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

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Summary

The Navy's Littoral Combat Ship/Frigate (LCS/FF) program is a program to procure a total of 40, and possibly as many as 52, small surface combatants (SSCs), meaning LCSs and frigates. The LCS/FF program has been controversial over the years due to past cost growth, design and construction issues with the first LCSs, concerns over the survivability of LCSs (i.e., their ability to withstand battle damage), concerns over whether LCSs are sufficiently armed and would be able to perform their stated missions effectively, and concerns over the development and testing of the modular mission packages for LCSs. The Navy's execution of the program has been a matter of congressional oversight attention for several years.

Two very different LCS designs are currently being built. One was developed by an industry team led by Lockheed; the other was developed by an industry team that was led by General Dynamics. The design developed by the Lockheed-led team is built at the Marinette Marine shipyard at Marinette, WI, with Lockheed as the prime contractor; the design developed by the team that was led by General Dynamics is built at the Austal USA shipyard at Mobile, AL, with Austal USA as the prime contractor.

The Navy's proposed FY2017 budget requested $1,125.6 million for the procurement of the 27th and 28th LCSs, or an average of $562.8 million for each ship. The Navy's proposed FY2017 budget also requested $86 million in so-called "cost-to-complete" procurement funding to cover cost growth on LCSs procured in previous fiscal years, and $139.4 million for procurement of LCS mission module equipment.

Congress, as part of its markup of the Navy's proposed FY0217 budget, funded the procurement of three LCSs (one more than requested). A total of 29 LCS have thus been procured through FY2017, leaving another 11 ships to be procured to reach a total of 40. Beyond that, however, the remainder of the LCS/FF program now appears to be in flux in certain key respects, including the following:

- **Total program quantity.** Although the program was limited by a December 2015 restructuring to a total of 40 ships, the Navy has a requirement for 52 SSCs, raising a possibility that the current reassessment of the program might lead to a decision by the Department of Defense to expand the total size of the program to something more than 40 ships, and possibly to as many as 52. It is also possible that the program might be reduced to something less than 40 ships.
- **Annual procurement rate.** It is possible the program's annual procurement rate could be increased from the one or two ships per year shown in the FY2017 budget submission to a rate of about three ships per year—a rate similar to those in budget submissions for years prior to FY2017—particularly if the program's total procurement quantity is increased to something more than 40.
- **The down select.** If the program's annual procurement rate is increased to something like three ships per year, it might prompt a reconsideration of whether to conduct a currently planned down select to a single LCS design.
- **Design and builder or builders of the FFs.** The design of the new FFs, and the shipyard or shipyards that will build them, are uncertain. Navy officials have stated that the Navy is reassessing what capabilities its wants to have in the new FFs, and is examining potential FF designs based on both LCS hull forms and other frigate-seized hull forms.

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Introduction

This report provides background information and issues for Congress on the Navy's Littoral Combat Ship/Frigate (LCS/FF) program, a program to procure a total of 40, and possibly as many as 52, small surface combatants (SSCs), meaning LCSs and frigates. The LCS/FF program has been controversial over the years for various reasons, and the Navy's execution of the program has been a matter of congressional oversight attention for several years. The program presents several oversight issues for Congress. Congress's decisions on the LCS/FF program will affect Navy capabilities and funding requirements, and the shipbuilding industrial base.

For an overview of the strategic and budgetary context in which the LCS/FF program and other Navy shipbuilding programs may be considered, see CRS Report RL32665, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, by (name redacted) .

Background

Program Overview

The Navy's Littoral Combat Ship/Frigate (LCS/FF) program is a program to procure a total of 40, and possibly as many as 52, small surface combatants (SSCs), meaning LCSs and frigates. The Navy's force-level goal for achieving and maintaining a fleet of 355-ships, which the Navy released in December 2016,[1] includes a goal of achieving and maintaining a force of 52 SSCs.

Prior to a program restructuring that was directed in February 2014 by then-Secretary of Defense Chuck Hagel, the LCS/FF program was called the LCS program, and included a planned procurement of 52 LCSs. The February 2014 restructuring changed the program into one for procuring 32 LCSs and 20 FFs. A second program restructuring that was directed in December 2015 by then-Secretary of Defense Ashton Carter reduced the program's total planned procurement to 40 ships, to consist of either 28 LCSs and 12 FFs, or 30 LCSs and 10 FFs, depending on exactly when production would shift from LCSs to FFs. The December 2015 restructuring also directed the Navy to reduce the planned procurement rate of the program from about three ships per year to one or two ships per year.

Since the start of LCS procurement, the Navy has been procuring two different LCS designs that are produced in two different shipyards. The December 2015 program restructuring directed the Navy to conduct a down select among these two designs by FY2019 (i.e., the Navy was directed to pick one of these two designs by FY2019), and produce all LCSs/FFs procured in FY2019 and subsequent years to a single design.

Until recently, the Navy had planned to conduct the down select in FY2018 or FY2019 and build the FFs to a design based on one of the LCS designs. More recently, however, the Navy has indicated that it is reassessing what types of capabilities it wants to have in the FF, that it is examining potential FF designs based on both the LCS hull forms and other frigate-sized hull forms, and that it plans to shift to production of FFs in FY2020 rather than FY2018 or FY2019.

[1] For more on the Navy's 355-ship force-level goal, see CRS Report RL32665, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, by (name redacted) .

A total of 29 LCSs have been procured through FY2017, leaving another 11 ships to be procured to reach a total of 40. Beyond that, however, the remainder of the LCS/FF program now appears to be in flux in certain key respects, including the following:

- **Total program quantity.** Although the program was limited by the December 2015 restructuring to a total of 40 ships, the Navy has a requirement for 52 SSCs, raising a possibility that the current reassessment of the program might lead to a decision by the Department of Defense (DOD) to expand the total size of the program to something more than 40 ships, and possibly to as many as 52. It is also possible that the program might be reduced to something less than 40 ships.
- **Annual procurement rate.** It is possible the program's annual procurement rate could be increased from the one or two ships per year shown in the FY2017 budget submission to a rate of about three ships per year—a rate similar to those in budget submissions for years prior to FY2017—particularly if the program's total procurement quantity is increased to something more than 40.
- **The down select.** If the program's annual procurement rate is increased to something like three ships per year, it might prompt a reconsideration of whether to conduct a down select to a single LCS design.
- **Design and builder or builders of the FFs.** The design of the new FFs, and the shipyard or shipyards that will build them, are uncertain. Navy officials have stated that the Navy is reassessing what capabilities its wants to have in the new FFs, and is examining potential FF designs based on both LCS hull forms and other frigate-seized hull forms.

LCS Sea Frames

In General

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 package, although under the Navy's latest plans for operating LCSs, that might not happen very frequently, or at all, for a given LCS. The LCS design, without any mission package, is referred to as the LCS sea frame.

The LCS's 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/FF program includes the development and procurement of ASW, MCM, and SUW mission packages for use by LCS sea frames. These three primary missions appear oriented toward countering, among other things, some of the littoral anti-access/area-denial (A2/AD) capabilities that have been fielded in recent years by Iran,[2] although they could also be used to counter similar A2/AD capabilities that might be fielded by other countries.

[2] For a discussion of Iran's littoral A2/AD capabilities, including submarines, mines, and small boats, see CRS Report R42335, *Iran's Threat to the Strait of Hormuz*, coordinated by (name redacted) .

Additional potential missions for LCSs include peacetime engagement and partnership-building operations; intelligence, surveillance, and reconnaissance (ISR) operations; maritime security and intercept operations (including anti-piracy operations); support of Marines or special operations forces; and homeland defense operations. An LCS might perform these missions at any time, regardless of its installed mission package, although an installed mission package 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 shallow-draft ports that are not accessible to Navy cruisers and destroyers.

Annual Procurement Quantities

Table 1 shows past (FY2005-FY2016) and projected (FY2017-FY2021) annual procurement quantities for LCSs/FFs under the Navy's FY2017 budget submission. Congress, as part of its markup of the Navy's proposed FY0217 budget, funded the procurement of three LCSs—one more than the two shown in the table as being requested for FY2017.

Table 1. Past (FY2005-FY2016) and Projected (FY2017-FY2021) Annual LCS Sea Frame Procurement Quantities

FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13
1	1	0	0	2	2	2	4	4
FY14	**FY15**	**FY16**	***FY17***	***FY18***	***FY19***	***FY20***	***FY21***	
4	3	3	*2*	*1*	*1*	*1*	*2*	

Source: Prepared by CRS based on FY2017 Navy budget submission.

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.

Two LCS Designs Built by Two LCS Shipyards

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 design developed by the Lockheed-led team is based on a steel semi-planing monohull (with an aluminum superstructure), while the design developed by the team that was led by GD is based on an all-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 part of the LCS/FF program.

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

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

The LCS design developed by the Lockheed-led team is built at the Marinette Marine shipyard at Marinette, WI,[3] with Lockheed as the prime contractor; these ships are designated LCS-1, LCS-3,

[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 (continued...)

LCS-5, and so on. The design developed by the team that was led by GD is built at the Austal USA shipyard at Mobile, AL, with Austal USA as the prime contractor;[4] these ships are designated LCS-2, LCS-4, LCS-6, and so on.

Two Block Buy Contracts for Procuring Ships 5-26

Ships 1 through 4 in the program were procured with single-ship contracts. The next 22 ships in the program (ships 5 through 26) were procured under two 10-ship block buy contracts that the Navy awarded to the two LCS builders in December 2010, and which were later extended in each case to include an 11th ship. The Navy sought and received legislative authority from Congress in 2010 to award these block buy contracts.[5]

LCSs in Service

As of May 19, 2017, eight LCSs (LCSs 1 through 8) had been commissioned into service, and a ninth LCS (LCS-10) has been delivered to the Navy and was awaiting commissioning. LCS 9 and LCSs 11 through 29 are in various stages of construction.

Navy Assessment of FF Requirements and Design Options

Regarding the Navy's examination of requirements and design options for the FFs, the Navy testified at a May 3, 2017, hearing on the LCS/FF program before the Seapower and Projection Forces subcommittee of the House Armed Services Committee that

> As maritime threats have evolved, the Navy is placing greater emphasis on distributed operations, highlighting the need for a full complement of SSCs and increasing the need for a Frigate with improved lethality and survivability. The Navy is defining the requirements for the Frigate to improve its ability to operate in a more contested environment than LCS, enhancing its role in distributed maritime operations. In this role, both LCS and Frigate will free up our large surface combatants to focus on their primary missions including area air defense, land strike, and ballistic missile defense. The Navy is also seeking to leverage Fleet-wide commonality of combat system elements wherever possible to deliver capability and flexibility in the most cost effective manner.
>
> To accomplish this, the Navy has established a Frigate Requirement Evaluation Team to update the previous Frigate analysis performed in 2014 and investigate the feasibility of incorporating additional capabilities and enhanced survivability features into the current Frigate designs, as well as explore other hull forms. The results of this analysis will inform the top level Frigate requirements based on cost and capability trades involved. The Navy's revised acquisition strategy is under development and will ensure designs are mature prior to entering into a detail design and construction (DD&C) contract. The Navy will engage with industry in order to support an aggressive conceptual design effort, leading to a Request for Proposals to award the DD&C contract in FY 2020.

(...continued)

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] Congress granted the authority for the block buy contracts 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. 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 (name redacted) and (name redacted) .

> As we work through the requirements and acquisition processes for the Frigate, we will endeavor to transition from LCS to Frigate in a manner that maximizes the competitive field for our shipbuilding industrial base. We understand the potential implications of future acquisition strategies to our shipyards and their workforces, and these are considerations we do not take lightly. We are committed to delivering increased capability to our sailors at the best value for the American taxpayer, and that includes maintaining a competitive and healthy industrial base.[6]

LCS Mission Packages

Procurement Quantities

Prior to the program's February 2014 restructuring, the Navy had planned to procure 64 LCS mission packages (16 ASW, 24 MCM, and 24 SUW) for 52 LCSs. The Navy has not announced how the program's February 2014 and December 2015 restructurings have changed planned numbers of mission packages.

Deliveries and Initial Operational Capability (IOC) Dates

Initial increments (i.e., versions) of LCS mission packages are undergoing testing. At an April 6, 2016, hearing on Navy shipbuilding programs before the Seapower subcommittee of the House Armed Services Committee, Department of the Navy officials testified that

> The LCS Mission Modules program continues to field capability incrementally as individual mission systems become available in order to fill these critical warfighting gaps. The SUW MPs are being introduced in three phases, providing capability to address Fast Attack Craft and Fast Inshore Attack Craft in the littorals and maritime security and escort roles previously assigned to Oliver Hazard Perry class Frigates and Cyclone class patrol ships. MCM MPs are being fielded in four phases delivering capability to address maritime mines and to replace legacy Avenger class Mine Countermeasures ships and MH-53E Sea Dragon helicopters that are nearing the end of service life. The ASW MPs will be delivered in a single phase and provide counter-submarine capability in littoral and deep water environments, High Value Unit (HVU) ASW escort and barrier patrol capability.
>
> Increment 1 of the SUW MP, which consists of the Gun Mission Module (2 Mk 46 30 mm guns) and the Aviation Module (embarked MH-60R) and Increment 2 which adds the Maritime Security Module (small boats), completed the initial phase of Initial Operational Test & Evaluation (IOT&E) in September of 2015 aboard the USS Coronado (LCS 4). A subsequent phase of IOT&E will be conducted on another Independence-variant LCS in the summer of 2016, following upgrades to the ship's Integrated Combat Management System and SeaRAM weapon system. USS Fort Worth (LCS 3), with an embarked SUW MP, is currently on an extended operational deployment based out of Singapore. This embarkation of an SUW MP is also the first instance of an MQ-8B Fire Scout Vertical Take-off Unmanned Aerial Vehicle being deployed in conjunction with an MH-60R helicopter aviation detachment. The Navy completed the second in a series of Guided Test Vehicle launches of the Army's Hellfire Longbow missile in December 2015 to evaluate performance of the LCS Surface-to-Surface Missile Module in a littoral

[6] Statement of RADM Ron Boxall, USN, Deputy Chief of Naval Operations, Director, Surface Warfare Division, and RADM John P. Neagley, USN, Program Executive Officer, Littoral Combat Ships, before the House Committee on Armed Services Subcommittee on Seapower and Projection Forces, on Littoral Combat Ships and the Transition to Frigate Class, May 3, 2017, pp. 2-3.

environment. The demonstration showed that the vertically-launched missiles could effectively acquire, discriminate and engage the representative targets.

Increment 1 of the MCM MP consists of the Remote Multi-Mission Vehicle (RMMV), towed sonar, and airborne mine detection and neutralization systems. Technical Evaluation (TECHEVAL) was completed in August 2015, aboard USS Independence (LCS 2). The Mission Package met the majority of its sustained area coverage rate test requirements, but significant reliability issues were noted with the RMMV and associated subsystems, which constitute the Remote Minehunting System (RMS). Based on TECHEVAL results, CNO and ASN (RDA) chartered an Independent Review Team to assess the RMS. The review team recommended halting the procurement of the RMMV Low Rate Initial Production (LRIP) 2 and recommended pursuing acceleration of other promising near term technologies to accomplish the MCM mission. The Navy will coordinate with all stakeholders, particularly the Fleet, in developing the way ahead for this important capability.

The ASW Mission Package, comprised of a continuously active variable depth sonar (VDS), multi-function towed array (MFTA), and a torpedo defense capability, is in development and preparing for Developmental Testing (DT). The ASW Mission Package completed its initial integration test onboard USS FREEDOM (LCS 1) on September 30, 2014. All primary test objectives were completed successfully. ASW MP testing has been successfully conducted using the Advanced Development Model (ADM) Platform. This platform allowed integration testing of the Continuous Active Sonar and VDS that will be associated with the ASW escort module. The ASW MP is on track to complete DT with IOT&E in late FY 2018.[7]

Manning and Deployment

Reduced-Size Crew

The LCS employs automation to achieve a reduced-sized core crew (i.e., sea frame crew). The original aim was to achieve a core crew of 40 sailors; the Navy subsequently decided to increase that number to about 50. Another 38 or so additional sailors are to operate the ship's embarked aircraft (about 23 sailors) and its embarked mission package (about 15 sailors in the case of the MCM package), which would make for a total crew of about 88 sailors (for an LCS equipped with an MCM mission package), compared to more than 200 for the Navy's frigates and about 300 (or more) for the Navy's current cruisers and destroyers.[8] The crew size for the frigate may differ from that of the LCS design.

Original 3-2-1 Crewing and Operating Plan

The Navy originally planned to maintain three crews for each two LCSs, and to keep one of those two LCSs continuously underway—an approach Navy officials referred to as the 3-2-1 plan. Under this plan, LCSs were to be deployed at forward station (such as Singapore) for 16 months

[7] Statement of the Honorable Sean J. Stackley, Assistant Secretary of the Navy (Research, Development and Acquisition) and Vice Admiral Joseph P. Mulloy, Deputy Chief of Naval Operations for Integration of Capabilities and Resources and Lieutenant General Robert S. Walsh, Deputy Commandant, Combat Development and Integration & Commanding General, Marine Corps Combat Development Command, Before the Subcommittee on Seapower of the Senate Armed Services Committee on Department of the Navy Shipbuilding Programs, April 6, 2016, pp. 16-17.

[8] See *Report to Congress, Littoral Combat Ship Manning Concepts*, Prepared by OPNAV—Surface Warfare, July 2013 (with cover letters dated August 1, 2013), posted at USNI News on September 24, 2013, at http://news.usni.org/2013/09/24/document-littoral-combat-ship-manning-concepts.

at a time, and crews were to rotate on and off deployed ships at 4-month intervals.[9] The 3-2-1 plan was intended to permit the Navy to maintain 50% of the LCS force in deployed status at any given time—a greater percentage than would be possible under the traditional approach of maintaining one crew for each LCS and deploying LCSs for seven months at a time. The Navy planned to forward-station three LCSs in Singapore and additional LCSs at another Western Pacific location, such as Sasebo, Japan, and at Bahrain. The 3-2-1 plan has now been superseded by a new crewing and operating plan that the Navy announced in September 2016 (see next section).

New Crewing and Operating Plan Announced September 2016

In September 2016, the Navy announced a new plan for crewing and operating the first 28 LCSs. Key elements of the new plan include the following:[10]

- the first four LCSs (LCSs 1 through 4) will each by operated by a single crew and be dedicated to testing and evaluating LCS mission packages (though they could be deployed as fleet assets if needed on a limited basis);
- the other 24 LCSs (LCSs 5 through 28) will be divided into six divisions (i.e., groups) of four ships each;
- three of the divisions (i.e., 12 of the 24 ships), all of them built to the LCS-1 design, will be homeported at Mayport, FL;
- the other three divisions (i.e., the remaining 12 ships), all of them built to the LCS-2 design, will be homeported at San Diego, CA;
- among the three divisions on each coast, one division will focus on MCM, one will focus on ASW, and one will focus on SUW;
- in each of the six divisions, one ship will be operated by a single crew, and will focus on training the crews of the other three ships in the division;
- the other three ships in each division will each be operated by dual crews (i.e., Blue and Gold crews), like the Navy's ballistic missile submarines;
- the crews for the 24 ships in the six divisions will be unified crews—the distinction between core crew and mission package crew will be eliminated;
- the 24 ships in the six divisions will experience changes in their mission packages (and thus in their mission orientations) infrequently, if at all; and
- 13 of the 24 ships in the six divisions (i.e., more than 50%) are to be forward stationed at any given point for periods of 24 months, with 3 at Singapore, 3 at another Western Pacific location, such as Sasebo, Japan, and 7 at Bahrain.

The Navy states that the new crewing and operating plan is intended to

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

[10] Source: Navy briefing on new LCS crewing and operating plan given to CRS and CBO, September 26, 2016. See also "Navy Adjusts LCS Class Crewing, Readiness and Employment," *Navy News Service*, September 8, 2016; Sam LaGrone, "Results of New LCS Review is Departure from Original Vision," *USNI News*, September 8, 2016; Sydney J. Freedberg Jr., "Navy Sidelines First 4 LCS; Overhauls Deployment, Crewing," *Breaking Defense*, September 8, 2016; Justin Doubleday, "Navy Introduces Major Change to Littoral Combat Ship Operations," *Inside the Navy*, September 9, 2016; David B. Larter, "Rebooting LCS: Hundreds More Sailors Needed in Sweeping Overhaul," *Navy Times*, September 9, 2016; Justin Doubleday, "Navy Begins Implementing Changes to Littoral Combat Ship Program," *Inside the Navy*, October 10, 2016.

- reduce disruptions to the deployment cycles of the 24 LCSs in the six divisions that under the 3-2-1 plan would have been caused by the need to test and evaluate LCS mission packages;
- improve training and proficiency of LCS crews;
- enhance each LCS crew's sense of ownership of (and thus responsibility for taking good care of) the ship on which it operates; and
- achieve a percentage of LCSs in deployed status, and numbers of forward-stationed LCSs, similar to or greater than what the Navy aimed to achieve under the 3-2-1 plan.

The Navy further states that the 12 frigates to be procured after the 28 LCSs will also use this new crewing and operating plan,[11] and that as the fleet continues to accumulate experience in operating and maintaining LCSs, elements of this new plan might be modified.[12]

Program Procurement Costs

Sea Frames

A March 2017 Government Accountability Office (GAO) report states that the total estimated acquisition cost of the 40 LCS/FF sea frames is $26,650.5 million (i.e., about $26.7 billion) in constant FY2017 dollars (an average of about $666.3 million per sea frame), including $3,971.6 million (i.e., about $4.0 billion) in research and development costs, including the detailed design and construction costs of the first two sea frames, and $22,429.2 million (i.e., about $22.4 billion) in procurement costs for the remaining 38 sea frames (an average of about $590.2 million each).[13]

The Navy's proposed FY2017 budget requested $1,125.6 million for the procurement of the 27th and 28th LCSs, or an average of $562.8 million for each ship. The three LCSs procured in FY2016 were funded at an average cost of $482.0 million. The increase in average cost from $482.0 million in FY2016 to $562.8 million is likely due in large part to the reduction in procurement quantity from three ships in FY2016 to two ships in FY2017.

Certain LCS sea frames procured in prior years were subject to an LCS program unit procurement cost cap that could be adjusted to take inflation in account.[14] The Navy states that after taking

[11] See "Navy Adjusts LCS Class Crewing, Readiness and Employment," *Navy News Service*, September 8, 2016.

[12] See, for example, Sydney J. Freedberg Jr., "Navy Sidelines First 4 LCS; Overhauls Deployment, Crewing," *Breaking Defense*, September 8, 2016.

[13] Government Accountability Office, *Defense Acquisitions[:] Assessments of Selected Weapon Programs*, GAO-17-333SP, March 2017, p. 105. The $249.7 million in total program cost not accounted for by research and development and procurement cost may be military construction (MilCon) costs.

[14] 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.

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. (continued...)

inflation into account, the most recent version of the unit procurement cost cap, which was to apply to up to 10 LCSs to be procured in FY2011 and subsequent years, was $538 million per ship as of December 2010. In awarding the two LCS block buy contracts in December 2010, the Navy stated that LCSs to be acquired under the two contracts were to have an average unit cost of about $440 million, a figure well below this $538 million figure.[15]

Mission Packages

A March 2017 GAO report states that the total estimated acquisition cost of 64 LCS mission packages is $7,100.7 million (i.e., about $7.1 billion) in constant FY2017 dollars (an average of about $110.9 million per package), including $2,611.6 million (i.e., about $2.6 billion) in research and development costs and $4,456.3 million (i.e., about $4.5 billion) in procurement costs (an average of about $69.6 each in procurement cost).[16]

In August 2013, the Navy had stated that

> The estimated Average Production Unit Cost (APUC) for all 59 OPN-funded mission packages [the other five mission packages were funded through the Navy's research, development, test and evaluation (RDT&E) account] is $69.8M in Constant Year (CY) Fiscal Year 2010 dollars. This is the most accurate answer for "How much does it cost to buy a mission package?" These mission packages are production-representative assets for Operational Test and deployment. The LCS Mission Modules program will use OPN to procure 23 MCM mission packages, 21 SUW mission packages, 15 ASW mission packages, and 59 sets of common mission package equipment.
>
> The APUC can be broken down into the estimated average initial procurement cost of the three types of mission packages and common mission package equipment. None of the figures in this paper represent budget values.
>
> — Mine Countermeasures (MCM) Mission Packages (23): $97.7M
>
> — Surface Warfare (SUW) Mission Packages (21): $32.6M
>
> — Anti-Submarine Warfare (ASW) Mission Packages (15): $20.9M
>
> — Sets of Common Mission Package Equipment (59): $14.8M...
>
> These estimates do not include the RDT&E expenditures that are associated with mission package development, integration, and test. These RDT&E expenditures include the five RDT&E-funded mission packages intended for use as development, training, and testing

(...continued)

2647/P.L. 111-84 of October 28, 2009). The provision repealed the three previous cost cap provisions and established a new cost cap of $480 million to be applied to up to 10 LCSs to be procured starting in FY2011, excluding certain costs, and with 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. The Navy stated that after taking inflation into account, the $480 million figure equates, as of December 2010, to $538 million.

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

[16] Government Accountability Office, *Defense Acquisitions[:] Assessments of Selected Weapon Programs*, GAO-17-333SP, March 2017, p. 107. The $32.8 million in total program cost not accounted for by research and development and procurement cost may be military construction (MilCon) costs.

> assets. Those five mission packages are not production-representative items. Including all prior RDT&E expenditures results in an average Program Acquisition Unit Cost of $99.7M for all 64 mission packages. This not an accurate answer for "How much does it cost to buy a mission package?" as past RDT&E expenditures are not relevant to the purchase price of a mission package today.[17]

Controversy and Proposals to Truncate Program

The LCS/FF program has been controversial over the years due to past cost growth, design and construction issues with the first LCSs, concerns over the survivability of LCSs (i.e., their ability to withstand battle damage), concerns over whether LCSs are sufficiently armed and would be able to perform their stated missions effectively, and concerns over the development and testing of the modular mission packages for LCSs. The Navy's execution of the program has been a matter of congressional oversight attention for several years.

Potential Foreign Sales

Industry has marketed various versions of the LCS to potential foreign buyers. An October 20, 2015, news release from the Defense Security Cooperation Agency (DSCA) stated:

> The State Department has made a determination approving a possible Foreign Military Sale to the Kingdom of Saudi Arabia for Multi-Mission Surface Combatant (MMSC) Ships and associated equipment, parts and logistical support for an estimated cost of $11.25 billion. The Defense Security Cooperation Agency delivered the required certification notifying Congress of this possible sale on October 19, 2015.
>
> The Government of Saudi Arabia has requested a naval modernization program to include the sale of Multi-Mission Surface Combatant (MMSC) ships and program office support. The Multi-Mission Surface Combatant program will consist of:
>
> — Four (4) MMSC ships (a derivative of the Freedom Variant of the U.S. Navy Littoral Combat Ship (LCS) Class)....
>
> Also included in this sale in support of the MMSC are: study, design and construction of operations; support and training facilities; spare and repair parts; support and test equipment; [and] communications equipment....
>
> In addition, this case will provide overarching program office support for the SNEP II [Saudi Naval Expansion Program II] to include: U.S. Government and contractor engineering, technical and logistics support, and other related elements of program support to meet necessities for program execution. The estimated value of MDE [major defense equipment] is $4.3 billion. The total estimated cost is $11.25 billion.[18]

[17] Navy information paper on LCS program dated August 26, 2013, and provided to CRS and CBO on August 29, 2013.

[18] DSCA news release, "Kingdom of Saudi Arabia - Multi-Mission Surface Combatant (MMSC) Ships," October 20, 2015, accessed April 18, 2016, at http://www.dsca.mil/major-arms-sales/kingdom-saudi-arabia-multi-mission-surface-combatant-mmsc-ships. See also, for example, Sam LaGrone, "Lockheed Martin Could Have More Flexibility to Build Planned Saudi Ships If Proposed LCS Trim Goes Through," *USNI News*, January 11, 2016; Christopher P. Cavas, "US OKs Potential $11.25B Saudi Deal for LCS Variant," *Defense News*, October 20, 2015; Sam LaGrone, "Saudi Arabia Set to Buy Four Lockheed Martin Freedom-Class Variants in $11.25B Deal," *USNI News*, October 20, 2015; Lara Seligman, "Lockheed: Move Toward Multimission Frigate Boosts International Interest," *Inside the Navy*, February 23, 2015; Lara Seligman, "Navy IPO [International Programs Office]: Foreign Militaries Interested In LCS Systems, Not Hull Design," *Inside the Navy*, September 8, 2015; Olga Belogolova, "Lockheed Martin: Two Potential International LCS Customers Out There," *Inside the Navy*, April 7, 2014.

A May 18, 2017, press report stated:

> The U.S. has reached a $6 billion deal for Saudi Arabia to buy four Littoral Combat Ships made by Lockheed Martin Corp. in a package of major arms purchases as President Donald Trump travels to the kingdom, people familiar with the transaction said.
>
> The U.S. and the Saudi Ministry of Defense "designed and negotiated a package totaling approximate $110 billion," Vice Admiral Joe Rixey, head of the Pentagon's Defense Security Cooperation Agency, said Friday on a conference call with analysts from Saudi Arabia, according to a White House transcript. "When completed, it will be the largest single arms deal in American history."
>
> While the package includes deals that were begun under President Barack Obama's administration—and initial steps toward others that may take years to complete—the final letter of agreement on the Littoral Combat Ships is the highest-profile element.
>
> It includes a better-armed version of the ships, support equipment, munitions and electronic-warfare systems, according to the people, who asked not to be identified in advance of an announcement that may come as early as Saturday morning Washington time. That's when Trump is scheduled to arrive in Riyadh on the first leg of an eight-day trip that will take him across the Middle East and to Europe....
>
> The littoral ships, designed for shallow coastal waters, are part of a package of agreements on weapons sales that already had been approved in late 2015 by the U.S. State Department, which oversees the Foreign Military Sales program. Congress also approved the sale, but it wasn't completed under Obama. From 2009 to 2016, the Obama administration approved $115 billion in potential sales to the Saudis.[19]

FY2017 Funding Request

The Navy's proposed FY2017 budget requested $1,125.6 million for the procurement of the 27th and 28th LCSs, or an average of $562.8 million for each ship. The Navy's proposed FY2017 budget also requested $86 million in so-called "cost-to-complete" procurement funding to cover cost growth on LCSs procured in previous fiscal years, and $139.4 million for procurement of LCS mission module equipment.

Issues for Congress for FY2018

FY2018 Funding Request

One issue for Congress for FY2018 is whether to approve, reject, or modify the Navy's FY2018 funding requests for the LCS/FF program, including the number of LCSs to be procured in FY2018, funding for LCS mission modules, and funding associated with developing the FF design.

The Program in General After FY2017

More generally, a potential broad oversight issue for Congress for FY2018 concerns the currently unresolved details of the remainder of the LCS/FF program, including the program's total procurement quantity, its annual procurement rate, whether there should be a down select to a

[19] Anthony Capaccio and Margaret Talev, "Saudis to Make $6 Billion Deal for Lockheed's Littoral Ships," *Bloomberg*, May 18, 2017.

single LCS design, what the design of the FF will be, and which shipyard or shipyards will build FFs. Navy announcements on these points could generate various specific oversight issues for Congress relating to ship costs and capabilities, acquisition strategies, and potential impacts on the shipbuilding industrial base.

Survivability, Lethality, Technical Risk, and Test and Evaluation Issues

A broad oversight area for Congress for the LCS/FF program for the past several years concerns survivability, lethality, technical risk, and test and evaluation issues relating to LCSs. The discussion below addresses this broad oversight area first with respect to LCS sea frames, and then with respect to LCS mission packages.

Sea Frames

March 2017 GAO Report

Regarding the LCS sea frames, a March 2017 GAO report assessing DOD weapon acquisition programs stated:

> **Technology Maturity**
>
> Sixteen of the 18 critical technologies—the total number of technologies for both designs—are mature. However, efforts continue to further mature two Independence variant technologies—the aluminum hull structure and the launch, handling, and recovery system. The Navy reported that it expects the results of now completed survivability testing of the aluminum structure by early 2017. Regarding the launch, handling, and recovery system, the program demonstrated unmanned operations during LCS 8's acceptance trial, but has yet to receive Navy certification to conduct manned operations as intended.
>
> **Design and Production Maturity**
>
> The LCS 4 survivability trial in January 2016 revealed weaknesses in the Independence variant design, according to the Director, Operational Test and Evaluation (DOT&E). In July 2016, LCS 6 completed shock trials in accordance with the DOT&E approved plan. This trial was conducted at a reduced severity due to serious concerns about the potential for damage to the ship. LCS 5 did not complete the entire shock trial because the Navy stopped testing in September 2016 due to concerns with the shock environment, personnel, and equipment. The Navy and DOT&E disagree on the need to complete this trial. The program now expects results of rough water trials—testing that occurred and resulted in damage on both designs several years ago—by June 2017.
>
> Since December 2015, five of the eight delivered LCS—ships of both variants—have suffered engineering casualties, which the Navy attributes to shortfalls in crew training, seaframe design, and construction quality. According to the Navy, these failures have resulted in substantial downtime and costs for repairs or replacements. We have found the Navy is responsible for paying for the vast majority of these types of damage, deficiencies, and defects on ships already delivered. While addressing deficiencies in the designs of each variant to increase the operational availability of the ships in-service, the Navy is also working to incorporate changes on follow-on ships. The Navy plans to make improvements to LCS either during construction or sometime after delivery, if funding is available. To date, nine LCS have been delivered and 13 are in various phases of construction. In 2015, the Navy provided the LCS shipbuilders schedule relief; however, even with modified ship delivery dates, both shipbuilders continue to deliver LCS

seaframes significantly behind the adjusted schedule. Program officials recently reported the shipyards would not deliver four LCS in fiscal year 2016 as planned. In addition to lagging schedule performance, the shipyards continue to deliver seaframes in excess of cost targets.

Other Program Issues

Following a pattern of LCS engineering casualties, in February 2016, the Navy initiated a program review to assess, among other things, LCS crewing, training, and maintenance. Recommended actions included, returning to a "Blue/Gold" crew rotation model; merging the seaframe and mission package crew into a single, approximately 70-person crew focused on a single mission area; and designating LCS 1-4 as test ships to support testing between fiscal years 2017 and 2022. In merging the seaframe and mission package crew, the Navy acknowledged that switching the LCS mission package—once a key building block of the LCS concept—will occur less often than originally conceived.

Program Office Comments

In addition to providing technical comments, the program office noted as of January 2017, there are nine LCS in the Fleet, with another 17 on contract. By 2018, LCS will be the second largest surface ship class in the Navy. Program officials reported the LCS design is stable, meets all validated and approved requirements, and is in full serial production at both shipyards. Program officials also reported the LCS program is on budget and below the congressional cost cap and hull over hull performance continues to improve, stabilizing the production cycle. Program officials stated LCS 5 and 6 successfully met all test objectives of the approved shock trial test plan, demonstrating the ability of both variants to survive the effects of underwater shock associated with the close-proximity detonation of a 10,000 pound charge. The program office stated they have completed required testing and are incorporating lessons learned into future LCS and frigates.[20]

Regarding the frigate variant of the LCS sea frame, the March 2017 GAO report stated:

> The Navy has not yet fully defined the frigate's design and cost. Despite these uncertainties, the Navy's current acquisition strategy—approved in March 2016—indicates it intends to request authorization from Congress in 2017 to use what it calls block buy contracting to buy all of the planned frigates and for funding the lead ship before solidifying realistic cost and design parameters. This acquisition strategy includes the Navy obtaining block buy option pricing in 2017 from both LCS shipyards for 12 LCS. Then, the Navy plans to combine frigate-specific design upgrades with the LCS priced options to inform its decision on a single frigate contractor and design in July 2018. The estimated cost for the program is uncertain—the Navy expects to have a formal estimate in May 2017, and DOD's Office of Cost Assessment and Program Evaluation has indicated an independent cost estimate will be completed in fiscal year 2018.
>
> The Navy is currently reviewing frigate build specifications received from the two LCS shipbuilders in the lead up to soliciting proposals in September 2017 for the frigate design upgrades. The Navy plans to review these proposals and award the frigate to a single shipyard before beginning detail design—a critical phase of design that more fully defines ship construction needs and cost expectations. Although the Navy has stated detail design will be completed before frigate construction begins in fiscal year 2020, awarding the contract for frigate construction before beginning frigate-specific detail

[20] Government Accountability Office, *Defense Acquisitions[:] Assessments of Selected Weapon Programs*, GAO-17-333SP, March 2017, p. 106.

design activities reduces the knowledge that will be available to help inform decisions by the shipbuilders and the Navy in the solicitation and contract award process.[21]

December 2016 DOT&E Report

Regarding the LCS sea frames, a December 2016 report from DOD's Director, Operational Test and Evaluation (DOT&E)—DOT&E's annual report for FY2016—states:

> • DOT&E has now evaluated both seaframe variants to be not operationally suitable because many of their critical systems are unreliable, and their crews do not have adequate training, tools, and documentation to correct failures when they occur. No matter what mission equipment is loaded on either of the ship variants, the low reliability and availability of seaframe components, coupled with the small crew size, imposed significant constraints on mission capability. During this last year, problems with main engines, waterjets, communications, air defense systems, and cooling for the combat system occurred regularly and required test schedules to be revised or operations to be conducted with reduced capability (e.g., conducting MCM missions without operational air defense systems). These reliability problems are often exacerbated because, by design, the ship's force is not equipped to conduct extensive repairs; problems cannot be corrected quickly due to the need to obtain vendor support, particularly when several vendor home bases are at disparate overseas locations. The inability of the ship to be ready at all times to reach maximum speed, keep its main air defense system in operation, and to cool its computer servers are substantially detrimental to the ships' ability to defend themselves in time of war, much less conduct their assigned missions in a lengthy, sustained manner.
>
> • The Navy has not conducted any of the planned live-fire air defense test events planned as part of the Enterprise Air Warfare Ship Self Defense TEMP or recently updated LCS TEMP. After multiple years of delays, the Navy had planned to conduct the first of those events on the self-defense test ship in FY16, but postponed the test indefinitely because of anticipated poor performance predicted by pre-test modeling and analysis of the planned test event scenario. Without these tests, an adequate assessment of the Independence-class probability of raid annihilation requirement is not possible. DOT&E expects that the Independence variant will have been in service nearly 10 years by the time that air defense testing is complete, which at the time of this report is not anticipated before FY20.
>
> • The Navy has identified it is not satisfied with the Freedom variant's radar and RAM system for defense against ASCMs. The Navy plans to replace the RAM system with SeaRAM, which is the system installed on the Independence variant. The Navy does not plan to test the existing Freedom-variant air defense systems installed on LCS 1 through 15. DOT&E assesses this to present a high risk for deploying crews, given that many Freedom-variant ships will deploy between now and 2020 when backfits of the SeaRAM system on those hulls are scheduled to begin.
>
> • Neither LCS variant has been operationally tested to evaluate its effectiveness against unmanned aerial vehicles and slow-flying aircraft. Although the Navy had planned to test the Independence variant's capability to defeat such threats in FY15, the testing was canceled in part due to range safety requirements that would have precluded operationally realistic testing. DOT&E concurred with this decision because proceeding with an unrealistic test would have been a needless waste of resources.

[21] Government Accountability Office, *Defense Acquisitions[:] Assessments of Selected Weapon Programs*, GAO-17-333SP, March 2017, p. 127.

• In the report to Congress responding to the NDAA for FY16, DOT&E noted that the envisioned missions, use of unmanned vehicles, and operating environments have shifted relative to the original LCS vision. DOT&E concluded that the current plan to employ LCS as a forward-deployed combatant, where it might be involved in intense naval conflict, appears to be inconsistent with its inherently poor survivability in those same environments.

• The ability of LCS to perform the bulk of its intended missions (SUW, MCM, ASW) depends on the effectiveness of the mission packages. To date, the Navy has not yet demonstrated effective capability for the MCM, SUW, or ASW mission packages. The Increment 2 SUW mission package has demonstrated some modest ability to aid the ship in defending itself against small swarms of fast-inshore attack craft (though not against threat-representative numbers and tactics), and the ability to support maritime security operations.

• The intentionally small crew size has limited the mission capabilities, combat endurance, maintenance capacity, and recoverability of the ships. The core crew of Independence seaframes does not include sufficient watchstanders qualified to operate the seaframe combat system to maintain an alert posture for extended periods of time. During normal peacetime operations, the combat systems can be overseen by a single combat system manager (CSM), but in any elevated threat environment the manning plan calls for two CSMs to stand watch together to reduce overtasking. Since the ship's crew includes only three qualified CSMs, the ship cannot maintain this alert posture for extended periods, such as might be required when transiting through contested areas, or escorting a high-value unit.

- In September 2016, the Navy released new plans to change the crewing structure. The Navy plans to phase out the 3-2-1 crewing construct and transition to a Blue/Gold model similar to the one used in crewing Ballistic Missile submarines. Originally, core crews and mission module crews were intended to move from hull to hull independently of one another; core crews will now merge with mission module crews and focus on a single warfare area – either SUW, MCM, or ASW. DOT&E does not yet have sufficient information to assess whether the new crewing model will solve the problems observed in the testing of both variants and whether ships will continue to be heavily dependent on Navy shore organizations for administrative and maintenance support.

• Freedom Variant Seaframe (LCS 1 and 3):

- DOT&E's FY15 annual report as well as the comprehensive classified report issued in December 2015 described DOT&E's assessment of the Freedom variant. The Navy did not conduct any additional testing or perform any modifications to the seaframe in 2016 that would affect these assessments.

• Independence Variant Seaframe (LCS 2 and 4):

- Although not all aspects of operational effectiveness and suitability could be examined during the 2015/16 operational test, that testing identified shortcomings in cybersecurity, air defense, surface self-defense, reliability, maintainability, and other operations, which are detailed in the DOT&E November 2016 classified report. DOT&E will issue an operational test report following the testing of the final increment of the SUW mission package to support acquisition decision making regarding the Full-Rate Production decision for the SUW mission package and other aspects of the LCS program.

- Air Defense.

▪ In the Navy-conducted non-firing radar tracking events against subsonic ASCM drones, the Sea Giraffe radar provided LCS crews with only limited warning to defend itself against ASCMs in certain situations.

▪ In the Navy-conducted testing of the Independence variant's ES-3601 ESM system, the Navy used Learjet aircraft equipped with ASCM seeker simulators to represent the ASCM threats. The ES-3601 detected the presence of the ASCM seekers in most instances but did not reliably identify certain threats. Classified results are contained in DOT&E's operational test report of November 2016.

▪ In the developmental test events evaluating the ship's capability to detect, track, and engage so-called low slow flyers (LSFs) (unmanned aerial vehicles, slow-flying fixed-wing aircraft, and helicopters), the only sensor used to provide tracking information for engaging LSFs with the 57 mm gun was the SAFIRE electro-optical/infrared system. The test events demonstrated that SAFIRE was unable to provide reliable tracking information against some targets. Furthermore, the safety standoff requirements on Navy test ranges were so severe that they precluded meaningful live-fire gun engagements against these targets. Because of these problems and constraints, the program decided to cancel all subsequent live-fire events, including those scheduled for operational testing, conceding that the Independence variant is unlikely to be consistently successful when engaging some LSFs until future upgrades of SAFIRE can be implemented. Future testing against LSFs will not be possible until the Navy finds a solution to the severe safety constraints that preclude engaging realistic targets.

▪ Although the Navy has postponed indefinitely its plans to conduct live-fire testing of the LCS air defense systems, the Navy has conducted some initial testing of the SeaRAM system, as it is employed aboard Arleigh Burke destroyers. In the Navy-conducted live-fire event aboard the self-defense test ship, the SeaRAM system was successful at defeating a raid of two GQM-163 supersonic targets. Although a stressing event, these targets were not representative of the threats they were attempting to emulate. The Navy does not currently have an aerial target that is capable of emulating some modern ASCM threats. During this test, SeaRAM employed the RAM Block 2 missile, which is different than the current LCS configuration that employs the RAM Block 1A missile. However, if the Navy decides to deploy LCSs with the Block 2 missile, then this test and others planned are germane to an LCS evaluation, however incomplete. DOT&E and the Navy continue to conduct test planning to optimize the available resources and ensure that LCS's air defense testing reflects the capabilities of deploying LCSs.

- Surface Self-Defense. The Navy conducted seven test events (four integrated test events and three dedicated operational test events), each consisting of a single attacking small boat. LCS was required to defeat the boat before it reached a prescribed keep-out range. LCS failed to defeat the small boats in two of the events.

▪ The 57 mm gun demonstrated inconsistent performance even in benign conditions, which raises doubts about the ship's ability to defend itself without the SUW mission package installed. The inaccuracy of the targeting systems, the difficulty in establishing a track on the target, and the requirement to hit the target directly when using the point-detonation fuze combine to severely impair effective employment of the gun, and limit effective performance to dangerously short ranges. The Navy has not conducted any testing to determine how well the ship will perform when faced with an attack in a realistic cluttered maritime environment including both neutral and hostile craft; the Navy has also not conducted operational testing to determine how well the ship (without the SUW mission package) will perform against multiple attacking boats. Nevertheless, given the performance observed during operational testing, the combination of faster threats, multiple threats, threats with longer-range standoff weapons, cluttered sea traffic, or poor visibility is likely to make it difficult for LCS (without the SUW mission package) to defend itself.

▪ The ship's electro-optical/infrared camera, SAFIRE, is the primary sensor for targeting the 57 mm gun. The system suffers from a number of shortcomings that contribute to inconsistent tracking performance against surface and air targets, including a

cumbersome human-systems interface, poor auto-tracker performance, and long intervals between laser range finder returns. These problems likely contributed to the poor accuracy of the 57 mm gun observed during live-fire events, though the root cause(s) of the gun's inaccuracy has not been determined definitively.

▪ Both of the failures of the surface self-defense test events were caused by MK 110 57 mm gun malfunctions. During the first presentation, the Proximity Fuze Programmer failed, causing all rounds to be fired in the default proximity mode, which then exploded in midair. The crew was unable to repair the failure and continued to fire the gun during the event until the target broached the minimum safety range. Technicians subsequently repaired the gun on July 7, 2015. The second failed event occurred on July 18 when the 57 mm gun jammed during the event. With the assistance of a civilian gun system technician, the crew downloaded the remaining ammunition, cleared the jam, and restored the gun to "single-sided" operation in about 4 hours by consolidating good components. Until repaired on August 7, 2015, the gun was limited to firing 60 rounds, rather than its normal 120, before reloading.

▪ On two occasions, the shock caused by firing the 57 mm gun unseated network cards, disabling the steering controls on the bridge and forcing the crew to steer the ship from an alternate location. On another occasion, gunfire shook network cables loose, disabling the 57 mm gun. Although the ship was able to recover from these failures within a few minutes and continue the engagement, these types of interruptions have the potential to prolong the ship's exposure to an advancing threat, as was observed during testing.

▪ In the most recent of the seven live fire test events the Navy conducted against a single-boat target, the crew employed the 57 mm differently than it had in previous live-fire events, and defeated the attacking boat with less ammunition and at a slightly longer range than in previous events. One event does not provide conclusive evidence that the ship can be effective in these scenarios, and such performance was never observed during the swarm-defense test events. Nevertheless, these results are encouraging and suggest that the Navy should examine tactics and alternative gun employment modes, including different projectile fuze settings, as a means to enhance LCS's currently limited capabilities.

- Missions of State. LCS 4 completed six mock Missions of State during the 2015 test period requiring the launch and recovery of two 11-meter rigid hull inflatable boats (RHIBs). Although the ship demonstrated the capability to meet Navy requirements for the timely launch of two 11-meter RHIBs to support effective Visit, Board, Search, and Seizure operations in Sea State 2 and below, the time needed to recover the boats aboard ship often exceeded the Navy requirement because of problems with the surface tow cradle and the twin-boom extensible crane (TBEC). Testing revealed operational deficiencies and safety concerns. Observers reported that flaws in the design of the surface tow cradle used in conjunction with the watercraft launch, handling, and recovery system and other problems limit safe launch, internal movement, and recovery of boats to Sea State 2 and below. The cumbersome multi-step boat launch/recovery process has several "single points of failure" – including the surface tow cradle, TBEC, the Mobicon straddle carrier, and a forklift – that increase the likelihood of delays and the possibility of mission failure. The failure of any of these components can halt boat operations and could leave a boat stranded at sea, which happened once during operational testing.

- Endurance and Speed. LCS 4 met its transit range requirement, demonstrating a fuel usage rate that enables it to travel more than 4,200 miles at 14 knots if called upon to do so (threshold 3,500 miles). LCS 4 failed its sprint speed requirement of 40 knots, demonstrating a maximum sustained speed of only 37.9 knots in calm waters. It fell just short of its sprint range requirement (1,000 miles at maximum speed), demonstrating fuel burn rates at maximum speed that would enable it to travel 947 miles. LCS 4 has long-standing problems with her ride control system hardware, including interceptors, fins, and

T-Max rudders, that affect the ship's maneuverability at high speeds. The ship also had reported recurring problems with frequent clogging of the gas turbine engine fuel oil conditioning module pre-filters and coalescers, and found it difficult to maintain high speed for prolonged periods. The crew found it necessary to station extra operators in the machinery room (normally an unmanned space) to change fuel filters and manually control the fuel oil heaters to keep the gas turbine engines in operation during these high-speed runs.

- Cybersecurity. In early 2016, the Navy made substantial changes to the LCS 4's networks, calling the effort "information assurance (IA) remediation," to correct many of the deficiencies in network security on the baseline Independence variant's total ship computing environment. Previous testing on LCS 2 in 2015 revealed several deficiencies in network protection such as the lack of proper settings and access controls, poor network segmentation, and lack of intrusion detection capabilities. The Navy designed and implemented the IA remediation program to mitigate or eliminate such vulnerabilities and was successful in eliminating some of the deficiencies that placed the ship at risk from cyber-attacks conducted by nascent (relatively inexperienced) attackers.

▪ DOT&E found that the Navy's testing, which included a Cooperative Vulnerability and Penetration Assessment (CVPA) and an Adversarial Assessment in 2016 on LCS 4, was inadequate to fully assess the LCS 4's survivability against cyber attacks originating outside of the ship's networks (an outsider threat). The testing was adequate to determine that some deficiencies remain when attacks occur from an insider threat, however, it was not adequate to determine the full extent of the ship's cybersecurity vulnerability or the mission effects of realistic cyber-attacks. Because of the imminent deployment of LCS 4, the Navy did not allow cybersecurity testers to make changes to the configuration of network components, as a cyber aggressor would almost certainly attempt to do to gain a foothold on the system. Testing was also impeded by electrical work, test site disruptions, and frequent network configuration changes because the test was conducted during a maintenance period. Because of these changes and the installation of systems (including the Harpoon missile and MQ-8B Fire Scout and its control system) after the test completed, DOT&E is uncertain whether an operationally representative configuration of the system was tested. Lack of physical access to many systems imposed by test artificialities, restrictions on the test team, and inadequate test preparation also limited the conduct of the test. The duration of Adversarial Assessment was reduced to less than half the original plan because of the delays experienced during the CVPA. Finally, DOT&E found that the Navy Operational Test Agency's threat emulation used for this test was lacking and did not meet the standards necessary for a robust cybersecurity examination. In July 2016, DOT&E issued guidance on cybersecurity test methods to all of the Service operational test agencies, in part due to the inadequacies in threat emulation observed in the LCS cybersecurity testing.

▪ Although the Navy's IA remediation corrected some of the most severe deficiencies known prior to the test period, the testing revealed that several problems still remain which will degrade the operational effectiveness of Independence-variant seaframes until the problems are corrected. The Navy reported that the second phase of IA remediation intended to correct additional network deficiencies has been installed on all follow on ships; however, DOT&E is unaware of the plans to test these changes on future ships, or whether these changes will correct the problems observed during the LCS 4 test.

- Operational Suitability. The Independence variant (with or without a mission package) is not suitable for SUW missions or MCM missions, and will remain that way until the Navy can reduce the failure rates of mission-essential equipment and correct the deficiencies that require workarounds and unsustainable manning. Unless corrected, the critical operational suitability problems highlighted below will continue to prevent the ship and mission packages from being operationally effective.

- LCS 2 Reliability and Availability. Although not tested in 2016, DOT&E's June 2016 early fielding report on the LCS 2 equipped with the MCM mission package delineated the suitability of the Independence variant. The type and severity of the failures observed on LCS 4 were also observed on LCS 2 during the 2015 Technical Evaluation period for the MCM mission package, suggesting that the reliability and availability problems observed are inherent to the Independence-variant seaframe, rather than isolated to one hull. The MCM mission package places different and greater demands on seaframe equipment than does the SUW mission package. The frequency of seaframe failures observed on the LCS 2 seaframe with the MCM mission package was greater than that observed on LCS 4 with the SUW mission package; implying the frequency of Independence variant seaframe failures and associated availability are likely mission package dependent (i.e., mission dependent). The following are the most significant seaframe equipment problems observed during the 2015 Technical Evaluation period.

▪ Recurring failures of the main propulsion diesel engines and their associated water jet assemblies hindered test operations throughout the test period. LCS 2 was unable to launch and recover RMMVs on 15 days because of four separate propulsion equipment failures involving diesel engines, water jets, and associated hydraulic systems and piping. These failures would also have limited the ship's capability to use speed and maneuver to defend itself against small boat threats.

▪ LCS 2 experienced multiple air conditioning equipment failures and was unable to supply enough cooling to support the ship's electronics on several occasions. One or more of the ship's three chilled water units was either inoperative or operating at reduced capacity for 159 days (90 percent of the period).

▪ LCS 2 experienced failures of critical systems such as the SeaRAM air defense system (four failures and a total downtime of 120 days), the ship's 57 mm gun (inoperative for 114 days), the SAFIRE electro-optical/infrared system (inoperative for 25 days), and the Sea Giraffe radar (multiple short outages) that were not repaired immediately because they did not preclude continuation of MCM testing in an environment devoid of air and surface threats. These failures would not have been ignored in a contested location; and many of these failures left the ship defenseless against certain threats for days at a time. Had these failures occurred in theater, the repair efforts would have affected MCM operations, likely forcing the ship off-station to effect repairs and/or embark technicians since the crew does not have the requisite training, parts, or documentation to effect repairs themselves.

▪ Similar to LCS 4, LCS 2 experienced several Ship Service Diesel Generator failures during the period, but was never without at least two of four generators operable (sufficient to power all combat loads, but which leaves the ship with no redundancy in the event of another failure).

▪ A Mobicon straddle carrier failure left the ship unable to conduct waterborne MCM operations for a period of 4 days until a technician could travel from Australia to diagnose the problem and make needed adjustments. This episode demonstrated the crew's paucity of documentation, training, and diagnostic equipment.

▪ Failure of a power conversion unit that supplied 400-Hertz power to the mission bay deprived the ship of MCM mission capability for 20 days while the ship was in port undergoing repairs. The ship also lost the capability to supply 400-Hertz power to the aircraft hangar, where it is needed to conduct pre-mission checks on the MH-60S and AMCM systems. The Navy never determined the cause of the near-simultaneous failures of the two power conversion units, although technicians considered them related.

- LCS 4 Reliability and Availability. The mission-essential equipment for conducting SUW on LCS 4 had poor reliability, with a failure that caused a partial loss of capability approximately every day and a complete loss of mission capability every 11 days on

average. Based on these failure rates, LCS has a near-zero chance of completing a 14-day mission (the length of time LCS can operate before resupply of food is required) or a 30-day mission (the length of time prescribed by Navy requirements documents) without experiencing an operational mission failure. When averaged over time, and accounting for both planned and unplanned maintenance downtimes, the ship was fully mission capable for SUW missions 24 percent of the 2015 test period, and was fully or partially mission capable 66 percent of the time. The following are the most significant seaframe equipment problems observed during the 2015-2016 developmental and operational test periods.

▪ LCS 4 suffered numerous failures of its propulsion systems, including the diesel engines, gas turbines, and steerable waterjets. The most debilitating problems occurred during the first developmental testing period in May and June 2015, when a combination of failures left the ship with only one working engine for 19 days. Following the July 2015 in-port maintenance period, the reliability of the propulsion systems improved, but single engines and waterjets continued to fail, and LCS spent 40 days of the 136-day test period with one or more engines inoperative or degraded. During the 2016 test periods, observers continued to report failures to the diesel engines and gas turbines that limited the ship's speed.

▪ LCS 4 was seldom able to keep all three air conditioning units fully operational. In one case, the systems were unable to supply enough cooling to support the ship's electronics for a 2-week period. The Navy recognized that the commercial off-the-shelf chilled-water air conditioning systems installed in LCS 2 and LCS 4 had serious reliability problems and, working with the shipbuilder, sourced the air conditioning systems on LCS 6 and follow-on Independence seaframes from a different manufacturer. Since the LCS program has not replaced the air conditioning systems on LCS 2 and LCS 4, those systems are still exhibiting severe reliability problems.

▪ LCS 4 experienced several Ship Service Diesel Generator failures during the periods of observation, but was never without at least two of four generators operable (sufficient to power all combat loads, but which leaves the ship with no redundancy in the event of another failure). Problems with electrical switchboards added to the difficulties, as certain combinations of diesel generators would not share load, reducing the redundancy in the system. Observers recorded four load sheds, which automatically severed power to non-essential systems, and in one case, caused key combat systems to shut down.

▪ During the 2015 test events, LCS 4 experienced numerous instances in which the flow of navigation data (heading, pitch, and roll) to the combat system was disrupted for short periods, which disabled the Sea Giraffe radar and the 57 mm gun and degraded SeaRAM's performance. The worst recorded instance occurred during the September 2015 live fire gun event when the flow of navigation data was interrupted 34 times, leading to a loss of all tracking information and the inability to fire the 57 mm gun for nearly 30 minutes. These outages significantly affected the crew's ability to defeat targets and contributed to the ship's failure to defeat all targets before they entered the keep-out zone. The problem defied early troubleshooting efforts and persisted into early 2016; however, observers did not report any navigation data outages after testing resumed in 2016, indicating that the Navy may have corrected the problem during installation of the IA remediation upgrades and other system changes. The Navy reported that the first instances of navigation data outages observed in 2015 were attributable to a cabling failure; and that the root cause of the failure was determined and corrected permanently. The Navy determined that the navigation data outages observed in 2016 were caused by the IA upgrade that had been recently installed in LCS 4 in early 2016; and the outages were remedied by reverting the network core switches back to the pre-IA upgrade routing protocol.

▪ The Independence variant's primary air defense system, SeaRAM, suffered from poor reliability and availability before, during, and after operational testing aboard LCS 4. Failures caused seven long periods of downtime (greater than 48 hours) between May 16, 2015, and June 18, 2016. Each repair required the delivery of replacement components that were not stocked aboard the ship, and most required assistance from shore-based subject matter experts. These failures left the ship defenseless against ASCMs, and would likely have forced it to return to port for repairs if it had been operating in an ASCM threat area. In addition, the SeaRAM aboard LCS 4 had five short (less than 5 minute) outages during live and simulated engagements against aerial targets, each of which might have resulted in an inbound ASCM hitting the ship. The SeaRAM aboard LCS 2 has also suffered from several long-lived failures.

▪ The ship's ride control system, used for high-speed maneuvering, did not appear to be fully functional at any time during developmental or operational testing in FY15 and FY16.[22]

The December 2016 DOT&E report also stated:

LFT&E [Live Fire Test & Evaluation]

• Neither LCS variant is expected to be survivable in high intensity combat because the requirements accept the risk of abandoning the ship under circumstances that would not require such an action on other surface combatants. Although the ships incorporate capabilities to reduce their susceptibility to attack, previous testing of analogous capabilities in other ship classes demonstrates it cannot be assumed LCS will not be hit in high-intensity combat. As designed, the LCS lacks the redundancy and the vertical and longitudinal separation of vital equipment found in other combatants. Such features are required to reduce the likelihood that a single hit will result in loss of propulsion, combat capability, and the ability to control damage and restore system operation.

• LCS does not have the survivability features commensurate with those inherent in the USS Oliver Hazard Perry‐class Guided Missile Frigate (FFG 7) it is intended to replace. The FFG 7 design proved to retain critical mission capability and continue fighting after receiving a significant hit.

• The LCS 4 Total Ship Survivability Trial (TSST) exposed weaknesses in the Independence-variant design.

- While the auxiliary bow thruster provided a limited means to recover propulsion, much of the ship's mission capability would have been lost because of the primary weapon damage or the ensuing fire and flooding.

- Damage to chilled water system piping caused an unrecoverable loss of several vital systems because of equipment overheating. The chilled water system's lack of cut-off valves does not allow for isolation of damaged sections.

- There is a lack of sufficient separation between the two damage control repair stations (DCRS). The Mission Bay Fire scenario resulted in the loss of both DCRS (one from the primary weapon effects and the second due to the spread of smoke as a result of the proximity to the fire boundary). The rescue and assistance locker located in the Helicopter Hangar is not outfitted with DCRS equipment exacerbating the damage control capability shortfalls.

- Installed damage control systems, such as Aqueous Film Forming Foam (AFFF) and Main Drainage, are designed with motor-operated valves co-located in the compartments

[22] Department of Defense, Director, Operational Test & Evaluation, *FY 2016 Annual Report*, December 2016, pp. 268-273.

that the systems are supposed to protect. As a result, the crew could not access these valves to reconfigure the damaged systems when remote operation was compromised by loss of power or data.

• The Navy conducted a reduced severity shock trial on USS Jackson (LCS 6), executing three shots of increasing severity, ending at 50 percent of the maximum design level. The Navy decided not to test up to the standard 2/3 design level due to concerns the ship would suffer a large amount of damage to non-shock hardened mission-critical equipment.

• In addition to reducing the shot severity, the Navy took several protective measures to reduce the risk of equipment damage and personnel injury to include:

- Removed some equipment before the trial or between shots, such as the Tactical Common Data Link antenna and racks, the navigational radar, and the 57 mm gun.

- Replaced some rigid pipes with flexible connections.

- Replaced some existing bolts with higher strength material.

- Added cable slack in some locations.

- Rerouted some ducts and pipes and modified ship structure to increase shock excursion space around equipment.

- Strengthened some bulkheads where heavy equipment was attached.

- Repaired missing and undersized foundation welds.

- Tied life rafts to the ship to make sure they did not self-deploy during the shots.

• A preliminary assessment of the LCS 6 shock trial demonstrated that:

- The Navy assumptions regarding the performance of non-hardened when exposed to underwater shock are overly conservative. The Navy assumed that these components and systems would become inoperable while the shock trial demonstrated most non-hardened components and systems remained operable or were restored to a limited or full capability prior to the ship's return to port on each shot.

- The ship maintained electrical power generation through all three shots, to include the Non-Vital Ship Service Diesel Generators.

- The SeaRAM system remained operable through all three shots.

- The main gun survived shot one, but the Navy removed it for the later shots, conceding that severe damage was likely. The actual gun survivability/firing capability at higher shock severities cannot be assessed.

- The auxiliary propulsion bow thruster remained operable through all three events.

- The trimaran ship design displayed unique structural behaviors not seen in mono-hull ships. The attenuation of the shock loading above the keel invalidated the Navy approach of using a target keel velocity as the metric to determine shot shock severity and confidence in the pertinent M&S tools to capture the shock trial phenomena. Despite achieving a target keel velocity, the majority of the LCS 6 deck mounted equipment did not experience the shock severity intended by the Navy.

• Based on the LCS 6 shock trial lessons learned, the Navy conducted a shock trial aboard USS Milwaukee (LCS 5) from August 29 through September 23, 2016, starting the trial at more traditional severity levels. However, the Navy stopped the LCS 5 trial after the second shot, thereby not executing the planned third shot due to concerns with the shock environment, personnel, and equipment. The Navy did not view the third LCS 5 shock event as worthwhile because of concerns that shocking the ship at the increased level would significantly damage substantial amounts of non-mission critical equipment, as

well as significantly damage a limited amount of hardened, mission critical equipment, thereby necessitating costly and lengthy repairs.

- The electrical distribution system remained operable or was restored to a limited or full capability prior to the ship's return to port after each shot.

- Most non-hardened components and systems, including the RAM air defense system, remained operable or were restored to a limited or full capability prior to the ship's return to port after each shot.

- By not executing the 2/3 level shot, the Navy could not validate the overly conservative assumptions made for the underwater threat shot in the LCS 3 TSST.

- DOT&E will release a more comprehensive classified report in 2017 upon complete analysis of the trial data.[23]

The December 2016 DOT&E report also stated:

Recommendations

• Status of Previous FY15 Recommendations....

- The Navy did not accept DOT&E's recommendation to obtain the intellectual property rights needed to develop high-fidelity digital models of the AN/SPS-75 (TRS-3D) and AN/SPS-77 (Sea Giraffe) radars for the Probability of Raid Annihilation Test Bed (a model used to evaluate the effectiveness of the LCS's air defenses). Although the Navy did respond to DOT&E's August 2015 memorandum, it appears that testing of the Freedom-variant's current configuration of air defense systems will be eliminated entirely, as LCS 17 and follow-on Freedom seaframes will be equipped with SeaRAM. This will leave the air defense capabilities of LCS 1 through 15 untested until the Navy backfits SeaRAM, which is not scheduled to begin until 2020.

- The Navy has not yet accepted or addressed DOT&E's recommendation to improve the shock resistance of mission-critical electronics in the Independence-variant LCS. Until this problem is addressed, LCS is likely to experience a disruption in operations during 57 mm gun engagements and other shock-inducing activities/events.

- The Navy has not yet formally addressed DOT&E's recommendation to work with the vendor to develop changes and improvements to SAFIRE, which are needed to improve the human-machine interface, reduce the time required to develop a new track, improve tracking, and correct other performance issues noted in FY15 testing. DOT&E reiterates this recommendation and suggests that the Navy also consider replacing the SAFIRE system with a more capable targeting system – one that is more user friendly and enables more accurate and effective gunfire for both air defense and SUW missions.

- The Navy has begun to correct the causes of Independence-variant seaframe problems that disrupted gunnery engagements and other operations, however, several problems still remain that will preclude effective gun employment. The debilitating problem of the intermittent loss of navigation data appears to have been corrected; however, the Navy has not yet corrected the 30 mm gun azimuth-elevation inhibits, and the 57 mm gun's azimuth-dependent range errors. Azimuth-elevation inhibit errors or gun turret-drive errors occur intermittently and are of short durations, and prevent the gunner from firing during an engagement. During testing these errors frequently interrupted engagements at key moments. The Navy developed tactics, techniques and procedures that are now in use to mitigate the problem. The Navy is investigating the root cause of this disruptive error.

[23] Department of Defense, Director, Operational Test & Evaluation, *FY 2016 Annual Report*, December 2016, pp. 275-276.

- The Navy has not yet addressed DOT&E's recommendation to devise a safe method to realistically test the ships' ability to counter LSF threats. The Navy should coordinate with test range authorities to examine the feasibility of reducing the safety standoff restrictions; without changes, no meaningful test of LCS's capability against these threats can be conducted.

- The Navy's recent change to the LCS concept of employment, which changes the crewing structure, training, and operational deployment of the class partially addresses DOT&E's recommendation to provide LCS crews with better training, technical documentation, test equipment, and tools, along with additional spares to improve the crews' self-sufficiency. It is not yet clear whether these changes will fully address the recommendation and will eliminate the maintenance problems DOT&E has articulated in multiple test reports.

- The Navy and LCS program are improving their organic expertise with LCS systems; however, the Navy continues to maintain an outsized reliance on equipment vendors and overseas contractors, especially for the maintenance and repair of some critical mission equipment. DOT&E continues to recommend reducing this reliance on outside vendors to ensure crews and the Navy's in-service engineering agent can fully support LCS repair and maintenance activities.

- As DOT&E recommended, the Navy is investigating options for re-engineering the recovery of watercraft; however, no solutions have been found to correct the problems with RMMV recovery nor has the Navy demonstrated the ability to recover other vehicles like the Knifefish UUV.

- The Navy has not made progress on developing tactics to mitigate system vulnerabilities to mines, mine collision, and entanglement hazards, and other surface and underwater hazards.[24]

The December 2016 DOT&E report also stated:

Recommendations...

FY16 Recommendations. Since December 2015, DOT&E issued three operational test reports for the LCS program, each of which contained multiple recommendations for the Navy's consideration that focus on the improvements needed to achieve operational effectiveness, suitability, and survivability, and to improve future testing. A selection of these recommendations is provided below.

Cybersecurity

1. After implementing changes to correct the deficiencies found in the LCS 4 cybersecurity test, conduct a full cybersecurity test, including a Cooperative Vulnerability and Penetration Assessment and Adversarial Assessment. This testing should be conducted on a ship that has received the second phase of IA remediation and should examine the Increment 3 SUW mission package configuration. Future tests should include a range of malicious activities from stealthy to noisy to gain data needed to characterize the ship's detect and react capabilities and should not be conducted during a ship maintenance period (since this contributed to the inadequacy of the LCS 4 test events).

2. Ensure that vulnerabilities identified on one ship are remedied on all ships.

3. Schedule and conduct a comprehensive cybersecurity assessment of the MH-60S helicopter with ALMDS and with AMNS.

[24] Department of Defense, Director, Operational Test & Evaluation, *FY 2016 Annual Report*, December 2016, pp. 276-277.

4. Expand future cybersecurity testing to include custom malware for system-specific operating systems and an examination of supervisory control and data acquisition systems and programmable logic controllers. Provide a stable ship configuration that accurately reflects the intended deployment configuration and allows for temporary changes to enable testers to examine mission-critical systems and evaluate the mission effects of cyber-attacks.

Seaframes

5. Develop a plan for integration of the MCM mission package with the Freedom-variant seaframe, including launch and recovery of MCM watercraft, and schedule early developmental testing to identify implementation challenges.

6. Improve reliability of mission systems and seaframe support systems to reduce logistics support requirements, crew workload, and unplanned downtime during MCM operations.

7. Improve the performance of the 57 mm gun system to increase the effective range and simplify targeting to enable faster and more lethal performance over a broader engagement range.

8. Improve the air-search radar on both seaframes to support earlier detections of ASCMs and tactical aircraft in both clear and jammed environments. Early detection increases the likelihood of survival against attack.

9. Increase the number of qualified Combat Systems Managers (CSMs) on the Independence-variant to provide additional operators for the seaframe sensors and guns.

10. Improve the reliability of the engineering systems, including diesel and gas turbine engines, steerable water jets, ride-control systems, and air conditioning equipment.

11. Determine the root cause of the Independence variant's fuel oil service system problems that occur during high-speed operations that made it necessary to station additional operators in the machinery room to replace Fuel Oil Conditioning Module pre-filters and control the fuel oil heaters manually.

12. Adequately fund the Air Warfare Ship Self-Defense Enterprise so that adequate testing of the LCS air defense systems can occur.

13. Improve the reliability and availability of SeaRAM.

14. Implement the equipment shock hardening measures employed on LCS 5 and 6 during the shock trial on all ships and survivability improvement findings/recommendations developed as a result of the two shock trial series.

15. Implement the survivability improvement recommendations developed by the LCS 4 TSST team. Most importantly, redesign the Independence variant's chilled water system to enable isolation of damaged sections.

16. Reevaluate LCS susceptibility to influence mines by conducting at-sea trials with the Advanced Mine Simulation System.[25]

Mission Packages

March 2017 GAO Report

The March 2017 GAO report assessing DOD weapon acquisition programs stated:

[25] Department of Defense, Director, Operational Test & Evaluation, *FY 2016 Annual Report*, December 2016, p. 277.

Mine Countermeasures (MCM)

The Navy designed and produced MCM mission package systems prior to maturing critical technologies. The Navy accepted seven MCM packages without demonstrating they meet threshold performance requirements and, is now replacing a key system—the remote multi-mission vehicle (RMMV). There are six MCM systems (Near Surface Detection, Airborne Mine Neutralization, Remote Minehunting, Coastal Mine Reconnaissance, Buried Minehunting, and Unmanned Mine Sweeping) the Navy plans to assemble and fully test in fiscal year 2020. After the Navy suspended developmental testing in October 2015 following the discovery of significant reliability issues, it studied the package and revised its approach. The Navy is now replacing the RMMV, which towed the AQS-20A sonar, with an unmanned boat. The new boat rides on the surface of the water as opposed to the semi-submersible RMMV. Program officials state the boat will be easier to launch and recover but could be susceptible to wave-movement, which may make it more difficult to find mines. The Near Surface Detection Module and Airborne Mine Neutralization Modules achieved initial capability in 2016. The remaining systems are still in development and are planned to be tested over the next several years.

Surface Warfare (SUW)

The Navy designed and produced SUW mission package systems prior to demonstrating the maturity of key systems leading to changes and delays to the SUW package. The Navy has accepted eight SUW packages with no deliveries planned for fiscal year 2017. One package currently consists of two 30 millimeter guns, an armed helicopter, and two rigid hull inflatable boats. In August 2014, the Navy found that the current package met interim performance requirements on the Freedom variant and, in 2015, the Navy tested this part of the package on the Independence variant. To meet threshold requirements a surface-to-surface missile is required. According to program officials, initial missile demonstrations were successful, but operational testing was delayed by about a year to fiscal year 2018 due to ship integration issues.

Antisubmarine Warfare (ASW)

The Navy reconfigured the ASW package after determining planned systems would not provide adequate capability. According to the Navy, the ASW systems are mature as they have been fielded by U.S. Navy and foreign navies. Navy program officials stated that the package's weight issues have been resolved, and the Navy has purchased an initial ASW package to be used for testing. The Navy is now planning to meet the threshold requirement for ASW in fiscal year 2019, a 2-year delay from last year's estimate.

Other Program Issues

The Navy will not achieve the capability to meet threshold requirements for all three of the mission packages until late fiscal year 2020, by which time it plans to have taken delivery of 24 ships. Starting in 2018, the Navy plans to modify LCS as a frigate and permanently install most of the ASW and SUW mission packages. These changes have, to date, not deterred the Navy from its plans to purchase 64 mission packages.

Program Office Comments

In commenting on a draft of this assessment, the Navy reported it is delivering operationally effective mission package capability to the fleet as it mature increments. The Navy stated it is purchasing the quantity of mission systems and packages needed for system integration, crew training, developmental and operational testing, and LCS deployments. The Navy reports it is purchasing the systems in accordance with relevant laws and DOD regulations. The SUW package achieved initial capability in fiscal 2015 and will meet requirements with the surface to surface missile module in fiscal 2018. ASW capability is planned to have an initial capability and meet requirements in fiscal 2019. The MCM package is delivering systems as they mature. Due to reliability of the

RMMV, the Navy reports it is restructuring the MCM package to perform the minehunting mission with a different vehicle. The MCM package is planned to achieve an initial capability in fiscal year 2020. The Navy reported it intends to adjust the program's package quantities in 2017 to support changes to the LCS and frigate programs.[26]

December 2016 DOT&E Report

The December 2016 DOT&E report states:

SUW Mission Package

• While equipped with the Increment 2 SUW mission package, LCS 4 participated in three engagements with small swarms of fast-inshore attack craft (small boats). LCS 4 failed the Navy's reduced requirement for interim SUW capability, failing to defeat each of the small boats before one penetrated the prescribed keep-out zone in two of the three events. Although LCS eventually destroyed or disabled all of the attacking boats in these events, the operational test results suggest that the Increment 2 SUW mission package provides the crew with a moderately enhanced self-defense capability (relative to the capability of the 57 mm gun alone) but not an effective offensive capability. In all three events, the ship expended an inefficiently large quantity of ammunition from the 57 mm gun and the two mission package 30 mm guns, while contending with azimuth elevation inhibits that disrupted or prevented firing on the targets. In one event, frequent network communication faults disrupted the flow of navigation information to the gun systems further hindering the crew's efforts to defeat the attacking boats. SAFIRE is a likely contributor to the observed 57 mm gun performance and large ammunition expenditure during surface engagements, and its cumbersome user interface contributed to the workload of already-overtasked watchstanders. LCS 4's failure to defeat this relatively modest threat routinely under test conditions raises questions about its ability to deal with more realistic threats certain to be present in theater, and suggests that LCS will be unsuccessful operating as an escort (a traditional frigate role) to other Navy ships. Additional details about the LCS gun performance and the factors and tactics that contribute to the ship's effectiveness are discussed in DOT&E's November 2016 classified report.

• The Navy has begun work on developing and testing the SSMM, the core component of the Increment 3 mission package. Operational testing in 2015 and 2016 revealed that the ship's radar, the only sensor available to provide initial targeting information to the Longbow HELLFIRE missiles employed from the SSMM, demonstrated performance limitations that might hinder its ability to support missile employment against small boat swarms. The Navy intends to conduct additional developmental testing to better understand these limitations; and the results of these tests will be used to inform future decisions by the Navy to modify missile targeting algorithms and tactics, as needed to overcome the limitations. The Navy plans to demonstrate the ability to meet the original LCS requirements for SUW swarm defense during operational testing of the Increment 3 mission package in FY18.

MCM Mission Package

• DOT&E concluded in a June 2016 early fielding report, based exclusively on the testing conducted before 2016, that an LCS employing the current MCM mission package would not be operationally effective or operationally suitable if called upon to conduct MCM missions in combat. The primary reasons for this conclusions are:

[26] Government Accountability Office, *Defense Acquisitions[:] Assessments of Selected Weapon Programs*, GAO-17-333SP, March 2017, p. 108.

- Critical MCM systems are not reliable.

- The ship is not reliable.

- Vulnerabilities of the RMMV to mines and its high rate of failures do not support sustained operations in potentially mined waters.

- RMMV operational communications ranges are limited.

- Minehunting capabilities are limited in other-than-benign environmental conditions.

- The fleet is not equipped to maintain the ship or the MCM systems.

- The AMNS cannot neutralize most of the mines in the Navy's threat scenarios.

• In the same early fielding report, DOT&E concluded that the current versions of the individual systems that comprise the current MCM mission package, specifically the RMS and the MH-60S AMCM helicopter equipped with ALMDS or AMNS, would not be operationally effective or operationally suitable if called upon to conduct MCM missions in combat.

• Although the Navy has implemented some corrective actions to mitigate the problems observed in earlier testing, the substantive unclassified details of DOT&E's assessment are unchanged from the FY15 edition of this

report. DOT&E's classified June 2016 early fielding report provides additional detail.

• Developmental MCM Systems. The Navy is continuing to develop the COBRA Block I, Knifefish, and UISS programs and has not yet conducted operational testing of these systems. However, early developmental testing or contractor testing of COBRA Block I and Knifefish have revealed problems that, if not corrected, could adversely affect the operational effectiveness or suitability of these systems, in operational testing planned in FY17 or FY18, and subsequently the future MCM mission package. In addition to the problems observed in early testing of developmental systems, DOT&E used lessons learned from earlier testing of the RMS to identify problems that are likely to affect the upcoming phases of Knifefish and UISS operational testing.

- During developmental testing of COBRA Block I in early FY16, test data revealed that the system's probability of detection is low against small mines and mines emplaced in some environmental conditions. Thus, without improvements, the capability of the current system will likely be limited in some operationally realistic threat scenarios. Operational testing, planned for 2017, will characterize the COBRA Block I capability against a broader range of operationally realistic conditions.

- For the Knifefish UUV program, the Navy's developmental efforts are currently focused on system design and have not yet tested Knifefish integration with either LCS seaframe variant. The Navy needs to test battery charging, off-board communications, maintainability, launch and handling equipment and procedures, and the ability of the crew to recover the vehicle reliably while employing the proposed grappling hook capture device to support Knifefish operations on both LCS variants. In addition, it is not yet known how Knifefish operations will be affected by concurrent LCS MCM activities, making operationally realistic testing of the Knifefish UUV in the combined MCM mission package essential.

- The Knifefish vehicle's low frequency broadband sonar is designed to detect bottom, moored, and buried mines. After early contractor testing revealed that sonar transmitter elements were failing prematurely, the Naval Research Laboratory recommended operating the elements at a significantly lower voltage to extend their operational life. While this change will likely improve the sonar's reliability, the reduction of the sonar's transmitting power will also likely reduce the range at which the sonar can detect objects. Although the operational implications of these changes are not yet known, the actions

taken to mitigate reliability problems could negatively affect the assessment of operational effectiveness in the upcoming operational assessment.

- Knifefish contractor testing in October uncovered a UUV structural failure mode during launch in which the vehicle broke in half during launch from a test ship. The contractor analyzed the failure and suspects it was caused by a combination of factors including the wave height encountered during launch, the vehicle position on the launch ramp, and the launch ramp geometry. The contractor is considering options to address this failure mode such as redesigning the launch ramp and restricting launches to lower sea states.

- The UISS contractor delivered the first engineering development unit only recently and has not yet conducted testing of a production representative system. The Navy will need to consider integration challenges that include off-board communications, maintainability, launch and handling equipment and procedures, and the ability of the crew to recover the system safely and reliably. Although the Navy plans to characterize UISS performance in dedicated minesweeping scenarios during the initial phases of LCS-based testing, operationally realistic testing of the system in the combined MCM mission package is also essential.

- Currently, LCS sailors do not possess an organic, in-situ means to measure environmental characteristics that are important to plan UISS minesweeping missions. Although the Navy is working on a solution that it hopes to make available by 2020, the lack of this capability may affect the LCS crew's ability to employ UISS effectively in upcoming operational testing that will characterize minesweeping performance over the range of conditions expected in potential threat scenarios.

• Current Navy plans for developing, integrating, and testing mine hunting and mine sweeping systems in the LCS MCM mission package are not adequately funded to mature the MCM capabilities to meet mission requirements.

ASW Mission Package

• The current threat torpedo surrogates have significant limitations in their ability to represent threat torpedoes. As such, operational assessment of each LCS variant with ASW mission package using these test articles will not fully characterize the ship's capability to defeat incoming threat torpedoes. The proposed development of a General Threat Torpedo (GTT) addresses many of DOT&E's concerns; however, the GTT's capability to support realistic operational testing depends on future Navy decisions to procure a sufficient quantity of GTTs.[27]

The December 2016 DOT&E report also stated:

Recommendations

• Status of Previous FY15 Recommendations.

- With respect to the MCM mission package and the cancellation of the RMS program, the Navy appears to have accepted the recommendation to shift to a performance-based test schedule rather than continuing a schedule-driven program. The LCS program needs ample time and resources to correct the numerous serious problems with the MCM mission package.[28]

The December 2016 DOT&E report also stated:

[27] Department of Defense, Director, Operational Test & Evaluation, *FY 2016 Annual Report*, December 2016, pp. 273-274. See also the separate assessment of the Remote Minehunting System (RMS) on p. 310.

[28] Department of Defense, Director, Operational Test & Evaluation, *FY 2016 Annual Report*, December 2016, pp. 276. See also the separate discussion of previous recommendations regarding the Remote Minehunting System (RMS) on pp. 310-311.

Recommendations...

FY16 Recommendations. Since December 2015, DOT&E issued three operational test reports for the LCS program, each of which contained multiple recommendations for the Navy's consideration that focus on the improvements needed to achieve operational effectiveness, suitability, and survivability, and to improve future testing. A selection of these recommendations is provided below....

SUW Mission Package

17. Consider developing multi-ship tactics or build additional capability into future mission packages to enable LCSs, operating in surface action groups, to more effectively counter small-boat swarms that are more threat-representative.

18. Improve the 30 mm gun system's accuracy and expand the guns' effective range so that crews are not limited to a narrow region of success. Without improvements, LCS crews are unlikely to be successful against realistically sized small-boat swarms.

MCM Mission Package

19. Limit procurement of ALMDS, AMNS, and AN/AQS-20A systems, which have significant operational performance limitations that negatively affect LCS MCM mission capability until much needed performance improvements are developed, tested, and proven effective in testing representative of realistic LCS mine-clearance operations. Suspend further use of RMMV v6.0 until completing a comprehensive reliability-centered analysis, correcting high impact failure modes, and testing repairs in an operationally realistic environment.

20. Given the cancelation of the RMS program, accelerate the development the most promising minehunting alternatives, including the USV with a towed AN/AQS-20C or AN/AQS-24C sensor and the Knifefish UUV with pre-planned product improvements.

21. Avoid overreliance on shore-based testing of mission package systems, which often results in unwarranted confidence in system performance in a maritime environment.

22. Fully resource the development of improvements to the ALMDS and AMNS (or alternative systems such as Barracuda). For ALMDS, efforts should focus on reducing the incidence of false contacts and eliminating the need for multi-pass search tactics. For mine neutralization systems, efforts should focus on reducing the incidents of fiber-optic communications losses, developing the ability to neutralize near-surface mines, and operating in high-current environments.

23. Demonstrate through end-to-end testing that the systems included in future mission packages can achieve the area search rate and detection/classification performance needed to support LCS effectiveness in timely and sustained minehunting and clearance operations. Testing should avoid segmented evaluations of individual components of the mission package.

24. Demonstrate viability of multi-ship LCS MCM Concept of Operations (CONOPS) that address operational concerns such as data sharing, contact management, asset scheduling, and mutual interference when multiple ships operate together to accelerate mine-clearance timelines and, since no planned version of the LCS MCM mission package is expected to perform all MCM functions, develop and demonstrate CONOPS for combined LCS and legacy MCM operations.

25. Accelerate development and production of the Navy Instrumented Threat Target (NAVITTAR) to ensure that sufficient resources are available to support planned developmental and operational testing of UISS and the MCM mission package. Implement a reliability improvement program to mitigate the high failure rate of NAVITTARs observed in early testing.

26. Characterize the magnetic properties of additional U.S. test ranges to identify a second suitable location to execute UISS operational testing.

27. To mitigate the risk of poor operational performance in the LCS MCM mission package, the Navy should demonstrate UISS integration aboard LCS in developmental testing prior to the initial phases of LCS-based operational testing, planned in FY18.

28. Provide adequate funding for developing, integrating, and testing mine hunting and mine sweeping systems in the LCS MCM mission package to mature the MCM capabilities to meet mission requirements.

ASW Mission Package

29. Acquire a sufficient quantity of GTTs, when developed, to characterize the capability of each LCS variant with ASW mission package to defeat threat torpedoes during operational assessment.

Future Operational Testing

30. Develop an operationally realistic, cost-effective alternative for training and testing of small-boat defense operations such as an accreditable, operator-in-the-loop simulation that incorporates tactical computing hardware and software and realistic threat presentations.

31. Provide adequate resources to conduct the full complement of test scenarios prescribed by the recently updated TEMP

32. Complete an update to the LCS TEMP to ensure that future tests, including integrated testing and plans for testing the over-the-horizon missile, are clear and resourced appropriately.

33. Fund development of test targets and ranges to adequately test LCS MCM systems, and then maintain and employ these assets to facilitate MCM operator training and proficiency after fielding.[29]

Additional Oversight Issues Raised in GAO Reports

Additional oversight issues raised in GAO reports include LCS operation and support (O&S) costs,[30] weight management on the LCS sea frames—an issue that can affect the ability of LCSs to accept new systems and equipment over their expected life cycles[31]—and construction quality on the lead ships in the LCS program.[32]

[29] Department of Defense, Director, Operational Test & Evaluation, *FY 2016 Annual Report*, December 2016, pp. 277-278. See also the separate discussion of FY2016 recommendations regarding the Remote Minehunting System (RMS) on p. 311.

[30] Government Accountability Office, *Littoral Combat Ship[:] Deployment of USS Freedom Revealed Risks in Implementing Operational Concepts and Uncertain Costs*, GAO 14-447, July 2014, 57 pp.

[31] Government Accountability Office, *Littoral Combat Ship[:] Additional Testing and Improved Weight Management Needed Prior to Further Investments*, GAO-14-749, July 2014, 54 pp.

[32] Government Accountability Office, *Littoral Combat Ship[:]Navy Complied with Regulations in Accepting Two Lead Ships, but Quality Problems Persisted after Delivery*, GAO-14-827, September 2014, 35 pp.

Legislative Activity for FY2017

Summary of Congressional Action on FY2017 Funding Request

Table 2 summarizes congressional action on the Navy's FY2017 procurement funding request for the LCS program.

Table 2. Congressional Action on FY2017 Procurement Funding Request

Figures in millions, rounded to nearest tenth

		Authorization			Appropriation		
	Request	HASC	SASC	Conf.	HAC	SAC	Conf.
Shipbuilding and Conversion, Navy (SCN) appropriation account							
Procurement of LCSs	1,125.6	1,510.3	1,097.6	1,097.6	1,439.2	1,600.6	1,563.7
Cost-to-complete funding for prior-year LCSs	86.0	86.0	86.0	86.0	86.0	86.0	86.0
Other Procurement, Navy (OPN) appropriation account							
Line 36: LCS common mission modules equipment	27.8	17.8	24.1	17.8	21.8	15.7	15.7
Line 37: LCS MCM mission modules	57.1	20.7	57.1	57.1	52.3	34.5	29.7
Line 38: LCS ASW mission modules	32.0	22.0	32.0	22.0	32.0	0	0
Line 39: LCS SUW mission modules	22.5	22.5	22.5	21.1	13.3	21.1	21.1
Line 39A: LCS launcher	0	24.9	0	0	0	0	0

Source: Table prepared by CRS based on FY2017 Navy budget submission, committee reports, authorization conference report, and appropriation conference explanatory statement.

Notes: HASC is House Armed Services Committee; **SASC** is Senate Armed Services Committee; **HAC** is House Appropriations Committee; **SAC** is Senate Appropriations Committee; **Conf.** is conference agreement.

FY2017 National Defense Authorization Act (H.R. 4909/S. 2943/P.L. 114-328)

House (Committee Report)

The House Armed Services Committee, in its report (H.Rept. 114-537 of May 4, 2016) on H.R. 4909 of the 114th Congress, recommends the funding levels shown in the HASC column of **Table 2**. The increase in LCS procurement funding is to fund the procurement of an additional LCS (for a total FY2017 procurement of three LCSs, rather than two LCSs as requested).

Section 126 of H.R. 4909 as reported states:

> SEC. 126. Limitation on availability of funds for Littoral Combat Ship or successor frigate.
>
> None of the funds authorized to be appropriated by this Act or otherwise made available for fiscal year 2017 for the Navy shall be used to select only a single contractor for the construction of the Littoral Combat Ship or any successor frigate class ship program until the Secretary of the Navy certifies to the congressional defense committees that such selection of a single contractor will be conducted—
>
> (1) using competitive procedures; and

(2) for the limited purpose of awarding a contract for—

(A) an engineering change proposal for a frigate class ship; or

(B) the construction of a frigate class ship.

Section 1042 of H.R. 4909 as reported states:

SEC. 1042. Limitation on retirement, deactivation, or decommissioning of mine countermeasures ships.

Section 1090 of the National Defense Authorization Act for Fiscal Year 2016 (Public Law 111–92; 129 Stat. 1016) is amended by striking subsection (b) and inserting the following:

"(b) Limitation on retirement of MCM ships.—

"(1) IN GENERAL.—None of the funds authorized to be appropriated by this Act or otherwise made available for the Department of the Navy for fiscal year 2017 may be obligated or expended to retire, deactivate, decommission, to prepare to retire, deactivate, decommission, or to place in storage backup inventory or reduced operating status any MCM-1 class ship.

"(2) WAIVER AUTHORITY.—

"(A) IN GENERAL.—The Secretary of the Navy may waive the limitation under paragraph (1) with respect to any MCM-1 class ship if the Secretary provides to the congressional defense committees certification that the operational test and evaluation for replacement capabilities for the ship is complete and such capabilities are available in sufficient quantities to ensure sufficient mine countermeasures capacity is available to meet requirements as set forth in the Join Strategic Capabilities Plan, the campaign plans of the combatant commanders, and the Navy's Force Structure Assessment.

"(B) REPORT.—The first time the Secretary of the Navy exercises the waiver authority under subparagraph (A), the Secretary shall submit to the congressional defense committees a report that includes—

"(i) the recommendations of the Secretary regarding MCM force structure;

"(ii) the recommendations of the Secretary regarding how to ensure the operational effectiveness of the surface MCM force through 2025 based on current capabilities and capacity, replacement schedules, and service life extensions or retirement schedules;

"(iii) an assessment of the MCM vessels, including the decommissioned MCM-1 and MCM-2 ships and the potential of such ships for reserve operating status; and

"(iv) an assessment of the Littoral Combat Ship MCM mission package increment one performance against the initial operational test and evaluation criteria.".

H.Rept. 114-537 states:

Littoral Combat Ship Over-the-Horizon Missile

The budget request contained no funds for the Littoral Combat Ship Over-the-Horizon Missile.

The committee notes that the Department of the Navy has decided to accelerate backfitting of the Over-the-Horizon missiles on Littoral Combat Ships to improve their lethality. The committee further notes that this funding would procure eight missiles and launcher installation, integration, and testing to allow outfitting of the LCS 3 and LCS 5 in fiscal year 2017 prior to their next deployment. Finally, the committee notes that this element was included in the Chief of Naval Operations' Unfunded Priorities List.

> The committee recommends $43.0 million, an increase of $18.1 million in Weapons Procurement, Navy, for procurement of 8 missiles, and an increase of $24.9 million in Other Procurement, Navy, for procurement, integration, and installation of a launcher. (Page 19)

H.Rept. 114-537 also states:

> *Frigate*
>
> In December 2015, citing concerns with the Navy's balance between capability and quantity of platforms, the Secretary of Defense directed the Secretary of the Navy, among other actions, to procure 40 Littoral Combat Ships (LCS) and frigates, a reduction of 12 ships. In response to this direction, the Navy modified the LCS procurement and initiated acquisition of the frigate based on a modified LCS in 2018, a year earlier than planned in the Navy's budget request for fiscal year 2016. The committee notes that there is considerable uncertainty in the frigate program, as reported by the U.S. Government Accountability Office. The committee notes that over $8.00 billion in investment remains to procure the frigate. Therefore, the committee directs the Comptroller General of the United States to submit a report to the congressional defense committees by March 1, 2017, as to the following items relating to the frigate production:(1) Plans to develop and mature the frigate design prior to starting production;(2) The strategy for acquiring the frigate;(3) Realism of frigate cost estimates; and (4) Planned capability of the frigate and the degree to which it will meet the Navy's small surface combatant needs. (Page 21)

H.Rept. 114-537 also states:

> *Littoral Combat Ship*
>
> The budget request included $1.13 billion for two Littoral Combat Ships (LCS).
>
> The committee notes that the Navy has entered into a block procurement contract with two shipbuilders that maximizes efficiency and minimizes costs for the LCS seaframe. Unfortunately, the committee also notes that the administration has not requested sufficient funding in fiscal year 2017 to take advantage of the competitive pricing, which could lead to a 20 percent increase in the unit cost.
>
> Therefore, the committee recommends $1.51 billion, an increase of $384.7 million, for procurement of a third Littoral Combat Ship. The committee notes that the Navy completed a Force Structure Assessment based on projected threats and determined that 52 small surface combatants were necessary. Senior Navy officials reaffirmed the 52 small surface combatant requirement in testimony before the committee earlier this year. Therefore, the committee is perplexed by the administration's statements that sufficient forces are available to support a reduction in the numbers of the small surface combatants to 40 ships. The Department of Defense briefed the committee as to options that they would pursue to mitigate the lower number of small surface combatants. The committee was unimpressed with the depth of this review. The committee is not willing to take risks in warfighting requirements and remains supportive of the Department of the Navy's Force Structure Assessment. (Page 22)

A statement of Administration policy on H.R. 4909 as reported states:

> Littoral Combat Ships (LCS): The Administration strongly objects to the bill's proposal to increase the purchase of LCS in FY 2017 from two to three as noted in the table supporting Section 4013, Shipbuilding and Conversion line number 11. The Administration reduced from 52 to 40 the total number of LCS and Frigates (FF) the Navy will purchase over the life of the program. A combined 40 LCS and FF will allow for the Department to invest in advanced capabilities across the fleet and will provide sufficient capacity to meet the Department's warfighting needs and to exceed recent presence levels with a more modern and capable ship than legacy mine sweepers, frigates, and coastal patrol craft they will replace. By funding two LCS in FY 2017, the

> President's Budget ensures that both shipyards are on equal footing and have robust production leading up to the competition to select the shipyard that will continue the program. Both LCS yards will remain active for five or more years. This competitive environment ensures the best price for the taxpayer on the remaining ships, while also achieving savings by down-selecting to one shipyard. The bill prevents the use of resources for higher priorities to improve the Department's warfighting capability, like undersea, other surface, and aviation investments.[33]

House (Floor Consideration)

The House, as part of its consideration of H.R. 4909 of the 114th Congress, adopted an en bloc amendment (called en bloc amendment No. 4) that included, inter alia, amendment 48 printed in H.Rept. 114-569 of May 16, 2016, a rule providing for the consideration of H.R. 4909. The text of the amendment is as follows:

> SEC. 1070. REPORT ON TESTING AND INTEGRATION OF MINEHUNTING SONAR SYSTEMS TO IMPROVE LITTORAL COMBAT SHIP MINEHUNTING CAPABILITIES.
>
> (a) REPORT TO CONGRESS.—Not later than April 1, 2018, the Secretary of the Navy shall submit to the congressional defense committees a report that contains the findings of an assessment of all operational minehunting Synthetic Aperture Sonar (hereinafter referred to as "SAS) technologies suitable to meet the requirements for use on the Littoral Combat Ship Mine Countermeasures Mission Package.

Senate

The Senate Armed Services Committee, in its report (S.Rept. 114-255 of May 18, 2016) on S. 2943 of the 114th Congress, recommends the funding levels shown in the SASC column of **Table 2**. The recommended reduction of $28 million in funding for procurement of LCSs is for "Unjustified growth." (Page 440) The recommended reduction of $3.7 million for LCS common mission modules equipment (line 36) is for "Cancelled program (RMS)." (Page 442)

S.Rept. 114-255 states:

> **Littoral Combat Ship**
>
> The budget request included $1.1 billion in line item 11 of Shipbuilding and Conversion, Navy for procurement of two Littoral Combat Ships. The committee notes unjustified unit cost growth in the other cost ($24.0 million) and other electronics ($4.0 million) categories, which increased without justification despite a quantity reduction compared to fiscal year 2016. Therefore, the committee recommends a decrease of $28.0 million in procurement for this program....
>
> **LCS common mission modules equipment**
>
> The budget request included $27.8 million in line item 36 of Other Procurement, Navy for LCS common mission modules equipment. This line item contains $12.2 million for mission bay training devices—MCM, which includes $3.7 million for training and support items associated with the remote minehunting system that was cancelled in 2016. Therefore, the committee recommends a decrease of $3.7 million for this program. (Page 25)

[33] Executive Office of the President, *Statement of Administration Policy*, H.R. 4909—*National Defense Authorization Act for Fiscal Year 2017*, May 16, 2016, p. 5.

Regarding a line item for LCS mission modules in the Navy's research and development account (this line item is not shown in **Table 2**), S.Rept. 114-255 states:

> **Littoral Combat Ship mission modules**
>
> The budget request included $160.1 million in PE [Program Element] 63596N for research, development, test, and evaluation of Littoral Combat Ship mission modules. The committee notes the Navy planned to spend $30.9 million in fiscal year 2016 to complete operational testing. Due to developmental test results, the Navy cancelled operational testing. As a result, the committee concurs with a Government Accountability Office finding and recommends a decrease of $30.9 million to this program due to available prior year funds. (Page 53)

Section 122 of S. 2943 as reported states:

> SEC. 122. Littoral Combat Ship.
>
> (a) Report on littoral combat ship mission packages.—
>
> (1) IN GENERAL.—The Secretary of the Navy shall include annually with the justification materials submitted with the budget of the President under section 1105(a) of title 31, United States Code, a report on Littoral Combat Ship mission packages.
>
> (2) ELEMENTS.—The report required under paragraph (1) shall include for each mission package and increment therein the following elements:
>
> (A) A description of the current status of and plans for development, production, and sustainment, including—
>
> (i) currently projected versus originally estimated unit costs for each system composing the mission package;
>
> (ii) currently projected versus originally estimated development cost, procurement cost, and 20-year sustainment cost for each system composing the mission package;
>
> (iii) demonstrated versus required performance for each system composing the mission package and for the mission package as a whole; and
>
> (iv) realized and potential cost, schedule, or performance problems with such development, production, or sustainment and mitigation plans to address such problems.
>
> (B) A description, including dates, for each developmental test, operational test, integrated test, and follow-on test event completed in the preceding fiscal year and forecast in the current fiscal year and each of the next five fiscal years.
>
> (C) The planned initial operational capability (IOC) date and a description of the performance level criteria that must be demonstrated to declare IOC.
>
> (D) A description of systems that reached IOC in the preceding fiscal year and the performance level demonstrated versus the performance level required.
>
> (E) The acquisition inventory objective listed by system.
>
> (F) The current locations and quantities of delivered systems listed by city, State, and country.
>
> (G) The planned locations and quantities of systems listed city, State, and country in each of the next five fiscal years.
>
> (b) Certification of littoral combat ship mission package program of record.—
>
> (1) IN GENERAL.—The Undersecretary of Defense for Acquisition, Technology, and Logistics shall include with the justification materials submitted with the budget of the

President under section 1105(a) of title 31, United States Code, for fiscal year 2018 a certification on Littoral Combat Ship mission packages.

(2) CERTIFICATION.—The certification required under paragraph (1) shall include the current program of record quantity for—

(A) surface warfare (SUW) mission packages;

(B) anti-submarine warfare (ASW) mission packages; and

(C) mine countermeasures (MCM) mission packages.

(c) Limitation on the use of funds to revise or deviate from the Littoral Combat Ship acquisition strategy.—

(1) LIMITATION ON REVISIONS AND DEVIATIONS.—Except as provided under paragraph (2), none of the funds authorized to be appropriated by this Act or otherwise made available for the Department of Defense for fiscal year 2017 may be used to revise or deviate from revision three of the Littoral Combat Ship acquisition strategy.

(2) WAIVER.—The Secretary of Defense may waive the limitation required under paragraph (1) if the Secretary submits to the congressional defense committees a notification of such waiver. The waiver shall include—

(A) the rationale of the Secretary for issuing such waiver to revise or deviate from revision three of the Littoral Combat Ship acquisition strategy;

(B) a determination that a proposed revision to, or deviation from, revision three of the Littoral Combat Ship acquisition strategy is in the national security interest;

(C) a description of the specific revisions or deviations to the Littoral Combat Ship acquisition strategy;

(D) the Littoral Combat Ship acquisition strategy that is in effect following such revision or deviation; and

(E) Independent Cost Estimates prepared by the Assistant Secretary of the Navy for Financial Management and Comptroller, as well as the Office of the Secretary of Defense, that compare the cost of such revision or deviation to revision three of the Littoral Combat Ship acquisition strategy.

(d) Definitions.—In this section:

(1) LITTORAL COMBAT SHIP MISSION PACKAGE.—The term "Littoral Combat Ship mission package" means a mission module combined with the crew detachment and support aircraft.

(2) MISSION MODULE.—The term "mission module" means the mission systems (such as vehicles, communications, sensors, weapons systems) combined with support equipment (such as support containers and standard interfaces) and software (including related to the mission package computing environment and multiple vehicle communications system).

(e) Repeal of reporting requirements related to naval vessels and merchant marine.—Section 126 of the National Defense Authorization Act for Fiscal Year 2013 (Public Law 112–239; 126 Stat. 1657) is amended by striking subsection (b).[34]

[34] Subsection (b) of Section 126 of P.L. 112-239 states:

(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,

(continued...)

Regarding Section 122, S.Rept. 114-255 states:

> **Littoral Combat Ship (sec. 122)**
>
> The committee recommends a provision that would require an annual report on Littoral Combat Ship (LCS) mission packages, a certification on the acquisition inventory objective of LCS mission packages, a limitation on the use of funds to revise or deviate from revision three of the LCS acquisition strategy, and a repeal of a reporting requirement related to LCS mission modules.
>
> The committee is concerned with the volume and complexity of LCS mission package testing that remains to be completed. Since 2009, the surface package has been delayed by 2 years, the antisubmarine package by 3 years, and the mine countermeasures package by at least 8 years. Significant design, testing, integration, and deployment challenges must be overcome before the promised LCS warfighting capability is realized.
>
> Therefore, the committee directs the Secretary of the Navy to submit a report on LCS mission packages, annually, with the President's budget request. For each mission package and increment therein, the report would include: (1) a description of the current status of and plans for development, production, and sustainment; (2) a description, including dates, for each developmental test, operational test, integrated test, and follow-on test event completed in the preceding fiscal year, forecast to be conducted in the current fiscal year, and in each of the next 5 fiscal years; (3) the planned initial operational capability (IOC) date and a description of the performance level criteria that must be demonstrated to declare IOC; (4) a description of systems that reached IOC in the preceding fiscal year and the performance level demonstrated versus the performance level required; (5) the acquisition inventory objective listed by system; (6) the current locations and quantities of the individual systems listed by city, state, and country; and (7) the planned locations and quantities of systems listed by city, state, and country in each of the next 5 fiscal years.
>
> Since 2007, the committee notes the program of record has required 64 LCS mission packages, including 16 for anti-submarine warfare (ASW), 24 for mine countermeasures (MCM), and 24 for surface warfare (SUW). Several major program changes have occurred since this program of record quantity was established to support 52 LCS, including: a revised acquisition strategy that reduces procurement to 40 ships, the decision to modify at least 12 LCS to a frigate design that includes LCS ASW and SUW mission package systems permanently installed, and a Remote Minehunting System Independent Review Team recommendation to exercise MCM capability from platforms other than LCS. Therefore, the committee recommends the Undersecretary of Defense for Acquisition, Technology, and Logistics recertify the LCS mission package program of record and submit this certification with the President's budget request for fiscal year 2018.
>
> The committee also notes that on March 29, 2016 revision three of the LCS acquisition strategy was approved by Under Secretary of Defense for Acquisition, Technology, and Logistics Frank Kendall. This revision was approved on February 19, 2016 by Assistant Secretary of the Navy (Research, Development & Acquisition) Sean Stackley and supports the President's fiscal year 2017 budget request. This revision plans to continue the procurement of both LCS designs in fiscal year 2017 in preparation for the down select to a single variant and transition to the frigate as early fiscal year 2018, but no later than fiscal year 2019. It also plans to procure LCS/frigate ships through fiscal year 2025

(...continued)

> and identifying actual and potential problems with such development or production and potential mitigation plans to address such problems.

for a total inventory of 40 ships. As the Secretary of Defense testified on March 17, 2016, ". . . we're investing in LCS and frigates because we need the capability they provide, and for missions like minesweeping and antisubmarine warfare, they're expected to be very capable. The department's warfighting analysis called for 40 small surface combatants, so that's how many we're buying . . . While this will somewhat reduce the number of LCS available for presence operations, that need will be met by higher-end ships . . . Under this rebalanced plan, we will still achieve our 308-ship goal within the next five years, and we will be better positioned as a force to effectively deter, and if necessary defeat, even the most advanced potential adversaries." Therefore, the committee requires, should the Secretary of Defense deem changes necessary, that the Secretary submit a waiver justification prior to revising or deviating from revision three of the LCS acquisition strategy. The waiver would be required to include the following related to such revision or deviation: the rationale, a determination that it is in the national security interest, a description of the changes, the resulting acquisition strategy, and independent cost estimates that compare the changes to revision three of the LCS acquisition strategy.

The committee notes section 126(b) of the National Defense Authorization Act for Fiscal Year 2013 (Public Law 112–239) requires a quarterly report on LCS mission modules. This reporting requirement is addressed in subsection (a) of this provision. Therefore, the committee recommends striking subsection (b) of section 126 of the National Defense Authorization Act for Fiscal Year 2013 (Public Law 112–239).

Additionally, the committee recommends initiating or continuing the Joint Capabilities Integration and Development System analysis necessary for future surface combatants, including the LCS replacement. It is essential that a follow-on small combatant be developed and procured starting in the 2020s to replace LCS, which begins retiring in the early-2030s. The committee believes the analytical assumptions for the follow-on small surface combatant must address the capability and survivability shortfalls of LCS in a high threat environment, including the ability to: attack enemy surface ships at over-the-horizon ranges with multiple salvos, defend nearby noncombatant ships from air and missile threats as an escort, conduct long-duration escort or patrol missions without frequent refueling, and be built to Navy level one survivability design standards. (Pages 7-9)

Section 1012 of S. 2943 as reported states:

SEC. 1012. Prohibition on use of funds for retirement of legacy maritime mine countermeasures platforms.

(a) Prohibitions.—Except as provided under subsection (b), none of the funds authorized to be appropriated by this Act or otherwise made available for fiscal year 2017 for the Navy may be obligated or expended to—

(1) retire, prepare to retire, transfer, or place in storage any AVENGER-class mine countermeasures ship or associated equipment;

(2) retire, prepare to retire, transfer, or place in storage any SEA DRAGON (MH–53) helicopter or associated equipment;

(3) make any reductions to manning levels with respect to any AVENGER-class mine countermeasures ship; or

(4) make any reductions to manning levels with respect to any SEA DRAGON (MH–53) helicopter squadron or detachment.

(b) Waiver.—The Secretary of the Navy may waive the limitations under subsection (a) if the Secretary certifies to the congressional defense committees that the Secretary has—

(1) identified a replacement capability and the necessary quantity of such systems to meet all combatant commander mine countermeasures operational requirements that are currently being met by the AVENGER-class ships and SEA DRAGON helicopters to be retired, transferred, or placed in storage;

(2) achieved initial operational capability of all systems described in paragraph (1); and

(3) deployed a sufficient quantity of systems described in paragraph (1) that have achieved initial operational capability to continue to meet or exceed all combatant commander mine countermeasures operational requirements currently being met by the AVENGER-class ships and SEA DRAGON helicopters.

Regarding Section 1012, S.Rept. 114-255 states:

Prohibition on use of funds for retirement of legacy maritime mine countermeasures platforms (sec. 1012)

The committee recommends a provision that would prohibit funds from being used to retire, prepare to retire, transfer, or place in storage any Avenger-class mine countermeasures ship, MH–53 Sea Dragon helicopter, or associated equipment, as well as make any reductions to the manning levels of any Avenger-class mine countermeasures ship or Sea Dragon squadron or detachment.

The Secretary of the Navy may waive this prohibition by certifying to the congressional defense committees that: (1) a replacement capability and the necessary quantity of such systems to meet all combatant commander mine countermeasures operational requirements that are currently being met has been identified, (2) all replacement systems have achieved initial operational capability (IOC), and (3) the Navy has deployed a sufficient quantity of replacement systems that have reached IOC to continue to meet or exceed all combatant commander mine countermeasures operational requirements currently being met.

The committee is concerned that the Navy's current plan to reach IOC of replacement mine countermeasures systems is not scheduled to occur until the fourth quarter of fiscal year 2020. However, the Navy's 30-year shipbuilding plan calls for the current Avenger-class mine countermeasures ships to begin retiring in fiscal year 2019. The committee is concerned a capability gap in a critical warfighting mission area may result if current mine countermeasures systems are not maintained until operationally effective and suitable replacements are fielded.

The committee looks forward to reviewing the Navy's plan to transition from legacy mine countermeasures systems, which is included in the mine countermeasures master plan required by section 1090 of the National Defense Authorization Act for Fiscal Year 2016 (Public Law 114–92). This plan is required to be submitted annually beginning with the President's budget request for fiscal year 2018. (Pages 265-266)

S.Rept. 114-255 also states:

Littoral Combat Ship propulsion and machinery control test capability

The committee notes the operational benefits and cost savings that propulsion and machinery control test capabilities have provided the Navy, including for Arleigh Burke-class destroyers, Zumwalt-class destroyers, and Whidbey Island-class dock landing ships. The committee is concerned by a series of recent significant and costly engineering casualties on Littoral Combat Ships (LCS), including: mechanical failures contributing to USS Freedom being underway for just 35 percent of its deployment in the 7th Fleet area of responsibility in 2013, a fuel valve and combining gear failure on the USS Milwaukee in 2015, and a combining gear casualty on USS Fort Worth in 2016. The committee believes establishing a LCS propulsion and machinery control test capability would provide the Navy with a critical resource that is currently lacking to troubleshoot issues,

identify root causes of casualties, and provide in-depth training to sailors. The net effect of such a test capability would be to reduce the time, cost, and inexperience associated with LCS propulsion and machinery control casualties.

Accordingly, the committee strongly encourages the Secretary of the Navy and Chief of Naval Operations to consider establishing an LCS propulsion and machinery control test capability for both the LCS Freedom and Independence classes. (Page 70)

Conference

The conference report (H.Rept. 114-840 of November 30, 2016) on S. 2943/P.L. 114-328 of December 23, 2016) recommends the funding levels shown in the authorization conference column of **Table 2**. The reduction of $28 million in SCN funding for procuring LCSs is for "Unjustified growth." (Page 1351) The reduction of $10 million for LCS common mission modules equipment (OPN account line 36) is for "RMMV program restructure." (Page 1353) The reduction of $10 million for LCS AWS mission modules (OPN account line 38) is for "Early to need." (Page 1353) The reduction of $1.4 million for LCS SUW mission modules (OPN account line 39) is for "MK-46 gun weapon system contract delays." (Page 1353)

Section 123 of S. 2943/P.L. 114-328 states:

SEC. 123. Littoral Combat Ship.

(a) Report on Littoral Combat Ship mission packages.—

(1) IN GENERAL.—The Secretary of Defense shall include in the materials submitted in support of the budget of the President (as submitted to Congress under section 1105(a) of title 31, United States Code) for each fiscal year through fiscal year 2022 a report on Littoral Combat Ship mission packages.

(2) ELEMENTS.—Each report under paragraph (1) shall include, with respect to each Littoral Combat Ship mission package and increment, the following:

(A) A description of the status of and plans for development, production, and sustainment, including—

(i) projected unit costs compared to originally estimated unit costs for each system that comprises the mission package;

(ii) projected development costs, procurement costs, and 20-year sustainment costs compared to original estimates of such costs for each system that comprises the mission package;

(iii) demonstrated performance compared to required performance for each system that comprises the mission package and for the mission package as a whole;

(iv) problems relating to realized and potential costs, schedule, or performance; and

(v) any development plans, production plans, or sustainment and mitigation plans that may be implemented to address such problems.

(B) A description, including dates, of each developmental test, operational test, integrated test, and follow-on test event that is—

(i) completed in the fiscal year preceding the fiscal year covered by the report; and

(ii) expected to be completed in the fiscal year covered by the report and any of the following five fiscal years.

(C) The date on which initial operational capability is expected to be attained and a description of the performance level criteria that must be demonstrated to declare that such capability has been attained.

(D) A description of—

(i) the systems that attained initial operational capability in the fiscal year preceding the fiscal year covered by the report; and

(ii) the performance level demonstrated by such systems compared to the performance level required of such systems.

(E) The acquisition inventory objective for each system.

(F) An identification of—

(i) each location (including the city, State, and country) to which systems were delivered in the fiscal year preceding the fiscal year covered by the report; and

(ii) the quantity of systems delivered to each such location.

(G) An identification of—

(i) each location (including the city, State, and country) to which systems are projected to be delivered in the fiscal year covered by the report and any of the following five fiscal years; and

(ii) the quantity of systems projected to be delivered to each such location.

(b) Certification of Littoral Combat Ship mission package program of record.—

(1) IN GENERAL.—The Under Secretary of Defense for Acquisition, Technology, and Logistics shall include in the materials submitted in support of the budget of the President (as submitted to Congress under section 1105(a) of title 31, United States Code) for fiscal year 2018 the certification described in paragraph (2).

(2) CERTIFICATION.—The certification described in this paragraph is a certification with respect to Littoral Combat Ship mission packages that includes, as of the fiscal year covered by the certification, the program of record quantity for—

(A) surface warfare mission packages;

(B) anti-submarine warfare mission packages; and

(C) mine countermeasures mission packages.

(c) Limitations.—

(1) LIMITATION ON DEVIATION FROM ACQUISITION STRATEGY.—

(A) IN GENERAL.—The Secretary of Defense may not revise or deviate from revision three of the Littoral Combat Ship acquisition strategy, until the date on which the Secretary submits to the congressional defense committees the certification described in subparagraph (B).

(B) CERTIFICATION.—The certification described in this subparagraph is a certification that includes—

(i) the rationale of the Secretary for revising or deviating from revision three of the Littoral Combat Ship acquisition strategy;

(ii) a description of each such revision or deviation; and

(iii) the Littoral Combat Ship acquisition strategy that is in effect following the implementation of such revisions or deviations.

(2) LIMITATION ON SELECTION OF SINGLE CONTRACTOR.—The Secretary of Defense may not select only a single prime contractor to construct the Littoral Combat Ship or any successor frigate class ship unless such selection—

(A) is conducted using competitive procedures and for the limited purpose of awarding a contract or contracts for—

(i) an engineering change proposal for a frigate class ship; or

(ii) the construction of a frigate class ship; and

(B) occurs only after a frigate design has—

(i) reached sufficient maturity and completed a preliminary design review; or

(ii) demonstrated an equivalent level of design completeness.

(d) Definitions.—In this section:

(1) LITTORAL COMBAT SHIP MISSION PACKAGE.—The term "Littoral Combat Ship mission package" means a mission module for a Littoral Combat Ship combined with the crew detachment and support aircraft for such ship.

(2) MISSION MODULE.—The term "mission module" means the mission systems (including vehicles, communications, sensors, and weapons systems) combined with support equipment (including support containers and standard interfaces) and software (including software relating to the computing environment and multiple vehicle communications system of the mission package).

(3) REVISION THREE.—The term "revision three of the Littoral Combat Ship acquisition strategy" means the third revision of the Littoral Combat Ship acquisition strategy approved by the Under Secretary of Defense for Acquisition, Technology, and Logistics on March 29, 2016.

(e) Repeal of quarterly reporting requirement.—Section 126 of the National Defense Authorization Act for Fiscal Year 2013 (Public Law 112–239; 126 Stat. 1657) is amended—

(1) by striking subsection (b); and

(2) by striking "(a) Designation required.— ".

Section 1071 of S. 2943/P.L. 114-328 states:

SEC. 1071. Report on testing and integration of minehunting sonar systems to improve Littoral Combat Ship minehunting capabilities.

(a) Report to congress.—Not later than April 1, 2018, the Secretary of the Navy shall submit to the congressional defense committees a report that contains the findings of an assessment of all operational minehunting Synthetic Aperture Sonar (hereinafter referred to as "SAS") technologies suitable to meet the requirements for use on the Littoral Combat Ship Mine Countermeasures Mission Package.

(b) Elements.—The report required by subsection (a) shall include—

(1) an explanation of the future acquisition strategy for the minehunting mission package;

(2) specific details regarding the capabilities of all in-production SAS systems available for integration into the Littoral Combat Ship Mine Countermeasure Mission Package;

(3) an assessment of key performance parameters for the Littoral Combat Ship Mine Countermeasures Mission Package with each of the assessed SAS technologies; and

(4) a review of the Department of the Navy's efforts to evaluate SAS technologies in operation with allied Navies for future use on the Littoral Combat Ship Mine Countermeasures Mission Package.

> (c) System testing.—The Secretary of the Navy is encouraged to perform at-sea testing and experimentation of sonar systems in order to provide data in support of the assessment required by subsection (a).

FY2017 DOD Appropriations Act (H.R. 5293/S. 3000/H.R. 244/P.L. 115-31)

House

The House Appropriations Committee, in its report (H.Rept. 114-577 of May 19, 2016) on H.R. 5293 of the 114th Congress, recommends the funding levels shown in the HAC column of **Table 2**. The recommended net increase in LCS sea frame procurement funding of $313.567 million includes an increase of $384.1 million for the procurement of a third LCS in FY2017 (rather than two LCSs as requested), a decrease of $42.5 million for "Basic construction excess growth," a decrease of $3.933 million for "Other electronics cost growth," and a decrease of $24.1 million for "Other costs excess growth." (Page 155)

Regarding funding for LCS mission modules, the recommended reduction of $6.085 million for line 36 (LCS common mission modules equipment) is for "Mission bay training devices excess growth," the recommended reduction of $4.822 million for line 37 (LCS MCM mission modules) is for "ALMDS [Airborne Laser Mine Detection System] unit cost growth," and the recommended reduction of $9.216 million for line 39 (LCS SUW mission modules) is for "Mk-46 gun weapon system contract delays." (Page 164)

A June 14, 2016, statement of Administration policy on H.R. 5293 as reported states:

> *Restoration of Third Littoral Combat Ship*. The Administration strongly objects to the Committee's proposal to increase the purchase of Littoral Combat Ships (LCS) in FY 2017 from two to three. The FY 2017 Budget request reduced from 52 to 40 the total number of LCS and Frigates (FF) the Navy would purchase over the life of the program. A combined program of 40 LCS and FF would allow DOD to invest in advanced capabilities across the fleet and would provide sufficient capacity to meet the Department's warfighting needs and to exceed recent presence levels with a more modern and capable ship than legacy mine sweepers, frigates, and coastal patrol craft they would replace. By funding two LCS in FY 2017, the Budget request ensures that both shipyards are on equal footing and have robust production leading up to the competition to select the shipyard that would continue the program. This competitive environment ensures the best price for the taxpayer on the remaining ships, while also achieving savings by down-selecting to one shipyard. The bill prevents the use of resources for higher priorities to improve DOD's warfighting capability, such as undersea, other surface, and aviation investments.[35]

Senate

The Senate Appropriations Committee, in its report (S.Rept. 114-263 of May 26, 2016) on S. 3000 of the 114th Congress, recommends the funding levels shown in the SAC column of **Table 2**. The recommended increase of $475 million for procurement of LCSs is for the procurement of an additional LCS (for a total FY2017 procurement of three LCSs, rather than the two that were requested for FY2017). (Page 98)

[35] Executive Office of the President, *Statement of Administration Policy*, H.R. 5293—*Department of Defense Appropriations Act, 2017*, June 14, 2016, pp. 3-4.

The recommended reduction of $12.2 million for LCS common mission modules equipment (line 36) is for "Restoring acquisition accountability: Mission bay training devices—MCM." (Page 106) The recommended reduction of $22.6 million for MCM mission modules (line 37) includes a reduction of $11.8 million for "Restoring acquisition accountability: Unmanned surface sweep system ahead of need," and a reduction of $10.8 million for "Restoring acquisition accountability: Knifefish ahead of need." (Page 106) The recommended reduction of $32.0 million (the entire requested amount) for LCS ASW Mission Modules (line 38) is for "Restoring acquisition accountability: ASW mission module ahead of need." (Page 106) The recommended reduction of $1.4 million for SUW Mission Modules (line 39) is for "Restoring acquisition accountability: MK–46 gun weapons system prior year contract savings." (Page 106)

Conference

The final version of the FY2017 DOD appropriations act is Division C of H.R. 244/P.L. 115-31 of May 5, 2017, the Consolidated Appropriations Act, 2017. The explanatory statement for Division C of H.R. 244/P.L. 115-31 provides the funding levels shown in the appropriation conference column of **Table 2**.

The net increase of $438.067 million in SCN funding for procurement of LCSs includes an increase of $475 million for the procurement of an additional LCS, a reduction of $21 million for "Basic construction excess growth," a reduction of $3.933 million for "Other electronics cost growth," and a reduction of $12 million for "Other costs excess growth. (PDF page 152 of 372)

In the OPN account (PDF page 163 of 372):

- The reduction of $12.17 million for LCS common mission modules equipment (OPN account line 36) is for "Mission bay training devices excess growth."
- The reduction of $27.422 million for LCS MCM mission modules (OPN account line 37) includes a reduction of $4.822 million for "ALMDS [airborne laser mine detection system] unit cost growth," a reduction of $11.8 million for "Unmanned surface sweep system early to need," and a reduction of $10.8 million for "Knifefish early to need."
- The reduction of $31.952 million for LCS ASW mission modules (OPN account line 38) (i.e., the reduction of the entire requested amount) is for "ASW mission module early to need."
- The reduction of $1.402 million for LCS SUW mission modules (OPN account line 39) is for "MK-46 gun weapons system prior year contract savings."

Appendix. Defense-Acquisition Policy Lessons of LCS Program

In reviewing the LCS/FF program, one possible question concerns what defense-acquisition policy lessons, if any, the program may offer to policymakers, particularly in terms of the rapid acquisition strategy that the Navy pursued for the LCS program, which aimed at reducing acquisition cycle time (i.e., the amount of time between starting the program and getting the first ship into service).

One possible perspective is that the LCS program demonstrated that reducing acquisition cycle time can be done. Supporters of this perspective might argue that under a traditional Navy ship acquisition approach, the Navy might have spent five or six years developing a design for a new frigate or corvette, and perhaps another five years building the lead ship, for a total acquisition cycle time of perhaps 10 to 11 years. For a program announced in November 2001, this would have resulted in the first ship entering service in between late 2011 and late 2012. In contrast, supporters of this perspective might argue, LCS-1 entered service on November 8, 2008, about seven years after the program was announced, and LCS-2 entered service on January 16, 2010, a little more than eight years after the program announced. Supporters of this perspective might argue that this reduction in acquisition cycle time was accomplished even though the LCS incorporates major innovations compared to previous larger Navy surface combatants in terms of reduced crew size, "plug-and fight" mission package modularity, high-speed propulsion, and (in the case of LCS-2) hull form and hull materials.

Another possible perspective is that the LCS program demonstrated the risks or consequences of attempting to reduce acquisition cycle time. Supporters of this perspective might argue that the program's rapid acquisition strategy resulted in design-construction concurrency (i.e., building the lead ships before their designs were fully developed), a practice long known to increase risks in defense acquisition programs. Supporters of this perspective might argue that the cost growth, design issues, and construction-quality issues experienced by the first LCSs were due in substantial part to design-construction concurrency, and that these problems embarrassed the Navy and reduced the Navy's credibility in defending other acquisition programs. They might argue that the challenges the Navy faces today in terms of developing an LCS concept of operations (CONOPS),[36] LCS manning and training policies, and LCS maintenance and logistics plans were increased by the rapid acquisition strategy, because these matters were partly deferred to later years (i.e., to today) while the Navy moved to put LCSs into production. Supporters of this perspective might argue that the costs of the rapid acquisition strategy are not offset by very much in terms of a true reduction in acquisition cycle time, because the first LCS to be equipped with a mission package that has reached IOC (initial operational capability) will not occur until late FY2014—almost 13 years after the LCS program was announced. Supporters of this perspective could argue that the Navy could have avoided many of the program's early problems and current challenges—and could have had a fully equipped first ship enter service in 2011 or 2012—if it had instead pursued a traditional acquisition approach for a new frigate or corvette. They could argue that the LCS program validated, for defense acquisition, the guideline from the world of business management that if an effort aims at obtaining something fast, cheap, and good,

[36] A CONOPS is a detailed understanding of how to use the ship to accomplish various missions.

it will succeed in getting no more than two of these things,[37] or, more simply, that the LCS program validated the general saying that haste makes waste.

A third possible perspective is that the LCS program offers few if any defense-acquisition policy lessons because the LCS differs so much from other Navy ships and the Navy (and DOD generally) consequently is unlikely to attempt a program like the LCS in the future. Supporters of this perspective might argue that the risks of design-construction concurrency have long been known, and that the experience of the LCS program did not provide a new lesson in this regard so much as a reminder of an old one. They might argue that the cost growth and construction delays experienced by LCS-1 were caused not simply by the program's rapid acquisition strategy, but by a variety of factors, including an incorrectly made reduction gear[38] from a supplier firm that forced the shipbuilder to build the lead ship in a significantly revised and suboptimal construction sequence.

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[37] The guideline is sometimes referred to in the business world as "Fast, cheap, good—pick two."

[38] 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 propulsors.