2010 by the current dual-award acquisition strategy (see next section). For additional background information on the down select strategy, see **Appendix D**.

2010 Dual-Award Acquisition Strategy (Implemented)

On November 3, 2010, while observers were awaiting the Navy's decision under the down select strategy (see previous section), the Navy notified congressional offices that it was prepared to implement an alternative dual-award acquisition strategy under which the Navy would forego making a down select decision and instead award each LCS bidder a 10-ship block buy contract for the six-year period FY2010-FY2015, in annual quantities of 1-1-2-2-2-2.[20] The Navy stated that, compared to the down select strategy, the dual-award strategy would reduce LCS procurement costs by hundreds of millions of dollars. The Navy needed additional legislative authority from Congress to implement the dual-award strategy. The Navy stated that if the additional authority were not granted by December 14, the Navy would proceed to announce its down select decision under the acquisition strategy announced on September 16, 2009. On December 13, 2010, it was reported that the two LCS bidders, at the Navy's request, had extended the prices in their bids to December 30, 2010, effectively giving Congress until then to decide whether to grant the Navy the authority needed for the dual-award strategy.

The Navy's November 3, 2010, proposal of a dual-award strategy posed an issue for Congress of whether this strategy would be preferable to the down select strategy, and whether Congress should grant the Navy, by December 30, 2010, the additional legislative authority the Navy would need to implement the dual-award strategy. On December 14, 2010, the Senate Armed Services Committee held a hearing to review the proposed dual-award strategy. Congress granted the Navy authority to implement the dual-award strategy in Section 150 of H.R. 3082/P.L. 111-322 of December 22, 2010, an act that, among other things, funded federal government operations through March 4, 2011.

On December 29, 2010, using the authority granted in H.R. 3082/P.L. 111-322, the Navy implemented the dual-award strategy, awarding a 10-ship, fixed-price incentive (FPI) block-buy contract to Lockheed, and another 10-ship, FPI block-buy contract to Austal USA. In awarding the contracts, the Navy stated that LCSs to be acquired under the two contracts are to have an average unit cost of about $440 million, a figure well below the program's adjusted unit procurement cost cap (as of December 2010) of $538 million (see "Unit Procurement Cost Cap"). The 20 ships to be acquired under the two contracts have a target cost and a higher ceiling cost. Any cost growth above the target cost and up to the ceiling cost would be shared between the

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Armed Services Committee [hearing] on the Current Status of the Littoral Combat Ship Program, March 10, 2009, pp. 7-8.

[19] The Navy had earlier planned to make the down select decision and award the contract to build the 10 LCSs in the summer of 2010, but the decision was delayed to as late as December 14. (The final bids submitted by the two LCS contractors were submitted on about September 15, and were valid for another 90 days, or until December 14.)

[20] For more on block buy contracts, see CRS Report R41909, *Multiyear Procurement (MYP) and Block Buy Contracting in Defense Acquisition: Background and Issues for Congress*, by Ronald O'Rourke and Moshe Schwartz.

contractor and the Navy according to an agreed apportionment (i.e., a "share line"). Any cost growth above the ceiling cost would be borne entirely by the contractor. The Navy stated that, as a worst case, if the costs of the 20 ships under the two FPI contracts grew to the ceiling figure and all change orders were expended, the average cost of the ships would increase by about $20 million, to about $460 million, a figure still well below the adjusted cost cap figure of $538 million.[21]

The Navy on December 29, 2010, technically awarded only two LCSs (one to each contractor). These ships (LCS-5 and LCS-6) are the two LCSs funded in FY2010. Awards of additional ships under the two contracts are subject to congressional authorization and appropriations. The Navy states that if authorization or sufficient funding for any ship covered under the contracts is not provided, or if the Navy is not satisfied with the performance of a contractor, the Navy is not obliged to award additional ships covered under contracts. The Navy states that it can do this without paying a penalty to the contractor, because the two block-buy contracts, unlike a typical multiyear procurement (MYP) contract, do not include a provision requiring the government to pay the contractor a contract cancellation penalty.[22]

For additional background information on the dual-award strategy, see **Appendix E**.

Changes in Mission Module Equipment

The Navy starting in January 2011 has announced changes to the composition of LCS mission modules. The sections below discuss these changes.

SUW Module: Griffin Selected as Recommended Replacement for N-LOS

The Navy originally had planned to use an Army missile program known as the Non-Line of Sight Launch System (NLOS-LS) as part of the LCS SUW mission package. The Navy planned for LCSs equipped with SUW mission packages to be nominally armed with three NLOS missile launchers, each with 15 missiles, for a total of 45 missiles per ship. The missiles could be used to counter swarm boats or other surface threats.

In May 2010, DOD approved an Army recommendation to cancel NLOS-LS.[23] Following the cancellation of NLOS-LS, the Navy assessed potential alternative systems for fulfilling the NLOS role in the SUW mission package.

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[21] Source: Contract-award information provided to CRS by navy office of Legislative Affairs, December 29, 2010.

[22] Source: Navy briefing to CRS and the Congressional Budget Office (CBO) on December 15, 2010. For a press article on this issue, see Cid Standifer, "FY-11 LCS Contracts On Hold Because Of Continuing Resolution," *Inside the Navy*, March 14, 2011.

The Navy's proposed dual-award strategy is broadly similar to a notional dual-award approach that was presented in this CRS report as an option for Congress (see **Appendix D**) since September 27, 2009, when the report was updated to incorporate the Navy's September 16, 2009, announcement of its proposed down select strategy.

For more on block buy contracts and MYP arrangements, see CRS Report R41909, *Multiyear Procurement (MYP) and Block Buy Contracting in Defense Acquisition: Background and Issues for Congress*, by Ronald O'Rourke and Moshe Schwartz.

[23] "Out of Sight," *Defense Daily*, May 17, 2010: 3. See also Kate Brannen, "U.S. Army Asks to Cancel NLOS-LS," *DefenseNews.com*, April 23, 2010; Jason Sherman, "Army Cancels NLOS-NS, Frees Up Billions For Other Procurement Needs," *Inside the Navy*, April 26, 2010; Sebastian Sprenger, "NLOS-LS Seen As Effective—But To (continued...)

On January 11, 2011, the Navy announced that it had selected the Griffin missile as its recommended replacement for NLOS-LS. The Navy stated that Griffin will be about half as expensive as NLOS-LS, and that it could be delivered about as soon as NLOS. The Navy stated that an initial version of the Griffin would be ready by 2014 or 2015, and that a follow-on, longer-ranged version would be ready by 2016 or 2017.[24] A March 2012 GAO report states that NLOS-LS had a range of 21 nautical miles and that, according to officials, the Griffin missile will initially have a range of 3 miles.[25]

Navy plans call for eventually replacing the Griffin missile with a longer-ranged successor weapon that could be either a variant of the current Griffin missile or a different missile. An October 20, 2011, press report based on a media roundtable that the Navy held the same day on the LCS program quoted Rear Admiral Jim Murdoch, the LCS program executive officer (PEO), as stating: "That [SUW mission package] increment 1 [with the Griffin missile] doesn't have quite the range we want, and unlike the NLOS, it doesn't have the sinker capability that ultimately I think the ship should have…. But it is an ability that we can advance now, and really that's kind of what the mission modules are about." The article states that the Navy "plans to begin a competition for an improved missile for the SUW mission package increment 2 as early as next year," and that "for the time being, Murdoch said the Griffin is a fine choice, especially given an austere fiscal climate."[26] The March 2012 GAO report states that "The Navy will not incorporate a surface-to-surface missile that can meet the module's requirements until after 2017 following a full and open competition."[27]

A May 9, 2011, press report stated that "the Navy's expeditionary warfare and surface warfare directorates are cooperating to build an expeditionary warfare module for the Littoral Combat Ship that builds on and overlaps with the ship's surface warfare package." According to the report, the equipment on the module will enable operations by Marine Corps teams, naval special warfare personnel, and Naval Expeditionary Combat Command (NECC) personnel. The report

(...continued)

Pricey—In Key Army Analysis," *Inside the Navy*, May 3, 2010.

[24] Grace Jean, "Buying Two Littoral Combat Ship Designs Saves the Navy $600 Million, Official Says," *NationalDefenseMagazine.org*, January 12, 2011; Carlo Munoz, "Navy Pushing Griffin For NLOS-LS Replacement," *Defense Daily*, January 13, 2011; Michael Fabey, "U.S. Navy Identifies New LCS Modules," *Aerospace Daily & Defense Report*, January 14, 2011: 3; Cid Standifer, "Raytheon's Griffin System To Replace NLOS In LCS Mission Package," *Inside the Navy*, January 17, 2011; David Wichner, "New Navy Ships May Use Small Raytheon Missile," *Arizona Daily Star (Tucson)*, January 18, 2011.

[25] Government Accountability Office: *Defense Acquisitions[:] Assessments of Selected Weapon Programs*, GAO-12-400SP, March 2012, p. 110.

[26] Megan Eckstein, "PEO-LCS: Surface Warfare Mission Package Will Use Griffin Missile," *InsideDefense.com*, October 20, 2011. Another press report based on the same media roundtable similarly stated:

> While the Navy still plans to use Raytheon's Griffin missile to replace the canceled Non-Line of Sight (NLOS) missile for surface warfare in initial LCS increments, Murdoch says he wants a better system for the second increment, which the Navy hopes to get next year.
>
> "Increment 1 does not have quite the range, the capability NLOS has," Murdoch says. "It does not have over-the-horizon range. You need to [have the weapon] be laser-designated."
>
> (Michael Fabey, "U.S. Navy Seeks To Improve On LCS Designs," *Aerospace Daily & Defense Report*, October 21, 2011: 1-2.)

See also Dan Taylor, "PEO LCS Has Identified Capabilities That Could Replace Griffin Missile," *Inside the Navy*, November 7, 2011.

[27] Government Accountability Office: *Defense Acquisitions[:] Assessments of Selected Weapon Programs*, GAO-12-400SP, March 2012, p. 110.

stated that the Navy's proposed FY2012 budget requests about $4 million in research and development work for the module, and that an additional $16 million for procurement is expected to be included between FY2013 and FY2016.[28]

ASW Module: Shift to Systems With "In Stride" Capability

A March 2012 GAO report stated that

> In 2008, the Navy took delivery of one partially capable ASW module at a cost of over $200 million, but subsequently cancelled plans to continue procuring the module and is redesigning it. According to program officials, the new design includes a variable-depth sonar and towed array, unmanned aerial vehicle, helicopter, and torpedo countermeasure.[29]

As background to this change, a January 14, 2011, press report had stated that the Navy

> discovered that while its [originally planned] LCS ASW module was able to do the mission, the equipment package proved unsatisfactory because the ship would actually have to stop in the water to deploy the equipment. "The ship could not do it in stride," says Capt. John Ailes, Navy mission module program office manager….
>
> As for its ASW defense, the Navy plans to deploy a module that will include three parts: a variable-depth sonar; a multi-functional towed array; and a lightweight towed array, Ailes says. The Navy will be testing the ASW module package throughout this and the coming year, he says, with an eye toward initial operational capability in 2017.[30]

A January 12, 2011, press report stated:

> For the anti-submarine warfare package, the Navy in 2012 expects to receive from Thales a low frequency sonar under development for demonstration and testing purposes. The towed array will provide sailors with a mobile anti-submarine capability. In the meantime, officials are moving ahead with other sensors, including the multifunction towed array for passive detection and the lightweight tow for torpedo countermeasures and non-acoustic rounds. The intent is to be able to counter enemy diesel submarines in the littorals. "You shift capabilities of the ship from a stationary anti-submarine warfare buried-in system to an in-stride littoral and open-ocean capability when you need it. That puts sensors and sound sources in the fleet in numbers," said [Rear Admiral Frank C. Pandolfe, director of the Navy's surface warfare division].[31]

An April 18, 2011, press report stated that the Navy plans to begin development of the new ASW package in FY2013 and field the system in FY2016.[32]

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[28] Cid Standifer, "LCS Expeditionary Module Will Build On Surface Warfare Mission Package," *Inside the Navy*, May 9, 2011.

[29] Government Accountability Office: *Defense Acquisitions[:] Assessments of Selected Weapon Programs*, GAO-12-400SP, March 2012, p. 110.

[30] Michael Fabey, "U.S. Navy Identifies New LCS Modules," *Aerospace Daily & Defense Report*, January 14, 2011: 3.

[31] Grace Jean, "Buying Two Littoral Combat Ship Designs Saves the Navy $600 Million, Official Says," *NationalDefenseMagazine.org*, January 12, 2011.

[32] Cid Standifer, "Navy Ditches Old LCS ASW Package, Will Field New Package In FY-16," *Inside the Navy*, April 18, 2011.

A June 13, 2011, press report quoting Navy officials stated that the new ASW mission package, called Increment 2, will include "a lightweight, multifunction towed array to protect against torpedoes and continuous active sonar," and will rely on technology that has already been through at-sea testing. The report states that Navy officials view Increment 2 as less complex and more technically mature—and consequently less expensive—than the original ASW package, called Increment 1, and that the Navy anticipates deploying the first Increment 2 package in FY2016.[33]

An August 15, 2011, press report stated:

> What was once a "barrier" system intended to look for submarines in a relatively small area is evolving into a more traditional approach meant to search while in motion.
>
> "Our ASW Module Number One was very focused on off-board and barrier operations," said Capt. John Ailes, the LCS mission module program manager for the Naval Sea Systems Command (NAVSEA) in Washington. "When we did the analysis, you had a ship going 40-plus knots stopping, putting stuff in the water, having the submarine pass between your sensors. That really didn't pan out very well in the operational context." When it worked, he said, "you could find the submarine if it was in the right place. But the analysis showed that what we really wanted to do was have something in stride." The original concept included a system of underwater arrays deployed from unmanned surface vehicles and an unmanned submersible craft. It was offboard, connected into networks—and not very maneuverable.
>
> The multimission submersible has now been cut from the package, along with the big sonar array, replaced by an existing multi-function array (MFA) and a new variable-depth sonar (VDS).
>
> NAVSEA's Integrated Warfare Systems office had been working with the British Royal Navy to develop software for a continuously active sonar, streamed by a towed array mounted on a ship.
>
> The Brits, operating from Type 23 frigates, "have been doing demonstrations at sea with the sonar for about five years," Ailes said.
>
> An advanced development model of the Thales Captas-4 VDS system was delivered to the U.S. Navy at Brest, France, on July 25, according to NAVSEA, and should arrive in the U.S. in early September. In place of the type 2087 sonar used by the Royal Navy, the U.S. version will use the TB-37 multifunction towed array, feeding an enhanced version of the SQQ-89 sonar processing system.
>
> Land-based testing of the sys-tem, NAVSEA said, will run through mid-2012, followed by at-sea testing of the system aboard a chartered commercial vessel operating for the LCS Mission Package Support Facility at Port Hueneme, Calif.
>
> A VDS competition is planned to follow the test program, Ailes said, with an award planned for 2014.
>
> Along with the MH-60S helicopter, the primary components of the ASW module now consist of the VDS, the MFA and Light Weight Tow, a torpedo decoy that expands the operational element of the familiar SLQ-25 Nixie system fitted to many warships.

[33] Cid Standifer, "NAVSEA: New LCS Anti-Sub Package Components Already Tested," *Inside the Navy*, June 13, 2011.

> The Naval Undersea Warfare Center at Newport, R.I., developed a prototype Light Weight Tow system and has conducted at-sea tests, NAVSEA said. The system's operation "requires minimal space, weight and manning," NAVSEA said in a statement, and is intended to be fitted on a variety of ships.
>
> Much work remains to be done to develop the new ASW module, and, according to Ailes, opera-tional tests aren't scheduled to begin until 2016.[34]

MCM Module: Possible Replacement of RAMICS by Modified AMNS

A March 2012 GAO report assessing DOD weapon acquisition programs stated:

> The rapid airborne mine clearance system was initially part of the MCM module, but was removed because of performance problems when destroying below-surface mines. The Navy plans to replace it by 2017. The Navy has also removed the unmanned surface vehicle (USV) and unmanned influence sweep system from its upcoming mission module. The USV design does not meet requirements, requiring a 6-year effort to improve the system's capabilities. The Navy has also deferred delivery of two other MCM systems.[35]

As background to these changes, the Navy stated in January 2011 that it was considering altering the MCM module by replacing the module's Rapid Airborne Mine Clearance System (RAMICS) with a modified version of the Airborne Mine Neutralization System (AMNS).[36] A January 12, 2011, press had stated that

> The rapid airborne mine clearance system, or RAMICS, a cannon designed to destroy mines floating below the surface in deep water, is not performing well in tests. Navy officials are looking to adapt the airborne mine neutralization system [AMNS], which kills mines at the bottom of the ocean, for the mission. Preliminary testing is showing promise, and if it works, then the Navy may not need RAMICS, [Rear Admiral Frank C. Pandolfe, director of the Navy's surface warfare division] said.
>
> "That would allow us to streamline the program, save money and go to a single kill vehicle," he said.[37]

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[34] Christopher P. Cavas, "Development Work Continues For U.S. Navy LCS Modules," *Defense News*, August 15, 2011: 18.

[35] Government Accountability Office: *Defense Acquisitions[:] Assessments of Selected Weapon Programs*, GAO-12-400SP, March 2012, p. 110.

[36] Source: Telephone call from Navy Office of Legislative Affairs to CRS on May 12, 2011.

[37] Grace Jean, "Buying Two Littoral Combat Ship Designs Saves the Navy $600 Million, Official Says," *NationalDefenseMagazine.org*, January 12, 2011. The potential replacement of RAMICS was discussed further in a January 13, 2011, press report. The January 13 press report stated that the Navy is considering replacing RAMICS with a modified version of the Airborne Laser Mine Detection System (ALMDS). The Navy states that if RAMICS were replaced, the replacement would be a modified version of AMNS, not a modified version of ALMDS. The January 13 press report stated:

> The Navy is looking to terminate an underperforming anti-mine system from the LCS mission package being designed for that mission.
>
> Service acquisition officials have become increasingly frustrated with the testing results of the Rapid Airborne Mine Clearance System (RAMCS), Rear Adm. Frank Pandolfe, head of the Navy's surface warfare directorate, said this week.
>
> While testing is still underway on the Northrop Grumman [NOC] system, which is to locate and destroy mines in shallow waters, the results have fallen short of service expectations, he said during

(continued...)

A June 13, 2011, press report based on information provided by the Navy stated that the use of RAMICS in the MCM module was canceled in the Navy's proposed FY2012 budget and that a modified version of AMNS would instead be used in the MCM module. The report stated that the Navy anticipates that the first version of the MCM package, called Increment 1, would be fully functional in FY2013, that Increment 2 is to be delivered in FY2015, and that Increment 3 is to be delivered in FY2017.[38]

An August 15, 2011, press report stated:

> Operational testing of the mine warfare module … is set to begin in 2013 aboard the Independence (LCS 2). The modules are being developed in several stages, or increments, Ailes explained.
>
> "Increment 1 [of the module] is the current mine countermeasures capability," [Captain John Ailes, the LCS mission module program manager for the Naval Sea Systems Command (NAVSEA)] said.
>
> Increment 2 will add COBRA—the Coastal Battlefield Reconnaissance and Analysis system being developed by Northrop Grumman. The system, integrated with the MQ-8B Fire Scout unmanned air vehicle, is intended to find and localize minefields along the shore and in beach surf.
>
> Increment 3, Ailes said, adds a minesweeping system, and a mine countermeasures capability mounted on an unmanned under-water vehicle will appear with Increment 4.
>
> Tests continue with the revamped Remote Minehunting Vehicle, a key element in the mine package, intended to tow AQS-20A minehunting sonars. The diesel-powered submersible has suffered from reliability problems, but has been operating out of Mayport, Fla., this summer from the Independence.
>
> "We feel highly confident, based on the fact that we've identified all the failures we've ever seen," Ailes said. "We strongly believe we're going to be able to get to 75 hours [of continuous operation] and probably exceed it.
>
> "We're right on the threshold right now, and it's just going to get better," he added.

(...continued)

> a Jan. 11 speech at the Surface Navy Association's annual conference in Arlington, Va.
>
> To remedy the situation, Pandolfe said program officials are looking to modify the Airborne Laser Mine Detection System (ALMDS) to carry out the RAMCS mission.
>
> Also manufactured by Northrop Grumman, the ALMDS uses directed energy system mounted on board a MH-60R helicopter to detect mines at the same shallow depth the RAMCS was designed to destroy.
>
> If the modification is successful, Navy decisionmakers plan to ax the RAMCS platform and use the ALMDS variant, Pandolfe said.
>
> (Carlo Munoz, "Navy Looks To Cut Anti-Mine System From LCS Mission Package," *Defense Daily*, January 13, 2011. Material in brackets as in original.)

[38] Cid Standifer, "NAVSEA: New LCS Anti-Sub Package Components Already Tested," *Inside the Navy*, June 13, 2011. See also Sam LaGrone, "US Navy Halts RAMICS Production," *Jane's Defence Weekly*, June 1, 2011: 10.

> Gone from the mine package, however, is the Rapid Airborne Mine Clearance System (RAM-ICS), a 30mm gun mounted on an H-60 helicopter that was to have blasted underwater mines from the air.
>
> The gun itself—the same weapon mounted on the ships as part of the surface warfare package and aboard LPD 17-class am-phibious ships—"worked very well," Ailes said.
>
> "But it was going to be very expensive to make the system work," he said.
>
> The system needed to perform complex calculations to account for refraction in the water—the phenomenon that makes something underwater, when viewed from above the surface, seem to be in a different location.
>
> "In turbulent water, it became a very complex physics problem to calculate where to aim it," he said. "It was very technically chal-lenging." A towed countermeasure system, based on the Navy's airborne mine neutralization system used on helicopters, is being evaluated for inclusion in the LCS mine package, Ailes said, with a decision expected late this year or early in 2012.
>
> "The cost would be significantly less than what we would need to make RAMICS work," he said, and could be produced in the same amount of time….
>
> System integration tests of the Unmanned Influence Sweep System towed minesweeping system were conducted in June at the Naval Surface Warfare Center at Panama City, Fla., and have continued into the summer. The tests included the first use of a prototype Sweep Power Subsystem, NAVSEA said, combining magnetic and acoustic sweep systems similar to the Mk 104 acoustic and Mk 105 magnetic sleds towed by minehunting helicopters.
>
> "The faster it goes, the faster it sweeps," Ailes said, citing tests using an unmanned surface craft (USV) operating at 20 to 25 knots. "Historically, those aren't minesweeping speeds, but our analysis shows it's very effective," he said. "The current ships we have don't sweep that fast, but the helicopter sweeps go at about that." An earlier plan to use a USV with the anti-submarine package has been dropped, and the choice of a USV to operate with the mine warfare package has yet to be made, Ailes said. While some of the USVs tried out so far have been effective, they've also been too big or too heavy, he said.[39]

2012 Establishment of LCS Council

On August 22, 2012, Admiral Jonathan Greenert, the Chief of Naval Operations, established an LCS Council headed by four vice admirals to address challenges faced by the LCS program for supporting the planned deployment of an LCS to Singapore beginning in 2013. The challenges were identified in four internal Navy reviews of the LCS program (two of them based on wargames) that were completed between February and August of 2012. The memorandum from the CNO establishing the council states that the council will be "empowered ... to drive action across the acquisition, requirements and Fleet enterprises of the Navy." The council was given an immediate focus of developing and implementing an LCS plan of action and milestones by

[39] Christopher P. Cavas, "Development Work Continues For U.S. Navy LCS Modules," *Defense News*, August 15, 2011: 18. The bracketed phrase "[of continuous operation]" as in original; other bracketed material added for clarity.

January 31, 2013. The memorandum also required the council to develop a charter for its operations within 14 days.[40] The charter for the council, dated September 2012, states that

> The LCS program's unique requirements, rapid acquisition, and innovative manning and sustainment strategies pose unique challenges as LCS is introduced to the fleet. The Council will rapidly and decisively resolve impediments to the LCS program's success, determine the way forward for the future evolution of LCS capabilities, and inform senior Navy civilian and uniformed leadership of key issues which require decisions at the highest level....
>
> The LCS Council will drive actions across the requirements, acquisition, and Fleet enterprises of the Navy to ensure the successful procurement, development, manning, training, sustainment, and operational employment of the LCS Class ships, their associated Mission Packages, and shore infrastructure.
>
> The LCS Council provides oversight and direction of the efforts required at all echelons of the administrative chain of command to achieve successful fleet introduction of LCS, to identify and resolve challenges and impediments, and to evolve the program. The Council is constituted and empowered to bridge "gaps and seams" that may exist or arise between various LCS stakeholders, warfare and mission communities, and supporting activities.[41]

Controversy and Proposals to Truncate the Program

The LCS program has encountered controversy from time to time over the years over issues such as the Navy's analytical basis for selecting a ship like the LCS as the best or most promising way to fill identified gaps in Navy littoral warfare capability,[42] the substantial cost growth on the first LCS sea frames that came to light in 2007 (see **Appendix B**), reports starting in 2011 of hull cracking on LCS-1 and corrosion on LCS-2 (see "Hull Cracking and Engine Problems on LCS-1" and "Corrosion on LCS-2" below), the combat survivability of the LCS (see "Combat Survivability" below), and the prospective ability of LCSs to perform certain missions (see "Mission Performance and Cost-Effectiveness" below).

Some observers, citing these issues or others, as well as potential future Navy operations and potential future constraints on defense spending, have proposed truncating the number of LCSs to be procured. For example, a May 2012 report by the Center for a New American Security (CNAS) recommended stopping the LCS program in FY2017 after procuring a total of 27 ships,[43]

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[40] Memorandum from Chief of Naval Operations to Director, Navy Staff, dated August 22, 2012, on Lilttoral Combat Ship (LCS) Council, posted at *InsideDefense.com* (subscription required), August 24, 2012. See also Defense Media Activity—Navy, "CNO Establishes LCS Council," *Navy News Service*, August 22, 2012; Christopher P. Cavas, "U.S. Navy Creates LCS 'Council' To Guide Development," *DefenseNews.com*, August 22, 2012; Megan Eckstein, "CNO Establishes LCS Council To Review Recent Data, Lessons Learned," *Inside the Navy*, August 27, 2012; Mike McCarthy, "Navy Establishes LCS Council," *Defense Daily*, August 27, 2012.

[41] *Littoral Combat Ship Council Charter*, September 2012, posted at InsideDefense.com (subscription required), September 28, 2012, p. 3.

[42] For a discussion of this issue, see, for example, pages 35-40 of the October 28, 2004, update of CRS Report RL32109, *Navy DD(X) and LCS Ship Acquisition Programs: Oversight Issues and Options for Congress, by Ronald O'Rourke*, out of print and available directly from the author. (In 2004, CRS Report RL32109 covered both the DD(X) destroyer program—now called the DDG-1000 destroyer program—and the LCS program.)

[43] David W. Barno, et al, *Sustainable Pre-eminence[:] Reforming the U.S. Military at a Time of Strategic Change*, Center for a New American Security, May 2012, pp. 35, 67. CNAS made a similar recommendation in a report it published in October 2011 (David W. Barno, et al, *Hard Choices[:] Responsible Defense in an Age of Austerity*, Center for a New American Security, October 2011, pp. 13, 14, 15, 16, 18, 20, 21, 34, 35. The report recommends procuring a (continued...)

and an April 2011 report by the Heritage Foundation recommended a future Navy fleet with a total of 28 small surface combatants—a category that appears to include both Oliver Hazard Perry (FFG-7) frigates (which are being phased out of service) and LCSs.[44]

The LCS is by no means the only Navy shipbuilding program to have encountered controversy in recent years for one reason or another; other examples include the Zumwalt (DDG-1000) class destroyer program (which encountered controversy due to concerns about the DDG-1000 design's cost and affordability) and the San Antonio (LPD-17) amphibious ship program (which encountered controversy due to construction quality problems). In response to criticisms of the LCS program, the Navy over the years has acknowledged certain problems and stated that it was taking action to correct them, disputed other arguments made against the program, and maintained its support for the program and for procuring a total of 55 LCSs. The August 2012 establishment of the LCS Council (see "2012 Establishment of LCS Council" above) might also be viewed as a Navy response to certain criticisms of the program made by some observers.

FY2013 Funding Request

The Navy's proposed FY2013 budget requests $1,785.0 million in procurement funding for the four LCSs requested for FY2013. The Navy's proposed budget also requests $102.6 million in procurement funding for LCS mission modules.

Issues for Congress

Impact of Sequestration

One potential issue for Congress concerns the impact on the LCS program of the sequestration of FY2013 funding. At a February 12, 2013, hearing before the Senate Armed Services Committee on potential impacts on the military services of a year-long CR and sequestration, the Navy testified that:

> On top of reductions in operations and maintenance funding, sequestration will reduce FY13 funding for each investment program (about $7.2 billion overall). In some programs, such F-35C Lightning II, P-8A Poseidon and E-2D Hawkeye, this reduction will compel us to reduce the number of platforms procured in FY13....
>
> If Congress authorizes the Navy to transfer funds within the FY13 budget, we intend to restore our most critical operations and maintenance requirements. This will be done by taking funding from investments such as perhaps the P-8A Poseidon, F-35C Lightning II and Littoral Combat Ship—resulting in fewer of these platforms being procured in FY13.[45]

(...continued)

total of 27 LCSs under three DOD budget scenarios, or a total of 12 LCSs under a fourth DOD budget scenario.)

[44] *A Strong National Defense[:] The Armed Forces America Needs and What They Will Cost*, Heritage Foundation, April 5, 2011, pp. 25-26.

[45] Statement of Admiral Jonathan Greenert, Chief of Naval Operations, before the Senate Armed Services Committee on the Impact of Sequestration, February 12, 2013, pp. 7, 8. Although the Navy's written statement for the hearing is from Admiral Greenert, the Navy's testimony at the hearing was actually given by the Vice Chief of Naval Operations, (continued...)

In connection with the above passage, it can be noted that reducing the number of LCSs procured in FY2013 below the requested quantity of four could compel the Navy to cancel or renegotiate at least one of the two multiyear block buy contracts that the Navy currently has with the two LCS builders.[46]

Mission Performance and Cost-Effectiveness

A potential overarching oversight issue for Congress concerns the LCS's prospective mission performance and cost-effectiveness, particularly in light of press reporting about recent Navy assessments of the program. A July 14, 2012, press report based on some of the internal Navy reviews of the LCS program that led to the August 2012 establishment of the LCS Council states:

> The original idea for the littoral combat ship (LCS) envisioned modular mission packages that could be rapidly swapped, so one ship could change missions easily from mine warfare, for example, to anti-submarine warfare over the course of a single deployment.
>
> But instead of taking just days to make the switch, it's now apparent it could take weeks. An LCS assigned to a particular operation will likely operate in a single "come-as-you-are" configuration, requiring additional ships equipped with other mission modules to provide the flexibility the concept once promised.
>
> That's one conclusion among many following a series of Navy exercises and reports intended to take stock of LCS. Other conclusions criticize the ship as failing to match capabilities inherent to the ships it would replace. The assessment aims to figure out what the ship can and can't do, how it should be employed, what kind of support it will need, and what changes must be made to man and fight the ships without wearing out their small crews.
>
> These include a classified study ordered by Adm. Mark Ferguson, the vice chief of naval operations; two war games carried out by U.S. Fleet Forces Command (USFFC) in Norfolk, Va.; and the ongoing operating experiences of the two ships already in service....
>
> The classified study, known as the OPNAV report (referring to staff reporting to the chief of naval operations), was headed by Rear Adm. Samuel Perez. Beginning in January, Perez and a 10-person team looked at all aspects of the fleet's "readiness to receive, employ and deploy" the LCS.
>
> USFFC in January conducted a "sustainment war game" to understand the issues and risks in manning and supporting an LCS across the Pacific Ocean—a key concern with the Freedom, the first LCS, scheduled to deploy to Singapore in the spring of 2013. It will be the first time an LCS has operated outside the Western Hemisphere.
>
> Another war game, focusing on operations and war fighting, was held in mid-June. The results of that effort are still being analyzed, Navy sources said.

(...continued)

Admiral Mark E. Ferguson III, who was substituting for Admiral Greenert at the hearing. The Navy presented similar testimony at a similar hearing before the House Armed Services Committee on February 13, 2013.

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

While the Navy would not release the OPNAV report, a number of sources familiar with both LCS and the report said it lays out in greater detail the problems and issues confronting the entire LCS effort, including the concept of operations (CONOPS), manning shortages, maintenance and training concerns, modularity and mission module issues, and commonality problems between the two LCS variants.

It also cites problems with how the LCS is perceived in the fleet, how leadership presents LCS capabilities, and the need to effect changes in virtually every operational area.

"As I looked at some of the draft documentation to say how we're going to run LCS, what I thought we needed to do was a rebaselining, understanding how much information we've generated on how we're going to operate these ships, and take that and build a foundation," said Rear Adm. Thomas Rowden, OPNAV's director of surface warfare, during an interview at the Pentagon. "I will call this a concept of employment, or CONEMP."

Rowden is leading the work to coordinate and compile the LCS analytical efforts.

"The reality of it is, it's time to step back and say, what did we get wrong here?"

CONOPS

Planners originally envisaged the LCS as a replacement for the fleet's frigates, minesweepers and patrol boats, but the new assessments conclude the ships are not equal to today's frigates or mine countermeasures ships, and they are too large to operate as patrol boats.

The LCS, according to the assessments, is not able to fulfill most of the fleet missions required by the Navy's primary strategy document, the "Cooperative Strategy for 21st Century Seapower," and included in a 2011 revision of the LCS CONOPS document.

Equipped with a surface warfare or maritime security mission package, the ships were judged capable of carrying out theater security cooperation and deterrence missions, and maritime security operations, such as anti-piracy.

But the LCS vessels cannot successfully perform three other core missions envisioned for them—forward presence, sea control or power projection missions—and they can provide only limited humanitarian assistance or disaster relief operations, sources said.

The shortcomings are well known in the fleet, prompting a perception that service leaders are looking for missions to fit LCS, rather than the other way around.

A key LCS failure identified by the OPNAV report, sources said, is its inability to effectively defend against anti-ship cruise missiles (ASCMs), a weapon carried by hundreds of small, fast-attack craft operated by virtually all potentially hostile navies....

The U.S. Navy's requirements document for the LCS says it must be able to operate offensively in multithreat environments—areas that would include the Arabian Gulf or the Yellow Sea—but until a solution is found, the assessments call for a CONOPS more consistent with the ships' capabilities, and suggest the need for studies to increase LCS combat power.

The Navy is continuing to look at ways to increase the ship's weaponry and lethality. A major gap is for a weapon to replace the Non-Line of Sight Launch System (NLOS-LS), a surface-to-surface missile program canceled in 2010 that was to have given the LCS a prodigious capability.

> "I certainly have asked to take a look at Harpoon, if we can take the weight," Rowden said. "Also looking at the Griffin," a small weapon being purchased for a trial installation on the Freedom. "There are some other missiles that we're looking at, but those are the two I can talk about right now."
>
> The Harpoon is currently the Navy's standard surface-to-surface missile, carried on destroyers and cruisers. But adding such a missile would probably mean removing something else to compensate for the additional weight. The Griffin is much smaller, but doesn't pack the Harpoon's punch.
>
> Rowden also has asked the Naval Sea Systems Command (NAVSEA) to study replacing the 57mm gun on both LCS designs with a 76mm weapon, similar to the weapon on today's frigates.
>
> "It's a larger gun, more range, certainly gives us a better opportunity to engage the enemy," Rowden said of the 76mm.
>
> The trouble with that weapon is that it can fit on Freedom LCS 1-class ships, but not on the narrow bow of the trimaran Independence LCS 2-class. "I don't know if we can get it on both hulls," Rowden acknowledged.
>
> Range is still another concern, because of capacity for both fuel and crew provisions. Although the original CONOPS called for ships to operate at sea for at least 21 days, the ships have storage capacity to only carry enough food for 14 days, according to sources familiar with the classified report....
>
> Eventually, all the effort will be gathered into the concept of employment, or CONEMP, document.
>
> "It is not going to be a static document," Rowden declared. "We're going to be inputting things, and as we learn things we're going to make modifications to keep it relevant and reflect experience.
>
> "We've got folks from Fleet Forces Command, Pacific Fleet, Naval Surface Forces, Naval Air Forces, NAVSEA, OPNAV and the manpower assessment team all working together to try and understand what we've observed and what we have learned so we can have a good, informed document with respect to this concept of employment," Rowden said.
>
> "My gut tells me we've got to get the manning squared away, then the training, sustainment and maintenance will flow from that as we move forward," he added. "We'll get to a better place to say these are the things we need to do to maximize the availability and capability of the ships."[47]

An August 2, 2012, Navy information paper responding to the above article states:

> **1. ASSERTION:** The Mission Package quick-swap concept is dead.

[47] Christopher P. Cavas, "LCS: Quick Swap Concept Dead," *DefenseNews.com*, July 14, 2012. See also Christopher P. Cavas, "Maintenance Hurdles Mount for New USN Ship," *DefenseNews.com*, July 23, 2012; Michael Fabey, "U.S. Navy Finds More LCS-1 Issues During Special Trials," *Aerospace Daily & Defense Report*, June 21, 2012: 2; Christopher P. Cavas, "U.S. Navy's LCS Yet to Fulfill Its Promise," *DefenseNews.com*, April 15, 2012.

RESPONSE: Each LCS will deploy with the Mission Package (MP) required to accomplish the Combatant Commander (COCOM)-directed missions. As expected, if COCOMs direct a MP swap, materiel staging and personnel movement will need to be planned and coordinated in advance. The physical swap of MP equipment can occur in less than 96 hours, as the requirement dictates.

2. ASSERTION: Planners originally envisaged LCS as a replacement for Frigates, Minesweepers, and Patrol Boats, but new assessments conclude that the ships are not equal to the legacy ships.

RESPONSE: While LCS will provide the capabilities and conduct the missions currently performed by the FFG, MCM and PC type ships, LCS is not a direct class replacement for any of these. It is a new ship type with distinct capabilities. LCS with its mission packages will provide equal or greater capability than the legacy platforms whose missions it is assuming.

3. ASSERTION: LCS vessels cannot successfully perform three other core missions envisioned for them-forward presence, sea control or power projection.

RESPONSE: LCS will be able to perform all of the missions for which she was built. As the ships transition from research and development assets to operational Fleet units, the ongoing efforts to determine the infrastructure requirements and sustainment processes will be implemented and provide the requisite support to enable the successful execution of these missions.

4. ASSERTION: Key failure is inability to effectively defend against ASCMs.

RESPONSE: LCS, with its 3-D air search radar and highly effective Rolling Airframe Missile, is at least as capable against the cruise missile threat as the CIWS-equipped FFG 7 and significantly more capable that the Avenger class MCM and Cyclone Class PC, which have no self-defense anti-cruise missile capability. LCS capability against ASCMs has been demonstrated with two live firings of RAM from LCS against cruise missile targets, as well as multiple tracking exercises and simulated ASCM engagements within the developmental test window.

5. ASSERTION: CONOPS dictates ships operate at sea for 21 days but ship can only store food for 14 days.

RESPONSE: The LCS CDD gives a 14-day threshold and a 30-day objective for replenishment, which supports the expected 21-day underway cycles referenced in the CONOPS. The CDD, not the CONOPS, is the governing document for all LCS requirements. And as noted earlier, when operating within its normal speed range profile (<15 knots), LCS has comparable endurance to an FFG 7.

6. ASSERTION: Navy is looking at ways to increase ship's weaponry and lethality.

RESPONSE: Every Navy weapon, sensor, ship and aircraft system is continually being reviewed and evaluated against current and future operations and threats to determine the best mix of total combat power that can be brought to the fight. LCS is no exception to this ongoing process.

7. ASSERTION: Major gap is the replacement of the Non-Line of Sight Launch System (NLOS-LS).

> **RESPONSE:** While the cancellation of NLOS was indeed a setback in bringing the surface-to-surface missile to LCS, the modular design of LCS allows the Navy to select another missile, without costly redesign. As an interim solution, the Griffin missile has already been selected for incorporation until an extended range missile can be competitively awarded.[48]

Potential oversight questions for Congress include the following:

- The Navy initiated LCS program in November 2001 because the Navy concluded that a ship like the LCS would be the most cost-effective way to fill Navy capability gaps for countering mines, small boats, and diesel-electric submarines in littoral waters. In light of subsequent growth in the cost of the LCS sea frame, the Navy's reported intention to increase the LCS crew size (which will increase LCS life cycle operation and support [O&S] costs), and the Navy's assessments of the LCS in recent exercises and war games, is the Navy still confident that the LCS program represents the most cost-effective way for the Navy to counter mines, small boats, and diesel-electric submarines in littoral waters?
- When does the Navy believe the LCS will be fully capable of performing its originally stated primary missions of countering mines, small boats, and diesel-electric submarines in littoral waters?
- How, if at all, will LCS procurement and life-cycle O&S costs be affected by Navy actions to address issues identified in recent Navy assessments of the LCS program?
- What missions other than countering mines, small boats, and diesel-electric submarines in littoral waters does the Navy now envisage as being significant missions for the LCS?
- Taking various factors into account—including but not limited to LCS sea frame procurement costs as they are now understood, LCS life-cycle O&S costs with an enlarged crew, the LCS's originally stated primary missions, other potentially significant missions for the LCS, recent Navy assessments of the LCS program, and the costs (if any) of addressing issues identified in those assessments—is the Navy still confident that the LCS program is more cost-effective than potential alternative courses of action?

Changes in Mission Module Equipment

A more specific potential oversight issue for Congress concerns the changes in LCS mission module equipment announced by the Navy since January 2011 (see "Changes in Mission Module Equipment" in "Background"). Potential oversight questions for Congress include the following:

- How, if at all, have the changes to the mission packages affected the scheduled Initial Operational Capability (IOC) dates of the packages?
- How have the changes to the systems in the mission packages affected the capabilities of the packages? For example, how will the replacement of the NLOS-LS missile by the Griffin missile in the SUW package affect the SUW

[48] Navy information paper dated August 2, 2012, provided by Navy Office of legislative Affairs to CRS and CBO on August 2, 2012.

capability of the LCS, particularly in light of the range of the Griffin missile compared to that of the NLOS-LS missile?

Combat Survivability

Another potential oversight issue for Congress for the LCS program concerns the combat survivability of the LCS. On this issue, there are two specific questions:

- Is the LCS program's survivability standard appropriate?
- Do the two LCS designs achieve this standard?

Each of these questions is discussed below.

Appropriateness of LCS Survivability Standard

Navy surface ships are designed to one of three survivability standards, called Level I (low), Level II (moderate), and Level II (high). Aircraft carriers, cruisers, and destroyers are designed to Level III. Frigates, amphibious ships, and certain underway replenishment (resupply) ships are designed to Level II. Other replenishment ships, as well as mine warfare ships, patrol craft, and support ships are designed to Level I. (For additional information on Navy surface ship survivability standards, see **Appendix F**.)

Although LCSs are not intended as direct replacements for the Navy's current patrol craft, mine warfare ships, and frigates, they are to perform missions that in several cases are similar to those currently performed by patrol craft, mine warfare ships, and frigates. The Navy decided to design the LCS to what it calls a Level 1+ survivability standard, which is greater than the Level I standard to which the Navy's current patrol craft and mine warfare ships were designed, but less than the Level II standard to which the Navy's current Oliver Hazard Perry (FFG-7) class frigates were designed.

The issue is whether a Level 1+ survivability standard is appropriate, given all considerations, including program affordability (designing a ship to a higher survivability standard generally increases its procurement cost) and the ship's expected operations over its lifetime.

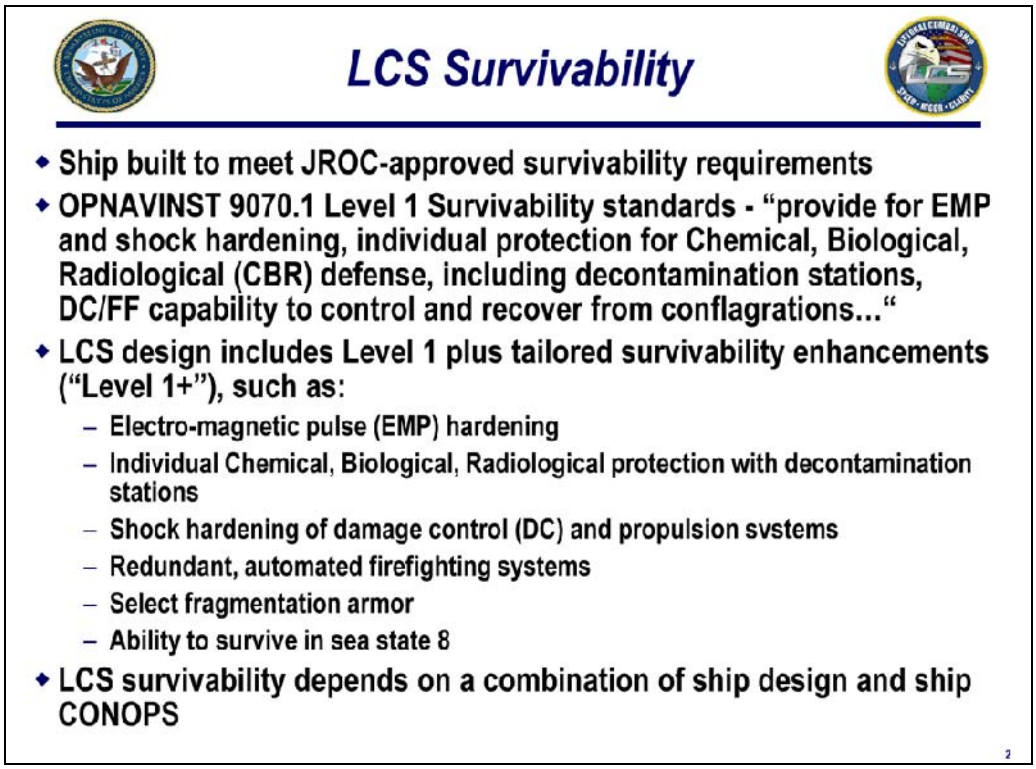
In terms of expected operations for the LCS, it can be noted that the Navy plans to station up to eight LCSs in at Bahrain, in the Persian Gulf. Currently, several Navy mine warfare ships and patrol craft are stationed at Bahrain, and the Navy regularly deploys other ships, including aircraft carriers, destroyers, frigates, and support ships, into the Gulf. In the late 1980s, two of the Navy's FFG-7 class frigates were severely damaged by enemy attack while operating in the Persian Gulf: In May 1987, the frigate Stark (FFG-31) was severely damaged by two Iraqi cruise missiles, and in April 1988 the frigate Samuel B. Roberts (FFG-58) was severely damaged by an Iranian mine. Both ships were saved by a combination of their built-in survivability features and the damage-control actions of their crews. (The ships were later repaired and returned to service.) How the physical structures of the two ships might have responded to the attacks if they had been designed to something less than a Level II survivability standard is not certain. Navy ships operating in the

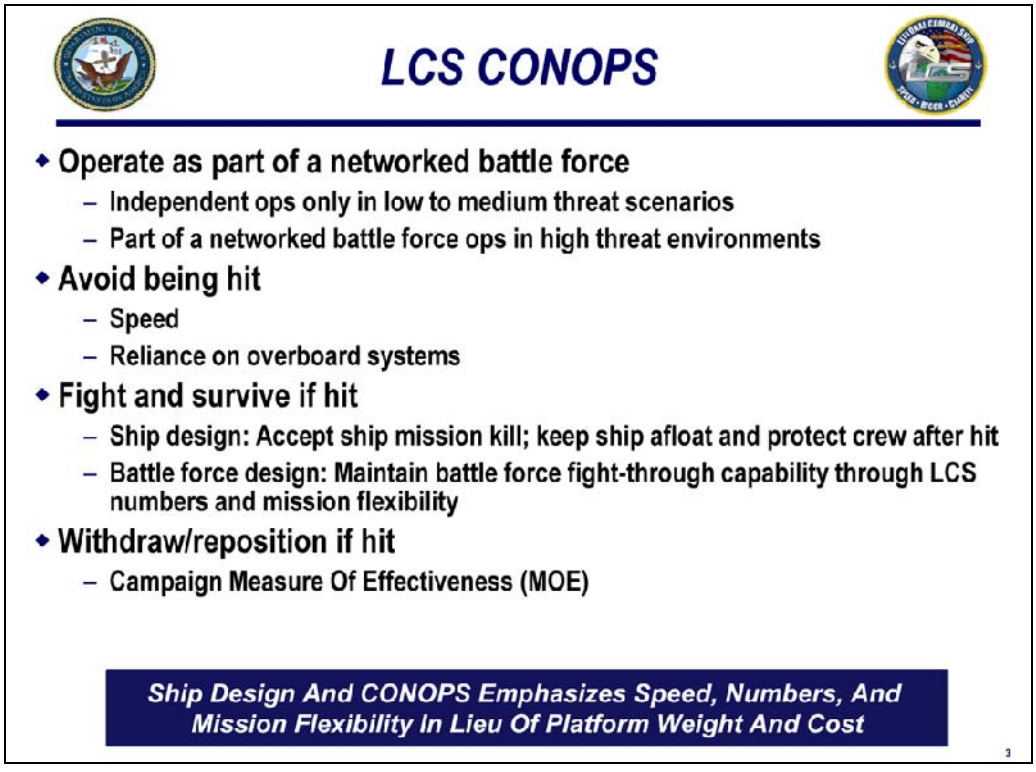
Gulf today continue to face significant potential threats from Iranian cruise missiles, mines, and other weapons.[49]

Navy Perspective

The Navy believes that, after taking planned ship employment and specific potential threats into proper account, a Level 1+ survivability standard is appropriate for the LCS. At the request of CRS and CBO, the Navy on April 29, 2011, briefed CRS and CBO on the issue of the LCS survivability standard. The Navy's briefing slides from that briefing are reproduced below.

[49] For a discussion, see, for example, CRS Report R42335, *Iran's Threat to the Strait of Hormuz*, coordinated by Kenneth Katzman.


LCS Survivability
• Ship built to meet JROC-approved survivability requirements
• OPNAVINST 9070.1 Level 1 Survivability standards - "provide for EMP and shock hardening, individual protection for Chemical, Biological, Radiological (CBR) defense, including decontamination stations, DC/FF capability to control and recover from conflagrations..."
• LCS design includes Level 1 plus tailored survivability enhancements ("Level 1+"), such as:
– Electro-magnetic pulse (EMP) hardening
– Individual Chemical, Biological, Radiological protection with decontamination stations
– Shock hardening of damage control (DC) and propulsion systems
– Redundant, automated firefighting systems
– Select fragmentation armor
– Ability to survive in sea state 8
• LCS survivability depends on a combination of ship design and ship CONOPS
2


LCS CONOPS
• Operate as part of a networked battle force
– Independent ops only in low to medium threat scenarios
– Part of a networked battle force ops in high threat environments
• Avoid being hit
– Speed
– Reliance on overboard systems
• Fight and survive if hit
– Ship design: Accept ship mission kill; keep ship afloat and protect crew after hit
– Battle force design: Maintain battle force fight-through capability through LCS numbers and mission flexibility
• Withdraw/reposition if hit
– Campaign Measure Of Effectiveness (MOE)
Ship Design And CONOPS Emphasizes Speed, Numbers, And Mission Flexibility In Lieu Of Platform Weight And Cost
3

Operating Environment

- LCS designed for small combatant ops in littorals
  - Replaces PC, MCM, and FFG classes
    - Presence, maritime security ops
    - Patrol, maritime interdiction ops
    - Littoral ASuW (small boats), ASW (diesels)
    - Mine countermeasures
    - Special operations forces support

- LCS operates in low-to-medium threat environments during independent littoral operations
  - Ship's gun overmatches individual small boat threat
  - Missile self-defense system designed to counter ambush attacks
- In high intensity combat operations, LCS relies on complementary assets for protection while conducting critical missions
  - Similar to PCs, MCMs, FFGs, Amphibs, P-3s
  - Missile self-defense systems designed only to counter leakers

LCS Design And CONOPS Reflect Navy's New Networked Battle Force Design

4

Avoiding a Hit

- Sprint speed of 40+ knots is integral to avoiding a hit:
  - Complicates enemy targeting
  - Allows quick repositioning against threats
  - Torpedo evasion
- Active and Passive defenses
  - 57 mm gun
  - Rolling Airframe Missiles (RAM and SeaRAM)
  - Chaff
- Reliance on off-board systems helps keep ship out of harm's way
  - e.g., ship remains outside of minefield
- Multiple LCSs operating together
  - Provide mutual cooperation and enhanced effectiveness against multiple or different threats (e.g., one ship conducting counter mine operations, while another providing counter small boat protection)

Combination Of High Speed, Active And Passive Defenses And Off-Board Systems Very Effective

5

Surviving And Fighting If Hit

- LCS has select fragmentation armor protection to enable sustained combat operations
  - LCS damage control/firefighting has multiple installed automatic and remote firefighting systems to control shipboard fires
- LCS ship structure is designed to minimize cascading flooding damage after a major hit
  - Shock-hardened hull keeps ship afloat with 15 percent damaged length, 3-compartment flooding
- Modular mission packages may continue mission functionality after hit
  - E.g., 30mm cannon can operate on battery power
- Distributed LCS design architecture allows battle force mission accomplishment despite individual LCS ship damage
  - Loss of a single LCS means the battle force loses only one mission set
  - Surviving LCSs can reconfigure their mission packages as necessary

Additional Ship Systems Redundancy And Protection Would Require Increased Weight And Expense

6

Repositioning After Hit

- LCS is designed to:
  - Maintain essential mobility after a hit
  - Allow ship to exit battle area under its own power
- LCS systems allow ship's crew to navigate and communicate while repositioning after a hit
- While mission loss is a tactical-level MOE, ship loss is a campaign-level MOE
  - Early "Streetfighter" CONOPS called for ships to be abandoned after a hit
  - LCS CONOPS focuses on crew safety and ship survival

7

December 2011 DOT&E Report

A December 2011 report from DOD's Director, Operational Test and Evaluation (DOT&E)—DOT&E's annual report for FY2011—provides a second perspective on the issue. The report states:

> LCS is not expected to be survivable in a hostile combat environment. This assessment is based primarily on a review of LCS design requirements, which do not require the inclusion of the survivability features necessary to conduct sustained operations in its expected combat environment. Even though two ships are already operational and two more are under construction, DOT&E cannot provide additional insight into the survivability of the class, or better assess the extent of their vulnerability to expected threats because the Navy has significantly delayed the release of their Detail Design Integrated Survivability Assessment Reports for both designs.
>
> Recommendations
>
> Status of Previous Recommendations. Two recommendations from FY05 and FY06 remain that involve a risk assessment on the adequacy of Level I survivability and detailed manning analyses to include mission package support. The Navy has partially addressed one FY09 recommendation to develop an LFT&E [live fire test and evaluation] program with the approval of the LFT&E Management Plan; however, the recommendation will not be fully addressed until the details of the surrogate testing and the lethality testing are developed. Both of the FY10 recommendations remain valid. The Navy should implement all recommendations from DOT&E's Combined Operational and Live Fire Early Fielding Report and address all deficiencies noted in the Navy's Board of Inspection and Survey Acceptance Trials report.

> FY11 Recommendations....
>
> 3. While the final survivability assessment of LCS cannot be made until the full ship shock trials and total ship survivability trials are completed, the Navy should continue to report vulnerabilities discovered during live fire tests and analyses. Doing so will inform acquisition decisions as soon as possible in the procurement of the LCS class.[50]

March 9, 2011, Hearing Before House Appropriations Committee Defense Subcommittee

At a March 9, 2011, hearing on the Navy's proposed FY2012 budget before the Defense subcommittee of the House Appropriations Committee, the following exchange took place concerning survivability standard for the LCS:

> REPRESENTATIVE JAMES MORAN: I'd like to ask questions about the Littoral Combat Ship and the Aegis Combat System. Perhaps the best directive that Admiral Roughead—either of our other distinguished witnesses may want to chime in as well—we know that the LCS is designed to fight in littoral waters, where larger surface and subsurface ships can't safely navigate.
>
> But according to the Pentagon's (inaudible) report that just came out in the last two or three months, the Department of Operational Tests and Evaluations, and I quote, "The LCS design is not required to include survivability features necessary to conduct sustained operations in the combat environment."
>
> So I have to ask, why are we buying 55 of these surface combatants if they're not designed to survive in a hostile combat environment? I don't understand how we can justify that. What other warfighter need does the LCS program satisfy if the ships are not designed to survive in a combat environment? Admiral?
>
> CHIEF OF NAVAL OEPRATIONS ADMIRAL GARY ROUGHEAD: Yes, sir. And I would submit that as you look at the levels of survivability that we have in our ships today, that the Littoral Combat Ship is not as hard and tough a ship, for example, as one of our guided missile destroyers. But it still possesses levels of survivability and redundancy that allow it to go into hostile environments. And so, there are varying degrees as to how we grade them. And LCS, in concert with the rest of the fleet, I believe is going to be a very key component of our ability to operate in the military.[51]

Achieving the Survivability Standard (Shock Testing)

On the question of where the two LCS designs achieve their intended Level 1+ survivability standard, one issue concerns the shock testing of the LCS designs. Information on this issue is presented below.

[50] Department of Defense, Director, Operational Test & Evaluation, *FY 2011 Annual Report*, December 2011, p. 141.

[51] Source: Transcript of hearing. For a press article discussing this exchange, see Andrew Burt, "CNO Defends Littoral Combat Ship's Role In Fleet Despite Low Survivability," *Inside the Navy*, March 14, 2011.

June 16, 2011, Press Report

A June 16, 2011, press report states:

> The Pentagon has waived the statutory requirement for full-up, system-level survivability testing of the Littoral Combat Ship because it would be "unreasonably expensive" and "impractical"....
>
> The [alternative LCS] live-fire test plan will [instead] consider previous testing results of components, subsystems and subassemblies that are similar to those being used on LCS.... In addition, the Pentagon will run "surrogate" tests to "fill key knowledge gaps," and conduct design analysis using validated and verified simulations and engineering assessments....
>
> The evaluation process also includes "plans for Total Ship Survivability Trials and Full Ship Shock Trials" for both LCS variants.[52]

Navy Information Paper Provided to CRS on April 29, 2011

On April 29, 2011, the Navy provided to CRS an information paper on LCS shock testing that stated:

> The LCS FSST [Full Ship Shock Trial] plan is similar to the FSST plans of the DDG 51 ARLEIGH BURKE Class destroyers and the LPD 17 SAN ANTONIO Class amphibious ships, where the Navy conducted the FSST on the third ships of the class, USS JOHN PAUL JONES (DDG 53) and USS MESA VERDE (LPD 19) respectively.
>
> There are several reasons supporting the Navy's plan to conduct a Full Ship Shock Trial (FSST) on later ships of the LCS Class. First, the follow (LCS 3 and forward) LCS Class ships incorporate the Flight 0+ Capability Development Document (CDD) and will be more representative of the ships of the class. These ships are incorporating lessons learned from LCS 1 and 2 and the early deployment of USS FREEDOM (LCS 1). Second, the Navy is conducting individual component and system level shock tests that must complete prior to conducting the FSST. The Navy must also complete the modeling and simulation to support initial survivability assessments and to help determine the test event geometry and charge size for the FSST. Lastly, preparation and completion of the environment assessment takes several years to complete; it is on track to support the current FSST schedule approved by the Director, Operational Test and Evaluation (DOT&E) as part of the review of the LCS Test and Evaluation Master Plan (TEMP).
>
> There is currently no particular "long pole in the tent", environmental impact studies, or otherwise for LCS FSST. The Navy is executing a methodical plan approved by OSD for the LCS Class. This plan will accommodate the December 2010 dual block buy award of two LCS seaframe variants.[53]

[52] Jason Sherman, "Pentagon Waives Testing Requirement For Navy's Littoral Combat Ship," *Inside the Pentagon*, June 16, 2011.

[53] Source: Navy information paper on LCS Full Ship Shock Trial (FSST) planning dated February 15, 2011, and provided by the Navy to CRS on April 29, 2011.

March 9, 2011, Hearing Before House Armed Services Committee Seapower and Projection Forces Subcommittee

At a March 9, 2011, hearing on Navy shipbuilding programs before the Seapower and Projection Forces subcommittee of the House Armed Services Committee, the following exchange took place concerning LCS survivability:

> REPRESENTATIVE HANK JOHNSON: I'm concerned that we may be prioritizing quantity at the expense of quality particularly given our short-term focus on light ships designed for use in coastal waters. I'm concerned about unresolved questions regarding survivability of the LCS.…
>
> Secretary Stackley, for years the Director of Operational Testing and Evaluation has raised serious concerns regarding survivability of the littoral combat ship and whether the LCS meets its Level 1 survivability requirement, why are LCS full ship shock tests not scheduled until Fiscal Year '14 when we will already have produced 10 or 12 ships? And why would we begin full-scale production of the ship if there are serious outstanding concerns regarding its survivability?
>
> ASSISTANT SECRETARY OF THE NAVY FOR RESEARCH DEVELOPMENT AND ACQUISITION SEAN STACKLEY: Yes, sir. Let me first by describing LCSs. LCS-1 and 2 are both designed to Level 1 level of survivability. And all the analysis and testing to date supports the determination that they in fact meet their survivability requirements. The scheduling of the full ship shock trial on LCS in 2014 is about right compared to all other shipbuilding programs.
>
> In fact, typically, in a major shipbuilding program, you don't shock the lead ship, you end up shocking one of the first follow ships. So, for example, the last major shipbuilding program that we conducted shock trials on, the DDG-51, the first ship to be shocked was DDG-53, which wasn't delivered until two years after the 51. And by the time she was shocked, we had about 20 DDG 51s under contract in a full rate production.
>
> The nature of the beast in shipbuilding is that you have such a large capital intense structure that's building these ships, that you cannot afford to stop construction and wait for the lead ship to be built, tested, and then get around to a full ship shock before you start construction again.
>
> So what we do is we address to the extent possible through analysis and surrogate testing and developmental testing, proof out the design so that by the time we get to the shock trial, the risk has been retired.
>
> And in fact, if you go back and look at the results from prior full ship shock trials, the change activity that's driven into those ship's designs is relatively minimal because we have in fact spent so much time on the front end of the design to retire that risk. And we see the same case here for LCS.[54]

[54] Source: Transcript of hearing.

Hull Cracking and Engine Problems on LCS-1

Another potential oversight issue for Congress for the LCS program concerns hull cracking and engine problems (including a shaft seal failure) on LCS-1.

A May 7, 2012, press report stated that "Rolls-Royce is gearing up for the serial production of new and more efficient axial waterjets for Freedom [LCS-1]-variant Littoral Combat Ships, designed to improve propulsion performance and reduce maintenance." The article stated that LCS-5 would be the first ship to receive the new waterjets, and that Rolls-Royce is also working on developing a new shaft seal so as to avoid the shaft seal failure experienced by LCS-1 in February 2012.[55]

An April 16, 2012, press report based on a Navy report to Congress about cracking in the superstructures of various Navy ship classes stated that LCS-1 "developed 16 cracks in its first 30 months, which the [Navy] report attributes to the deckhouse being integrated into the hull, resulting in higher stress concentrations. The [Navy] report also notes there was some inadequate local structure detail, including brackets and abrupt geometric changes, as well as some workmanship issues." The press report quoted the Navy report as stating that the cracking on LCS-1 was repaired, and that design and process changes had been made to mitigate cracking on follow-on ships.[56]

An April 23, 2012, press report stated:

> Lockheed Martin Corp.'s first littoral combat ship, delivered to the U.S. Navy in 2008, has been plagued by engine failures, 17 cracks and malfunctioning equipment during sea trials, a nonpartisan government oversight group said in a report sent to Congress.
>
> Lockheed's first littoral ship, the USS Freedom, built under the company's supervision by its partner Marinette Marine Corp., developed cracks as long as 18 inches along weld joints, the Project On Government Oversight in Washington said in a letter today to U.S. lawmakers.
>
> Flooding, corrosion and cracks accounted for 640 equipment failures, sending the ship back to dry dock for repairs last year, the group said in a report that included photographs of the damage....
>
> The Navy is reviewing the group's report, spokesman Chris Johnson said in an e-mail. "However, nearly all of these issues were well-reported and have been corrected as warranted," he said. The report is based on information that is more than a year old, Lockheed spokesman Keith Little said in an e-mail. The ship has been certified by the Navy and the American Bureau of Shipping, he said.[57]

A February 12, 2012, press report stated:

[55] Megan Eckstein, "Rolls-Royce To Deliver Improved, More maintainable LCS Waterjets In Fall," *Inside the Navy*, May 7, 2012.

[56] Megan Eckstein, "Navy Report: Cruiser Superstructure Cracking To Cost $270 Million To Repair," Inside the Navy, April 16, 2012.

[57] Gopal Ratnam, "Lockheed's Littoral Ship Had 640 Failures, Group Says," *Bloomberg Government (bgov.com)*, April 23, 2012.

> The U.S. Navy combat ship USS Freedom, built in Marinette, suffered another setback recently when it developed a leak off the coast of California and was forced to return to port.
>
> It was at least the fourth serious problem the ship has encountered since it was commissioned in Milwaukee in September 2008.
>
> The latest problem occurred Feb. 1 when Freedom "suffered a failure of the port shaft mechanical seal," the Navy told the publication Defense News.
>
> Some flooding occurred, and the ship returned to its home port of San Diego.
>
> During a heavy-weather ocean trial a year ago, sailors discovered a 6-inch horizontal hull crack below the waterline that forced them to return to port, avoiding heavy seas. The leak originated in a weld seam between two steel plates.
>
> In September 2010, one of Freedom's gas turbines quit working—requiring the Navy to cut short an offshore exercise. That turbine, made by Rolls-Royce, was replaced.
>
> In May 2010, the ship had problems with its water-jet propulsion system that had to be repaired in San Diego.[58]

A January 31, 2012, press report stated:

> The U.S. Navy has already altered its Freedom Class Littoral Combat Ship, LCS-1, to address problems uncovered in testing, but the ship still needs to be fundamentally redesigned, say leading defense analysts.
>
> They base their conclusions on briefings from the Aviation Week Intelligence Network (AWIN) revealing findings of Navy and industry reports detailing the vessel's hull and deckhouse cracking and engine problems. AWIN was given exclusive access to the documents....
>
> The reports accessed by AWIN dealt only with LCS-1. They were generated during the first half of last year, following the ship's initial operations, and detail the cracking and engine problems on the ship. The reports include pictures of 17 cracks as well as a chart listing their location, length and other attributes.
>
> The cracking was so pronounced even before the second set of rough-water trials were set to begin last year, the reports show, that the Navy sent engineers to the ship to monitor the cracks.
>
> As a result of the cracking issues, the ship designed to be the Navy's cheetah of the seas and envisioned as comprising about half of the service's future surface combatant fleet was limited to a "safe operating envelope" in which it could travel no faster than a laden cargo freighter in sea state 5 conditions, the reports show.
>
> Sea-state 5 is in the middle of the scale of ocean conditions, with waves of 8.2 to 13.1 ft.—considered to be "rough" water, one level higher than "moderate."
>
> Operational limits

[58] Rick Barrett, "Marinette-Built Navy Ship Hits Choppy Waters," *Milwaukee Journal Sentinel (www.jsonline.com)*, February 12, 2012.

> Navy LCS officials issued the near-term guidance with the new operational limits, depending on sea conditions and time away from port, about three months after the service acknowledged finding a single crack aboard the ship, the reports show.
>
> That guidance was to be re-evaluated after the ship's post-shakedown availability (PSA). LCS-1 started its PSA in June [2011], the Pentagon notes, and remained in the shipyard through the end of the year.
>
> The reports indicate that mission planners were told LCS-1 would sometimes need to alter or ditch planned missions if it encountered sea conditions outside of its safe operating envelop. In rougher seas sailors have been told to avoid roll angles greater than 45 deg....
>
> While operating under the limiting guidance, the ship's crew has had to perform extra inspections—weekly or daily—to find cracks and "limit" their size, and to inspect the ship after the hull has been slammed by waves or rougher seas....
>
> One crack identified in the report could only be viewed by using a mirror while hanging over the side of the vessel....
>
> At least one re-cracking was found, and in at least one other case it was too difficult to determine whether there was further cracking because the area was too hard to see....
>
> One day, the engine ingested about 475 gal. of seawater. At least 1,000 gal. of water, combined, were consumed by the engine during seven subsequent occasions, the reports say.
>
> Significant quantities of salt were discovered through the starboard engine and intake system, according to the reports. Internal components also showed signs of corrosion—apparently due to unanticipated and prolonged exposure to moisture and salt.
>
> All the engine hardware deterioration was due to seawater contamination, the reports say.[59]

Another January 31, 2012, press report in the same publication stated:

> U.S. Navy and Lockheed Martin officials contest the findings of service and contractor reports from last year indicating that the cracking and engine problems on the Freedom-class Littoral Combat Ship (LCS-1) were far worse than the program initially acknowledged, and say those issues have been fixed.
>
> The Aviation Week Intelligence Network (AWIN) was granted exclusive access to the reports, which service officials say they do not know about and could be outdated....
>
> Lockheed Martin and the Navy say the Freedom has since been repaired and upgraded to address the issues identified during that time and is scheduled to be redelivered to Naval Sea Systems Command (Navsea) soon with an eye toward re-evaluating its operational limitations.
>
> "USS Freedom was delivered in 2008 and since that time has spent all of her time either deployed or in testing phases for the Navy," says Joe North, vice president of Littoral Ship Systems for Lockheed Martin Mission Systems & Sensors. "As the lead ship in a totally new

[59] Michael Fabey, "'Damning' Documents Point To Need For Major LCS-1 Redesign," *Aerospace Daily & Defense Report*, January 31, 2012: 1-3.

class, she has been through extensive testing and been certified and approved by both the Navy as well as the American Bureau of Shipbuilding."

The ship, North notes, has logged 55,000 nm, is operational, and "continues to perform well and meets all requirements ... Freedom has finished her formal post-delivery availability and we are in full stride preparing for deployment."[60]

Navsea also says the ship's problems lie astern.

"Navsea isn't familiar with any new official 'reports,' either from Navy or industry sources, indicating the issues [are] either new or as alarming [as indicated]," said Navsea spokesman Christopher Johnson when asked about the reports' findings and analysts' conclusions....

"We have no knowledge of 'spiderweb cracks' or an 18-inch crack," North says. "Freedom contains hundreds of miles of welds and thousands of joints—this single hull crack was fixed and has not caused a problem on the ship. For any first-in-class ship, that is a very good scorecard."

Navsea's Johnson says it is "patently false" to say the ship has any current speed restrictions on it. The reports indicated the ship was limited to a "safe operating envelope" in which it could travel no faster than a laden cargo freighter in sea-state 5 conditions, i.e., waves of 8.2 to 13.1 ft.

"Following the hull crack event aboard Freedom last year, the operating speed was reduced during the transit to home port for repairs," he says. "Since the repairs and subsequent inspection, LCS-1 is approved to operate within the full scope of the designed safe operating envelope."

Cracking

Lockheed's North says, "The crack previously disclosed occurred during sea trials and when the ship encountered heavy seas, she was limited in speed for safety. This is standard practice. There have been no speed restrictions or limitations on the ship since that time and she is fully operational."...

Regarding the failure of a Rolls-Royce Trent MT30001 gas turbine engine, Johnson cites an earlier release saying, "The root cause analysis of the engine failure revealed that the gas turbine intakes were allowing saltwater to be ingested into the engine during high seas evolutions, which lead to the eventual failure of an HP [high pressure] turbine blade. The saltwater did not induce corrosion internal to the engine. However, it changed the air flow through the engine, which eventually led to the failure."

Navsea's Johnson says, "As a result of the failure, a redesign of the intake structure along with improved mating seals were implemented on LCS-1 on post delivery and are in line for LCS-3 and subsequent ships."

Navy officials acknowledge that the proof that the LCS-1 fixes work will be when it goes back into the water for tests and operations.[61]

[60] The ellipsis in this quote is as in the original.

[61] Michael Fabey, "Lockheed, Navy Downplay Cracking, Engine Problems On For [sic] LCS," *Aerospace Daily & Defense Report*, January 31, 2012: 4-5.

An October 21, 2011, press report based on a media roundtable that the Navy held the previous day on the LCS program stated:

> [Rear Admiral Jim Murdoch, the LCS program executive officer (PEO)] said yesterday the Navy has addressed [LCS-1 hull cracking and LCS-2 corrosion] problems and provided a "pretty comprehensive response" to questions related to them.
>
> "I don't think the corrosion nor the cracking issues pose any risk to the acquisition strategy," he said….
>
> "I think the designs are good," he said. "I'm sure there are going to be refinements to them that we make elsewhere throughout these ships," he added, noting improvements made to items such as air-conditioning condensers.[62]

A May 2, 2011, press report stated that

> The Navy has wrapped up part of its investigation into cracks that appeared on the first Littoral Combat Ship... and determined that the design being used for the third ship in the class will not present the same problems....
>
> ... non-destructive tests will determine if the LCS-1 structure meets design requirements, while the review of the ship design analysis will examine the validity of the design itself. Those studies will guide the program office's decisions on required repairs, modifications to the ship and possible changes to the design or quality assurance processes.[63]

An April 12, 2011, press report stated:

> Navy officials looking into an incident in which cracking developed on portions of the Lockheed Martin [LMT]-version of the Littoral Combat Ship have ruled out design flaws as a cause, according to a senior company official.
>
> Program officials were notified by Naval Sea Systems Command "a couple of weeks" ago that the LCS design of the Lockheed Martin variant was not to blame for the cracks, Joe North, vice president of the company's Littoral Ship Systems, said during an April 8 briefing with reporters at the company's offices in Arlington, Va. Navy review of structural cracks on the USS Freedom (LCS-1) is still under review, he added.
>
> "It certainly is not design," he said regarding the Navy review. "So, now we are looking at was it [caused] by stresses under the way [the Navy] went through the heavy sea testing, or was it potentially a flaw in the weld that got through."
>
> North added, "It could be [caused] from ... a workmanship issue. You can [just] imagine the number of miles of welds on a ship."
>
> In February, the Navy was forced to suspend heavy sea trials on the LCS-1 after a three- to six-inch crack in the ship's hull developed during the trials. In addition to the hull cracks, structural anomalies were also found in the ship's main superstructure, according to North.

[62] Emelie Rutherford, "Navy Confident LCS Costs Are Controlled," *Defense Daily*, October 21, 2011: 1-2.

[63] Cid Standifer, "Navy Concludes LCS-3 Design Is Not At Risk For Cracking Found In LCS-1," *Inside the Navy*, May 2, 2011.

> Since the suspension of sea tests for LCS-1, service officials have been reviewing the incident, with Lockheed Martin officials supporting the investigation by supplying the Navy with technical information, North said.
>
> "What we have done, basically, is re-run our models and fed them the data, the engineering basis for everything we have looked at," he said. "So, they are taking that, plus their own assessments and they are controlling the overall assessment of the ship."
>
> He could not comment on when the Navy review of the incident will be complete, but noted that company officials have already begun to address some of the issues that led to the cracking on LCS-1 on the new LCS-3 ship, which is now under construction at Marinette Marine shipyards in Wisconsin.
>
> "What we have done on [LCS]-3 ... from a producability standpoint, is [ask] how can we make this better, the second time around," North said.
>
> To that end, North acknowledged that in "some very small areas" on LCS-1 where program officials found it difficult to get a "full-penetration weld" employees would "be forced to try and get a hand in" and get a solid weld.
>
> "So we corrected those [areas] in [LCS]-3 going forward, so that we get full capability ... and completely make sure up front that everything is done," he said.
>
> While the hull cracking took Navy and Lockheed Martin officials by surprise, the cracks on the boat's superstructure "were predicted," North said, adding they are "more of a nuisance issue that occurs." The superstructure on board LCS-3 has also been corrected to address the flaws in LCS-1.[64]

A March 18, 2011, press report stated that LCS-1

> developed a crack as long as six inches through its hull during sea trials, prompting a U.S. Navy investigation of the design.
>
> The Navy is analyzing the crack to determine if changes are required for future Lockheed Martin hulls, Naval Sea Systems Command spokesman Christopher Johnson said yesterday in an e-mail. This includes reviewing "the design, construction drawings and welding procedures," he said.
>
> During a heavy-weather ocean trial on the USS Freedom in mid-February, he said, sailors discovered a six-inch horizontal hull crack below the waterline that leaked five gallons an hour. Inside the hull the crack measured three inches. It originated in a weld seam between two steel plates.
>
> The ship returned to its home port in San Diego, avoiding rough seas, after the commanding officer judged the leak rate "manageable," Johnson said.
>
> Smaller cracks that indicated welding "defects" showed up in the welds of the vessel's aluminum structure during sea trials last year, Johnson said in his e-mail.

[64] Carlo Munoz, "Lockheed Martin: Navy Rules Out Design Flaws As cause For LCS Cracks," *Defense Daily*, April 12, 2011. See also Cid Standifer, "Lockheed: LCS-1 Crack Caused By Faulty Welding, Not A Design Flaw," *Inside the Navy*, April 11, 2011, and Michael Fabey, "Welds Implicated In LCS Cracks," *Aerospace Daily & Defense Report*, April 11, 2011: 3.

> Initial analysis of the second Lockheed-built vessel, the USS Independence, showed improved welding, he said.
>
> A spokesman for Lockheed Martin, Keith Little, said the company "is working closely with the Navy to confirm the root cause" and has made all necessary repairs to the ship. "We are also supporting the Navy in additional testing along the hull to confirm this crack was an isolated anomaly," Little said….
>
> Johnson said in his e-mail that repair of the hull crack was completed March 12….
>
> Johnson said that several years ago the Navy conducted an "early fatigue analysis" on the Freedom that "identified high-stress areas" in the aluminum superstructure. The areas were fitted with instruments to collect data and to monitor for cracks.
>
> Cracks showed up late last year in the predicted areas. The measuring instruments remain in place, and the Navy implemented some design changes to the superstructure "to correct high stress and fatigue issues," Johnson said.[65]

Corrosion on LCS-2

Another potential oversight issue for Congress for the LCS program concerns corrosion on LCS-2. An October 21, 2011, press report based on a media roundtable that the Navy held the previous day on the LCS program stated:

> [Rear Admiral Jim Murdoch, the LCS program executive officer (PEO)] said yesterday the Navy has addressed [hull cracking and corrosion] problems and provided a "pretty comprehensive response" to questions related to them.
>
> "I don't think the corrosion nor the cracking issues pose any risk to the acquisition strategy," he said.
>
> The Navy knows how to address the corrosion issue and has made needed refinements to the ship design, he said. He said the changes did note create a significant cost or impact the ship's capability.
>
> "I think the designs are good," he said. "I'm sure there are going to be refinements to them that we make elsewhere throughout these ships," he added, noting improvements made to items such as air-conditioning condensers.[66]

A Navy statement provided by the Navy to CRS on June 23, 2011, states:

> Diver inspections and ultrasonic tests recently conducted on LCS 2 (USS INDEPENDENCE) revealed aggressive galvanic corrosion pitting within all four of the water jet tunnels and water jet cone assemblies. These cone assemblies are inaccessible while the ship is in the water. Drydocking and removal of the water jets is required to effect permanent repair of the damage. The Navy will make interim waterborne repairs by

[65] Tony Capaccio, "Lockheed NMartin's First Littoral Combat Ship Cracks, Navy Says," *Bloomberg News*, march 18, 2011.

[66] Emelie Rutherford, "Navy Confident LCS Costs Are Controlled," *Defense Daily*, October 21, 2011: 1-2. See also Megan Eckstein, "LCS Ship Designs Evolving To Address Corrosion, Increase Speed," *Inside the Navy*, October 24, 2011.

installing doubler plates around all four water jet tunnels and cone assemblies. The ship is safe to operate until the temporary repairs are completed.

LCS 2 is experiencing galvanic corrosion and pitting in the area of the water jet propulsion "tunnel" areas, especially in the inaccessible "cone assemblies" due to dissimilar metals. Initial dive inspections during LCS 2 construction test and trials highlighted concern for corrosion due to dissimilar metals; the primary area of concern was the steel propulsion shafts that power the water jets. To monitor this corrosion, periodic, planned diver inspections were conducted; continued corrosion and pitting were found within the water jet tunnels.

The ship was dry docked in June 2010 to effect a number of underwater repairs and the decision was made to also conduct repairs to the water jet tunnels (clad welding and plate replacement.) Additionally, work was completed to electrically isolate the water jets shafts from the hull to prevent further corrosion in both the tunnels and the cone assemblies. In an effort to reduce the corrosion occurring within the tunnels, HYCOTE (an underwater epoxy coating system) was also applied to the accessible areas in the tunnels. These efforts were unsuccessful in fully isolating and protecting the water jet tunnel and cone assemblies.

The planned short-term mitigation for LCS 2 is to install doubler plates, 360 degrees around the exterior of all four water jet tunnel cone assemblies (interior to the ship) as well as a portion of the tunnels where the majority of the pitting appears to be occurring. This work can be done without dry docking the ship. By adding material 360 degrees around the cone assemblies (instead of simply over the major pitted areas) the ship remains safe to operate until the long-term fix can be implemented. The repair work is planned during windows from June-July 2011 and will take place in Mayport, Florida.

The long term solution is to fully repair the existing corrosion damage and install a Cathodic Protection System in both the cone assemblies and the water jet tunnels. A Cathodic Protection System design was initiated in 2010 for the tunnels and cone assemblies. The full system design will be installed during the dry-docking portion of the ship's Post Shakedown Availability in 2012. This system will stop the corrosion in the tunnels and cone assemblies.

The waterborne portion of the Cathodic Protection System will be installed on LCS 4 (CORONADO) prior to launch; the design change will be fully implemented and tested prior to ship delivery.

The protection system is included in the baseline design for LCS 6 and follow ships.

LCS 2 (USS Independence) was commissioned in Mobile, AL, on 16 January 2010. The ship is currently in Mayport, FL, conducting post-delivery tests and trials designed to further test the ship's systems and familiarize the crew with the unique hull form and operating concept.[67]

A June 21, 2011, press report states:

Poor maintenance rather than faulty craftsmanship is likely to be the cause of "aggressive corrosion" on a US Navy warship, its Australian builder says.

[67] Source: Navy statement provided by Navy to CRS on June 23, 2011. See also Andrew Burt, "LCS-2 To Undergo Repairs In Coming Weeks For Corrosion Problems," *Inside the Navy*, June 27, 2011.

> Austal defended itself yesterday against a claim that the aluminium warship it built [LCS-2] was suffering from severe rust less than two years after being commissioned....
>
> Chief executive Andrew Bellamy said any corrosion on the vessel, known as a "littoral combat ship" for its ability to hug the shore, would be the fault of the operator or maintainer.
>
> "We have built 230 vessels of this type that have not suffered from this type of problem … where the operator and the maintainer of the ship have followed the procedures in a thorough way,"' Mr Bellamy said. "I suspect there is a problem in the area of operational maintenance if there is a galvanic corrosion issue."...
>
> Mr Bellamy seemed unconcerned about the rust claim, dismissing it as a "storm in a teacup" and unlikely to threaten Austal's contract.[68]

A June 17, 2011, press report states:

> "This could be a very serious setback," said Norman Polmar, an independent naval analyst and author in Alexandria, Virginia. "If the ship develops a serious flaw, you're not going to continue producing them."...
>
> Aluminum-hulled ships such as Austal's tend to rust faster than steel-hulled ships, Polmar said. "But I'm surprised it happened so early," he said. "This ship is brand new."...
>
> The Navy statement did not provide an estimate of the cost of the repair work.[69]

Technical Risk

Another potential oversight issue for Congress concerns the amount of technical risk in the program. The discussion below addresses this issue first with respect to the LCS sea frame, and then with respect to LCS mission packages.

Sea Frame

Regarding technical risk in developing and building the LCS sea frame, a March 2012 GAO report assessing DOD weapon acquisition programs stated:

> **Technology Maturity**
>
> Sixteen of the 19 critical technologies for both LCS designs are mature and have been demonstrated in a realistic environment. Three technologies—LCS 1's overhead launch and retrieval system and LCS 2's aluminum structure and trimaran hull—are nearing maturity. The LCS 1 overhead launch and retrieval system, which is essential to antisubmarine warfare and mine countermeasures missions, has moved weight equivalent to a mission system, but has not yet demonstrated its maturity by loading and offloading an actual mission module

[68] Jared Lynch, "Rust Not Our Fault, Insists Austal," Sydney *Morning Herald (www.smh.com.au)*, June 21, 2011. See also "Austal Outlines Efforts Against Corrosion in Warships," accessed online on July 1, 2011, at http://www.defpro.com/news/details/25510/.

[69] David Lerman and Tony Capaccio, "Navy Finds 'Aggressive Corrosion On New Ship," *Bloomberg.com*, June 17, 2011. See also Michael Fabey, "U.S. Navy Reports Corrosion Problems With LCS-2," *Aerospace Daily & Defense Report*, June 20, 2011: 5.

vehicle. Program officials stated that a test of the Remote Multi-Mission Vehicle with the launch and recovery system has not been scheduled and will depend on the availability of LCS 1 and the vehicle. Developmental testing for the vehicle is scheduled for 2013. In addition, program officials believe that LCS 2's aluminum structure and trimaran hull are mature because the ship is operational. However, an April 2010 independent technology readiness assessment did not reach the same conclusion about the aluminum structure, in part because of the inability to assure a 20 year service life.

Design and Production Maturity

The Navy started construction of LCS 1 and 2 without a stable design and has had to incorporate design and production changes into follow-on seaframes. When the LCS 1 and 2 construction contracts were awarded, the basic and functional design of each seaframe were respectively only 20 percent and 15 percent complete. Construction began 1 to 2 months following these contract awards. This concurrent design-build strategy ultimately led to increases in construction costs.

LCS 1 has been in operation for about 3 years and the Navy has discovered cracks in the superstructure and hull. The program office indicated that the cracks occurred either in high stress areas on the ship or due to workmanship issues, such as welding deficiencies. Program officials stated that all cracks have been fixed and design changes and improved production processes, such as improving accessibility in welding areas, are being developed. The design

changes, which decrease the stress on parts of the ship, will also be made on LCS 3, which is almost complete, as well as future seaframes. The Navy also reported corrosion on LCS 2, which has been in operation for over a year, due to insufficient insulation between the aluminum hull and the steel water jet. The Navy plans to install a system to mitigate the deterioration of metals on LCS 2 and future seaframes. The Navy believes these measures are sufficient to address the cracking and corrosion issues and can be done within the program's budget....

Program Office Comments

In commenting on a draft of this assessment, the Navy stated that it has retired the increased construction costs associated with the concurrent design/build period. The Navy noted that due to the complex nature of ship design and construction, lead ships generally have design changes that are incorporated into follow-on ships as a result of extensive testing and ship underway lessons learned. That is common practice in ships, even with a stable baseline, as evidenced by changes incorporated in the DDG 51 Class. LCS 3 and 4 have experienced minimal design changes and reflect learning, with both shipbuilders investing in their shipyards. LCS 3 is 99 percent complete and will deliver in June 2012. LCS 4 was about 80 percent complete at launch and was christened in January 2012. LCS 5 completed a detail design review and a production readiness review and its fabrication began in August 2011. LCS 6 followed suit and started fabrication in August 2011. Technical comments provided by the Navy were incorporated as appropriate.[70]

[70] Government Accountability Office, *Defense Acquisitions[:] Assessments of Selected Weapon Programs*, GAO-12-400SP, March 2012, p. 108.

Mission Packages

March 2011 GAO Report

Regarding technical risk in developing LCS mission packages, the March 2012 GAO report assessing DOD weapon acquisition programs stated:

> **Mine Countermeasures (MCM)**
>
> The Navy has accepted delivery of two partially capable MCM mission modules and, in 2012, expects to accept delivery of a module and procure another module. The Navy plans to begin operational testing onboard LCS in 2012, but the contents of the MCM module are still changing to address cost and capability concerns. For example, the remote minehunting system (RMS), comprised of an underwater vehicle and sonar, experienced a Nunn-McCurdy unit-cost breach in 2009. Further, the Navy has found performance issues, in part because the equipment required to launch and recover the underwater vehicle is not reliable and sonar performance does not currently meet threshold requirements. Since the Navy already purchased 10 underwater vehicles and determined there is no better alternative, RMS will remain in the module. The Navy is currently executing a plan to improve its reliability and then plans to begin producing the upgraded RMS in 2015. The rapid airborne mine clearance system was initially part of the MCM module, but was removed because of performance problems when destroying below-surface mines. The Navy plans to replace it by 2017. The Navy has also removed the unmanned surface vehicle (USV) and unmanned influence sweep system from its upcoming mission module. The USV design does not meet requirements, requiring a 6-year effort to improve the system's capabilities. The Navy has also deferred delivery of two other MCM systems.
>
> **Surface Warfare (SUW)**
>
> The Navy has accepted delivery of two partial SUW modules, including two 30 millimeter guns and a prototype of an 11-meter small boat. In 2012, the Navy plans to accept delivery of two and procure one more partial module. The Navy has replaced the cancelled Non-Line-of-Sight Launch System—which had a proposed range of 21 nautical miles—with the Griffin missile, which according to officials, will initially have a range of 3 miles. The Navy will not incorporate a surface-to-surface missile that can meet the module's requirements until after 2017 following a full and open competition.
>
> **Antisubmarine Warfare (ASW)**
>
> In 2008, the Navy took delivery of one partially capable ASW module at a cost of over $200 million, but subsequently cancelled plans to continue procuring the module and is redesigning it. According to program officials, the new design includes a variable-depth sonar and towed array, unmanned aerial vehicle, helicopter, and torpedo countermeasure. These ASW technologies are in use by another navy, but they have not been adapted for use with LCS. In 2012, the Navy will begin engineering analysis of the new ASW module, followed by development start in 2013 and initial delivery in fiscal year 2016.
>
> **Other Program Issues**
>
> The Navy plans to purchase 24, and deliver 9, LCS seaframes by 2016; however, it will not have a single fully capable mission module at that time. As of September 2011, the program planned to conduct a key DOD review in January 2012; however, this review, which includes a program cost estimate and technology maturity assessment, has been delayed to an unspecified date in 2012.

Program Office Comments

In commenting on a draft of the assessment, the program office did not concur with our assessment of the LCS Mission Modules; specifically with regard to the state of development and maturity of the mission modules. The program believes that recent testing has been very successful. For example, the MCM module has recently completed developmental and end-to-end testing to neutralize mines. The SUW module supported deployment of LCS 1 on missions that resulted in the capture of cocaine. From inception, the program has remained stable, fielding systems as they achieve the required level of maturity. The few systems experiencing issues are being replaced with alternative systems or are targets of increased focus and attention. The program also provided technical comments, which were incorporated as appropriate.

GAO Response

Major elements of each of the three mission modules have yet to be demonstrated and there are unknowns about their cost and performance. Until the program demonstrates these capabilities in a realistic environment, the program will be at increased risk of cost growth, schedule delays, and performance shortfalls.[71]

December 2011 DOT&E Report

A December 2011 report from DOD's Director, Operational Test and Evaluation (DOT&E)—DOT&E's annual report for FY2011—states:

> Both developmental and operational testing of the AN/AQS-20A Sonar Mine Detecting Set, an Airborne Mine-countermeasures mission module system within the LCS MCM mission package, revealed the system is deficient in meeting required thresholds for False Classification Density (FCD) and Vertical Localization. These deficiencies may preclude the LCS MCM mission package from meeting its required threshold for Area Coverage Rate Sustained (ACRS). If the FCD and Vertical Localization deficiencies are not corrected prior to IOT&E, they may adversely affect the operational effectiveness of the LCS MCM Mission Package.
>
> Developmental testing of the Airborne Laser Mine Detection System (ALMDS), an Airborne Mine-countermeasures mission module system within the LCS MCM mission package, revealed the system is deficient in meeting the required threshold for FCD. This deficiency will likely preclude the LCS MCM mission package from meeting its required threshold for ACRS. If the ALMDS FCD deficiency is not corrected prior to IOT&E, it will adversely affect the operational effectiveness of the LCS MCM Mission Package....
>
> FY11 Recommendations.
>
> 1. The Navy should investigate solutions and correct AN/AQS-20A FCD and Vertical Localization deficiencies prior to the LCS MCM Mission Package IOT&E.
>
> 2. The Navy should investigate solutions and correct the ALMDS FCD deficiency prior to the LCS MCM Mission Package IOT&E.[72]

[71] Government Accountability Office, *Defense Acquisitions[:] Assessments of Selected Weapon Programs*, GAO-12-400SP, March 2012, p. 110.

[72] Department of Defense, Director, Operational Test & Evaluation, *FY 2011 Annual Report*, December 2011, p. 141.

Total Program Acquisition Cost

Another potential oversight issue for Congress for the LCS program concerns the lack of an official DOD estimate of the program's total acquisition (i.e., research and development plus procurement) cost. Although DOD's December 31, 2011, SAR for the LCS program provides an estimated total acquisition cost for 55 LCS sea frames (see "Acquisition Cost" in "Background"), DOD has not reported a total estimated acquisition cost for the entire LCS program, including costs for both 55 LCS sea frames and 64 LCS mission packages.

Supporters of the LCS program could argue that substantial data is available in the Navy's annual budget submission on annual LCS research and development and procurement costs for the five-year period covered by the Future Years Defense Program (FYDP). Skeptics could argue that a major acquisition program like the LCS program should not proceed to higher annual rates of production until the program's potential total acquisition cost is reported and assessed against other defense spending priorities.

Separate SAR Reporting of Sea Frame and Mission Module Costs

Another potential oversight issue for Congress is whether DOD should report LCS sea frame costs and LCS mission module costs in separate SARs, or together in the same SAR. As mentioned earlier (see "Acquisition Cost" in "Background"), DOD in its December 31, 2010, SAR for the LCS program stated that DOD has decided to "to separate the [LCS] program into two separate and distinct programs with separate reporting requirements. The Seaframe portion of the program is reported in this SAR as approved at MS [Milestone] B. The Mission Module portion of the program will begin reporting when it receives its Milestone B decision."

Supporters of publishing these two sets of costs in separate SARs could argue that it will facilitate congressional oversight of the program by helping Congress differentiate sea frame costs from mission module costs. Supporters of publishing these two sets of costs together in the same SAR could argue that publishing them in separate SARs could complicate congressional oversight of the program by making the total cost of the LCS program as a whole (including costs for both sea frames and mission modules) less visible to Congress, and by making costs in the LCS sea frame SAR less easily comparable to costs reported in SARs for other Navy shipbuilding programs.

Operational Concepts

Another potential oversight issue for Congress for the LCS program concerns operational concepts for using LCSs once they enter service. A February 2010 GAO report stated:

> The Navy has made progress in developing operational concepts for LCS, but faces risks in implementing its new concepts for personnel, training, and maintenance that are necessitated by the small crew size. Specifically, the Navy faces risks in its ability to identify and assign personnel given the time needed to achieve the extensive training required. GAO's analysis of a sample of LCS positions showed an average of 484 days of training is required before reporting to a crew, significantly more than for comparable positions on other surface ships. Moreover, the Navy's maintenance concept relies heavily on distance support, with little maintenance performed on ship. The Navy acknowledges that there are risks in implementing its new concepts and has established groups to address how to implement them. However, these groups have not performed a risk assessment as described in the 2008 National Defense Strategy. The Strategy describes the need to assess and mitigate risks to

> executing future missions and managing personnel, training, and maintenance. If the Navy cannot implement its concepts as envisioned, it may face operational limitations, have to reengineer its operational concepts, or have to alter the ship design. Many of the concepts will remain unproven until 2013 or later, when the Navy will have committed to building almost half the class. Having a thorough risk assessment of the new operational concepts would provide decision makers with information to link the effectiveness of these new concepts with decisions on program investment, including the pace of procurement.[73]

An April 2011 news analysis article states:

> The Navy promises this ship will be ideal for going after fast, swarming small craft like those operated by the Iranian Pasdaran, or Revolutionary Guards, and for chasing pirates. With speeds in excess of 40 knots, "it's great for a knife fight," some like to say. But the speed currently touted as a great war-fighting quality was originally meant for transit. You would perform your mine-hunting mission at the top of the Persian Gulf, for example, zip back to Bahrain or somewhere, change out the mission module in two or three hours, and zoom back to be on station by morning with a surface or anti-submarine warfare module installed, ready for action. But it gradually became apparent the modules couldn't be swapped out that fast—two or three days is more like it—and the transit speed requirement diminished in value. Even though the original requirement is gone, the speed remains—at the cost of endurance and other factors—and the Navy has found other ways to describe its usefulness.
>
> Another remarkable characteristic of the program is that the 20 ships just contracted or issued options for—on a fixed-price incentive basis—are the same basic designs already being built. Yet no true operational experience has been gained with the first ships, and the new ships show only a handful of modifications.
>
> Apart from the Navy's inability to properly forecast how fast these ships could be built, fielded and paid for, there is a similar tone-deafness to how they will be employed. The service has done its best to estimate how the ships will be manned, supported, deployed and used, but at this point—eight years after the program started—it's still mostly conjecture.
>
> It's one thing to develop a new class of destroyer or submarine or strike fighter. While new designs have updated and different features and capabilities, it is conceptually understood how to support and operate them. But that is not the case with the LCS. Just about everyone involved with the new type will have to learn how to support, operate and use them…
>
> Although nearly half the planned LCS fleet is now built, under contract or with contract options, there is no demonstrable example of exactly how this LCS concept is going to work. Consider:
>
> • LCS has no proven concept of operations. Tactical commanders with on-scene and area responsibilities so far have no experience in deploying these ships and experiencing what they can do.
>
> • Command-and-control questions on the ships themselves remain. Who, for example, should have weapons release authority—the ship's commanding officer or the officer in charge of the mission detachment?

[73] Government Accountability Office, *Littoral Combat Ship[:] Actions Needed to Improve Operating Cost Estimates and Mitigate Risks in Implementing New Concepts*, GAO-10-257, February 2010, summary page.

- Are the ships best operated in small numbers or in groups? What sorts of groups work best with each kind of mission? In what roles might they be effective on their own?

- What are the best mission sets for the ships? Already, Adm. John Harvey, head of U.S. Fleet Forces command, is urging the fleet not to use them in ways for which they are not intended—and that was after only one ship was in service. Do people understand what these ships are for and what they can do?

- The ships have no area air defense capability. Who will protect them and how will that be coordinated?

- No other surface ship has been designed to operate as many offboard vehicles as the LCS. How will each ship coordinate its own offboard systems, including unmanned air, surface and underwater vehicles? Should different ships take responsibility for particular dimensions—i.e., should one ship control all the underwater vehicles, or should that be left to each CO or OIC? Should one ship take on all those particular vehicles, or can each ship deploy its own?

- Are these ships well-suited to a "knife fight" with high-speed small craft, as some have urged, or would a better tactic be to stand off and fight with the 57mm gun and offboard systems such as armed helicopters or drones?

- Is the high speed really necessary? Should more fuel be added at the expense of speed?

- The ships are not patrol boats and do not have long endurance, despite proclamations that they are great for anti-piracy work. Do they need a redesign if that's the mission?

- Is it better to fit a ship with a single mission module for longer periods, or better to frequently swap out the modules?

- Can all the necessary personnel be accommodated? The ships are limited to 75 or 76 berths—no room for extra riders, such as special operations forces, or more likely, technical representatives for the multiplicity of vehicles each ship will eventually carry.

- Will the mission modules prove effective? The mine module already has lost several major components. Will it prove the equal of the fleet's mine countermeasures ships the LCS is set to replace? Will the anti-submarine warfare module really prove effective? Already, the Navy has classified the cost of the system, along with component details, so it has gotten harder to make this assessment. However, reports abound that the system is ineffective.

- Will the unique support systems for the ships prove their effectiveness? The tiny crew of 40 needs an exceptionally high level of pier support—will they get it? Will the needs of parts and maintenance supply be met routinely?

- Will future managers accept that both kinds of LCS have entirely separate and unique combat system suites? With dozens of different systems on each design, sailors qualified to serve on one LCS or the other are no more qualified to serve on the other LCS class than an amphibious sailor. Will that stand? At some point down the road, will some future CNO or Navy secretary decide that the fleet can't afford both types of combat systems and order the premature disposal of all of one of the types long before the end of their service life? Those are just some of the issues facing the development of the LCS.

Perhaps the only sure thing is that the Navy has tried its best to come up with possible answers to these questions. The thing to do now is not to promise that solutions are at hand

> but to put the LCS in the hands of young sailors and let them go out, get hands-on experience with the ships in multiple scenarios, find out how they'll work best, and adapt.
>
> The 1930s were exciting times for sailors and aviators living through the great age of naval aviation experimentation and making believers out of doubters. The 2010s and 2020s could prove just as rewarding for today's LCS sailors, headed on courses both known and unknown.[74]

A report by the Center for Strategic and Budgetary Assessments (CSBA) provides additional discussion of possible operational concepts for the LCS.[75]

Legislative Activity for FY2013

FY2013 Funding Request

The Navy's proposed FY2013 budget requests $1,785.0 million in procurement funding for the four LCS sea frames requested for FY2013. The Navy's proposed budget also requests $102.6 million in procurement funding for LCS mission modules.

FY2013 National Defense Authorization Act (H.R. 4310/P.L. 112-239)

House

Section 128 of the FY2013 National Defense Authorization Act (H.R. 4310 of the 112th Congress) as reported by the House Armed Services Committee (H.Rept. 112-479 of May 11, 2012) states:

> SEC. 128. REPORT ON LITTORAL COMBAT SHIP DESIGNS.
>
> Not later than December 31, 2013, the Secretary of the Navy shall submit to the congressional defense committees a report on the designs of the Littoral Combat Ship, including comparative cost and performance information for both designs of such ship.

Section 129 states:

> SEC. 129. COMPTROLLER GENERAL REVIEWS OF LITTORAL COMBAT SHIP PROGRAM.
>
> (a) Acceptance of LCS-
>
> (1) IN GENERAL- The Comptroller General of the United States shall conduct a review of the compliance of the Secretary of the Navy with part 246 of title 48 of the Code of Federal Regulations and subpart 46.5 of the Federal Acquisition Regulation in accepting the LCS.

[74] Christopher P. Cavas, "Past Imperfect[:] Like First Carriers, Littoral Combat Ship Enters Age of Experimentation," *Armed Forces Journal*, April 2011 (accessed at http://www.armedforcesjournal.com/2011/04/5848053).

[75] Martin M. Murphy, *Littoral Combat Ship[:] An Examination of its Possible Concepts of Operation*, Washington, Center for Strategic and Budgetary Assessments, 2010, 71 pp.

(2) MATTERS INCLUDED- The review under paragraph (1) shall include a discussion of the knowledge of, and determinations by, the LCS program office and contractors with respect to the following:

(A) Potential for cracks in the LCS hull and deckhouse and any corresponding potential design risks.

(B) Chargeable equipment failures.

(C) Potential for engine failures or breakdowns.

(D) Meeting key performance parameters, including speed.

(E) Review of the quality of seals and welds.

(F) Review of water jet corrosion.

(G) Completeness of records to support acceptance of the LCS.

(H) How the LCS risk and problems compare to lead ships in comparable programs.

(I) Security of the ship and systems, including any known lapses.

(J) Manning analysis, including how it would affect key performance parameters.

(K) Strategies for balancing cost, schedule, and performance trade-offs as required by section 201 of the Weapon Systems Acquisition Reform Act of 2009 (P.L. 111-23; 123 Stat. 1719).

(b) Operational Support- Not later than 180 days after the date of the enactment of this Act, the Comptroller General shall submit to the congressional defense committees a report on the operational support and sustainment strategy for the Littoral Combat Ship program, including modernization and logistics support.

(c) Cooperation- For purposes of conducting the review under subsection (a)(1) and (b), the Secretary of Defense shall ensure that the Comptroller General has access to—

(1) all relevant records of the Department; and

(2) all relevant communications between Department officials, whether such communications occurred inside or outside the Federal Government.

H.Rept. 112-479 recommends approving the Navy's requests for FY2013 procurement funding for LCS sea frames (page 375) and for LCS mission modules (page 378).

The report also states:

Littoral Combat Ship

The committee is aware of considerable issues that have plagued the Littoral Combat Ship (LCS) program over recent years. While the Navy has briefed the congressional defense committees on problems involving the LCS program, the committee believes that the Navy has not adequately informed Congress to the full extent possible on program deficiencies, including mechanical and structural failures. The committee is also concerned with the lack of transparency regarding these significant issues as was addressed in the annual report by

> the Director, Operational Test and Evaluation which stated that its assessment of the program was limited because the "program offices have not released any formal developmental T&E reports." Therefore, the committee directs the Secretary of the Navy to provide a comprehensive briefing to the House Committee on Armed Services within 30 days after the date of the enactment of this Act on the LCS program, in a classified or unclassified session. (Page 33)

The report also states:

> With the first two Littoral Combat ships (LCS) delivered to the fleet, each of a different design, each has had various problems that are being addressed by the Navy. LCS–1 has had some cracking and shaft seal problems and LCS–2 has had problems with galvanic corrosion within the water jets. The committee is aware that the Navy intends to forward stage up to four LCS to Singapore, and while supporting the budget request for four LCS in fiscal year 2013, it encourages the Navy to ensure the problems discovered to date have technical solutions and that these solutions are incorporated on forthcoming ships. (Page 35)

Senate

Section 127 of the FY2013 National Defense Authorization Act (S. 3254 of the 112th Congress) as reported by the Senate Armed Services Committee (S.Rept. 112-173 of June 4, 2012) states:

> SEC. 127. DESIGNATION OF MISSION MODULES OF THE LITTORAL COMBAT SHIP AS A MAJOR DEFENSE ACQUISITION PROGRAM.
>
> (a) Designation Required- The Secretary of Defense shall—
>
> (1) designate the effort to develop and produce all variants of the mission modules in support of the Littoral Combat Ship program as a major defense acquisition program under section 2430 of title 10, United States Code; and
>
> (2) with respect to the development and production of each variant, submit to the congressional defense committees a report setting forth such cost, schedule, and performance information as would be provided if such effort were a major defense acquisition program, including Selected Acquisition Reports, unit cost reports, and program baselines.
>
> (b) Additional Quarterly Reports- The Secretary shall submit to the congressional defense committees on a quarterly basis a report on the development and production of each variant of the mission modules in support of the Littoral Combat Ship, including cost, schedule, and performance, and identifying actual and potential problems with such development or production and potential mitigation plans to address such problems.

Regarding Section 127, the report states:

> **Designation of mission modules of the littoral combat ship as a major defense acquisition program (sec. 127)**
>
> The committee recommends a provision that would require the Secretary of Defense to designate the effort to develop and produce all variants of the mission modules in support of the Littoral Combat Ship program as a major defense acquisition program under section 2430 of title 10, United States Code.

> The committee seeks greater visibility into the procurement costs associated with mission modules supporting the Littoral Combat Ship program. The committee believes that, to ensure that it has the visibility required to fully understand and closely track the costs of developing and producing each variant of the mission module, the overall effort should be designated as a major defense acquisition program (MDAP). In so doing, the committee expects to receive all of the cost, schedule, and performance information on this effort that is typically produced in connection with typical MDAPs, including, selected acquisition reports, unit cost reports and program baselines. The committee hopes that this initiative will help discipline how the Department of the Navy has structured its plan to develop and produce each variant of the mission modules and improve Congress' ability to subject the overall effort to strong oversight.
>
> As part of this initiative, the committee directs the Secretary of the Navy to provide the congressional defense committees, no later than 30 days after enactment of this Act, with the Department of the Navy's estimates as to the cost of completing the development and production of each mission module, operative as of May 31, 2012.
>
> The committee understands that in the fourth quarter of 2012, the Department of the Navy expects to approve the mission modules for entry into Milestone B, that is, the engineering and manufacturing development phase of the Defense Acquisition Management System. At that time, the committee expects that the Milestone Decision Authority will certify that, as required under section 2366b of title 10, United States Code, reasonable cost and schedule estimates have been developed to execute, with the concurrence of the Director of the Cost Assessment and Program Evaluation, the product development and production plan under the program. To ensure that the Department of the Navy's plans to develop and produce these mission modules is realistic and affordable, the committee looks forward to receiving these cost and schedule estimates, will exercise close oversight of this certification, and expects that the Department will not waive the certification. (Page 15)

Section 251 states:

> SEC. 251. MISSION PACKAGES FOR THE LITTORAL COMBAT SHIP.
>
> (a) Report Required- Not later than March 1, 2013, the Secretary of the Navy shall, in consultation with the Director of Operational Test and Evaluation, submit to the congressional defense committees a report on the mine countermeasures warfare (MCM), antisubmarine warfare (ASW), and surface warfare (SUW) Mission Packages for the Littoral Combat Ship.
>
> (b) Elements- The report required by subsection (a) shall set forth the following:
>
> (1) A plan for the Mission Packages demonstrating that Preliminary Design Review for every capability increment precedes Milestone B or equivalent approval for that increment.
>
> (2) A plan for demonstrating that the capability increment for each Mission Package, combined with a Littoral Combat Ship, on the basis of a Preliminary Design Review and post-Preliminary Design Review assessment, will achieve the capability specified for that increment.
>
> (3) A plan for demonstrating the survivability and lethality of the Littoral Combat Ship with its Mission Packages sufficiently early in the development phase of the system to minimize costs of concurrency.

Regarding Section 251, the report states:

Mission packages for the littoral combat ship (sec. 251)

The committee recommends a provision that would require the Secretary of the Navy to produce a report, in consultation with the Director of Operational Test and Evaluation, on the mine countermeasures warfare, antisubmarine warfare, and surface warfare mission packages for the Littoral Combat Ship (LCS).

The Secretary's report would be required, at a minimum, to set forth the following:

(1) A plan for the Mission Packages demonstrating that Preliminary Design Review for every capability increment precedes Milestone B or equivalent approval for that increment;

(2) A plan for demonstrating that the capability increment for each Mission Package, combined with a Littoral Combat Ship, on the basis of a Preliminary Design Review and post-Preliminary Design Review assessment, will achieve the capability specified for that increment; and

(3) A plan for demonstrating the survivability and lethality of the Littoral Combat Ship with its Mission Packages sufficiently early in the development phase of the system to minimize costs of concurrency.

The committee remains concerned about this program's ability to deliver combat-ready LCS when our sailors need them in support of worldwide maritime operations. The development and fielding of these mission module capabilities will require the Navy to field a range of 24 critical technologies, including sensors, vehicles, and weapons. In addition, there have been perturbations in the objective systems to be deployed in the mission modules, as the Navy is replacing some items because of poor performance or increasing costs. All of this argues for pursuing the regular order in defining, developing, testing, and fielding incremental improvements in capability for the LCS. This provision will make it clear that the Navy should follow a regular, transparent process in managing the mission module program. (Pages 45-46)

S.Rept. 112-173 recommends approving the Navy's requests for FY2013 procurement funding for LCS sea frames (page 325) and for LCS mission modules (page 327).

Conference

Section 126 of the conference report (H.Rept. 112-705 of December 18, 2012) on H.R. 4310/P.L. 112-239 of January 2, 2013, states:

SEC. 126. DESIGNATION OF MISSION MODULES OF THE LITTORAL COMBAT SHIP AS A MAJOR DEFENSE ACQUISITION PROGRAM.

(a) DESIGNATION REQUIRED.—The Secretary of Defense shall—

(1) designate the effort to develop and produce all variants of the mission modules in support of the Littoral Combat Ship program as a major defense acquisition program under section 2430 of title 10, United States Code; and

(2) with respect to the development and production of each such variant, submit to the congressional defense committees a report setting forth such cost, schedule, and performance

information as would be provided if such effort were a major defense acquisition program, including Selected Acquisition Reports, unit cost reports, and program baselines.

(b) ADDITIONAL QUARTERLY REPORTS.—The Secretary shall submit to the congressional defense committees on a quarterly basis a report on the development and production of each variant of the mission modules in support of the Littoral Combat Ship, including cost, schedule, and performance, and identifying actual and potential problems with such development or production and potential mitigation plans to address such problems.

Section 127 states:

SEC. 127. REPORT ON LITTORAL COMBAT SHIP DESIGNS.

Not later than December 31, 2013, the Secretary of the Navy shall submit to the congressional defense committees a report on the designs of the Littoral Combat Ship, including comparative cost and performance information for both designs of such ship.

Section 128 states:

SEC. 128. COMPTROLLER GENERAL REVIEW OF LITTORAL COMBAT SHIP PROGRAM.

(a) ACCEPTANCE OF LCS–1 AND LCS–2.—The Comptroller General of the United States shall conduct a review of the compliance of the Secretary of the Navy with subpart 246.5 of title 48 of the Code of Federal Regulations and subpart 46.5 of the Federal Acquisition Regulation in accepting the LCS–1 and LCS–2 Littoral Combat Ships.

(b) OPERATIONAL SUPPORT.—Not later than 180 days after the date of the enactment of this Act, the Comptroller General shall submit to the congressional defense committees a report on the operational support and sustainment strategy for the Littoral Combat Ship program, including manning, training, maintenance, and logistics support.

(c) COOPERATION.—For purposes of conducting the review under subsection (a) and the report under subsection (b), the Secretary of Defense shall ensure that the Comptroller General has access to—

(1) all relevant records of the Department; and

(2) all relevant communications between Department officials, whether such communications occurred inside or outside the Federal Government.

Regarding Section 128, the report states:

Comptroller General review of Littoral Combat Ship program (sec. 128)

The House bill contained a provision (sec. 129) that would require the Comptroller General of the United States to conduct a review of the Littoral Combat Ship (LCS) program's quality and a review of the U.S. Navy's operational and sustainment support strategy for the program. In particular, the provision would direct the Comptroller General to review whether the Secretary of the Navy was complying with regulations in accepting delivery of LCS vessels.

> The Senate amendment contained no similar provision The Senate recedes with an amendment that would limit the acceptance compliance review to LCS-1 and LCS-2, the two lead ships in the program.
>
> The conferees note the Navy Board of Inspection and Survey released a July 2012 report regarding LCS "Material Condition and Maintainability." This report highlights numerous sustainment issues that the conferees expect the Navy's LCS Council to address. The conferees specifically note concerns with training requirements, Title 10 compliance for long-term maintenance requirements, potential operational impediments, corrosion control challenges, and manning, among other issues. The conferees also expect the Comptroller General to address these shortfalls, in addition to any other deficiencies he may find, and identify the steps the Navy is taking to ensure success for the long-term sustainment of LCS. (Page 6 [pdf page 65 of 629] of the Joint Explanatory Statement on the conference report.)

Section 241 states:

> SEC. 241. MISSION PACKAGES FOR THE LITTORAL COMBAT SHIP.
>
> (a) REPORT REQUIRED.—Not later than March 1, 2013, the Secretary of the Navy shall, in consultation with the Director of Operational Test and Evaluation, submit to the congressional defense committees a report on the mine countermeasures warfare, antisubmarine warfare, and surface warfare mission packages for the Littoral Combat Ship.
>
> (b) ELEMENTS.—The report required by subsection (a) shall set forth the following:
>
> (1) A plan for the mission packages demonstrating that preliminary design review for every capability increment precedes Milestone B or equivalent approval for that increment.
>
> (2) A plan for demonstrating that the capability increment for each mission package, combined with a Littoral Combat Ship, on the basis of a preliminary design review and post-preliminary design review assessment, will achieve the capability specified for that increment.
>
> (3) A plan for demonstrating the survivability and lethality of the Littoral Combat Ship with its mission packages sufficiently early in the development phase of the system to minimize costs of concurrency.

The conference report recommends approving the Navy's requests for FY2013 procurement funding for LCS sea frames and for LCS mission modules (see pdf pages 474 and 476 of 629, respectively, of the Joint Explanatory Statement for the conference report).

Department of Defense, Military Construction and Veterans Affairs, and Full-Year Continuing Appropriations Act, 2013 (H.R. 933 of 113th Congress)

House

H.R. 933 of the 113th Congress as passed by the House on March 6, 2013, includes the FY2013 DOD appropriations act as Division A. Division A of the bill approves the Navy's requests for FY2013 procurement funding for LCS sea frames and for LCS mission modules.[76]

FY2013 DOD Appropriations Bill (H.R. 5856 of 112th Congress)

House

The House Appropriations Committee, in its report (H.Rept. 112-493 of May 25, 2012) on H.R. 5856 of the 112th Congress, recommends approving the Navy's requests for FY2013 procurement funding for LCS sea frames (page 156) and for LCS mission modules (page 161).

The report states:

> LITTORAL COMBAT SHIP MANNING
>
> From its inception, the Littoral Combat Ship (LCS) was planned to be minimally manned by small, experienced crews and therefore contains limited berthing commensurate with the minimal manning requirement. It is the Committee's understanding that all crewmembers were to have experienced at least one deployment prior to joining the LCS crew and that no first tour junior officers or first term enlisted sailors would be eligible to join an LCS crew without having prior at-sea experience. Since the prototypical training opportunities are not available on the LCS and manning is limited, the entire crew must be capable of performing a variety of tasks. The Committee now understands that the Navy is assigning ensigns without prior sea duty to each LCS crew as part of a new pilot program. The Committee is concerned that the lack of training opportunities will pose a particular challenge for junior officers with no at-sea crew experience. In addition, the LCS will have to rely on the addition of an interim or temporary berthing module when fully manned to accommodate all of the personnel onboard due to an insufficient number of permanent berths.
>
> The Committee is concerned that the current LCS manning model is unrealistic and that relying on temporary solutions such as berthing modules to accommodate additional crewmembers is both impractical and detrimental to the quality of life of the entire crew. The Committee understands that more berths could be added to future ships to provide sufficient permanent berthing for all crewmembers. The Committee directs the Secretary of the Navy to submit a report to the congressional defense committees not later than 120 days after enactment of this Act on future manning plans for the LCS. The report should include the Navy's plan for future manning requirements, including how additional crewmembers will be accommodated based on the outcome of the aforementioned pilot program, how training opportunities for junior crew members will be provided, a projected timeline for proposed

[76] Explanatory statement for H.R. 933, pdf pages 149 and 154 (lines 29-31) of 394.

manning changes, and a projected cost of ship modifications to accommodate additional crew members. (Page 28)

Senate

The Senate Appropriations Committee, in its report (S.Rept. 112-196 of August 2, 2012) on H.R. 5856 of the 112th Congress, recommends approving the Navy's requests for FY2013 procurement funding for LCS sea frames (page 124) and for LCS mission modules (page 130).

Conference

For further action on the FY2013 DOD appropriations act, see H.R. 933 of the 113th Congress above.

Appendix A. Summary of Congressional Action in FY2005-FY2012

This appendix presents a summary of congressional action on the LCS program in FY2005-FY2010.

FY2005

In FY2005, Congress approved the Navy's plan to fund the construction of the first two LCS sea frames using research and development funds rather than shipbuilding funds, funded the first construction cost of the first LCS (LCS-1), required the second LCS (LCS-2) to be built (when funded in FY2006) to a different design from the first, prohibited the Navy from requesting funds in FY2006 to build a third LCS, and required all LCSs built after the lead ships of each design to be funded in the SCN account rather than the Navy's research and development account.

FY2006

In FY2006, Congress funded the procurement of LCSs 2, 3, and 4. (The Navy requested one LCS for FY2006, consistent with Congress's FY2005 action. Congress funded that ship and provided funding for two additional ships.) Congress in FY2006 also established a unit procurement cost limit on the fifth and sixth LCS sea frames of $220 million per ship, plus adjustments for inflation and other factors (Section 124 of the FY2006 defense authorization bill [H.R. 1815/P.L. 109-163] of January 6, 2006), required an annual report on LCS mission packages and made procurement of more than four LCSs contingent on the Navy certifying that there exists a stable design for the LCS.

FY2007

In FY2007, Congress funded the procurement of LCSs 5 and 6. (The Navy canceled these two ships in 2007 before they were placed under contract for construction.)

FY2008

In FY2008, Congress accepted the Navy's cancellation of LCSs 3 through 6; funded the procurement one additional LCS in FY2008 (which the Navy called LCS-5);[77] significantly reduced the Navy's FY2008 funding request for the LCS program; amended the LCS sea frame unit procurement cost cap to $460 million per ship for LCSs procured in FY2008 and subsequent years (Section 125 of the conference report [H.Rept. 110-477 of December 6, 2007] on H.R. 1585, the FY2008 defense authorization bill, which was enacted as H.R. 4986/P.L. 110-181 of

[77] The Navy apparently called this ship LCS-5 because the original LCS-5 and LCS-6 were canceled by the Navy before they were replaced under contract, leaving LCS-4 as last LCS under contract to have been canceled. In spite of its designation, LCS-5 would have been the third LCS in the restructured LCS program, and was the seventh to have been funded by Congress.

January 28, 2008); and required the Navy to use fixed-price-type contracts for the construction of LCSs procured in FY2008 and subsequent years.

The Navy in 2007 requested that Congress amend the existing unit procurement cost cap for the fifth and sixth ships to $460 million, plus adjustments for inflation and other factors. Congress amended the cost cap to $460 million, but applied it not only to the fifth and sixth LCSs, but to all LCSs procured in FY2008 and subsequent years. The use of fixed-price contracts for future LCSs was something that the Navy had stated an intention to do as part of its plan for restructuring the LCS program.

FY2009

In FY2009, Congress delayed the implementation of the LCS sea frame unit procurement cost cap by two years, to ships procured in FY2010 and subsequent years (Section 122 of the FY2009 defense authorization act [S. 3001/P.L. 110-417 of October 14, 2008]); rescinded $337 million in FY2008 shipbuilding funds for the LCS program, effectively canceling the funding for the LCS procured in FY2008 (Section 8042 of the FY2009 defense appropriations act [Division C of H.R. 2638/P.L. 110-329 of September 30, 2008]); and funded the procurement of two LCSs at a cost of $1,020 million.

FY2010

In FY2010 Congress funded the procurement of two LCSs at a cost of $1,080 million and rescinded $66 million in FY2009 Other Procurement, Navy (OPN) funding for LCS mission modules. Section 121 of the FY2010 defense authorization act (H.R. 2647/P.L. 111-84 of October 28, 2009) granted the Navy contracting and other authority to implement the LCS acquisition strategy that the Navy announced on September 16, 2009, and amended the LCS unit procurement cost cap. Section 122 of the act requires the LCS program to be treated as a major defense acquisition program (MDAP) for purposes of program management and oversight. Section 123 of the act required a report on the Navy's plan for homeporting LCSs.

FY2011

In FY2011, Congress approved the Navy's request for authority to implement a dual-award acquisition strategy for the LCS program through Section 150 of H.R. 3082/P.L. 111-322, and funded the procurement of two LCSs at a cost of $1,169.0 million in H.R. 1473/P.L. 112-10.

FY2012

In FY2011, Congress provided $1,755.1 million to complete the procurement cost of four LCSs in H.R. 2055/P.L. 112-74. The $1,755.1 million provided was a $47-million reduction from the amount requested. These four ships had already received $78.9 million in prior-year advance procurement funding.

Appendix B. Cost Growth on LCS Sea Frames in FY2007-FY2013 Budgets

This appendix presents details on cost growth on the first few LCS sea frames in the FY2007-FY2012 budget submissions.

FY2007 Budget

The proposed FY2007 Navy budget, submitted in February 2006, showed that:

- the estimate for the first LCS had increased from $215.5 million in the FY2005 budget and $212.5 million in the FY2006 budget to $274.5 million in the FY2007 budget—an increase of about 27% from the FY2005 figure and about 29% form the FY2006 figure;
- the estimate for the second LCS increased from $213.7 million in the FY2005 budget and $256.5 million in the FY2006 budget to $278.1 million—an increase of about 30% from the FY2005 figure and about 8% from the FY2006 figure; and
- the estimate for follow-on ships scheduled for FY2009-FY2011, when the LCS program was to have reached a planned maximum annual procurement rate of six ships per year, had increased from $223.3 million in the FY2006 budget to $298 million—an increase of about 33%.

The Navy stated in early 2006 that the cost increase from the FY2006 budget to the FY2007 budget was due mostly to the fact that LCS procurement costs in the FY2006 budget did not include items that are traditionally included in the so-called end cost—the total budgeted procurement cost—of a Navy shipbuilding program, such as Navy program-management costs, an allowance for changes, and escalation (inflation). The absence of these costs from the FY2006 LCS budget submission raised certain potential oversight issues for Congress.[78]

[78] These oversight issues included the following:

—Why were these costs excluded? Was this a budget-preparation oversight? If so, how could such an oversight occur, given the many people involved in Navy budget preparation and review, and why did it occur on the LCS program but not other programs? Was anyone held accountable for this oversight, and if so, how? If this was not an oversight, then what was the reason?

—Did the Navy believe there was no substantial risk of penalty for submitting to Congress a budget presentation for a shipbuilding program that, for whatever reason, significantly underestimated procurement costs?

—Do LCS procurement costs in the budget now include all costs that, under traditional budgeting practices, should be included? If not, what other costs are still unacknowledged?

—Have personnel or other resources from other Navy programs been used for the LCS program in any way? If so, have the costs of these personnel or other resources been fully charged to the LCS program and fully reflected in LCS program costs shown in the budget?

FY2008 Budget

On January 11, 2007, the Navy reported that LCS-1 was experiencing "considerable cost overruns." The Navy subsequently stated that the estimated shipyard construction cost of LCS-1 had grown to $350 million to $375 million. This suggested that the end cost of LCS-1—which also includes costs for things such as Navy program-management costs and an allowance for changes—could be in excess of $400 million. The Navy did not publicly provide a precise cost overrun figure for LCS 2, but it stated that the cost overrun on LCSs 1 and 2 was somewhere between 50% and 75%, depending on the baseline that is used to measure the overrun.

GAO testified in July 2007 that according to its own analysis of Navy data, the combined cost of LCSs 1 and 2 had increased from $472 million to $1,075 million—an increase of 128%.[79] CBO testified in July 2007 that:

> Several months ago, press reports indicated that the cost could well exceed $400 million each for the first two LCS sea frames. Recently, the Navy requested that the cost cap for the fifth and sixth sea frames be raised to $460 million, which suggests that the Navy's estimate of the acquisition cost for the first two LCSs would be around $600 million apiece....
>
> As of this writing, the Navy has not publicly released an estimate for the LCS program that incorporates the most recent cost growth, other than its request to raise the cost caps for the fifth and sixth ships. CBO estimates that with that growth included, the first two LCSs would cost about $630 million each, excluding mission modules but including outfitting, postdelivery, and various nonrecurring costs associated with the first ships of the class. As the program advances, with a settled design and higher annual rates of production, the average cost per ship is likely to decline. Excluding mission modules, the 55 LCSs in the Navy's plan would cost an average of $450 million each, CBO estimates.[80]

FY2009 Budget

The proposed FY2009 budget, submitted in February 2008, showed that the estimated end costs of LCS-1 and LCS-2 had increased to $531 million and $507 million, respectively—or to $631 million and $636 million, respectively, when OF/PD (outfitting and post-delivery) and FSD MSSIT (Final System Design Mission Systems and Ship Integration Team) costs are included, or to $606 million and $582 million, respectively, when OF/PD costs are included, but FSD MSSIT costs are not included.

FY2010 Budget

The proposed FY2010 budget, submitted in May 2009, showed that the estimated end costs of LCS-1 and LCS-2 had increased to $537 million and $575 million, respectively (or to $637

[79] Defense Acquisitions[:] Realistic Business Cases Needed to Execute Navy Shipbuilding Programs, Statement of Paul L. Francis, Director, Acquisition and Sourcing Management Team, Testimony Before the Subcommittee on Seapower and Expeditionary Forces, Committee on Armed Services, House of Representatives, July 24, 2007 (GAO-07-943T), pp. 4 and 22.

[80] 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, p. 18.

million and $704 million, respectively, when OF/PD and FSD MSSIT costs are included, or to $612 million and $650 million, respectively, when OF/PD costs are included, but FSD MSSIT costs are not included). CBO reported on June 9, 2008, that:

> Historical experience indicates that cost growth in the LCS program is likely. In particular, using the lead ship of the FFG-7 Oliver Hazard Perry class frigate as an analogy, historical cost-to-weight relationships indicate that the Navy's original cost target for the LCS of $260 million in 2009 dollars (or $220 million in 2005 dollars) was optimistic. The first FFG-7 cost about $670 million in 2009 dollars to build, or about $250 million per thousand tons, including combat systems. Applying that metric to the LCS program suggests that the lead ships would cost about $600 million apiece, including the cost of one mission module. Thus, in this case, the use of a historical cost-to-weight relationship produces an estimate that is less than the actual costs of the first LCSs to date but substantially more than the Navy's original estimate.
>
> Based on actual costs the Navy has incurred for the LCS program, CBO estimates that the first two LCSs could cost about $700 million each, including outfitting and postdelivery and various nonrecurring costs associated with first ships of a class but excluding mission modules. However, as of May 1, 2008, LCS-1 was 83 percent complete and LCS-2 was 68 percent complete. Thus, additional cost growth is possible, and CBO's estimate reflects that cost risk.
>
> Overall, CBO estimates that the LCSs in the Navy's plan would cost about $550 million each, on average, excluding mission modules. That estimate assumes that the Navy would select one of the two existing designs and make no changes. As the program advanced with a settled design and higher annual rates of production, average ship costs would probably decline. If the Navy decided to make changes to that design, however, the costs of building future ships could be higher than CBO now estimates.[81]

FY2011 Budget

The proposed FY2011 budget, submitted in February 2010, showed that the estimated end cost of LCS-1 remained unchanged from the previous year at $537 million, and that the estimated end cost of LCS-2 had increased to $607 million. These two figures become $656 million and $736 million, respectively, when OF/PD and FSD MSSIT costs are included, or $631 million and $682 million, respectively, when OF/PD costs are included, but FSD MSSIT costs are not included. The Navy's FY2011 budget submission states that OF/PD and FSD MSSIT costs are non-end cost items, and that FSD MSSIT costs for LCS-1 and LCS-2 "are not true construction costs and are [instead] costs associated with design completion."[82]

FY2012 Budget

The proposed FY2012 budget, submitted in February 2011, showed that the estimated end cost of LCS-1 remained unchanged from the previous year at $537 million, and that the estimated end

[81] Congressional Budget Office, *Resource Implications of the Navy's Fiscal Year 2009 Shipbuilding Plan*, June 8, 2008, pp. 26-27.

[82] Source: Department of Navy, *Department of the Navy Fiscal Year (FY) 2011 Budget Estimates, February 2010, Justification of Estimates, Research, Development, Test & Evaluation, Navy, Budget Activity 4*, Exhibit R-2A, RDT&E Project Justification, PE 0603581N: Littoral Combat Ship (LCS), pages 34-35 of 46 (PDF pages 552-553 of 1054).

cost of LCS-2 had increased to $653 million. These two figures become $670.4 million and $808.8 million, respectively, when OF/PD and FSD MSSIT costs are included, or $645.4 million and $754.8 million, respectively, when OF/PD costs are included, but FSD MSSIT costs are not included. The Navy's FY2011 budget submission states that OF/PD and FSD MSSIT costs are non-end cost items, and that FSD MSSIT costs for LCS-1 and LCS-2 "are not true construction costs and are [instead] costs associated with design completion."[83]

FY2013 Budget

The proposed FY2013 budget, submitted in February 2012, showed that the estimated end costs of LCS-1 and LCS -2 remained unchanged from the previous year at $537 million and $653 million, respectively. These two figures become $670.4 million and $813.4 million, respectively, when OF/PD and FSD MSSIT costs are included, or $645.4 million and $759.4 million, respectively, when OF/PD costs are included, but FSD MSSIT costs are not included. The Navy's FY2012 budget submission states that OF/PD and FSD MSSIT costs are non-end cost items, and that FSD MSSIT costs for LCS-1 and LCS-2 "are not true construction costs and are [instead] costs associated with design completion."[84]

Reasons for Cost Growth

Various reasons have been cited for cost growth in the LCS program, including the following:

- **Unrealistically low original estimate.** Some observers believe that the original cost estimate of $220 million for the LCS sea frame was unrealistically low. If so, a potential follow-on question would be whether the LCS represents a case of "low-balling"—using an unrealistically low cost estimate in the early stages of a proposed weapon program to help the program win approval and become an established procurement effort.
- **Impact of Naval Vessel Rules (NVR).** Navy and industry officials have attributed some of the cost growth to the impact of applying new Naval Vessel Rules (NVR)—essentially, new rules specifying the construction standards for the ship—to the LCS program. The NVR issued for the LCS program incorporated, among other things, an increase in the survivability standard (the ability to withstand damage) to which LCSs were to be built. Building the ship to a higher survivability standard represented a change in requirements for the ship that led to many design changes, including changes that made ship more rugged and more complex in terms of its damage-control systems. In addition, Navy and industry officials have testified, the timing of the issuing of NVR created a situation of concurrency between design and construction in the LCS program, meaning that the ship was being designed at the same time that the shipyard was

[83] Source: Department of Defense, *Department of Defense Fiscal Year (FY) 2012 Budget Estimates, February 2011, Navy Justification Book Volume 2, Research, Development, Test & Evaluation, Navy, Budget Activity 4*, Exhibit R-2A, RDT&E Project Justification, PE 0603581N: Littoral Combat Ship (LCS), page 33 of 42 (PDF page 469 of 888).

[84] Source: Department of Defense, *Department of Defense Fiscal Year (FY) 2013 President's Budget Submission, February 2012, Navy Justification Book Volume 2, Research, Development, Test & Evaluation, Navy, Budget Activity 4*, Exhibit R-2A, RDT&E Project Justification, PE 0603581N: Littoral Combat Ship (LCS), pages 39 and 40 of 48 (PDF pages 491 and 492 of 940).

attempting to build it—a situation long known to be a potential cause of cost growth. This concurrency, Navy officials testified, was a consequence of the compressed construction schedule for the LCS program, which in turn reflected an urgency about getting LCSs into the fleet to meet critical mission demands.

- **Improperly manufactured reduction gear.** Navy and industry officials testified that cost growth on LCS-1 was partly due to a main reduction gear[85] that was incorrectly manufactured and had to be replaced, forcing a reordering of the construction sequence for the various major sections of the ship.
- **Increased costs for materials.** Some observers have attributed part of the cost growth in the program to higher-than-estimated costs for steel and other materials that are used in building the ships.
- **Emphasis on meeting schedule combined with cost-plus contract.** Some portion of cost growth on LCS-1 has been attributed to a combination of a Navy emphasis on meeting the ship's aggressive construction schedule and the Navy's use of a cost-plus contract to build the ship.[86]
- **Shipyard Performance.** Shipyard performance and supervision of the LCS shipyards by the LCS team leaders and the Navy has been cited as another cause of cost growth.[87]

July 2007 GAO Testimony

GAO testified in July 2007 that:

> We have frequently reported on the wisdom of using a solid, executable business case before committing resources to a new product development effort....
>
> A sound business case would establish and resource a knowledge-based approach at the outset of a program. We would define such a business case as firm requirements, mature technologies, and an acquisition strategy that provides sufficient time and money for design activities before construction start. The business case is the essential first step in any

[85] A ship's reduction gear is a large, heavy gear that reduces the high-speed revolutions of the ship's turbine engines to the lower-speed revolutions of its propellers.

[86] The Senate Armed Services Committee, as part of its discussion of the LCS program in its report (S.Rept. 110-77 of June 5, 2007) on the FY2008 defense authorization bill (S. 1547), stated:

> Reviewing this LCS situation will undoubtedly result in a new set of "lessons learned"' that the acquisition community will dutifully try to implement. However, the committee has previously expressed concerns about the LCS concept and the LCS acquisition strategy. The LCS situation may be more a case of "lessons lost." Long ago, we knew that we should not rush to sign a construction contract before we have solidified requirements. We also knew that the contractors will respond to incentives, and that if the incentives are focused on maintaining schedules and not on controlling cost, cost growth on a cost-plus contract should surprise no one. After the fact, everyone appears ready to agree that the original ship construction schedule for the lead ship was overly aggressive. (Page 98)

[87] See Katherine McIntire Peters, "Navy's Top Officer Sees Lessons In Shipbuilding Program Failures," *GovermentExecutive.com*, September 24, 2008; Christopher J. Castelli, "Audit Exposes Failed Management of Troubled Littoral Warship," *Inside the Navy*, February 4, 2008; Christopher J. Castelli, "Audit Reveals Both LCS and Industry Teams Violated Management Rules," *Inside the Pentagon*, July 10, 2008 (reprinted in essentially identical form, with the same headline, in the July 14, 2008, issue of sister publication *Inside the Navy*).

acquisition program that sets the stage for the remaining stages of a program, namely the business or contracting arrangements and actual execution or performance. If the business case is not sound, the contract will not correct the problem and execution will be subpar. This does not mean that all potential problems can be eliminated and perfection achieved, but rather that sound business cases can get the Navy better shipbuilding outcomes and better return on investment. If any one element of the business case is weak, problems can be expected in construction. The need to meet schedule is one of the main reasons why programs cannot execute their business cases. This pattern was clearly evident in both the LPD 17 [amphibious ship] and LCS programs. In both cases, the program pushed ahead with production even when design problems arose or key equipment was not available when needed. Short cuts, such as doing technology development concurrently with design and construction, are taken to meet schedule. In the end, problems occur that cannot be resolved within compressed, optimistic schedules. Ultimately, when a schedule is set that cannot accommodate program scope, delivering an initial capability is delayed and higher costs are incurred....

What happens when the elements of a solid business case are not present? Unfortunately, the results have been all too visible in the LPD 17 and the LCS. Ship construction in these programs has been hampered throughout by design instability and program management challenges that can be traced back to flawed business cases. The Navy moved forward with ambitious schedules for constructing LPD 17 and LCS despite significant challenges in stabilizing the designs for these ships. As a result, construction work has been performed out of sequence and significant rework has been required, disrupting the optimal construction sequence and application of lessons learned for follow-on vessels in these programs....

In the LCS program, design instability resulted from a flawed business case as well as changes to Navy requirements. From the outset, the Navy sought to concurrently design and construct two lead ships in the LCS program in an effort to rapidly meet pressing needs in the mine countermeasures, antisubmarine warfare, and surface warfare mission areas. The Navy believed it could manage this approach, even with little margin for error, because it considered each LCS to be an adaptation of an existing high-speed ferry design. It has since been realized that transforming a high-speed ferry into a capable, networked, survivable warship was quite a complex venture. Implementation of new Naval Vessel Rules (design guidelines) further complicated the Navy's concurrent design-build strategy for LCS. These rules required program officials to redesign major elements of each LCS design to meet enhanced survivability requirements, even after construction had begun on the first ship. While these requirements changes improved the robustness of LCS designs, they contributed to out of sequence work and rework on the lead ships. The Navy failed to fully account for these changes when establishing its $220 million cost target and 2-year construction cycle for the lead ships.

Complicating LCS construction was a compressed and aggressive schedule. When design standards were clarified with the issuance of Naval Vessel Rules and major equipment deliveries were delayed (e.g., main reduction gears), adjustments to the schedule were not made. Instead, with the first LCS, the Navy and shipbuilder continued to focus on achieving the planned schedule, accepting the higher costs associated with out of sequence work and rework. This approach enabled the Navy to achieve its planned launch date for the first Littoral Combat Ship, but required it to sacrifice its desired level of outfitting. Program officials report that schedule pressures also drove low outfitting levels on the second Littoral Combat Ship design as well, although rework requirements have been less intensive to date. However, because remaining work on the first two ships will now have to be completed out-of-sequence, the initial schedule gains most likely will be offset by increased labor hours to finish these ships.

The difficulties and costs discussed above relate to the LCS seaframe only. This program is unique in that the ship's mission equipment is being developed and funded separately from the seaframe. The Navy faces additional challenges integrating mission packages with the ships, which could further increase costs and delay delivery of new antisubmarine warfare, mine countermeasures, and surface warfare capabilities to the fleet. These mission packages are required to meet a weight requirement of 180 metric tons or less and require 35 personnel or less to operate them. However, the Navy estimates that the mine countermeasures mission package may require an additional 13 metric tons of weight and seven more operator personnel in order to deploy the full level of promised capability. Because neither of the competing ship designs can accommodate these increases, the Navy may be forced to reevaluate its planned capabilities for LCS.[88]

[88] Defense Acquisitions[:] Realistic Business Cases Needed to Execute Navy Shipbuilding Programs, Statement of Paul L. Francis, Director, Acquisition and Sourcing Management Team, Testimony Before the Subcommittee on Seapower and Expeditionary Forces, Committee on Armed Services, House of Representatives, July 24, 2007 (GAO-07-943T), pp. 8-11.

Appendix C. 2007 Program Restructuring and Ship Cancellations

The Navy substantially restructured the LCS program in 2007 in response to significant cost growth and delays in constructing the first LCS sea frames. This restructuring led to the cancellation of four LCSs that were funded in FY2006 and FY2007. A fifth LCS, funded in FY2008, was cancelled in 2008. This appendix presents the details of the program restructuring and ship cancellations.

2007 Program Restructuring

March 2007 Navy Restructuring Plan

In response to significant cost growth and schedule delays in the building of the first LCSs that first came to light in January 2007 (see next section), the Navy in March 2007 announced a plan for restructuring the LCS program that:

- canceled the two LCSs funded in FY2007 and redirected the funding for those two ships to pay for cost overruns on earlier LCSs;
- announced an intention to lift a 90-day stop-work order that the Navy had placed on LCS-3 in January 2007—provided that the Navy reached an agreement with the Lockheed-led industry team by April 12, 2007, to restructure the contract for building LCSs 1 and 3 from a cost-plus type contract into a fixed price incentive (FPI)-type contract—or terminate construction of LCS-3 if an agreement on a restructured contract could not be reached with the Lockheed team by April 12, 2007;
- announced an intention to seek to restructure the contract with the General Dynamics-led industry team for building LCSs 2 and 4 into an FPI-type contract—if LCSs 2 and 4 experienced cost growth comparable to that of LCSs 1 and 3—and, if such a restructuring were sought, terminate construction of LCS-4 if an agreement on a restructured contract for LCS-2 and LCS-4 could not be reached;
- reduced the number of LCSs requested for FY2008 from three to two (for the same requested FY2008 procurement funding of $910.5 million), and the number to be requested for FY2009 from six to three; and
- announced an intention to conduct an operational evaluation to select a favored design for the LCS that would be procured in FY2010 and subsequent years, and to conduct a full and open follow-on competition among bidders for the right to build that design.[89]

[89] Source: Navy briefing to CRS and Congressional Budget Office (CBO) on Navy's proposed LCS program restructuring plan, March 21, 2007.

April 2007 Termination of LCS-3

On April 12, 2007, the Navy announced that it had not reached an agreement with Lockheed on a restructured FPI-type contract for LCS-1 and LCS-3, and consequently was terminating construction of LCS-3.[90] (The Navy subsequently began referring to the ship as having been partially terminated—a reference to the fact that Lockheed was allowed to continue procuring certain components for LCS-3, so that a complete set of these components would be on hand to be incorporated into the next LCS built to the Lockheed design.) (The designation LCS-3 is now being reused to refer to one of the two LCSs procured in FY2009.)

November 2007 Termination of LCS-4

In late September 2007, it was reported that the Navy on September 19 had sent a letter to General Dynamics to initiate negotiations on restructuring the contract for building LCSs 2 and 4 into an FPI-type contract. The negotiations reportedly were to be completed by October 19, 2007—30 days from September 19.[91] On November 1, 2007, the Navy announced that it had not reached an agreement with General Dynamics on a restructured FPI-type contract for LCS-2 and LCS-4, and consequently was terminating construction of LCS-4.[92] (The designation LCS-4 is now being reused to refer to one of the two LCSs procured in FY2009.)

Cancellation of Prior-Year Ships

Table C-1 below summarizes the status of the nine LCSs funded by Congress from FY2005 through FY2009. As shown in the table, of the nine ships, five were later canceled, leaving four ships in place through FY2009—LCSs 1 and 2, and the two LCSs funded in FY2009. Ship designations LCS-3 and LCS-4 are being reused as the designations for the two ships funded in FY2009.

[90] Department of Defense News Release No. 422-07, April 12, 2007, "Navy Terminates Littoral Combat Ship 3."

[91] Geoff Fein, "Navy Seeking To Negotiate FPI Contract With General Dynamics," *Defense Daily*, September 24, 2007; Geoff Fein, "Navy, General Dynamics Meet To Discuss New LCS Fixed Price Structure," *Defense Daily*, September 27, 2007; Tony Capaccio, "General Dynamics Urged To Take Fixed Price On Warship Contract," *Bloomberg News*, September 28, 2007; Jason Sherman, "Navy, General Dynamics Discuss Fixed-Price Contract For LCS," *Inside the Navy*, October 1, 2007.

[92] Department of Defense News Release No. 1269-07, November 1, 2007, "Navy Terminates Littoral Combat Ship (LCS 4) Contract."

Table C-1. Status of LCSs Funded in FY2005-FY2009

FY funded	Navy hull designation	Status
2005	LCS-1	**Commissioned into service** on November 8, 2008. This ship is included in **Table 2**.
2006	LCS-2	**Commissioned into service** on January 16, 2010. This ship is included in **Table 2**.
	LCS-3 (not the same ship as LCS-3 below)	**Canceled by Navy** in April 2007 after being placed under contract due to inability to come to agreement with contractor on revised (fixed-price) contract terms for LCSs 1 and 3. This ship is ***not*** included in **Table 2**.
	LCS-4 (not the same ship as LCS-4 below)	**Canceled by Navy** in November 2007 after being placed under contract due to inability to come to agreement with contractor on revised (fixed-price) contract terms for LCSs 2 and 4. This ship is ***not*** included in **Table 2**.
2007	none (ship canceled before being placed under contract)	**Canceled by Navy** in March 2007 before being placed under contract as part of Navy's LCS program restructuring; funds reapplied to cover other program costs. This ship is ***not*** included in **Table 2**.
	none (ship canceled before being placed under contract)	**Canceled by Navy** in March 2007 before being placed under contract as part of Navy's LCS program restructuring; funds reapplied to cover other program costs. This ship is ***not*** included in **Table 2**.
2008	LCS-5 (for a while, at least, although the ship was canceled before being placed under contract; the ship designation is now being used for the first of the two ships funded in FY2010)	**Canceled by Navy following Congress's decision** in September 2008, as part of its action on the FY2009 defense appropriations bill, to rescind the funding for the ship. This ship is ***not*** included in **Table 2**.
2009	LCS-3 (not the same ship as LCS-3 above; the ship designation is being reused)	**Under construction.** This ship is included in **Table 2**.
	LCS-4 (not the same ship as LCS-4 above; the ship designation is being reused)	**Under construction.** This ship is included in **Table 2**.

Source: Prepared by CRS.

Appendix D. Down Select Acquisition Strategy Announced in September 2009

This appendix presents additional background information on the down select acquisition strategy announced by the Navy on September 16, 2009.

DOD and Navy Background Information

A September 16, 2009, Department of Defense (DOD) news release on the proposed down select strategy stated:

> The Navy announced today it will down select between the two Littoral Combat Ship (LCS) designs in fiscal 2010. The current LCS seaframe construction solicitation [for the FY2010 LCSs] will be cancelled and a new solicitation will be issued. At down select, a single prime contractor and shipyard will be awarded a fixed price incentive contract for up to 10 ships with two ships in fiscal 2010 and options through fiscal 2014. This decision was reached after careful review of the fiscal 2010 industry bids, consideration of total program costs, and ongoing discussions with Congress.
>
> "This change to increase competition is required so we can build the LCS at an affordable price," said Ray Mabus, secretary of the Navy. "LCS is vital to our Navy's future. It must succeed."
>
> "Both ships meet our operational requirements and we need LCS now to meet the warfighters' needs," said Adm. Gary Roughead, chief of naval operations. "Down selecting now will improve affordability and will allow us to build LCS at a realistic cost and not compromise critical warfighting capabilities."
>
> The Navy cancelled the solicitation to procure up to three LCS Flight 0+ ships in fiscal 2010 due to affordability. Based on proposals received this summer, it was not possible to execute the LCS program under the current acquisition strategy and given the expectation of constrained budgets. The new LCS acquisition strategy improves affordability by competitively awarding a larger number of ships across several years to one source. The Navy will accomplish this goal by issuing a new fixed price incentive solicitation for a down select to one of the two designs beginning in fiscal 2010.
>
> Both industry teams will have the opportunity to submit proposals for the fiscal 2010 ships under the new solicitation. The selected industry team will deliver a quality technical data package, allowing the Navy to open competition for a second source for the selected design beginning in fiscal 2012. The winner of the down select will be awarded a contract for up to 10 ships from fiscal 2010 through fiscal 2014, and also provide combat systems for up to five additional ships provided by a second source. Delivery of LCS 2, along with construction of LCS 3 and LCS 4 will not be affected by the decision. This plan ensures the best value for the Navy, continues to fill critical warfighting gaps, reduces program ownership costs, and meets the spirit and intent of the Weapons System Acquisition Reform Act of 2009....
>
> The Navy remains committed to the LCS program and the requirement for 55 of these ships to provide combatant commanders with the capability to defeat anti-access threats in the littorals, including fast surface craft, quiet submarines and various types of mines. The

> Navy's acquisition strategy will be guided by cost and performance of the respective designs as well as options for sustaining competition throughout the life of the program.[93]

A September 16, 2009, e-mail from the Navy to CRS provided additional information on the proposed down select strategy, stating:

> The Navy remains committed to a 55 ship LCS program and intends to procure these ships through an acquisition strategy that leverages competition, fixed price contracting and stability in order to meet our overarching objectives of performance and affordability.
>
> In the best interest of the Government, the Navy cancelled the solicitation to procure up to three LCS Flight 0+ ships in FY10 due to affordability.
>
> Based on proposals received in August, the Navy had no reasonable basis to find that the LCS Program would be executable going forward under the current acquisition strategy, given the expectation of constrained budgets.
>
> In the near future, and working closely with Congress, the Navy will issue a new FY10 solicitation which downselects between the two existing designs and calls for building two ships in FY10 and provides options for two additional ships per year from FY11 to FY14 for a total of ten ships. The intent is for all of these ships to be built in one shipyard, which will benefit from a stable order quantity, training and production efficiencies to drive costs down. Both industry teams will have the opportunity to submit proposals for the FY10 ships under the new solicitation.
>
> To sustain competition throughout the life of the program and in conjunction with the downselect, the Navy will develop a complete Technical Data Package which will be used to open competition for a second source of the selected design in FY12, awarding one ship with options for up to four additional ships through FY14, to a new shipbuilder.
>
> Our FY10 solicitation will call for the prime to build an additional five combat systems to be delivered as government-furnished equipment for this second source shipyard. Separating the ship and combat systems procurement will enable bringing the LCS combat system into the broader Navy's open architecture plan.
>
> In short, this strategy calls for two shipbuilders in continuous competition for a single LCS seaframe design, and a government-provided combat system.
>
> The revised strategy meets the full spirit and intent of the Weapon Systems Acquisition Reform Act of 2009 by increasing Government oversight, employing fixed price contract types, maximizing competition, leveraging open architecture, using Economic Order Quantity and Block Buy strategies, and ensuring future competition for shipbuilding as enabled by development of a Technical Data Package to solicit ships from a second shipyard.
>
> We also continue to work closely with Congress on the Navy's LCS procurement intentions....
>
> The Navy intends to continue with construction and delivery of LCS 3 and LCS 4, ultimately for use as deployable assets. We will continue to explore all avenues to ensure this is an affordable program.[94]

[93] Department of Defense, "Littoral Combat Ship Down Select Announced," News Release 722-09, September 16, 2009, available online at http://www.defenselink.mil/releases/release.aspx?releaseid=12984.

The Navy briefed CRS and CBO about the proposed down select strategy on September 22, 2009. Points made by the Navy in the briefing included the following:

- The bids from the two industry teams for the three LCSs requested in the FY2010 budget (which were submitted to the Navy in late July or early August 2009)[95] were above the LCS unit procurement cost cap in "all scenarios."
- Negotiations with the industry teams were deemed by the Navy to be not likely to result in award prices for the FY2010 ships that were acceptable to the Navy.
- The Navy judged that the current LCS teaming arrangements "considerably influenced costs" in the FY2010 bids.
- The Navy judged that it cannot afford more than a two-ship award in FY2010 within the amount of funding ($1,380 million) requested for LCS sea frame procurement in FY2010.
- In response to the above points, the Navy decided to seek a new acquisition strategy for LCSs procured in FY2010 and subsequent years that would make the LCS program affordable by leveraging competition, providing stability to LCS shipyards and suppliers, producing LCSs at efficient rates, giving industry incentives to make investments that would reduce LCS production costs, and increasing commonality in the resulting LCS fleet.
- Under the Navy's proposed strategy, the winner of the LCS down select would be awarded a contract to build two ships procured in FY2010, with options to build two more ships per year in FY2011-FY2014. The contract would be a block-buy contract augmented with Economic Order Quantity (EOQ) authority, so as to permit up-front batch purchases of long leadtime components, as would be the case under a multiyear procurement (MYP) contract. Unlike an MYP contract, however, the block buy contract would not include a termination liability.
- The winner of the down select would deliver to the Navy a technical data package that would permit another shipyard to build the winning LCS design.
- The Navy would hold a second competition to select a second LCS bidder. This competition would be open to all firms other than the shipyard that is building the 10 LCSs in FY2010-FY2014. The winner of this second competition would be awarded a contract to build up to five LCSs in FY2012-FY2014 (one ship in FY2012, and two ships per year in FY2013-FY2014).
- The Navy would maintain competition between the two shipyards for LCSs procured in FY2015 and subsequent years.
- The prime contactor on the team that wins the LCS down select (i.e., Lockheed or General Dynamics) would provide the combat systems for all the LCSs to be

(...continued)

[94] Email from Navy Office of Legislative Affairs to CRS, entitled "LCS Way Ahead," September 16, 2009.

[95] See, for example, Christopher P. Cavas, "LCS Bids Submitted to U.S. Navy," *DefenseNews.com*, August 3, 2009, which states: "Lockheed Martin announced its proposal was sent to the Navy on July 31, and rival General Dynamics confirmed its plans were sent in by the Aug. 3 deadline." See also Bettina H. Chavanne, "Lockheed Submits First LCS Proposal Under Cost Cap Regulations," *Aerospace Daily & Defense Report*, August 4, 2009: 5.

procured in FY2010-FY2014—the 10 that would be built by the first shipyard, and the others that would be built by the second shipyard.

- The structure of the industry team that wins the down select would be altered, with the prime contractor on the team being separated from the shipyard (i.e., the shipyard building the 10 LCSs in FY2010-FY2014). The separation, which would occur some time between FY2010 and FY2014, would be intended in part to prevent an organizational conflict of interest on the part of the prime contractor as it provides combat systems to the two shipyards building LCSs.
- The current combat system used on the selected LCS design will be modified over time to a configuration that increases its commonality with one or more of the Navy's existing surface ship combat systems.
- The Navy intends to complete the construction and delivery of LCS-3 and LCS-4.
- The Navy believes that the proposed acquisition strategy does the following: maximize the use of competition in awarding contracts for LCSs procured in FY2010-FY2014; provide an opportunity for achieving EOQ savings with vendors; provide stability and efficient production quantities to the shipyards and vendors; provide an opportunity to move to a common combat system for the LCS fleet; and provide the lowest-possible total ownership cost for the Navy for the resulting LCS fleet, in large part because the fleet would consist primarily of a single LCS design with a single logistics support system. The Navy also believes the proposed strategy is consistent with the spirit and intent of the Weapon Systems Acquisition Reform Act of 2009 (S. 454/P.L. 111-23 of May 22, 2009).

Regarding the Navy's ability to sustain a competition between two LCS builders for LCS construction contracts years from now, when the annual LCS procurement rate is projected to drop to 1.5 ships per year (i.e., a 1-2-1-2 pattern), Under Secretary of the Navy Robert Work reportedly stated:

> "We are going to be able to compete those. We will be able to compete three [ships] every two years and one of the yards will win two and one yard will win one. Sometimes, we'll do a five multi-year [procurement contract]. We have all sorts of flexibility in here," he said.[96]

Potential Oversight Questions for Congress

Prior to the Navy's November 3, 2010, proposal for a dual-award acquisition strategy, the proposed down select strategy posed several potential oversight questions for Congress, including the following:

- Did the timing of the Navy's September 2009 announcement of the strategy—very late in the congressional process for reviewing, marking up, and finalizing action on the FY2010 defense budget—provide Congress with sufficient time to

[96] Geoff Fein, "Official: Navy OK With Either LCS, New Acquisition Plan Adds Flexibility In Out Years," *Defense Daily*, February 18, 2010: 3.

adequately review the proposal prior to finalizing its action on the FY2010 defense budget?

- Does the Navy's proposed strategy allow the Navy enough time to adequately evaluate the operational characteristics of the two LCS designs before selecting one of those designs for all future production?
- Does the Navy's proposed method for conducting the LCS down select—the Request for Proposals (RFP)—appropriately balance procurement cost against other criteria, such as life-cycle operation and support (O&S) cost and ship capability?
- What risks would the Navy face if the shipyard that wins the competition to build the 10 LCSs in FY2010-FY2014 cannot build them within the contracted cost?
- How does the Navy plan to evolve the combat system on the winning LCS design to a configuration that has greater commonality with one or more existing Navy surface ship combat systems?
- What are the Navy's longer-term plans regarding the two "orphan" LCSs that are built to the design that is not chosen in the down select?
- What potential alternatives are there to this acquisition strategy?

Each of these questions is discussed briefly below.

Enough Time for Adequate Congressional Review of Navy Proposal?

One potential issue for Congress concerning the proposed down select strategy was whether the timing of the Navy's September 2009 announcement of the strategy—very late in the congressional process for reviewing, marking up, and finalizing action on the FY2010 defense budget—provided Congress with sufficient time to adequately review the proposal prior to finalizing its action on the FY2010 defense budget. The announcement of the Navy's proposed acquisition strategy on September 16, 2009, came

- after the defense committees of Congress had held their hearings to review the FY2010 budget submission;
- after the FY2010 defense authorization bill (H.R. 2647/S. 1390) and the Department of Defense (DOD) appropriations bill (H.R. 3326) had been reported in the House and Senate;
- after both the House and Senate had amended and passed their versions of the FY2010 defense authorization bill, setting the stage for the conference on that bill; and
- after the House had passed its version of the FY2010 DOD appropriations bill.

The timing of the Navy's announcement was a byproduct of the fact that the Navy was not able to see and evaluate the industry bids for the three LCSs that the Navy had originally requested for FY2010 until August 2009. The September 16, 2009, announcement date may have been the earliest possible announcement date, given the time the Navy needed to consider the situation created by the bids, evaluate potential courses of action, and select the proposed acquisition strategy.

Although the Navy might not have been able to present the proposed down select strategy to Congress any sooner than September 16, the timing of the Navy's announcement nevertheless put Congress in the position of being asked to approve a major proposal for the LCS program—a proposal that would determine the basic shape of the acquisition strategy for the program for many years into the future—with little or no opportunity for formal congressional review and consideration through hearings and committee markup activities.

A shortage of time for formal congressional review and consideration would be a potential oversight issue for Congress for any large weapon acquisition program, but this might have been especially the case for the LCS program, because it was not be the first time that the Navy put Congress in the position of having to make a significant decision about the LCS program with little or no opportunity for formal congressional review and consideration. As discussed in previous CRS reporting on the LCS program, a roughly similar situation occurred in the summer of 2002, after Congress had completed its budget-review hearings on the proposed FY2003 budget, when the Navy submitted a late request for the research and development funding that effectively started the LCS program.[97]

[97] The issue of whether Congress was given sufficient time to review and consider the merits of the LCS program in its early stages was discussed through multiple editions of past CRS reports covering the LCS program. The discussion in those reports raised the question of whether "Navy officials adopted a rapid acquisition strategy for the LCS program in part to limit the amount of time available to Congress to assess the merits of the LCS program and thereby effectively rush Congress into approving the start of LCS procurement before Congress fully understands the details of the program." The discussion continued:

> With regard to the possibility of rushing Congress into a quick decision on LCS procurement, it can be noted that announcing the LCS program in November 2001 and subsequently proposing to start procurement in FY2005 resulted in a situation of Congress having only three annual budget-review seasons to learn about the new LCS program, assess its merits against other competing DOD priorities, and make a decision on whether to approve the start of procurement. These three annual budget-review seasons would occur in 2002, 2003, and 2004, when Congress would review the Navy's proposed FY2003, FY2004, and FY2005 budgets, respectively. Congress' opportunity to conduct a thorough review of the LCS program in the first two of these three years, moreover, may have been hampered:
>
> - **2002 budget-review season (for FY2003 budget)**. The Navy's original FY2003 budget request, submitted to Congress in February 2002, contained no apparent funding for development of the LCS. In addition, the Navy in early 2002 had not yet announced that it intended to employ a rapid acquisition strategy for the LCS program. As a result, in the early months of 2002, there may have been little reason within Congress to view the LCS program as a significant FY2003 budget-review issue. In the middle of 2002, the Navy submitted an amended request asking for $33 million in FY2003 development funding for the LCS program. Navy officials explained that they did not decide until the middle of 2002 that they wanted to pursue a rapid acquisition strategy for the LCS program, and consequently did not realize until then that there was a need to request $33 million in FY2003 funding for the program. By the middle of 2002, however, the House and Senate Armed Services committees had already held their spring FY2003 budget-review hearings and marked up their respective versions of the FY2003 defense authorization bill. These two committees thus did not have an opportunity to use the spring 2002 budget-review season to review in detail the Navy's accelerated acquisition plan for the LCS program or the supporting request for $33 million in funding.
> - **2003 budget-review season (for FY2004 budget)**. To support a more informed review of the LCS program during the spring 2003 budget-review season, the conferees on the FY2003 defense authorization bill included a provision (Section 218) requiring the Navy to submit a detailed report on several aspects of the LCS program, including its acquisition strategy. In response to this legislation, the Navy in February 2003 submitted a report of eight pages in length, including a title page and a first page devoted mostly to a restatement of Section 218's requirement for the report. The House and Senate Armed Services committees, in their reports

(continued...)

Supporters of the idea of approving the Navy's proposed down select strategy as part of Congress's work to finalize action on the FY2010 defense budget could argue one or more of the following:

- The timing of the Navy's proposal, though not convenient for Congress, nevertheless represented a good-faith effort by the Navy to present the proposal to Congress at the earliest possible date. The Navy conducted multiple briefings with congressional offices starting in September 2009 to explain the proposed strategy.
- The LCS program needed to be put on a more stable long-term path as soon as possible, and if Congress did not approve the proposal as part of its work in finalizing action on the FY2010 defense budget, another year would pass before the LCS program could be put on a stable path approved by Congress.
- Although cost growth and construction problems with the LCS program can be viewed as a consequence of past attempts to move ahead too quickly on the LCS program, the Navy's acquisition strategy does not risk repeating this experience, because it does not represent another attempt to move ahead on the program at an imprudent speed. To the contrary, the strategy seeks to reduce execution risks by limiting LCS procurement to a maximum of four ships per year and providing a stable planning environment for LCS shipyards and suppliers.
- If the proposed strategy were not approved by Congress as part of its action on the FY2010 budget, the LCSs procured in FY2010 would be more expensive to procure, since they would not benefit from economies of scale that would come from awarding the FY2010 ships as part of a contract that also includes LCSs to be procured in FY2011-FY2014.

Supporters of the idea of deferring a decision on the Navy's proposed down select strategy until the FY2011 budget cycle could argue one or more of the following:

- Navy briefings to Congress on the proposed strategy starting in September 2009, though helpful, were not sufficient for Congress to fully understand the features and potential implications of the Navy's proposed acquisition strategy—much less the relative merits of potential alternatives to that strategy.
- The risks of making a quick decision on the Navy's proposed acquisition strategy, with little time for formal congressional review and consideration, are underscored by the history of the LCS program, which includes substantial cost growth and construction problems that can be viewed as the consequence of past

(...continued)

> on the FY2004 defense authorization bill, have expressed dissatisfaction with the thoroughness of the report as a response to the requirements of Section 218. (For details, see the "Legislative Activity" section of this report.) It is thus not clear whether the defense authorization committees were able to conduct their spring 2003 budget-review hearings on the FY2004 budget with as much information about the LCS program as they might have preferred.

(See, for example, CRS Report RL 32109, *Navy DD(X), CG(X), and LCS Ship Acquisition Programs: Oversight Issues and Options for Congress*, by Ronald O'Rourke, updated July 29, 2005, pp. CRS-59 to CRS-60. This discussion was carried through multiple updates of CRS reports covering the LCS program.)

attempts to move ahead quickly on the program, without more-extensive congressional review and consideration.

- The desire to avoid paying a relatively high cost for LCSs procured in FY2010, though real, should not have been a controlling factor in this situation (i.e., should not have been "the tail that wags the dog"). Paying a higher cost for LCSs procured in FY2010, though not optimal, would be an investment to buy time for Congress to more fully review and consider the merits of both the Navy's proposal and potential alternatives to it. Problems avoided through a full congressional review and consideration of the Navy's proposal and potential alternatives during the FY2011 budget cycle could eventually save the Navy a lot more money than the Navy hopes to save on the LCSs procured in FY2010 by procuring them as part of a contract that also includes LCSs to be procured in FY2011-FY2014.
- Approving the Navy's proposed acquisition strategy at a late juncture in the annual congressional process for reviewing and marking up the defense budget would set an undesirable precedent from Congress's standpoint regarding late submissions to Congress of significant proposals for large defense acquisition programs, and encourage DOD to do the same with other large weapon acquisition programs in the future in the hopes of stampeding Congress into making quick decisions on major proposals for those programs.

Enough Time to Evaluate the Two Designs' Operational Characteristics?

Another potential issue for Congress concerning the Navy's down select strategy was whether the strategy allowed the Navy enough time to adequately evaluate the operational characteristics of the two LCS designs before selecting one of those designs for all future production. Potential oversight questions for Congress included the following:

- Since LCS-1 as of September 2009 had been in commissioned service for less than a year, and LCS-2 as of that date had not yet been delivered to the Navy, how firm was the basis for the Navy's determination that both LCS designs meet the Navy's operational requirements for LCS?
- By the summer of 2010—when the Navy plans to award a contract to the winner of the down select—the Navy will have had only a limited time to evaluate the operational characteristics of LCS-1 and LCS-2 through fleet exercises and use in actual Navy deployments. Will the Navy at that point have a sufficient understanding of the two designs' operational characteristics to appropriately treat the operational characteristics of the two designs in the down select?

The Navy and its supporters could argue that the Navy has chosen a preferred design for other new Navy ships (such as the DDG-1000 destroyer) on the basis of paper designs only, and consequently that the Navy would have a firmer basis for performing the LCS down select than it has had on other shipbuilding programs. They can argue that the Navy has a good understanding of the basic differences between the ships—that the Lockheed design, for example, may have better features for supporting small boat operations (which are used for certain LCS missions), while the General Dynamics design may have better features for supporting helicopter and unmanned aerial vehicle (UAV) operations (which are used for certain LCS missions).

Skeptics could argue that the Navy in the past has talked about performing an extensive operational review of each design prior to settling on an acquisition strategy for follow-on ships in the program, and that the innovative nature of the LCS—a modular ship with plug-and-fight mission packages and a small crew—increases the risks associated with selecting a single LCS design before performing such an extensive operational review. Skeptics could argue that the Navy is depriving itself of the opportunity to better understand, through exercises and real-world deployments, the implications for overall fleet operations of building all LCSs to one design or the other before performing the down select.

Weight Given to Procurement Cost vs. Other Factors in Request for Proposals (RFP)

Another potential issue for Congress concerning the Navy's down select strategy concerned the criteria that the Navy will use for selecting a winning design in the down select. Some observers, particularly supporters of the General Dynamics LCS design, argued that the Navy's proposed method for evaluating the two LCS designs in the LCS down select—set forth in the Request for Proposals (RFP) for the down select—focused too much on procurement cost and not enough on other factors, particularly life-cycle fuel cost, other components of life-cycle operating and support (O&S) cost, and ship capability. Other observers, particularly supporters of the Lockheed LCS design, argued (as did the Navy) that the Navy's proposed method for conducting the LCS down select adequately took into account factors other than procurement cost. The issue was viewed as having the potential for leading to a protest of the Navy's down select decision by the firm that is not selected.[98]

Regarding the role of life-cycle operation and support (O&S) cost in the Navy's down select decision, a February 2010 GAO report stated:

> The Navy estimated operating and support costs for LCS seaframes and mission packages in 2009, but the estimates do not fully reflect DOD and GAO best practices for cost estimating and may change due to program uncertainties. GAO's analysis of the Navy's 2009 estimates showed that the operating and support costs for seaframes and mission packages could total $84 billion (in constant fiscal year 2009 dollars) through about 2050. However, the Navy did not follow some best practices for developing an estimate such as (1) analyzing the likelihood that the costs could be greater than estimated, (2) fully assessing how the estimate may change as key assumptions change, and (3) requesting an independent estimate and comparing it with the program estimate. The estimates may also be affected by program uncertainties, such as potential changes to force structure that could alter the number of ships and mission packages required. The costs to operate and support a weapon system can total 70 percent of a system's costs, and the lack of an estimate that fully reflects best practices

[98] For examples of articles discussing this issue, see Sean Reilly, "Loser To Fight In LCS Deal?" *Mobile (AL) Press-Register*, March 28, 2010: 1; Cid Standifer, "Austal USA, GD Officials Criticize Navy's RFP Criteria For LCS Award," *Inside the Navy*, March 29, 2010; Zachary M. Peterson, "Navy LCS Proposal Request Seeks 'Qualitative' Total Ownership Cost Figures," *Inside the Navy*, March 22, 2010; Emelie Rutherford, "Navy Stands By LCS Due Date As Hill Backers Of Each Bidder Swap Barbs," *Defense Daily*, March 18, 2010: 2-3; Geoff Fein, "General Dynamics' LCS Burns Less Fuel At Higher Speeds, Navy Documents Show," *Defense Daily*, March 2, 2010: 1-2; Geoff Fein, "Sessions Presses Navy Over Fairness of LCS RFP Evaluation," *Defense Daily*, March 1, 2010: 6-7; Geoff Fein, "USS Independence [LCS-2] Is The More Fuel Efficient of Two LCS Variants, Austal Official Says," *Defense Daily*, February 24, 2010: 2-3; Geoff Fein, "LCS RFP: Greater Emphasis Placed On Ship Price, Less On Life-Cycle Cost," *Defense Daily*, January 29, 2010: 5-7; Christopher P. Cavas, "RFP for LCS: Cost Main Factor in Winning Bid," *NavyTimes.com*, January 28, 2010.

> could limit decision makers' ability to identify the resources that will be needed over the long term to support the planned investment in LCS force structure. With a decision pending in 2010 on which seaframe to buy for the remainder of the program, decision makers could lack critical information to assess the full costs of the alternatives.[99]

A February 8, 2010, press report stated that "the Navy will draw up total life-cycle cost estimates for both the Lockheed Martin and General Dynamics versions of the Littoral Combat Ship before the program goes before the Defense Acquisition Board this year for its Milestone B. review. The service included the announcement in a response to a Government Accountability Office report that criticized LCS life-cycle estimates."[100]

At the request of Senator Jeff Sessions, the CBO analyzed the impact of O&S cost and other types of costs on the total life-cycle costs of the LCS and (for purposes of comparison) four other types of Navy ships. The results of CBO's analysis were released in the form of an April 28, 2010, letter to Senator Sessions. The letter states:

> CBO projected the life-cycle cost of the LCS-1 under three different assumptions about the average annual amount of fuel the ship will use over its 25-year life: low, moderate, and high. In all three scenarios, procurement costs dominate the life-cycle cost of the LCS-1, ranging from 58 percent to 66 percent of the total.… Personnel costs make up 14 percent to 16 percent of the LCS-1's total life-cycle cost in the various scenarios, and fuel costs account for 8 percent to 18 percent.
>
> The low-fuel case assumes that the LCS-1 generally operates at relatively low speeds—10 knots or less 90 percent of the time it is under way and 30 knots or more only about 3 percent of the time. That speed profile is based in part on how the Navy operated the LCS-1 between March 2009 and March 2010. In that scenario, operation and support costs total 33 percent of the ship's life-cycle cost: 16 percent for personnel costs, 8 percent for fuel costs (assuming that the ship consumes 25,000 barrels of fuel per year), and 9 percent for other O&S costs….
>
> The moderate-fuel case—which CBO considers the most likely of the three scenarios—assumes that the LCS-1 operates at 30 or more knots for about 5 percent of the time, at 14 knots to 16 knots 42 percent of the time (a range that might be typical when the ship was traveling from its home port to a deployment location), and at less than 12 knots for the rest of its time under way. In that scenario, O&S costs total 34 percent of the ship's life-cycle cost: 15 percent for personnel, 11 percent for fuel, and 8 percent for other O&S costs. The moderate speed profile would result in fuel usage of about 35,000 barrels per year, slightly less than the 37,600 barrels that the Navy assumed in formulating its 2011 budget request. By comparison, the [Navy's] FFG-7 class frigates consumed about 31,000 barrels of fuel per ship in 2009.
>
> The high-fuel case assumes that the LCS-1 operates at 30 or more knots for about 20 percent of its time under way, an assumption based partly on a speed profile developed by the Naval Sea Systems Command for the LCS program. In that scenario, O&S costs represent about 40 percent of the ship's life-cycle cost—more than in the other scenarios for the LCS-1 but less than for any of the other types of ships considered in this analysis. Personnel costs make up 14 percent of the life-cycle total; fuel costs, 18 percent; and other O&S costs, 8 percent.

[99] Government Accountability Office, *Littoral Combat Ship[:] Actions Needed to Improve Operating Cost Estimates and Mitigate Risks in Implementing New Concepts*, GAO-10-257, February 2010, summary page.

[100] Cid Standifer, "Navy Will Project Operation Costs Of Both LCS Models for DAB Review," *Inside the Navy*, February 8, 2010.

> Projected fuel usage in this scenario is about 67,000 barrels per year. That estimate is unlikely to be exceeded in actual practice: It is twice the historical average for frigates and about 80 percent of the amount used by the Navy's destroyers (which do not have the capability to speed at 40 knots, as the littoral combat ship does, but are three times larger than the LCS-1).[101]

At a May 6, 2010, hearing on Navy shipbuilding programs before the Seapower Subcommittee of the Senate Armed Services Committee, Senator Sessions questioned Sean Stackley, the Navy's acquisition executive (i.e., the Assistant Secretary of the Navy [Research, Development and Acquisition]), regarding the role of fuel costs in the Navy's evaluation of the two LCS designs.

Potential Risks If First Shipyard Cannot Build Ships Within Cost

Another potential issue for Congress concerning the Navy's down select strategy concerned the potential risks the Navy would face if the shipyard that wins the competition to build the 10 LCSs in FY2010-FY2014 cannot build them within the contracted cost. The competition between the two existing LCS industry teams to be the winner of the down select could be intense enough to encourage the teams to bid unrealistically low prices for the contract to build the 10 ships.

The Navy and its supporters could argue that the Navy's plan to award a fixed-price contract to the winner of the down select would shift the cost risk on the 10 ships from the government to the shipyard. They could also argue that the Navy plans to carefully evaluate the bid prices submitted by the two industry teams for the down select to ensure that they are realistic, and that the existence of the second LCS shipyard would provide the Navy with an ability to continue building LCSs if production at the first yard were disrupted due to financial issues.

Skeptics could argue that even with a fixed-price contract, the Navy's proposed strategy poses cost risks for the government, because a shipyard could submit an unrealistically low bid so as to win the down select, and then recover its losses on those 10 ships by rolling the losses into prices for downstream ships in the program. Alternatively, the shipyard could present the Navy with the prospect of going out of business and disrupting the LCS production effort unless the Navy were to provide a financial bailout to cover the yard's losses on the 10 ships. Skeptics could argue that Navy decisions dating back to the 1970s to award multi-ship construction contracts to shipyards that had not yet built many ships of the kind in question sometimes led to less-than-satisfactory program outcomes, including substantial financial bailouts.

Increasing LCS Combat System Commonality with Other Combat Systems

Another potential issue for Congress regarding the Navy's down select strategy concerned the Navy's plan to evolve the combat system on the winning LCS design to a configuration that has greater commonality with one or more existing Navy surface ship combat systems. The Navy in its September 16, 2009, announcement did not provide many details on this part of its proposed acquisition strategy, making it difficult to evaluate the potential costs and risks of this part of the strategy against potential alternatives, including an alternative (which Navy officials have discussed in the past) of designing a new LCS combat system that would, from the outset, be highly common with one or more existing Navy surface ship combat systems.

[101] Letter dated April 28, 2010, from Douglas W. Elmendorf, Director, CBO, to the Honorable Jeff Sessions, pp. 3-5. The letter is available online at http://www.cbo.gov/ftpdocs/114xx/doc11431/04-28-SessionsLetter.pdf.

Navy's Longer-Term Plans Regarding Two "Orphan" Ships

Another potential issue for Congress concerning the Navy's down select strategy concerned the Navy's longer-term plans regarding the two "orphan" LCSs built to the design that was not selected in the down select. The Navy stated that it planned to keep these two ships in the fleet because they will be capable ships and the Navy has an urgent need for LCSs. These two LCSs, however, will have unique logistic support needs, potentially making them relatively expensive to operate and support. At some point, as larger numbers of LCSs enter service, the costs of operating and supporting these two ships may begin to outweigh the increasingly marginal addition they make to total LCS fleet capabilities. Potential alternatives to keeping the ships in the active-duty fleet as deployable assets include selling them to foreign buyers, converting them into research and development platforms, shifting them to the Naval Reserve Force (where they would be operated by crews consisting partially of reservists), or decommissioning them and placing them into preservation (i.e., "mothball") status as potential mobilization assets. Potential questions for Congress included the following:

- Does the Navy intend to keep the two orphan LCSs in the active-duty fleet as deployable assets for a full 25-year service life?
- If so, how would be the life-cycle operation and support (O&S) costs of these two ships compare to those of the other LCSs? In light of these O&S costs, would it be cost-effective to keep these two ships in the active-duty fleet as deployable assets for a full 25-year service life, particularly as large numbers of LCSs enter service?
- If the Navy does not intend to keep the two orphan LCSs in the active-duty fleet as deployable assets for a full 25-year service life, when does the Navy anticipate removing them from such service, and what does the Navy anticipate doing with them afterward?

Potential Alternatives to Navy's September 2009 Strategy

Another potential issue for Congress concerning the Navy's down select strategy concerned potential alternatives to that strategy. A variety of alternatives can be generated by changing one or more elements of the Navy's proposed strategy. One alternative would be a strategy that would keep both LCS designs in production, at least for the time being. Such a strategy might involve the following:

- the use of block-buy contracts with augmented EOQ authority, as under the Navy's proposed acquisition strategy, to continue producing both LCS designs, so as to provide stability to shipyards and suppliers involved in producing both LCS designs;
- the use of Profit Related to Offer (PRO) bidding between the builders of the two LCS designs, so as to generate competitive pressure between them and thereby restrain LCS production costs;[102] and

[102] Under PRO bidding, the two shipyards would compete not for LCS quantities (because each shipyard would know that it was going to build a certain number of LCSs over the term of their block-buy contracts), but rather for profit, with the lowest bidder receiving the higher profit margin. PRO bidding has been used in other defense acquisition programs where bidders do not compete for quantity. The Navy, for example, began using PRO bidding in the DDG-51 (continued...)

- designing a new LCS combat system that would have a high degree of commonality with one or more existing Navy surface ship combat systems and be provided as government-furnished equipment (GFE) for use on both LCS designs—an idea that was considered by the Navy at an earlier point in the program.

The Navy's November 3, 2010, proposal for a dual-award LCS acquisition strategy is broadly similar to the notional dual-award approach outlined above. This notional dual-award approach has been presented in this CRS report as an option for Congress since September 27, 2009, when the report was updated to incorporate the Navy's September 16, 2009, announcement of its proposed down select strategy. The discussion below concerns the notional dual-award approach outlined above.

Supporters of an alternative like the one outlined above could argue that it would

- provide stability to LCS shipyards and suppliers;
- use competition to restrain LCS production costs;
- permit the Navy to receive a full return on the investment the Navy made in creating both LCS designs;
- reduce the life-cycle operation and support costs associated with building two LCS designs by equipping all LCSs with a common combat system;
- allow the Navy to design an LCS combat system that is, from the outset, highly common with one or more of the Navy's existing surface ship combat systems;
- achieve a maximum LCS procurement rate of four ships per year starting in FY2011 (two years earlier than under the Navy's proposal), thus permitting more LCSs to enter service with the Navy sooner;
- build both LCS designs in substantial numbers, thereby avoiding a situation of having a small number of orphan LCS ships that could have potentially high operation and support costs;
- preserve a potential to neck down to a single LCS design at some point in the future, while permitting the Navy in the meantime to more fully evaluate the operational characteristics of the two designs in real-world deployments; and
- increase the potential for achieving foreign sales of LCSs (which can reduce production costs for LCSs made for the U.S. Navy) by offering potential foreign buyers two LCS designs with active production lines.

Supporters of the Navy's proposed acquisition strategy could argue that an alternative like the one outlined above would, compared to the Navy's proposed strategy

- achieve lower economies of scale in LCS production costs by splitting production of LCS components between two designs;

(...continued)

destroyer program it in the 1990s.

- achieve, at the outset of series production of LCSs, less bidding pressure on shipyards, and thus higher LCS production costs, than would be achieved under the Navy's proposed strategy of using a price-based competition to select a single design for all future LCS production;
- miss out on the opportunity to restrain LCS costs by using the level of efficiency achieved in building an LCS design at one shipyard as a directly applicable benchmark for gauging the level of efficiency achieved by the other shipyard in building the same LCS design;
- increase Navy LCS program-management costs and the burden on Navy program-management capabilities by requiring the Navy to continue managing the construction of two very different LCS designs;
- achieve lower economies of scale in LCS operation and support costs because the two LCS designs would still differ in their basic hull, mechanical, and electrical (HM&E) systems, requiring the Navy to maintain two separate HM&E logistics support systems;
- receive only a limited return on the investment the Navy made in developing the two current LCS combat systems (since LCSs in the long run would not use either one), and require the Navy to incur the costs and the technical risks associated with designing a completely new LCS combat system;
- require the Navy to build some number of LCSs with their current combat systems—which are different from one another and from other Navy surface ship combat systems—while awaiting the development of the new LCS combat system, and then incur the costs associated with backfitting these earlier LCSs with the new system when it becomes available;
- send to industry a signal that is undesirable from the government's perspective that if the Navy or other parts or DOD begin producing two designs for a new kind of weapon system, the Navy or DOD would be reluctant to neck production down to a single design at some point, even if government believes that doing so would reduce program costs while still meeting operational objectives; and
- miss out on the opportunity that would be present under the Navy's proposed acquisition strategy to increase the potential for achieving foreign sales of LCSs by offering potential foreign buyers an LCS design that, through U.S. production, enjoys significant economies of scale for both production and operation and support.

Appendix E. Dual-Award Acquisition Strategy Announced in November 2010

This appendix presents additional background information on the dual-award acquisition strategy announced by the Navy on November 3, 2009.

November 4, 2010, Navy Point Paper

A November 4, 2010, Navy point paper on the dual-award strategy proposed on November 3, 2010, stated the following (this is the full text of the point paper):[103]

Littoral Combat Ship Proposed Revised Acquisition

Dual Ten Ship Awards

- In summer 2009 Navy received bids for three FY10 ships from Lockheed Martin/Marinette Marine/Bollinger and General Dynamics Bath Iron Works/Austal USA industry teams. These bids did not reflect competitive pricing and well exceeded the Congressional Cost Cap. In order to reverse cost trends on the program, the acquisition strategy was revised to the current down select strategy.

- The Navy's Littoral Combat Ship acquisition strategy to down select to a single design has resulted in a highly effective competition between the industry bidders. Navy is on the path to down select in accordance with the terms of the current solicitation.

- The industry response to the competitive acquisition strategy has resulted in has resulted in reduction in cost for the LCS ships relative to the previous bids. These competitive bids, coupled with Navy's desires to increase ship procurement rates to support operational requirements, has created an opportunity to award each bidder a fixed price ten-ship block buy—a total of 20 ships from Fiscal Year 2010 to Fiscal Year 2015. A comparison between the two strategies of which ships are included in a down select/second source versus dual 10 ship block buy appears in the table below.

- The current NDAA [national defense authorization act] language permits the Navy to procure up to 10 ships in a block buy. In order to execute a dual ten ship award, Navy believes Congressional authorization is required.

- If Congressional support for this approach is granted, Navy will work with industry to revise the ship procurement schedules within current proposal pricing (FY10 – FY15 vice FY10 – FY14).

- Navy is continuing on the path to down select and absent authorization, we will proceed to down select by mid-December 2010.

- There are numerous benefits to this approach including stabilizing the LCS program and the industrial base with award of 20 ships; increasing ship procurement rate to support

[103] Source: Navy point paper on proposed alternative LCS acquisition strategy dated November 4, 2010.

operational requirements; sustaining competition through the program; and enhancing Foreign Military Sales opportunities.

- The Navy intends to procure the Technical Data Package for both designs and if necessary a second source for either or both designs could be brought into the program.

- Either approach will ensure the Navy procures affordably priced ships.

		FY10	FY11	FY12	FY13	FY14	FY15	TOTAL
Downselect	Winner	2	2	2	2	2	4	**19**
	Second Source			1	2	2		
	TOTAL	2	2	3	4	4	4	
Dual Award	Contractor A	1	1	2	2	2	2	**20**
	Contractor B	1	1	2	2	2	2	
	TOTAL	2	2	4	4	4	4	

Near-Term Issue for Congress

The Navy's proposed dual-award strategy posed a near-term issue for Congress of whether this strategy would be preferable to the down select strategy, and whether Congress should grant the Navy, by December 30, the additional legislative authority the Navy would need to implement the dual-award strategy.

December 14 Senate Armed Services Committee Hearing

On December 14, 2010, the Senate Armed Services Committee held a hearing to review the Navy's proposed dual-award strategy. The witnesses at the hearing included Navy leaders and representatives from CBO, GAO, and CRS. The committee's web page for the hearing[104] contains links to the prepared statements of the GAO and CRS witnesses, and states that the Navy and CBO witnesses did not submit their prepared statements in electronic form. (The CBO witness asked in his opening remarks that CBO's December 10, 2010, letter report on the relative costs of the down select and dual-award strategies[105] be entered into the record for the hearing. CBO's letter report is available from the CBO website.) The committee's web page for the hearing also contains a link to the transcript of the hearing.

Some General Observations

General observations that could be made on the Navy's proposed dual-award strategy included but are not limited to the following:

[104] http://armed-services.senate.gov/testimony.cfm?wit_id=9812&id=4897.

[105] Congressional Budget Office, letter report to Senator John McCain on LCS acquisition strategies dated December 10, 2010, 7 pp.

- The dual-award strategy would avoid, at least for now, the possibility of a contract protest being filed against a Navy down select decision.
- Although the dual-award strategy includes the possibility of the Navy at some point bringing a second source into the program for either or both LCS designs, the dual-award strategy does not include the guaranteed opportunity present in the down select strategy for shipyards not currently involved in building LCSs to compete for the right to become the second LCS builder.
- The Navy's November 4, 2010, point paper on the dual-award strategy does not outline the Navy's intentions regarding the currently different combat systems (i.e., the built-in collections of sensors, weapons, displays, and software) on the two LCS designs.
- The dual-award strategy would require each LCS contractor to build 10 ships over a period of six years (FY2010-FY2015) rather than five years (FY2010-FY2014), but at the same price that was bid for the five-year schedule. In addition, LCSs built under the dual-award strategy would incorporate combat systems that would be built by combat system manufacturers in smaller annual quantities than would be the case under the down select strategy, possibly increasing the costs of these combat systems. Factors such as these could, at the margin, alter the profitability for each contractor of building its respective group of 10 ships.

It could also be noted that the Navy's proposed dual-award strategy is broadly similar to a notional dual-award approach that was presented in this CRS report as an option for Congress (see **Appendix D**) since September 27, 2009, when the report was updated to incorporate the Navy's September 16, 2009, announcement of its proposed down select strategy.

Potential Oversight Questions for Congress

Potential oversight questions for Congress in assessing whether the proposed dual-award strategy would be preferable to the down select strategy, and whether to grant the Navy, by December 30, the additional legislative authority the Navy would need to implement a dual-award strategy, included but were not limited to the following:

- Did the timing of the Navy's proposal provide Congress with enough time to adequately assess the relative merits of the down select strategy and the dual-award strategy? Given that the contractors submitted their bids by about September 15, could the Navy have notified Congress of the proposed dual-award strategy sooner than November 3, giving Congress more time to seek information on and evaluate the proposal? Should the Navy have asked the contractors to extend their bid prices for another, say, 30 or 60 or 90 days beyond the original December 14 expiration date, so as to provide more time for congressional review of the Navy's proposal?[106] (As mentioned earlier, on

[106] A December 6, 2010, press report states: "Lockheed officials have indicated that they could extend the pricing in their proposal for a short while beyond Dec. 14, to allow time for Congress to approve the change. Lockheed Chief Financial Officer Bruce Tanner told an investment conference last week that Lockheed could extend the prices it offered for a day or two, but not indefinitely…. Analysts said they expected both companies to show some flexibility on the expiration of their pricing, given that each firm stood to win a contract valued at around $5 billion." (Andrea (continued...)

December 13, it was reported that the two LCS bidders, at the Navy's request, had extended the prices in their bids for 16 days, to December 30. At the December 14 hearing, Navy witnesses expressed strong doubts about the willingness of the bidders to extend their bid prices for any significant additional amount of time, since agreements with their parts suppliers and other arrangements on which the bids are based would no longer be valid.)

- What role, if any, did a desire by the Navy to avoid a potential contract protest against the Navy's down select decision play in the Navy's decision to propose the alternate dual-award strategy? For example, how concerned, if at all, was the Navy that the announcement of an LCS down select decision might lead to a contract protest and controversy somewhat like what has been experienced in the Air Force's KC-X aerial refueling tanker acquisition program?[107] A December 13, 2010, press report on the LCS program stated: "One high-level Navy source recently said that without the dual-ship approach, 'there is 100 percent chance of a protest.'"[108]
- What are the potential relative costs of the down select and dual-award acquisition strategies, including development costs, procurement costs, and life-cycle operation and support (O&S) costs? Did the Navy fully and accurately estimated these costs—including potential costs for developing, procuring, and installing a common combat system for both LCS designs—and reported all these potential costs to Congress?
- What are the potential relative risks of the down select and dual-award acquisition strategies, including development risks, production cost risks, production schedule risks, and life-cycle O&S risks? Did the Navy fully and accurately estimated these risks, and reported all these potential risks to Congress?
- What are the Navy's intentions, under the proposed dual-award acquisition strategy, regarding the currently different combat systems on the two LCS designs? Does the Navy intend to leave them unchanged, adopt one of the combat systems as the common system for both designs, or develop a new combat system for both designs? If the Navy intends to pursue the second or third of these paths, what is the Navy's plan (including schedule) for doing so? If the Navy does not have a definite plan regarding the combat systems for the ships, how well can the potential costs and risks of the dual-award strategy be estimated and compared to those of the down select strategy?
- What are the potential industrial-base impacts of the dual-award strategy, including impacts on the two LCS contractors, on shipyards that could, under the

(...continued)

Shalal-Esa, "U.S. Navy Hopeful Congress Will Approve Ship Buys," *Reuters.com*, December 6, 2010.) Another December 6, 2010, press report that was posted online on December 3, 2010, stated: "Theoretically, Lockheed Martin and Austal could likely agree to extend the price deadline, but the Navy has not asked them to do so yet, [Navy spokeswoman Captain Cate] Mueller said." (Cid Standifer, "Stand-Alone Bill May Be Needed To Approve LCS Dual Block Buy Plan," *Inside the Navy*, December 6, 2010.)

[107] For more on the KC-X program, see CRS Report RL34398, *Air Force KC-46A Tanker Aircraft Program: Background and Issues for Congress*, by Jeremiah Gertler.

[108] Christopher P. Cavas, "Deadline Looms For U.S. Navy's LCS," *Defense News*, December 13, 2010: 1.

down select strategy, bid for the right to become the second LCS builder, and on combat system manufacturers?

- What impact, if any, might the Navy's proposal to shift from its down select strategy to the dual-award strategy have on the ability of the Department of Defense (DOD) to implement down select strategies for other acquisition programs? For example, will the Navy's proposal to shift to the dual-award strategy cause contractors bidding for other acquisition programs to treat with increased skepticism stated DOD intentions to carry out down selects? If so, could that reduce the benefits of competition that DOD might hope to achieve through the use of down select strategies?

Enough Time for Adequate Congressional Review of Navy Proposal?

Regarding whether the timing of the Navy's proposal provides Congress with enough time to adequately assess the relative merits of the down select strategy and the dual-award strategy, it can be noted that this was the third time in the history of the LCS program that the Navy presented Congress with an important choice about the future of the LCS program late in the congressional budget-review cycle, after Congress had completed its spring budget-review hearings and some of its committee markups. The first instance was in mid-2002, when the Navy submitted an amended request to Congress for FY2003 funding to get the LCS program started using a rapid acquisition strategy.[109] The second was in September 2009, when the Navy announced its proposed down select strategy for the LCS program (see the discussion of this issue in **Appendix D**).

In light of the third instance—the Navy's proposal of November 3, 2010, for using a dual-award strategy rather than a down select strategy—a potential issue for Congress are the implications for the LCS program and congressional oversight of defense acquisition programs in general of proceeding with the LCS program in part on the basis of policies originally presented as proposals to Congress late in the congressional budget-review cycle, after Congress had completed its spring budget-review hearings and some of its committee markups. The Navy's November 3, 2010, notification to Congress of the proposed dual-award strategy, combined with a request by the Navy that Congress act on that proposal by December 30, provided relatively little time for Congress to collect cost and other information from the Navy (including information that Navy might not offer in initial briefings to individual congressional offices), for Congress to solicit cost and other information from independent sources such as CBO and GAO,

[109] The Navy's original FY2003 budget request, submitted to Congress in February 2002, contained no apparent funding for development of the LCS. In addition, the Navy in early 2002 had not yet announced that it intended to employ a rapid acquisition strategy for the LCS program. As a result, in the early months of 2002, there may have been little reason within Congress to view the LCS program as a significant FY2003 budget-review issue. In the middle of 2002, the Navy submitted an amended request asking for $33 million in FY2003 development funding for the LCS program. Navy officials explained that they did not decide until the middle of 2002 that they wanted to pursue a rapid acquisition strategy for the LCS program, and consequently did not realize until then that there was a need to request $33 million in FY2003 funding for the program. By the middle of 2002, however, the House and Senate Armed Services committees had already held their spring FY2003 budget-review hearings and marked up their respective versions of the FY2003 defense authorization bill. These two committees thus did not have an opportunity to use the spring 2002 budget-review season to review in detail the Navy's accelerated acquisition plan for the LCS program or the supporting request for $33 million in funding.

for CBO and GAO to develop such information and provide it to Congress, for Congress to hold hearings at which all this information might be discussed in a group setting, with multiple parties present, and for congressional offices to then form their evaluations of the Navy's proposal.

Relative Costs

Regarding the relative costs of the down select and dual-award acquisition strategies, there were at least three significant cost elements to consider: ship procurement costs; costs for possibly modifying the combat systems on LCSs so as to achieve more commonality in combat system equipment among all LCSs, and between LCSs and other Navy ships; and operational and support (O&S) costs.

Ship Procurement Costs

Navy Estimate

Regarding ship procurement costs, the Navy estimates that procuring LCSs under the dual-award strategy would cost $1 billion less through *FY2016*, and $600 million less through *FY2015*, than procuring them under the down select strategy. The Navy states that the $1 billion in savings through FY2016 translates to $910 million in net present value terms, and that the $600 million in savings through FY2015 translates to $496 million in net present value terms.[110]

The Navy estimates that ship procurement costs will be lower under the dual-award strategy than they would have been under the down select strategy due to the following cost factors, which are not listed in any particular order:[111]

- **Costs due to the second source under down select strategy building its first LCS.** The Navy estimates that certain ship procurement costs would be higher under the down select strategy because the second source under the down select strategy—that is, the unknown shipyard that would have been chosen in the second-stage competition that would have occurred under the down select strategy—would be building its first LCS. These higher costs include the following:
  - **Tooling, jigs, fixtures, etc.** The second source under the down select strategy would incur costs for the purchase of LCS-specific tooling, jigs, fixtures, etc. Marinette and Austal already have already paid for these things.
  - **Engineering and support services.** The Navy's estimate includes a higher cost for engineering and support services at the second source under the down select strategy, because these costs typically are higher for a lead ship at a shipyard than for subsequent ships at that yard.
  - **Learning curve position.** In estimating the amount of labor hours required to build the first ship covered under the second source's block-buy contract,

[110] Source for $496 million figure: Navy briefing to CRS and CBO, March 30, 2011.

[111] Source for these points: Navy information paper dated April 12, 2011, as clarified and elaborated in a telephone conversation with CRS on April 21, 2011.

the Navy's estimate takes into account the fact that the second source under the dual-award strategy has already built LCSs (i.e., the yard is already some way down its LCS production learning curve), whereas the second source under the down select strategy would be building its first LCS (i.e., the yard would be at the top of its LCS production learning curve).

- **Change orders.** The Navy budgets a 10% allowance for change orders (i.e., design changes) for a lead ship built at a shipyard, compared to 5% for subsequent ships built at that yard.
- **Rework.** The Navy's estimate includes a higher cost for rework at the second source under the down select strategy because lead ships typically experience higher rework rates.

- **Slope of shipyard learning curve.** The Navy estimates that the second source under the dual-award strategy will achieve a steeper production learning curve (i.e., a greater amount of ship-to-ship reduction in shipyard labor hours required to build each ship) than would have been achieved by the second source under the down select strategy. In making this estimate, the Navy cites facilities improvements at Marinette and Austal that the Navy believes will permit Marinette and Austal to achieve learning curves of a certain steepness.
- **Shipyard labor rates.** The Navy estimates that the second source under the dual-award strategy will feature labor rates that are lower than those that would have occurred at the second source under the down select strategy.
- **Vendor material costs.** The Navy estimates that the second source under the dual-award strategy will obtain lower material prices from vendors than the second source under the down select strategy would have obtained because the second source under the dual-award strategy can seek bids from vendors on materials for a 10-ship contract, while the second source under the down select strategy would have sought bids from vendors on materials for a 5-ship contract.[112]
- **Profit rates.** The Navy estimates that the profit rates earned by second source under the dual-award strategy are lower than those that would be earned by the second source under the down select strategy, due to aggressive bidding by Marinette and Austal during what these yards thought was the first-stage competition under the down select strategy—a competition that was to have chosen the one LCS design to which all future LCSs would be built.

In evaluating the Navy's treatment of the above cost factors, potential questions include the following:

- How reasonable is it for the Navy to estimate that the second source under the dual-award strategy would have a steeper shipyard learning curve, lower shipyard labor rates, and a lower profit rate than the second source under the down select strategy would have had? Given the number and capabilities of

[112] The Navy also adjusted its cost estimate to account for differences in production quantities of scale for LCS combat systems that would occur under the down select and dual-award strategies. Under the down select strategy, one combat system maker would make combat systems for all LCSs. Under the dual-award strategy, two combat system makers would each make combat systems for one-half of the LCSs.

shipyards that might have participated in the second stage competition under the down select strategy, the potential intensity of a competition among these yards to win a share of a large Navy shipbuilding program, and the uncertainty about which specific yard might have won that competition, how certain can the Navy be that the second source that was chosen under that competition would have a shallower learning curve (and that it would not make facility investments to achieve a steeper curve), higher labor costs, and a lower profit rate than the second source under the dual-award strategy?

- How reasonable is it for the Navy to estimate that the second source under the down select strategy would have higher vendor material costs, given that this second source might have been a builder of other Navy ships and consequently might have been able to bundle its LCS material purchases together with those for its other Navy ships, so as to achieve increased economies of scale in material production? Navy officials in recent years have encouraged shipyards to achieve cross-yard economies of scale of this kind.
- If the second source under the down select strategy were instead estimated to be equal to the second source under the dual-award strategy in terms of shipyard learning curve slope, shipyard labor rates, vendor material costs, and profit rates, how much would this reduce the Navy's estimate of the savings in ship procurement costs that would occur under the dual-award strategy?

CBO Estimate

In contrast to the Navy, which estimated that ship procurement costs would be lower under the dual-award strategy, CBO in its December 10, 2010, letter report estimated that ship procurement costs would be $740 million higher more through FY2015 under the dual-award strategy. CBO's letter report included several cautionary statements about its estimates relating to limits on the information available to CBO in developing its estimates. The Navy and CBO estimates of ship procurement costs through FY2015 are summarized in **Table E-1**.

Table E-1. Navy and CBO Estimates of Ship Procurement Costs Through FY2015 Under Down Select and Dual-Award Strategies

For the period FY2010-FY2015, in current (i.e., then-year) dollars

Acquisition approaches	Estimated Cost
Navy estimate	
19-ship down-select plan	10,400 million
20-ship dual-award plan	9,800 million
Difference between two plans	Dual-award plan costs $600 million ***less***
CBO estimate	
19-ship down-select plan	11,080 million
20-ship dual-award plan	11,820 million
Difference between two plans	Dual-award plan costs $740 million ***more***

Source: Table prepared by CRS based on data presented in Congressional Budget Office, letter report to Senator John McCain on LCS acquisition strategies dated December 10, 2010, Table 2 on page 5.

December 14, 2010, Hearing

At the December 14, 2010, hearing on LCS acquisition strategy before the Senate Armed Services Committee, the Navy witnesses defended the Navy's estimate, stating that it was based on actual bid data from the two LCS bidders, and that CBO's estimate did not reflect full exposure to this bid data, because the data was proprietary and was being closely held by the Navy pending a potential announcement by the Navy of a down select decision (if the dual-award strategy were not pursued).

As discussed in the previous section, however, the Navy's estimate was also based on certain assumptions about the unknown shipyard that would have been chosen under the second-stage competition that would have occurred under the down select strategy. The Navy's assumptions about this unknown yard compared to the second source under the dual-award strategy accounts for some portion of the Navy's estimated savings.

Potential Changes in Costs of Other Ships Not Accounted For

Under the down select strategy, shipyards competing to become the second LCS builder could include yards that currently build other ships for the Navy, such as, possibly, General Dynamics' Bath Iron Works (GD/BIW) of Bath, ME, Northrop Grumman's Ingalls shipyard of Pascagoula, MS, or General Dynamics' National Steel and Shipbuilding Company (NASSCO) of San Diego, CA. If such a yard were to be selected under the down select strategy to become the second LCS builder, it could reduce the cost of other Navy ships being built at that yard by more fully spreading the fixed overhead costs of that yard. The Navy and CBO estimates in **Table E-1** do not account for possible changes in the costs of other Navy ships that might be occur as a consequence of changes in the spreading of shipyard fixed overhead costs.

Combat System Modification Costs

Any savings the dual-award strategy might realize relative to the down select strategy in terms of costs for procuring LCSs could be offset by potential additional costs under the dual-award strategy for modifying the combat systems on LCSs so as to achieve more commonality in combat system equipment among all LCSs, and between LCSs and other Navy ships. Prior to its September 2009 announcement of its proposed down select strategy, Navy officials on some occasions had spoken about the possibility of modifying the combat systems of one or both LCS designs so as to achieve more commonality in combat system equipment among all LCSs, and between LCSs and other Navy ships.[113]

A November 29, 2010, press report stated that "the Navy intends to keep separate the combat systems of the Lockheed and Austal USA versions of the Littoral Combat Ships for its dual buy strategy, but will 'procure the tech data package to allow for consideration of [a] common combat system in the future,' according to Navy spokeswoman Capt. Cate Mueller." The report also quoted an industry official as saying that the Navy is likely "still strategizing as to how they're going to single up on a combat system."[114]

[113] See, for example, Christopher P. Cavas, "Two LCS Designs, One Big Dilemma," *Defense News*, December 13, 2010: 22.

[114] Andrew Burt, "Navy Open To Combining Combat Systems On Both Littoral Combat Ships," *Inside the Navy*, (continued...)

At the December 14 hearing, the Navy stated the following regarding the issue of potential combat system modification costs:

> The current [LCS] acquisition strategy does not call for the changeout of the [LCS] combat system.
>
> Let me describe some characteristics of the combat system. As it was mentioned earlier, the total cost for the [LCS] combat system is on the order of about $70 million. When we think of the combat system, we break it down into a couple key components—weapons, sensors, and command and control [aka command and decision, or C and D] system. We have in fact, on the weapons side of the combat system, commonality [between the two LCS designs]. Both ships' 57-millimeter Bofors guns, both ships we're looking at RAM–CRAM [sic: RAM or SEARAM] weapons systems. So the weapon system is already common both between them and also with other ships in the inventory.
>
> Now, on the sensor side, we have contemplated moving towards a common sensor, and inside of this solicitation the Navy asked for priced bids for a new sensor to consider for the future. In total, the cost for bringing a new sensor—that's both common for LCS and with the rest of the fleet—is about $20 million nonrecurring and about $2 million a ship difference.
>
> So weapons are common. If the Navy chose to go to a common system for performance reasons, the cost impact would be about $20 million nonrecurring and a couple million dollars a ship.
>
> Then on the C and D side, which is largely the software system and displays and processors, the Navy does not have a drive right now to go towards common C and D for this class either in the down-select or dual-award. It is something that we could consider in the future.[115]

A January 17, 2011, press report stated:

> "The median class size in the Navy is about 12 to 14 ships, so we have a lot of 12-ship classes that have their own combat system," [Rear Admiral David Lewis, the Navy's program executive officer for ships,] said, "so we have no plans on changing the combat system on the ships. They're effective. At this point, they meet the requirements, and so I don't see any appetite in the Navy for changing those."…
>
> Lewis admitted that the business case could change after the two 10-ship contracts have run their course, but said he was skeptical it would make more sense to change combat systems then than now.[116]

An August 18, 2011, press report stated:

> [Rear Admiral James] Murdoch [head of the program executive office], said the Navy has not yet decided on whether both classes should have the same combat system or whether the

(...continued)

November 29, 2010. Material in brackets as in original. The Austal USA version of the LCS is the version developed by the General Dynamics-led LCS industry team.

[115] Transcript of spoken testimony of Sean J. Stackley, Assistant Secretary of Navy for Research, Development, and Acquisition.

[116] Cid Standifer, "Rear Adm. Lewis: Navy Has 'No Appetite' To Change LCS Combat System," *Inside the Navy*, January 17, 2011.

> program should shift to a single system. There was no timeframe for a decision and the Navy was awaiting feedback from the two firms, he said.
>
> "I'm not going to prejudge that," he said, adding he did not expect any changes in the "immediate term."[117]

Life-Cycle Operation and Support (O&S) Costs

Any savings the dual-award strategy might realize relative to the down select strategy in terms of costs for procuring LCSs could also be offset by potential additional life-cycle operation and support (O&S) costs of operating significant numbers of two different LCS designs. A December 8, 2010, GAO report states: "According to the Navy, [estimated savings in LCS procurement costs under the dual-award strategy] would be offset, in part, by an additional $842 million in total ownership costs, which the Navy equates to a net present value of $295 million."[118] The Navy confirmed this figure at the December 14 hearing, and stated that this estimate was carefully prepared and consistent with past Navy analyses on this question.

GAO's December 8 report states:

> Navy officials expressed confidence that their cost estimate supporting the dual award provides details on the costs to operate and support both designs. However, since little actual LCS operating and support data are available to date, the Navy's estimates for these costs are currently based on data from other ships and could change as actual cost data become more available. These estimates are also based on new operational concepts for personnel, training, and maintenance that have not been fully developed, tested, and implemented. For example, the Navy has not yet implemented a comprehensive training plan, and it is possible that the plan could cost more or less than the training costs currently accounted for by the Navy.[119]

CBO's December 10 letter report states:

> Operating and maintaining two types of ships would probably be more expensive, however. The Navy has stated that the differences in costs are small (and more than offset by procurement savings), but there is considerable uncertainty about how to estimate those differences because the Navy does not yet have much experience in operating such ships.[120]

Resulting Net Costs

Using the above information, it appears that the Navy estimates that, compared to the down select strategy, the dual award strategy might save a net total of $615 million (net present value) through FY2016, or $201 million (net present value) through FY2015. This figure includes $910 million (net present value) in savings in ship procurement costs through FY2016, or $496 million (net

[117] Mike McCarthy, "LCS-5, -6 Will Keep Separate Combat Systems, PEO Says," *Defense Daily*, August 18, 2011: 3-4.

[118] Government Accountability Office, *Navy's Proposed Dual Award Acquisition Strategy for the Littoral Combat Ship Program*, GAO-11-249R, December 8, 2010, Table 1 on page 3.

[119] Government Accountability Office, *Navy's Proposed Dual Award Acquisition Strategy for the Littoral Combat Ship Program*, GAO-11-249R, December 8, 2010, p. 6.

[120] Congressional Budget Office, letter report to Senator John McCain on LCS acquisition strategies dated December 10, 2010, p. 3.

present value) in ship procurement costs through FY2015, less $295 million (net present value) in additional ship O&S costs.

This figure does not account for possible changes in the costs of other Navy ships that might be occur as a consequence of changes in the spreading of shipyard fixed overhead costs. The estimated net savings of $615 million (net present value) through FY2016 ($201 million [net present value] through FY2015) would be reduced by any LCS combat system modification costs. Navy testimony at the December 14 hearing suggests that combat system modification costs might range from zero (no modifications) to a few tens of millions of dollars (changing the radar on the ships).

Using CBO's estimate rather than the Navy's estimate for relative ship procurement costs (see **Table E-1**) would make the dual-award strategy more expensive than the down select strategy. As mentioned earlier, the Navy witnesses at the December 14 hearing defended the Navy's estimate of ship procurement costs, stating that it was based on actual bid data from the two LCS bidders, and that CBO's estimate did not reflect full exposure to this bid data, because the data is proprietary and being closely held by the Navy pending a potential announcement by the Navy of a down select decision (if the dual-award strategy is not pursued).

Relative Risks

Regarding the potential relative risks of the down select and dual-award acquisition strategies, the December 8 GAO report states that "a second ship design and source provided under the dual award strategy could provide the Navy an additional hedge against risk, should one design prove problematic."[121] It might also be argued that the dual-award strategy avoids the construction risks present under the down select strategy of having LCSs built by a shipyard that has not previously built LCSs.

On the other hand, it might be argued that if there *is* a substantial risk of an LCS design proving problematic, then the LCS program should not be put into series production in the first place, and that if there *is not* a substantial risk of an LCS design proving problematic, then the value of hedging against that risk would be negligible. It might also be argued that managing the construction of two very different LCS designs could place increased demands on overall Navy program management capacities and on the Navy's Supervisor of Shipbuilding (SUPSHIP) capabilities for on-site monitoring of the construction of Navy ships—factors that might increase the chances of program-management challenges in the LCS program or of the Navy not detecting in a timely manner construction-quality problems that might occur in one or both LCS designs.[122]

[121] Government Accountability Office, *Navy's Proposed Dual Award Acquisition Strategy for the Littoral Combat Ship Program*, GAO-11-249R, December 8, 2010, p. 4.

[122] Limits on Navy SUPSHIP capacities may have been a factor in the delayed discovery by the Navy of construction quality problems on Navy San Antonio (LPD-17) class amphibious ships. For a discussion of LPD-17 class construction quality problems, CRS Report RL34476, *Navy LPD-17 Amphibious Ship Procurement: Background, Issues, and Options for Congress*, by Ronald O'Rourke.

Appendix F. Navy Surface Ship Survivability Standards

This appendix presents additional background information on Navy surface ship survivability standards.

November 2004 CBO Report

A November 2004 CBO report states:

> The concept of survivability as it relates to Navy ships rests on three features: susceptibility, vulnerability, and recoverability. Susceptibility is a ship's ability to avoid an enemy strike, or its probability of being hit. Vulnerability is the ship's ability to withstand the strike, or its probability of being destroyed if hit. Recoverability is the ability of the crew to restore a ship's systems so the ship can carry out its missions while damaged. Key determinants of survivability include, among other things, a ship's defensive systems, the way it is constructed, and the resources on board the ship to redress damage.
>
> In designing and building ships, all three of those concepts must be balanced. For example, a vessel that had zero susceptibility when its defensive systems were engaged but that had had little attention paid to reducing its vulnerability would be subject to crippling attack when its defenses were down, such as when it was on a nonalert status in a foreign port. Conversely, a ship that was built to withstand almost any kind of attack would most likely be too heavy, costly, and slow to be effective in combat situations.
>
> The Navy divides its surface ships into three broad survivability categories that reflect the environments in which they are expected to function: Level I, Level II, and Level III. Ships built to Level I are expected to operate in the least severe environment, away from the area where a battle group is operating or the general war-at-sea region. Those vessels should be able to maintain good handling in bad weather and should have systems for fighting fires on board the ships, hardening against electromagnetic pulses, and protection against chemical, biological, or radiological contamination. However, they are not expected to "fight hurt," as the Navy puts it. Such ships include material support ships, mine-warfare vessels, and patrol combatants.
>
> Ships built to Level II are expected to operate in a more severe environment, such as in support of a battle group in the war-at-sea region. Level II survivability should include the capacity to continue fighting even if the ship is hit by enemy weapons. Such ships would have all of the features of Level I but more redundancy in their primary and support systems, better structural integrity and compartmentalization (such as being built with numerous watertight sections), protection against conventional and nuclear blasts, and a smaller signature (meaning they have a smaller radar cross-section, make less noise when passing through the water, and are less susceptible to mines). Ships built to Level II include the logistics support ships that supply materials, fuel, and ammunition to carrier battle groups and amphibious warfare ships during combat.
>
> Level III is the most severe environment envisioned for surface warships. Vessels designed to withstand that environment should have all of the features of ships designed to Level II as well as better defensive systems and more ability to deal with the degrading effects of hits from antiship cruise missiles, torpedoes, and mines (through better damage-control systems

and greater structural integrity). Ships built to Level III specifications include aircraft carriers and major surface combatants, such as Aegis-capable cruisers and destroyers.[123]

OPNAVINST 9070.1 of September 23, 1988

Enclosure 2 (pages 9 and 10) of OPNAVINST (Office of the Chief of Naval Operations Instruction) 9070.1 of September 23, 1988, on survivability policy for Navy surface ships,[124] states:

[123] Congressional Budget Office, *The Future of the Navy's Amphibious and Maritime Prepositioning Forces*, November 2004, p. 25. In a footnote to this passage, the CBO report states that "This discussion comes almost entirely from Department of the Navy, Chief of Naval Operations, Ship Safety and Survivability Office*, Survivability Design Handbook for Surface Ships* (September 2000)."

[124] OPNAVINST 9070.1, September 23, 1988, entitled "Survivability Policy for Surface Ships of the U.S. Navy," 10 pp., accessed on April 29, 2011, at http://doni.daps.dla.mil/Directives/09000%20General%20Ship%20Design%20and%20Support/09-00%20General%20Ship%20Design%20Support/9070.1.pdf. The home page at http://doni.daps.dla.mil/default.aspx, entitled "Department of the Navy Issuances," states that it is a "digital collection of unclassified issuances released by the Secretary of the Navy [and] Chief of Naval Operations." EMP is electromagnetic pulse; CBR is chemical, biological, radiological; DC/FF is damage control / firefighting; TLRs is top level requirements.

DEFINITION OF SURVIVABILITY LEVELS FOR SURFACE SHIPS

Survivability weapons effects and operational environments are categorized in terms of the three levels of severity described below. They provide a basis for establishing survivability performance standards and are not intended to describe conditions of readiness or mission impact. Definitive engineering design values shall be developed to characterize the degrees of severity relative to the weapons effects identified in enclosure (1). Ship survivability features shall provide affordable protection at the levels specified in enclosure (3) to support sustained mission capability:

Level I - low
Level II - moderate
Level III - high

Level I represents the least severe environment anticipated and excludes the need for enhanced survivability for designated ship classes to sustain operations in the immediate area of an engaged Battle Group or in the general war-at-sea region. In this category, the minimum design capability required shall, in addition to the inherent sea keeping mission, provide for EMP and shock hardening, individual protection for CBR, including decontamination stations, the DC/FF capability to control and recover from conflagrations and include the ability to operate in a high latitude environment.

Level II represents an increase of severity to include the ability for sustained operations when in support of a Battle Group and in the general war-at-sea area. This level shall provide the ability for sustained combat operations following weapons impact. Capabilities shall include the requirements of Level I plus primary and support system redundancy, collective protection system, improved structural integrity and subdivision, fragmentation protection, signature reduction, conventional and nuclear blast protection and nuclear hardening.

Level III, the most severe environment projected for combatant Battle Groups, shall include the requirements of Level II plus the ability to deal with the broad degrading effects of damage from anti-ship cruise missiles (ASCMs), torpedoes and mines.

SURVIVABILITY PROTECTION REQUIREMENTS BY SHIP CLASS

The operationally relevant ship survivability protection requirements presented below incorporate the severity levels and conditions described in enclosure (2) and shall be implemented in concert with applicable TLRs and associated design standards and performance specifications.

PROTECTION REQUIREMENTS BY SHIP CLASS

SHIP CLASS	NUCLEAR/CONVENTIONAL WEAPON PROTECTION LEVELS		CBR PROTECTION LEVELS	NUCLEAR/ CONVENTIONAL PROTECTION LEVELS (1)
	SHIP	EQUIPMENT	SHIP	PERSONNEL
AIRCRAFT CARRIERS	III	III	III	III
BATTLE FORCE SURFACE COMBATANTS	III	III	III	III
FRIGATES	II	II	II	II
AMPHIBIOUS WARFARE SHIPS	II	II	II	II
UNDERWAY REPLENISHMENT STATION SHIPS	II	II	II	II
SHUTTLE SHIPS	I	I	I	I
PATROL COMBATANT AND MINE WARFARE SHIPS	I	I	I	I
NAVAL STRATEGIC SEALIFT	I	I	I	I
MATERIAL SUPPORT SHIPS	I	I	I	I
ALL OTHER AUXILIARY SHIPS/CRAFT	I	I	I	I

NOTE: (1) Personnel hazard environments include fragments and debris, thermal radiation, initial and residual nuclear radiation, chemical and biological agents, temperature extremes, fire, smoke and toxic products of combustion and laser irradiation.

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