

GAO

Report to the Subcommittee on
Seapower and Expeditionary Forces,
Committee on Armed Services, House
of Representatives

October 2007

DEFENSE ACQUISITIONS

Overcoming Challenges Key to Capitalizing on Mine Countermeasures Capabilities





Highlights of [GAO-08-13](#), a report to the Subcommittee on Seapower and Expeditionary Forces, Committee on Armed Services, House of Representatives

Why GAO Did This Study

The Navy initiated a move away from traditional minesweepers in favor of putting new kinds of anti-mine capabilities aboard ships with a variety of missions—most recently, the Littoral Combat Ship. In addition to a new ship, this approach includes several new systems and new operational concepts. GAO assessed the Navy's progress in (1) developing new mine countermeasures systems, including the Littoral Combat Ship, and (2) introducing these new capabilities to the fleet. To accomplish this, GAO reviewed Navy and program documents and previous GAO work. GAO supplemented its analysis with discussions with Navy and Department of Defense officials and contractors.

What GAO Recommends

GAO is recommending that the Department of Defense analyze intelligence preparation capabilities, determine if Littoral Combat Ship concepts of operation can be reconciled, examine the need for and feasibility of fielding mine countermeasures systems on other ships, and delay full-rate production of certain systems. The Department of Defense concurred or partially concurred with the first three recommendations. It did not agree to delay full-rate production of systems, citing training needs and production efficiencies. GAO maintains that a delay is warranted as long as the Littoral Combat Ship remains the systems' main platform.

To view the full product, including the scope and methodology, click on [GAO-08-13](#). For more information, contact Paul Francis at (202) 512-4841 or francis@gao.gov.

DEFENSE ACQUISITIONS

Overcoming Challenges Key to Capitalizing on Mine Countermeasures Capabilities

What GAO Found

The Navy has made progress developing individual mine countermeasures systems and the Littoral Combat Ship. The Navy expects 3 of the 19 systems it is developing to be ready for fleet use by the end of 2007, and recent test results have been promising. However, significant challenges remain to fielding new capabilities.

- Operational testing plans for four systems in limited production will not provide a complete understanding of how the systems will perform when operated from the Littoral Combat Ship. Other ships will be used in testing to inform full-rate production decisions on the individual systems. While other ships may serve as platforms for the anti-mine systems, the Littoral Combat Ship is their primary platform, and it will have different launch, recovery, and handling systems. In addition, Navy plans call for testing these systems in smooth, uncluttered environments, although operating environments are expected to be less favorable.
- The first two Littoral Combat Ships have encountered design and production challenges. Costs are expected to more than double from initial estimates, and the Navy anticipates lead ship delivery nearly 18 months later than first planned. This may slow the planned transition from current mine countermeasures platforms.
- The Navy has reduced its investments in intelligence preparation of the environment capabilities—including the capability to locate and map minefield boundaries—even though improvements in this area could reduce mine countermeasures mission timelines by 30 to 75 percent. These capabilities are especially important for the Littoral Combat Ship, as it must stand clear of suspected minefields.

The Navy has refined its concepts of operation for the Littoral Combat Ship, increasing awareness of operational needs. However, the Navy has not yet reconciled these concepts with the ship's physical constraints, and the trade-offs involved ultimately will determine the ship's capabilities. For example, operation of mine countermeasures systems is currently expected to exceed the personnel allowances of the ship, which could affect the ship's ability to execute this mission. In addition, the Littoral Combat Ship will have only limited capability to conduct corrective maintenance aboard. However, because the Navy recently reduced the numbers of certain mission systems from two to one per ship, operational availability for these systems may decrease below current projections. Moreover, the mine countermeasures mission package currently exceeds its weight limitation, which may require the Navy to accept a reduction in speed and endurance capabilities planned for the Littoral Combat Ship. It is important that the Navy assess these uncertainties and determine whether it can produce the needed mine countermeasures capabilities from the assets it is likely to have and the concepts of operation it can likely execute.

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United States Government Accountability Office
Washington, DC 20548

October 12, 2007

The Honorable Gene Taylor
Chairman
The Honorable Roscoe G. Bartlett
Ranking Member
Subcommittee on Seapower and Expeditionary Forces
Committee on Armed Services
House of Representatives

Sea mines offer potential enemies a low-cost, simple-to-deploy, and sometimes highly effective weapon against U.S. Navy ships. These mines currently exist in more than 300 different forms and are possessed by over 50 countries. Since 1950, enemy sea mines have directly caused damage to or destruction of 15 Navy ships—more than all other weapons combined. After mines damaged two U.S. ships during Operation Desert Storm, the Navy renewed its focus on defeating enemy sea mines and began to develop several new mine countermeasures systems. It initiated a move away from traditional minesweepers—ships dedicated chiefly to mine countermeasures—in favor of putting anti-mine capabilities aboard other ships. Initial plans called for these systems to be deployed from aircraft carriers, amphibious ships, surface combatants, and submarines.

More recently, the Navy has decided to employ the Littoral Combat Ship as its primary platform for conducting mine countermeasures. The Littoral Combat Ship is envisioned as a new kind of vessel that will be able to be reconfigured to meet three different missions including mine countermeasures, anti-submarine warfare, and surface warfare. To execute its mine countermeasures mission, the Littoral Combat Ship will transport manned and unmanned systems to suspected minefields and deploy them while the ship remains clear of the minefield. The ship will rely upon “intelligence preparation of the environment”—an approach used to reduce uncertainties concerning the enemy, environment, and terrain—to designate minefield boundaries. The Navy currently plans to invest over \$9 billion in Littoral Combat Ships.

In recent years, the Navy’s required annual update of its master plan outlining its progress developing new mine countermeasures capabilities has begun to reflect tightening fiscal constraints across mine countermeasures programs and increasing mission responsibilities for the Littoral Combat Ship. In light of these developments, you asked us to

review the Navy's acquisition plans for mine countermeasures systems. In response to your request, we assessed the Navy's progress and identified remaining challenges in (1) developing new mine countermeasures systems, including the Littoral Combat Ship, and (2) introducing these new capabilities to the fleet.

To assess the Navy's progress and identify remaining challenges to developing new mine countermeasures systems, we reviewed program documents, including acquisition strategies, requirements documents, test plans and reports, and cost and schedule performance reports. To supplement our analysis, we held discussions with a number of Navy offices, Department of Defense agencies, and contractor officials responsible for acquiring and testing the Littoral Combat Ship, its mine countermeasures mission package, and other mine countermeasures systems external to the Littoral Combat Ship. We also drew from our prior work on these systems. To assess progress and identify remaining challenges associated with introducing new mine countermeasures systems to the fleet, we analyzed concepts of operation for the Littoral Combat Ship and mine warfare campaign analyses. We corroborated this information through discussions with Navy operational forces and commands, the Navy's assessments directorate, and the Office of the Secretary of Defense. For more information on the methodology used in this report, see appendix I. We conducted our analysis from October 2006 to August 2007 in accordance with generally accepted government auditing standards.

Results in Brief

The Navy has made progress developing individual mine countermeasures systems and the Littoral Combat Ship. The Navy has authorized production for 5 of the 19 systems it is developing, 3 of which it expects to be ready for fleet use by the end of 2007. Several of these new systems have shown promising performance in recent testing. However, significant challenges remain to fielding these new capabilities.

- Operational testing for four systems in limited production—all planned to deploy from the Littoral Combat Ship—will not provide a complete understanding of how the systems will perform when they are operated from the ship. Ships other than the Littoral Combat Ship will be used in this testing and will serve as the basis for making full-rate production decisions on the individual systems. While other ships may be capable of serving as platforms for the mine countermeasures systems, the Littoral Combat Ship is their primary platform, and it will have different launch and recovery systems from the other ships. In addition, Navy

plans call for testing of these systems in smooth, uncluttered sea environments, which represent favorable conditions for conducting mine countermeasures, while the Navy expects undersea operating environments to be more rocky and cluttered.

- The first two Littoral Combat Ship seaframes have encountered design and production challenges, resulting in significant cost growth. The Navy expects the ships to exceed their initial budgets by over 100 percent and anticipates lead ship delivery will occur nearly 18 months later than initially planned. These issues may slow the Navy's planned transition from current mine countermeasures platforms to the Littoral Combat Ship.
- The Navy has reduced its investments in intelligence preparation capabilities—including the capability to locate and map minefield boundaries—even though improvements in this area could reduce mine countermeasures mission timelines by 30 to 75 percent. These capabilities are especially important for the Littoral Combat Ship, as it must stand clear of suspected minefields.

The Navy has refined its concepts of operation for the Littoral Combat Ship. This has produced a better understanding of operational needs. At the same time, the physical constraints of the ship have become better understood, and they may limit the Navy's ability to implement the operational concepts, resulting in less capability than currently expected. For example, the ship's ability to complete operations within desired operational timelines remains unclear. The physical characteristics of the seaframe have yet to be fully reconciled with manning and sustainment concepts. Operation of mine countermeasures systems is currently expected to exceed the personnel allowances of the Littoral Combat Ship seaframe. In addition, many of the systems within this mission package were designed for fielding from larger platforms with more robust onboard maintenance facilities than those offered by the Littoral Combat Ship. The Littoral Combat Ship will have a limited capability to conduct corrective maintenance aboard. Furthermore, the Navy has recently reduced some mission system quantities from two to one per ship. These quantity reductions may decrease operational availability for these systems below current projections. Moreover, the mine countermeasures mission package currently exceeds its weight limitation, a fact that may require the Navy to accept a reduction in speed and endurance capabilities planned for the Littoral Combat Ship. Alternatively, the Navy could alter its concepts of operation. Acknowledging these challenges, the Office of

the Secretary of Defense recently directed the Navy to revisit its planned number of mission packages and associated system spares.

We are making several recommendations to the Secretary of Defense aimed at improving the department's transition to the Littoral Combat Ship, including the following: (1) analyzing whether capabilities resulting from current intelligence preparation investments will enable the Littoral Combat Ship to meet required mission timelines, (2) determining the extent to which concepts of operation and the likely performance of the Littoral Combat Ship and other assets can be reconciled to provide the needed mine countermeasures capability, (3) evaluating the need for and feasibility of fielding mine countermeasures systems on other platforms in addition to the Littoral Combat Ship, and (4) delaying approval of full-rate production for systems within the mine countermeasures mission package until operational testing is successfully completed from their primary platform, presently identified as the Littoral Combat Ship. The Department of Defense agreed or partially agreed with most of our recommendations, but did not agree with our recommendation aimed at ensuring an accurate understanding of operational suitability for new mine countermeasures systems. The department stated that delaying full-rate production for these systems would result in gaps in industrial production, cost increases, and delays in delivering mine warfare capability to operational forces. However, we do not believe full-rate production of new mine countermeasures systems is warranted until the Department of Defense has ensured they are compatible with the unique operating environment posed by their primary platform, the Littoral Combat Ship.

Background

Mine countermeasures involves detecting, classifying, localizing, identifying, and neutralizing enemy sea mines in areas ranging from deep water through beach zones against the full spectrum of bottom, moored, floating, buried, stealthy, contact, and influence mines. The Navy's mine countermeasures strategy focuses on closing identified capability gaps, measurably reducing timelines for deployment and the detect-to-engage sequence for mine countermeasures systems, and removing the sailor from the minefield. To achieve these goals, the Navy is transitioning from current dedicated mine countermeasures ships, helicopters, and manned undersea assets to the Littoral Combat Ship as its primary mine countermeasures platform of the future.

Mine countermeasures missions can require mine hunting, mine neutralization, and minesweeping. Mine hunting involves towing sonar devices that detect and classify objects in the ocean and on the ocean

bottom. The Navy marks the coordinates of any objects classified as minelike for later destruction. Mine neutralization requires placing an explosive charge near the mine target in order to destroy the mine in place. This task is currently performed by Navy explosive ordnance disposal divers, marine mammals, or mechanical systems. Minesweeping includes towing devices that either (1) mechanically cut the lines holding mines in place or (2) simulate the magnetic or acoustic signatures of a passing ship, resulting in mine detonation. Mines that have been mechanically swept are typically destroyed by divers after severing.

For more than a decade, the Navy has pursued a transformation in the way it conducts mine countermeasures operations. Until now, the Navy has relied on 14 MCM 1 Avenger-class ships and 12 MHC 51 Osprey-class vessels to conduct surface mine countermeasures operations. These ships are slow-moving, requiring transport to theater by another ship, but designed with features such as fiberglass-sheathed wooden hulls that enable them to operate within minefields.¹ While the Navy has retired all but four of its Osprey-class ships, it plans to maintain its full complement of Avenger-class ships until 2017 to enable the Littoral Combat Ship and its mine countermeasures systems to be fielded in sufficient quantities. To support these plans, the Navy is currently upgrading Avenger-class combat systems and mechanical equipment to improve the mission effectiveness of these ships.

The Navy also relies upon the MH-53E Sea Dragon helicopter to perform airborne mine countermeasures missions. The MH-53E is a large aircraft that operates from shore bases or ships of opportunity—often amphibious ships with flight decks. The Navy's 31 MH-53E helicopter airframes are rapidly approaching the end of their planned service lives. To sustain this capability, the Navy has, to date, funded a fatigue life extension program for 20 MH-53E aircraft, which will enable these airframes to be structurally reinforced. The Navy plans to retire its MH-53E helicopters from service beginning in 2015.

The Littoral Combat Ship represents the Navy's mine countermeasures platform of the future. It is fast-moving and designed to transport manned and unmanned mine countermeasures systems to the vicinity of the minefield and deploy them while remaining clear of the minefield. Its design concept consists of two distinct parts—the ship itself and the

¹MHC 51 Osprey-class hulls are made of glass-reinforced plastic fiberglass.

mission package it carries and deploys. For the Littoral Combat Ship, the ship is referred to as the seaframe and consists of the hull; command and control systems; automated launch, recovery, and handling systems; and certain core systems like the radar and 57-millimeter gun. The Navy is designing the seaframe to meet speed, endurance, weight, manning, and cost parameters. The Littoral Combat Ship's mine countermeasures capability will be embedded within its mission package. The Navy is also developing and procuring systems to support anti-submarine warfare and surface warfare mission packages. The Navy's acquisition approach is to populate initial versions of these mission packages with a mixture of developmental and production-representative systems, gradually moving to all production-representative systems that constitute the baseline configuration for each package. Table 1 shows how the Navy is employing this approach for its first four mine countermeasures mission packages.

Table 1: Littoral Combat Ship Mine Countermeasures Mission Package Configurations (Quantities of Individual Mission Systems Identified in Parentheses)

	Mission package 1	Mission package 2	Mission package 3	Mission package 4 (baseline configuration)
Planned delivery date	Fiscal year 2007	Fiscal year 2009	Fiscal year 2010	Fiscal year 2011
Production-representative mission systems included	<ul style="list-style-type: none"> • AN/AQS-20A Sonar (2) • Airborne Laser Mine Detection System (1) 	<ul style="list-style-type: none"> • AN/AQS-20A Sonar (3) • Airborne Laser Mine Detection System (2) • Airborne Mine Neutralization System (2) • Remote Multi-Mission Vehicle (2) 	<ul style="list-style-type: none"> • AN/AQS-20A Sonar (3) • Airborne Laser Mine Detection System (1) • Airborne Mine Neutralization System (1) • Remote Multi-Mission Vehicle (2) • Organic Airborne Surface Influence Sweep System (1) • Coastal Battlefield Reconnaissance and Analysis System (1) 	<ul style="list-style-type: none"> • AN/AQS-20A Sonar (3) • Airborne Laser Mine Detection System (1) • Airborne Mine Neutralization System (1) • Remote Multi-Mission Vehicle (2) • Organic Airborne Surface Influence Sweep System (1) • Coastal Battlefield Reconnaissance and Analysis System (2) • Rapid Airborne Mine Clearance System (1) • Unmanned Surface Vehicle (1) • Unmanned Surface Sweep System (1)
Engineering development models included	<ul style="list-style-type: none"> • Battlespace Preparation Autonomous Undersea Vehicle (2) • Airborne Mine Neutralization System (1) • Remote Multi-Mission Vehicle (1) • Unmanned Surface Vehicle (1) • Unmanned Surface Sweep System (1) 	<ul style="list-style-type: none"> • Unmanned Surface Vehicle (1) • Unmanned Surface Sweep System (1) 	<ul style="list-style-type: none"> • Unmanned Surface Vehicle (1) • Unmanned Surface Sweep System (1) 	
Estimated unit cost	\$37.7 million	\$66.0 million	\$65.3 million	\$76.2 million

Source: Navy.

Note: Mission package cost figures are in fiscal-year 2005 dollars and do not include procurement costs for the Littoral Combat Ship mission package computing environment, mission package backfit costs, stowage containers, MH-60S helicopter, or Vertical Take-off and Landing Tactical Unmanned Aerial Vehicles.

The mine countermeasures mission package capability is made up of airborne mine countermeasures systems employing the MH-60S helicopter, unmanned underwater vehicles, unmanned aerial vehicles, and unmanned surface vehicles. To operate these mission package systems, the Navy will deploy additional crew members with the Littoral Combat Ship and plans to assign each mine countermeasures-configured Littoral Combat Ship an MH-60S helicopter sourced from an expeditionary squadron. The full suite of Littoral Combat Ship countermine systems will be used to hunt, neutralize, and sweep mines as the operational need dictates.

In addition to the mine countermeasures capability resident on the Littoral Combat Ship, the Navy is developing unmanned underwater vehicles launched from submarines. These vehicles will provide clandestine minefield mapping capability, enabling advance intelligence preparation of the environment, and detection of changes within the ocean environment. Intelligence gathering of suspected waters is a necessary precursor to deploying the Littoral Combat Ship, as the ship itself must stay clear of the mined area. Intelligence preparation of the environment is necessary to determining appropriate tactics, planning mine countermeasures missions, managing and evaluating the performance of sensors and systems, and assessing battle damage.

The Under Secretary of Defense for Acquisition, Technology, and Logistics is statutorily required to be primarily responsible for developing and testing naval mine countermeasures.² The Secretary of Defense may waive this requirement if he certifies certain matters to the congressional defense committees to include that the Secretary of the Navy submitted a master plan outlining its progress toward developing new mine countermeasures capabilities and the budget provides sufficient resources for executing the updated mine countermeasures master plan.³

² National Defense Authorization Act for Fiscal Years 1992 and 1993, Pub. L. No. 102-190, § 216 (a), as amended by the National Defense Authorization Act for Fiscal Year 1996, Pub. L. No. 104-106, § 215. The National Defense Authorization Act for Fiscal Year 2000, Pub. L. No. 106-65, § 911(a)(1) re-designated the position of the Under Secretary of Defense for Acquisition and Technology in the Department of Defense to the Under Secretary of Defense for Acquisition, Technology, and Logistics.

³In accordance with the National Defense Authorization Act for Fiscal Years 1992 and 1993, Pub. L. No. 102-190, § 216, as most recently amended by the National Defense Authorization Act for Fiscal Year 2006, Pub. L. No. 109-163, § 216.

Current Acquisition and Testing Challenges Could Affect the Navy's Ability to Transition to New Mine Countermeasures Systems

The Navy has made progress in developing new mine countermeasures systems and platforms, including the Littoral Combat Ship, but significant challenges remain to fielding these capabilities. Current test plans for systems that will be operated from the Littoral Combat Ship do not require testing from this platform prior to entering full-rate production. In addition, planned test environments for these systems may not be realistic as compared to current threat environments. As a result, the Navy may develop an incomplete understanding of the operational suitability and effectiveness of mine countermeasures systems it plans to field on the Littoral Combat Ship. Also, unanticipated design and production challenges with the first two Littoral Combat Ships have increased program costs and required the Navy to delay purchase of additional seaframes. This may slow the Navy's planned transition from current mine countermeasures platforms to the Littoral Combat Ship. Finally, limited planned investment for new intelligence preparation of the environment capabilities, including capability to locate and map minefield boundaries, increases risk to the safety of the Littoral Combat Ships operating inside minefields and extends the amount of time required to complete mine countermeasures missions.

The Navy Has Made Progress Developing New Mine Countermeasures Systems

The Navy is in the process of developing 16 new systems to provide future mine hunting, mine neutralization, and minesweeping capability to the joint forces. To date, the Navy has authorized production for five new systems, three of which are expected to enter the fleet by the end of 2007. Beyond these, six systems are in varying stages of system development, while the Navy continues science and technology efforts for another five systems. Table 2 outlines the Navy's progress developing and fielding these capabilities.

Table 2: Navy's Progress Developing and Fielding Systems Intended to Hunt, Neutralize, and Sweep Sea Mines

Mission	System	Description	Host platform	Development status	Planned fielding date
Mine hunting	Coastal battlefield reconnaissance and analysis system	Provides intelligence preparation of the battlefield information, which accurately depicts tactical objectives, minefields, and obstacles in the surf zone, on the beach, and through the beach exit during amphibious and expeditionary operations; future increments planned will provide active (day/night), surf zone, buried minefield detection, and real-time processing capabilities	MQ-8B Fire Scout vertical takeoff and landing tactical unmanned aerial vehicle on the Littoral Combat Ship	Low-rate initial production	2007
	AN/AQS-20A sonar	Provides for identification of bottom mines in shallow water and detection, localization, and classification of bottom, close-tethered, and volume mines in deep water	MH-60S helicopter and/or the Remote Multi-Mission Vehicle on the Littoral Combat Ship	Low-rate initial production	2007
	Remote minehunting system	Underwater vehicle towing the AN/AQS-20A sonar to detect, classify, locate, and identify minelike objects	Littoral Combat Ship primarily, but six Arleigh Burke-class destroyers (DDG 91-96) are also capable	Low-rate initial production	2008
	SQQ-32 with high-frequency wideband	Detects, classifies, and localizes bottom, close-tethered, and volume mines in deep water using high-frequency broadband sonar	MCM 1 Avenger class ships	System development	2009
	Airborne laser mine detection system	Detects, classifies, and localizes floating and near-surface moored mines in deep water	MH-60S helicopter on the Littoral Combat Ship	Low-rate initial production	2011
	Surface mine countermeasures unmanned undersea vehicle with low-frequency broadband	Detects bottom and buried mines in shallow water using low-frequency broadband sonar	MCM 1 Avenger class ships and Littoral Combat Ship	Science and technology	2011
	Search-classify-map unmanned undersea vehicle	Performs mine reconnaissance and maps near-shore areas of the littorals for mines and minefields	Small boats	Science and technology	TBD
	Inspect/identify unmanned undersea vehicle	Provides detection of capability of floating, near-surface, and volume mines in very shallow water environments	To be determined	Science and technology	TBD
Joint direct attack munitions assault breaching system	Neutralizes surface-laid mines and obstacles in the beach and surf zones	Air Force bombers or naval tactical aircraft	Production	2007	
Mine neutralization	Expendable mine neutralization system	Neutralizes volume, close-tethered, and bottom mines in shallow water	MCM 1 Avenger class ships	System development	2008

Mission	System	Description	Host platform	Development status	Planned fielding date
	Airborne mine neutralization system	Positively identifies and explosively neutralizes unburied bottom and moored sea mines in shallow water that are impractical or unsafe to counter using existing minesweeping systems	MH-60S helicopter on the Littoral Combat Ship	System development	2009
	Rapid airborne mine clearance system	Mounted 30-millimeter gun firing supercavitating projectiles to neutralize near-surface and floating moored mines	MH-60S helicopter on the Littoral Combat Ship	System development	2010
	Countermine system	Neutralizes buried and surface-laid surface mines in the beach and surf zones	Air Force bombers or naval tactical aircraft	System development	2016
	Autonomous unmanned undersea vehicle	Provides neutralization of floating and near-surface mines in very shallow water environments	To be determined	Science and technology	TBD
	Organic airborne and surface influence sweep system	Provides organic, high-speed magnetic/acoustic influence minesweeping capability where mine hunting is not feasible (adverse environmental conditions)	MH-60S helicopter on the Littoral Combat Ship	System development	2010
Mine sweeping	Unmanned surface vehicle sweep system	Micro-turbine-powered magnetic towed cable and acoustical signal generator towed from a rigid hull inflatable boat	Littoral Combat Ship	Science and technology	2010

Source: Navy.

Recent Navy testing of several of these new mine countermeasures systems has produced encouraging results. The Navy has completed over 1,000 hours of offshore vehicle operations using the Remote Minehunting System—demonstrating performance in several key performance parameters—and has installed this system on the USS *Bainbridge* for operational test and evaluation. The Navy has also completed initial integration for four of the five new airborne systems it plans to deploy using the MH-60S helicopter. Sensor performance during testing for these airborne systems has met or exceeded Navy expectations—particularly for the AN/AQS-20A sonar, Airborne Laser Mine Detection System, and Airborne Mine Neutralization System, which have demonstrated significant progress toward achieving their key performance parameters.

Testing Limitations Could Preclude a Full Understanding of System Suitability and Effectiveness

Several of the mine countermeasures systems have begun or are planned to shortly begin operational testing. These tests aim at assessing operational suitability and operational effectiveness. Operational suitability is concerned with placing and sustaining the system when fielded and is concerned with, for example, how long a system can operate before failing and how quickly a system can be repaired. Operational effectiveness measures the overall ability of a system to accomplish a mission; in the case of a mine countermeasures system, effectiveness measures may be concerned with the frequency of accurately detecting the presence of a mine or the speed at which a system can cover a particular area.

Of the 16 mine hunting, neutralization, or sweeping systems in development, the Navy plans to field at least 9 on the Littoral Combat Ship as part of its mine countermeasures mission package. The Navy approved many of these nine systems to enter system development on the basis of earlier plans to field them on aircraft carriers, amphibious ships, and guided missile destroyers. As a result, the Navy's acquisition and testing plans for these systems do not require operational test and evaluation onboard the Littoral Combat Ship prior to entering full-rate production. Table 3 outlines these plans.

Table 3: Dates of Operational Test and Evaluation and Initial Littoral Combat Ship Testing for Mine Countermeasures Systems in Development

System	Expected date of operational test and evaluation	Expected date of first testing from Littoral Combat Ship ^a
AN/AQS-20A sonar	Fiscal year 2007	Fiscal year 2009
Remote minehunting system	Fiscal year 2008	Fiscal year 2009
Airborne laser mine detection system	Fiscal year 2008	Fiscal year 2009
Airborne mine neutralization system	Fiscal year 2008	Fiscal year 2009
Coastal battlefield reconnaissance and analysis system	Fiscal year 2008 ^b	Fiscal year 2009
Organic airborne and surface influence sweep system	Fiscal year 2009	Fiscal year 2009
Rapid airborne mine clearance system	Fiscal year 2010	Fiscal year 2009
Surface mine countermeasures unmanned undersea vehicle with low-frequency broadband	Fiscal year 2010	Fiscal year 2009
Unmanned surface sweep system	To be determined	To be determined

Source: Navy.

^aThis testing will demonstrate systems interface and usage aboard ship as part of the planned Littoral Combat Ship operational assessment.

^bRepresents date of operational assessment for first increment.

The Navy plans to make full-rate production decisions for many of these systems using performance data collected during operational testing aboard existing ships. For example, the Navy intends to operationally test and evaluate the Remote Minehunting System using an Arleigh Burke-class guided missile destroyer. Similarly, the Navy plans to test airborne mine countermeasures systems using their intended aircraft—the MH-60S helicopter—but will service and base these tests from existing fleet assets or shore.

While existing ships may serve as platforms for these systems, the Littoral Combat Ship is the primary platform. The other ships cannot replicate the unique conditions that will be found onboard the Littoral Combat Ship, a fact that could place the Navy at risk for overestimating the operational suitability of its new mine countermeasures systems. For instance, the Navy plans to move, load, and deploy all Littoral Combat Ship mine countermeasures systems using an automated launch, recovery, and handling system. This system is newly designed and is necessary to achieve reduced manning onboard each Littoral Combat Ship. Because the launch, recovery, and handling system is fully integrated with each seaframe, the Navy will not be able to test this system with mine countermeasures systems until a Littoral Combat Ship is delivered to the fleet in 2009. As a result, the Navy may not have a complete understanding of the suitability of these systems to operate from the Littoral Combat Ship.

Also, the Office of the Secretary of Defense's Director, Operational Test and Evaluation, noted in a fiscal year 2006 report that the delivery schedule for the first Littoral Combat Ship omits significant events normally associated with lead ships, including analysis of performance characteristics. The report also noted that the delivery schedule does not allow for an adequate initial operational test and evaluation of the ship to make informed decisions. Because the Navy has not proposed a test and evaluation strategy that allows acquisition decisions to be informed by timely reporting of adequate operational test results, the Director, Operational Test and Evaluation, has not yet approved the Navy's test and evaluation master plan for the Littoral Combat Ship.

Further, the Navy is testing the performance of new mine countermeasures systems in an A-1 environment, which is the least stressing environments for these systems to detect, identify, neutralize,

and/or sweep for mines.⁴ While this testing approach is consistent with achieving threshold performance levels, as outlined in each system's key performance parameters, the Littoral Combat Ship is expected to perform its mine countermeasures mission in more rocky and cluttered underwater environments that contain rugged terrain and many different objects that could be mistaken for mines. The Director, Operational Test and Evaluation, has reported that the testing of subsurface systems associated with the Littoral Combat Ship needs to be conducted in operationally realistic littoral environments. Testing in unrealistic environments increases risk that systems may not perform effectively when operated from the Littoral Combat Ship.

In addition, the AN/AQS-20A sonar, Airborne Laser Mine Detection System, Airborne Mine Neutralization System, Organic Airborne and Surface Influence Sweep System, and Rapid Airborne Mine Clearance System will perform their missions from an MH-60S Block 2A or 2B helicopter the Navy intends to assign to each Littoral Combat Ship.⁵ The Navy plans to acquire 69 Block 2A aircraft and 148 Block 2B capable aircraft, which will support a variety of missions, including mine countermeasures. In addition, the Navy has identified funding to retrofit 42 Block 2A aircraft to the Block 2B configuration, minus the capability to employ the Rapid Airborne Mine Clearance System. However, due to strong demand for the MH-60S across the fleet, as well as the Block 2B version only recently entering production, the Navy has had difficulty allocating operationally representative helicopters to complete developmental testing of mine countermeasures systems. As a result, the Navy has used surrogate platforms including the MH-53E helicopter to complete developmental tests for many of these systems. However, the Navy may not be able to replicate the level of performance demonstrated in these tests when the systems are operated from the MH-60S. Furthermore, because previous technical challenges have delayed the fielding of new mine countermeasures systems, several systems will be

⁴The Navy classifies sea floor (bottom) types as either A, B, C, or D depending on floor composition, predicted mine case burial, and degree of roughness. The Navy categorizes the amount of clutter in the water as 1, 2, or 3 depending on the amount of non-mine bottom objects per square nautical mile. The A-1 environment has smooth surfaces and zero to few objects that could be mistaken for mines.

⁵The MH-60S Block 2A helicopter is designed to employ the AN/AQS-20A sonar and Airborne Laser Mine Detection System. The Block 2B helicopter is designed to operate these two systems plus the Airborne Mine Neutralization System, Organic Airborne and Surface Influence Sweep System, and Rapid Airborne Mine Clearance System.

competing for MH-60S flight testing at the same time, potentially requiring the Navy to further modify its test plans for these systems, a possibility that could affect their planned fielding dates within the fleet.

Continuing technical challenges with the MH-60S carriage, stream, tow, and recovery system could further affect Navy test plans for mine countermeasures systems. The carriage, stream, tow, and recovery system includes a winch, tow cable, and an external carriage/docking mechanism and is used by the MH-60S to lower the AN/AQS-20A sonar, the Airborne Mine Neutralization System, and the Organic Airborne and Surface Influence Sweep System into the water, and then later to recover the systems. According to Navy officials, the system's tow cable has not worked properly in recent testing with the Organic Airborne and Surface Influence Sweep System. If this cable continues to malfunction in testing, the Navy may have to redesign the tow cable and/or the carriage, stream, tow, and recovery system, possibly further delaying operational testing of mine countermeasures systems from MH-60S aircraft.

Slower Delivery of Littoral Combat Ships May Affect the Navy's Planned Transition from Legacy Mine Countermeasures Platforms

Littoral Combat Ship seaframe construction has progressed on both lead ship designs, although both seaframes have substantial design changes, schedule delays, and cost growth. The Navy expects the first two Littoral Combat Ships to exceed their combined budget of \$472 million by over 100 percent and anticipates lead ship delivery will occur nearly 18 months later than initially planned. An expanded discussion of Littoral Combat Ship design and production challenges can be found in appendix III. As a result of these challenges, the Navy canceled construction of the third Littoral Combat Ship after failing to reach agreement with the prime contractor to modify the existing cost basis contract to a fixed price contract. Also, Littoral Combat Ship cost growth has required the Navy to defer construction of additional seaframes. The Navy plans to use funds previously appropriated for construction of the fifth and sixth Littoral Combat Ships to instead pay for cost growth on the remaining three ships under contract. Finally, the Navy is modifying its acquisition strategy for the Littoral Combat Ship and now plans to conduct an evaluation in 2009 prior to selecting a single design for the acquisition of the next increment of Littoral Combat Ships, called Flight 1.

These acquisition challenges create a disconnect between the availability of mine countermeasures systems—several of which are scheduled to field in 2007—and the availability of Littoral Combat Ships to deploy them. Delays could also affect the Navy's plan to transfer mission responsibilities from current airborne and surface mine countermeasures assets to Littoral

Combat Ships beginning in 2015 if sufficient numbers of Littoral Combat Ships are not fielded by that time. According to some Navy officials, this risk could be mitigated by deploying new mine countermeasures systems from other surface ships, including destroyers, amphibious ships, and aircraft carriers. These officials report that this action may require the Navy to upgrade certain engineering or computing systems on these vessels, but note that the Navy has already borne such costs on six Arleigh Burke-class destroyers modified to accommodate the Remote Minehunting System. Despite these capability improvements, the Navy has significantly scaled back plans to field the Remote Minehunting System from the destroyers.

Limited Planned Investment for New Intelligence Preparation Capabilities Could Affect Mission Timelines

While the Navy has made significant investment in new mine countermeasures systems and the Littoral Combat Ship, planned investments for intelligence preparation of the environment capabilities have been reduced. The Littoral Combat Ship relies on intelligence preparation capabilities to a greater degree than existing dedicated mine countermeasures ships. As these capabilities degrade, the distance at which the Littoral Combat Ship must stand off from a suspected minefield can be expected to increase. This situation could impact the Littoral Combat Ship's ability to achieve desired mission timelines. The Navy estimates that intelligence preparation of the environment could reduce mine countermeasures mission timelines by 30 to 75 percent.

The Littoral Combat Ship is not designed to operate in a minefield. Instead, the Navy intends the ship to stand off from the minefield and deploy its sensors forward. As a result, the Littoral Combat Ship is designed to perform to Level 1 survivability requirements. Level 1 includes minimal survivability features and is the standard for existing mine countermeasures ships in the fleet. However, these ships are designed with unique features—including hulls that minimize magnetic signatures—that enable them to operate in minefields. Typically, surface combatants like the Littoral Combat Ship are designed to Level 3 survivability. As a result, the Director, Operational Test and Evaluation, has previously recommended that the Navy assess the risks to be sure Level 1 survivability is sufficient for the Littoral Combat Ship. Since then, the Navy has maintained its intent for the Littoral Combat Ship to have Level 1 survivability. Accordingly, the Littoral Combat Ship will require intelligence preparation of the environment to conduct its mine countermeasures mission while remaining outside of the minefield. Intelligence preparation of the environment will serve to map the boundaries of the minefield and subsequently reduce risk to the

warfighters who will be operating the mine countermeasures systems from the Littoral Combat Ship. However, as table 4 shows, according to current development and fielding plans for intelligence preparation of the environment systems, the Navy will not have the assets in place to perform these functions when Littoral Combat Ships enter the fleet.

Table 4: Mine Countermeasure Systems That Will Perform the Intelligence Preparation of the Environment Mission

System	Description	Host platform	Development status	Planned fielding date
Battlespace preparation autonomous undersea vehicle	Uses side scan sonar and environmental sensors to support mine reconnaissance and intelligence preparation of the environment	Littoral Combat Ship	System development	2007 (engineering development model only will be fielded; there is no program funding for procurement)
Mission reconfigurable unmanned undersea vehicle system	Conducts autonomous, clandestine intelligence preparation of the environment in support of mine countermeasures missions	Nuclear submarines	Technology development	2016
Littoral remote sensing	Conducts wide-area surveillance of the near-shore environment using remote surveillance and reconnaissance assets	Various platforms	Science and technology	To be determined

Source: Navy.

Currently, intelligence preparation of the environment capability is provided to a limited degree through the mine countermeasures and environmental decision aids library, which is a software-based collection of meteorological and oceanographic condition data gathered by survey ships. However, the Navy has reduced funding for additional systems intended to perform the battlespace preparation mission necessary for the Littoral Combat Ship. For example, the Navy reduced its planned funding for the Mission Reconfigurable Unmanned Undersea Vehicle System by \$200 million across the future years defense program in its fiscal year 2008 budget request, resulting in a delay to initial operational capability of this system from 2013 to 2016. This decision follows a series of program delays, starting with the predecessor Long-term Mine Reconnaissance System program. After completing approximately 95 percent of the Long-term Mine Reconnaissance System’s design, the Navy canceled acquisition plans for 12 operational systems due to cost growth and remaining technical challenges facing the program. Also, the Battlespace Preparation Autonomous Undersea Vehicle, which the Navy previously planned to include in the baseline configuration of the Littoral Combat Ship mine countermeasures mission package, will now only be in the form of an

engineering development model, not a fully developed system. In addition, while development of the Surface Mine Countermeasures Unmanned Undersea Vehicle with Low Frequency Broadband capabilities offers potential benefits for intelligence preparation of the environment, the technology is still early in development within the Office of Naval Research and will not be available when the Littoral Combat Ship enters the fleet and begins conducting mine countermeasures missions.

Intelligence preparation of the environment is also necessary for commanders to determine the right tactics, conduct mission planning, conduct asset and sensor management, monitor sensor and system performance, conduct battle damage assessments, and determine remaining risk to follow-on forces. Intelligence preparation of the environment also provides the necessary means to perform the change detection mission, which determines if objects in the water are existing objects that were previously identified or new objects that must be further investigated to determine if they are mines. This activity can reduce mine countermeasures mission timelines up to an hour for each object that does not have to be further investigated to determine if it is actually a mine.

The Capabilities Envisioned by the Concepts of Operation Have Not Been Reconciled with the Capabilities of the Ship Design

The Navy has refined its concepts of operation for Littoral Combat Ship warfighting, manning, training, and sustainment. These concepts have evolved concurrently with the design of the ship's seaframe and the development of individual mission systems. As table 5 shows, however, the Navy has not yet fully reconciled Littoral Combat Ship operational concepts with design characteristics of the ship.

Table 5: Littoral Combat Ship Seaframe and Mine Countermeasures Mission Package Characteristics

	Littoral Combat Ship seaframe characteristics	Mine countermeasures mission package needs	Mitigation options and limitations
Mission package personnel	15 allocated	19 needed to conduct mine countermeasures missions	<ul style="list-style-type: none"> Plans for 4 shore-based personnel to support post-mission analysis may be unrealistic
Aviation detachment personnel	20 allocated	23 needed to operate and sustain MH-60S helicopter and Vertical Take-off and Landing Unmanned Aerial Vehicle	<ul style="list-style-type: none"> 3 personnel may perform post-mission analysis Additional berthing and other impacts on accommodations are under review
Sustainment	Minimal maintenance and sparing aboard	Some onboard sparing to maintain operational availability of mission systems	<ul style="list-style-type: none"> Intent to maintain and supply spares from shore-based interim support and Mission Package Support Facility
Weight	180 metric tons allocated for mission package	Baseline mission package (MP4) exceeds weight allowance by about 10 percent	<ul style="list-style-type: none"> Mitigation plans have not been identified for baseline package Mission packages 1 and 2 do not include all systems planned for baseline package; Navy plans to backfit earlier packages to include all baseline systems

Source: Navy.

In particular, the Littoral Combat Ship is designed to accommodate fewer personnel, mission systems, and spares than envisioned to execute its mine countermeasures mission. As a result, even though the Littoral Combat Ship is designed to transit to and within theater quickly, a fact that should reduce mission timelines, the Navy expects it to require an extended period of time once it arrives on station to complete the detect-to-engage sequence relative to dedicated surface mine countermeasures assets.

The Navy now has better knowledge regarding how it will introduce mine countermeasures-configured Littoral Combat Ships to the fleet. To date, the Navy has approved two concepts of operation: a warfighting concept of operations covering the conduct of missions from the Littoral Combat Ship and a wholeness concept of operations covering manning, training, and sustainment for the Littoral Combat Ship. In addition, the Navy has begun drafting a concept of operations for mission package support. The Navy continues to refine these documents to reflect evolving program plans and incorporate new perspectives from within the fleet.

Number of Mission Personnel Currently Expected to Exceed Littoral Combat Ship Seaframe Personnel Capacity

While the manning construct for the Littoral Combat Ship is minimal by design, conducting mine countermeasures missions may be challenging given the variety and complexity of mission tasks personnel aboard the ship are expected to perform. Currently, the Navy plans to embark a maximum of 15 mission package personnel and 20 aviation detachment personnel with each mine countermeasures-configured Littoral Combat Ship. These personnel are expected to conduct mission planning, operate and support the MH-60S and its airborne sensors, safely launch and recover unmanned systems, and conduct post-mission analysis.⁶

While sailors and aviators can perform some steps in the detect-to-engage sequence concurrently, others must be performed in order. For example, personnel must conduct detection, classification, and identification of mines before neutralization can begin. The availability of Littoral Combat Ship personnel to manage these operations may be constrained in light of current plans to deploy and operate multiple offboard sensors at one time. Fleet operators are concerned that current manning limits would require the Navy to work Littoral Combat Ship personnel more hours than fleet commanders consider safe or accept an inability to meet mission requirements within desired timelines.⁷ Navy operators currently estimate that 19 mission package personnel and 23 aviation detachment personnel will be needed per ship to complete planned missions—an excess of 7 personnel above seaframe constraints. The Navy is exploring alternatives as it continues to refine concepts of operation.

Some Navy officials have suggested that conducting post-mission analysis of Littoral Combat Ship sensor data on shore may reduce the number of personnel needed to embark each ship by up to four. However, the use of shore-based personnel to conduct this analysis is not possible because the Littoral Combat Ship is not designed with communications capabilities to transmit the volume of data collected by some of its mine countermeasures systems. A scenario where the data would be physically carried to shore is also unlikely given where the ship may be deployed.

⁶Post-mission analysis involves analyzing large amounts of data collected by mine countermeasures sensors in order to plan and execute additional mission tasks in the detect-to-engage sequence.

⁷This concern is also reflected in the Director, Operational Test and Evaluation's fiscal year 2006 report on the Littoral Combat Ship and a recent draft of the *Littoral Combat Ship Platform Wholeness Concept of Operations (Revision B)*.

A Minimally Manned Littoral Combat Ship Requires Different Training Concepts and Strategies

The Navy has made progress in identifying and developing training programs for Littoral Combat Ship capabilities. However, as key systems remain in development—including the seaframes themselves—the Navy acknowledges that developing a training curriculum for operating new mine countermeasures systems aboard the ship is difficult. The limited number of mission system operators planned for the Littoral Combat Ship permits only limited training aboard ship as compared to other ship classes. The Navy is taking a new train-to-qualify approach for the Littoral Combat Ship that is significantly different from the approach used for other ship classes in that it embarks fully qualified personnel aboard rather than bringing personnel aboard first and then training them. Therefore, the Navy is training Littoral Combat Ship personnel ashore, requiring the Navy to begin establishing a new training infrastructure that includes a robust simulation capability. The Navy is struggling to identify requirements and estimate costs for this training infrastructure because of continuing uncertainty regarding numbers of personnel per ship, ship basing locations, and seaframe and mine countermeasures system acquisition schedules. As a result, the additional investment required of the Navy to support a mine countermeasures-configured Littoral Combat Ship is unclear.

Achieving the minimal manning concepts for the Littoral Combat Ship increases the importance of robust training for fleet sailors assigned to the ship. Training to meet the higher level of readiness expected of sailors aboard the Littoral Combat Ship to conduct missions entails realistic training opportunities that represent the variety of mine countermeasures missions and tasks identified for the ship. Some training opportunities, such as the Rim of the Pacific—a large conventional exercise occurring every 2 years—offer significant and challenging scenarios that help fleet personnel gain valuable experience. As the schedules for Littoral Combat Ship seaframe and mission system deliveries adjust to accommodate ongoing acquisition challenges, the opportunities to fully train in such exercises are further postponed. The first opportunity to participate in Rim of the Pacific will now be in 2010 because of seaframe schedule delays. As a result, it may take the Navy longer than planned to complete training for its full complement of Littoral Combat Ship personnel.

Littoral Combat Ship Sustainment Capabilities May Affect Operational Availability of Mine Countermeasures Systems

The Navy designed new mine countermeasures systems to operate from platforms with more robust sustainment capabilities than those offered by the Littoral Combat Ship. As such, these systems largely require intermediate- or depot-level maintenance in the event a component breaks or malfunctions.⁸ This approach was implemented prior to the Navy identifying the Littoral Combat Ship as a host platform for these new systems. The original platforms on which the Navy planned to field these systems—including aircraft carriers, destroyers, and amphibious ships—have the ability to perform many of these corrective maintenance tasks, while the Littoral Combat Ship does not. Alternatively, the Littoral Combat Ship will rely on shore support to a degree greater than any previous ship class. As such, if a mine countermeasures system breaks onboard the Littoral Combat Ship and a spare is not readily available, the ship may not be able to achieve its mission requirements within desired timelines as envisioned in current concepts of operation.

In addition, while the Navy's plans to logistically support Littoral Combat Ships from shore include establishing a forward mission support facility, decisions regarding forward-basing locations for these ships are pending, requiring the Navy to establish an interim support facility based in the United States. The Navy has not yet determined the size and scope of the infrastructure due to continuing uncertainty with seaframe and mission package deployments worldwide, package configuration, and system quantities. Although the Navy plans to stand up an interim sustainment facility, plans for long-term support hinge on resolving these uncertainties and identifying funding to construct and maintain permanent facilities.

The Navy also continues to evaluate sparing plans for Littoral Combat Ship mine countermeasures systems, but seaframe design characteristics may limit these options. The Navy has specified seaframe weight as a key performance parameter, as it significantly affects the speed at which the ship can travel. The weight requirement for the mission packages is 180 metric tons.⁹ This requirement was established while mine countermeasures systems were still early in development, and their

⁸Intermediate-level maintenance consists of off-equipment repair capabilities possessed by operating units and in-theater sustainment organizations. Depot maintenance consists of all repairs beyond the capabilities of the operating units, including rebuild, overhaul, and extensive modification of equipment.

⁹The 180 metric ton requirement is composed of 75 metric tons for fuel and 105 metric tons for mission systems.

weights were relatively unknown. Currently, the baseline mine countermeasures package—the fourth mine countermeasures package to be configured—exceeds the weight requirement by approximately 10 percent. While the initial mine countermeasures packages meet the weight requirement, they do not contain all of the systems that constitute the baseline package. Because the Navy plans to backfit the first three mission packages to the baseline configuration, the Navy can expect to face challenges meeting the weight requirement for all packages currently planned. These weight challenges increase risk that the level of capability planned for the Littoral Combat Ship mine countermeasures mission package may not be achievable and could require the Navy to further reduce the number of mine countermeasures systems planned across the program. To meet the seaframe weight allowance, the Navy may be forced to remove systems from the baseline mission package, resulting in less mine warfare capability per ship. The weight constraint might also force a reevaluation of the Navy’s current plans to backfit the first three packages with new systems as they become available. Recognizing this, the Navy is exploring ways to reduce weight while maintaining capability.

In addition, the Navy has decreased the number of mine countermeasures systems planned for the Littoral Combat Ship. Prior plans indicated the ship would carry multiple quantities of each mine countermeasures system. However, between fiscal years 2007 and 2008, the Navy reduced its planned number of individual airborne mine countermeasures systems within the mission package. Table 6 outlines these changes.

Table 6: Reductions to System Quantities within the Baseline Littoral Combat Ship Mine Countermeasures Mission Package

System	Fiscal year 2007 plan	Fiscal year 2008 plan
AN/AQS-20A Sonar	4	3
Airborne Mine Neutralization System	2	1
Airborne Laser Mine Detection System	2	1
Organic Airborne Surface Influence Sweep System	2	1
Rapid Airborne Mine Clearance System	2	1

Source: Navy.

Given the assumptions for how mission systems will operate and their projected operational availability, and in light of the minimal onboard logistics and maintenance capability of the Littoral Combat Ship, a decrease in certain mission system quantities from two to one per package

introduces additional risk that a needed capability will not be available during a mine countermeasures mission. The occurrence of such an event could significantly extend mission timelines. For example, the area that a mine countermeasures-configured Littoral Combat Ship could cover in a given timeframe could be expected to decrease. However, as previously discussed, the weight limitation of the seaframe further compounds this challenge as it effectively prohibits embarkation of more than one of several types of mine countermeasures systems, regardless of mission need.

In March 2007, the Undersecretary of Defense for Acquisition, Technology and Logistics requested that the Secretary of the Navy reassess the planned number of mine countermeasures mission systems contained within a mission package. This request also tasked the Navy with reexamining planned quantities of mine countermeasures mission packages needed to support 55 Littoral Combat Ship seaframes.

Conclusions

The Navy's mine countermeasures strategy seeks to close capability gaps, reduce mission timelines, and remove the sailor from the minefield. Plans for implementing this strategy originally sought to shift mission responsibilities away from dedicated mine countermeasures ships to other ship platforms—aircraft carriers, amphibious ships, surface combatants, and submarines—but more recently have tasked primary responsibility for this mission to the Littoral Combat Ship.

The Navy's ability to carry out mine countermeasures missions as currently envisioned depends upon the collective capability yielded by (1) fleet assets, including seaframes, mission packages, and intelligence preparation resources; and (2) new concepts of operation. At this point, there are several uncertainties about the performance and availability of these assets as well as their compatibility with planned concepts of operation. For example, the weight and manpower demands of the mine countermeasures mission package currently exceed the capacity of the Littoral Combat Ship seaframes, and the reduced investment in intelligence preparation assets could affect mission timelines.

It is possible that the Navy can compensate for the shortcomings of one asset by using other assets or changing its planned concepts of operation. At the same time, it is possible that certain shortcomings—including slower delivery of Littoral Combat Ships and deficiencies in intelligence preparation capabilities—may not be reconcilable without lowering expected mission capabilities. The Navy has time now to assess these

uncertainties and determine whether it can produce the needed mine countermeasures capabilities from the assets it is likely to have and the concepts of operation it can likely execute. The Navy can also avail itself of options to close or narrow potential capability gaps by changing the mix of assets, altering the concepts of operation, or both—thus capitalizing on the substantial investments it is making.

Recommendations for Executive Action

Given the importance of intelligence preparation of the environment for enabling Littoral Combat Ship operations, we recommend that the Secretary of Defense analyze whether capabilities resulting from current intelligence preparation investments will enable the Littoral Combat Ship to meet required mission timelines. If necessary, the Secretary of Defense should assess options for improving intelligence preparation of the environment capabilities.

Given the importance of well-developed manning and sustainment concepts to achieving mine countermeasures timelines, we recommend that the Secretary of Defense direct the Navy to determine the extent to which concepts of operation and the likely performance of the Littoral Combat Ship and other assets can be reconciled to provide the needed mine countermeasures capability.

In light of delays facing the Littoral Combat Ship program, as well as the planned decommissioning of existing mine countermeasures ships and helicopters, we recommend that the Secretary of Defense direct the Navy to evaluate the need for and feasibility of fielding mine countermeasures systems currently planned for the Littoral Combat Ship on alternative ship platforms as well.

To ensure an accurate understanding of operational suitability for new mine countermeasures systems, we recommend that the Secretary of Defense delay approval of full-rate production for systems contained within the mine countermeasures mission package, pending successful completion of operational testing onboard their primary platform, currently identified as the Littoral Combat Ship.

Agency Comments and Our Review

In written comments on a draft of this report, the Department of Defense agreed with our recommendation to analyze whether capabilities resulting from current intelligence preparation investments will enable the Littoral Combat Ship to meet mission timelines as planned and to assess options for improving these capabilities, if necessary. Intelligence preparation

investments are important for enabling the Navy's transition to the Littoral Combat Ship as its mine countermeasures platform of the future. The Department of Defense noted that it has completed analysis in the past and continues to evaluate intelligence preparation investments. According to the department, there is merit in examining the risks and capabilities from emerging satellite and other remote sensing technologies. The Department of Defense also stated that systems such as the Littoral Remote Sensing system and the Mission Reconfigurable Unmanned Undersea Vehicle System show promise and warrant continued consideration. Nevertheless, department investments in intelligence preparation capabilities—including the Mission Reconfigurable Unmanned Undersea Vehicle System—have continued to be reduced. While such decisions may be warranted, their cumulative effects must be analyzed against objective criteria, especially the Littoral Combat Ship's mission timelines.

The Department of Defense also concurred with our recommendation to evaluate the need for and feasibility of fielding mine countermeasures systems now planned for the Littoral Combat Ship on alternative ship platforms. The department stated that it intends to include this analysis in its fiscal year 2010 Naval Mine Countermeasures Master Plan (expected to be completed in early 2009 in support of the Navy's fiscal year 2010 budget request).

The Department of Defense partially concurred with our recommendation to determine the extent to which concepts of operation and the likely performance of the Littoral Combat Ship and other assets can be reconciled to provide the required mine countermeasures capability. The department agreed with our recommended action, but did not believe new tasking was necessary. Specifically, it stated that concepts of operation remain under heavy scrutiny from multiple agencies including the Navy, Joint Staff, and the Office of the Secretary of Defense. According to the department, manning requirements, systems integration, logistics, system performance parameters, and maintainability of equipment are all being considered and reconciled in the Littoral Combat Ship concepts of operation as the ship's mission is reviewed and evaluated. We agree with the department that new tasking is not necessary as long as these actions are taken.

The Department of Defense did not concur with our recommendation to delay approval of full-rate production for systems contained within the mine countermeasures mission package until those systems complete operational testing onboard the Littoral Combat Ship—their primary

platform. The department stated that delaying full-rate production for these systems would result in gaps in industrial production, cost increases, and delays in delivering mine warfare capability to operational forces. The department further noted that mine countermeasures systems intended for employment from the MH-60S helicopter and/or Vertical Take-off and Landing Unmanned Aerial Vehicle do not require the Littoral Combat Ship to continue testing and development because these aerial systems will have the ability to operate from a variety of sea and land based platforms. However, as long as the Littoral Combat Ship remains the primary host platform for new mine countermeasures systems, we believe the prudent course is to delay full-rate production of these systems until the Navy has operationally tested and evaluated them onboard this unique ship. Should the department decide to field these systems from other platforms, then full-rate production decisions prior to testing aboard the Littoral Combat Ship may be warranted. Further, we note that our recommendation would continue low-rate initial production of systems as planned—not suspend production entirely, which would invite production gaps and increase costs. We also believe that by maintaining low-rate initial production of systems, the Navy will have sufficient quantities on hand to enable operational forces to train in advance of the Littoral Combat Ship joining the fleet.

The Department of Defense’s written comments are included in their entirety in appendix II. The department also provided technical comments, which were incorporated into the report as appropriate.

As agreed with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from its date. At that time, we will send copies of this report to interested congressional committees, the Secretary of Defense, and the Secretary of the Navy. We will also make copies available to others on request. In addition, this report will be available at no charge on the GAO Web site at <http://www.gao.gov>.

If you have any questions about this report or need additional information, please contact me at (202) 512-4841. Contact points for our Office of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made contributions to this report are listed in appendix IV.

A handwritten signature in black ink that reads "Paul L. Francis". The signature is written in a cursive, flowing style.

Paul L. Francis
Director
Acquisition and Sourcing Management

Appendix I: Scope and Methodology

To assess the Navy's progress and identify remaining challenges in developing new mine countermeasures systems, we analyzed program documentation including acquisition strategies, performance requirements, budget submissions, test plans and reports, and cost and schedule performance reports. We also drew from our prior work related to the Littoral Combat Ship and individual airborne mine countermeasures systems. In addition, we reviewed Department of Defense reports related to these and other programs for mine countermeasures. To supplement our analysis, we held discussions with a number of Navy and Defense officials responsible for acquiring and testing the Littoral Combat Ship, its mine countermeasures mission package, and other mine countermeasures systems external to the Littoral Combat Ship.

To assess the Navy's progress and identify remaining challenges associated with introducing new mine countermeasures systems to the fleet, we analyzed concepts of operation for the Littoral Combat Ship and mine countermeasures mission requirements. We compared these documents with Littoral Combat Ship performance requirements and design specifications to determine the degree to which the Navy had reconciled manning, sustainment, and warfighting concepts with key characteristics of the Littoral Combat Ship. To supplement this analysis, we further discussed these issues with Navy and Defense officials responsible for developing and reviewing Littoral Combat Ship concepts of operation and introducing the ship to the fleet.

To address our objectives, we visited and interviewed officials from the Navy's Surface Warfare, Expeditionary Warfare, and Assessments Divisions; Commander, U.S. Third Fleet; Commander, Naval Surface Forces; Navy Warfare Development Command; Commander, Operational Test and Evaluation Force, Navy; Naval Mine and Anti-Submarine Warfare Command; and the mine warfare, mission modules, unmanned maritime vehicle systems, and Littoral Combat Ship program offices. We also met with officials from the Director, Operational Test and Evaluation; the Office of the Secretary of Defense; Joint Staff; the Naval Surface Warfare Center—Panama City; Naval Special Clearance Team One; the Office of Naval Research; the Office of the Deputy Assistant Secretary of the Navy for Littoral and Mine Warfare; Navy Supervisor of Shipbuilding; Lockheed Martin; Marinette Marine Corporation; General Dynamics; and Austal.

We conducted our analysis from October 2006 to August 2007 in accordance with generally accepted government auditing standards.

Appendix II: Comments from the Department of Defense



ACQUISITION,
TECHNOLOGY
AND LOGISTICS

OFFICE OF THE UNDER SECRETARY OF DEFENSE

3000 DEFENSE PENTAGON
WASHINGTON, DC 20301-3000

SEP 26 2007

Mr. Paul L. Francis
Director, Acquisition and Sourcing Management
U.S. Government Accountability Office
441 G Street, N.W.
Washington, D.C. 20548

Dear Mr. Francis:

This is the Department of Defense response to the GAO Draft Report 08-13, "DEFENSE ACQUISITIONS: Overcoming Challenges Key to Capitalizing on Mine Countermeasures Capabilities," dated August 24, 2007, GAO Code I20597. The Department's comments on the recommendations are enclosed. I submitted separately a list of technical changes for your consideration.

The Department partially concurs with the statements in the draft report, concurs with recommendations one and three, partially concurs with recommendation two, and non-concurs with recommendation four.

The Department appreciates the opportunity to comment on the draft report. For further questions concerning this report, please contact Ms. Darlene Costello, Deputy Director, Naval Warfare, (703) 697-2205.

Sincerely,

David G. Ahern
Director
Portfolio Systems Acquisition

Enclosure:
As stated



GAO DRAFT REPORT DATED AUGUST 24, 2007
GAO-08-13 (GAO CODE 120597)

“DEFENSE ACQUISITIONS: OVERCOMING CHALLENGES KEY
TO CAPITALIZING ON MINE COUNTERMEASURES
CAPABILITIES”

DEPARTMENT OF DEFENSE COMMENTS
TO THE GAO RECOMMENDATIONS

RECOMMENDATION 1: The GAO recommends that the Secretary of Defense analyze whether capabilities resulting from current intelligence preparation investments will enable the Littoral Combat Ship to meet required mission timelines. If necessary, the Secretary of Defense should assess options for improving intelligence preparation of the environment capabilities. (Page 25/GAO Draft Report)

DOD RESPONSE: Concur. The Department has completed analysis in the past and continues to evaluate intelligence preparation investments to enable the Littoral Combat Ship (LCS) to meet required mission timelines. No additional investment is necessary at this time. There is merit in examining the risks and capabilities from emerging satellite and other remote sensing technologies. Systems such as the Littoral Remote Sensing system and the Mission Reconfigurable Unmanned Undersea Vehicle System (MRUUVS) show promise and warrant continued consideration.

RECOMMENDATION 2: The GAO recommends that the Secretary of Defense direct the Navy to determine the extent to which concepts of operation and the likely performance of the Littoral Combat Ship and other assets can be reconciled to provide the needed mine countermeasures capability. (Page 25/GAO Draft Report)

DOD RESPONSE: Partially concur. All aspects of the concept of operations remain under heavy scrutiny from multiple agencies, including Navy, the Joint Staff and the Office of the Secretary of Defense. New tasking is not necessary. The points highlighted in the report are recognized as key enablers or inhibitors of the platform's mission performance capability. Manning requirements, systems integration, logistics, system performance parameters, and maintainability of equipment onboard Littoral Combat Ship are all being considered and reconciled in the concept of operations as the platform's mission is reviewed and evaluated.

RECOMMENDATION 3: The GAO recommends that the Secretary of Defense direct the Navy to evaluate the need for and feasibility of fielding mine countermeasures

systems currently planned for the Littoral Combat Ship on alternative ship platforms as well. (Page 25/GAO Draft Report)

DOD RESPONSE: Concur. The modular capabilities inherent in Mine Countermeasure Systems under development should provide the flexibility to operate these systems from a number of alternative ship and aircraft platforms. Maximizing the number of platforms available for testing and or future deployment could be advantageous to the department. The department intends to include an analysis of alternate platforms in the fiscal year 2010 Naval Mine Countermeasures Master Plan.

RECOMMENDATION 4: The GAO recommends that the Secretary of Defense delay approval of full-rate production for systems contained within the mine countermeasures mission package, pending successful completion of operational testing onboard their primary platform, currently identified as the Littoral Combat Ship. (Page 25/GAO Draft Report)

DOD RESPONSE: Non-concur. Full Rate Production (FRP) decisions on current programs of record (Acquisition Category designated) have and will continue to be made following the guidance of Department of Defense Instruction 5000.2, Operations of the Defense Acquisition System. Each of these systems has its own, approved requirements documents, including testing plans, which support individual FRP Decisions by the Milestone Decision Authority. Other systems under development may require operational testing on Littoral Combat Ship (LCS) prior to FRP.

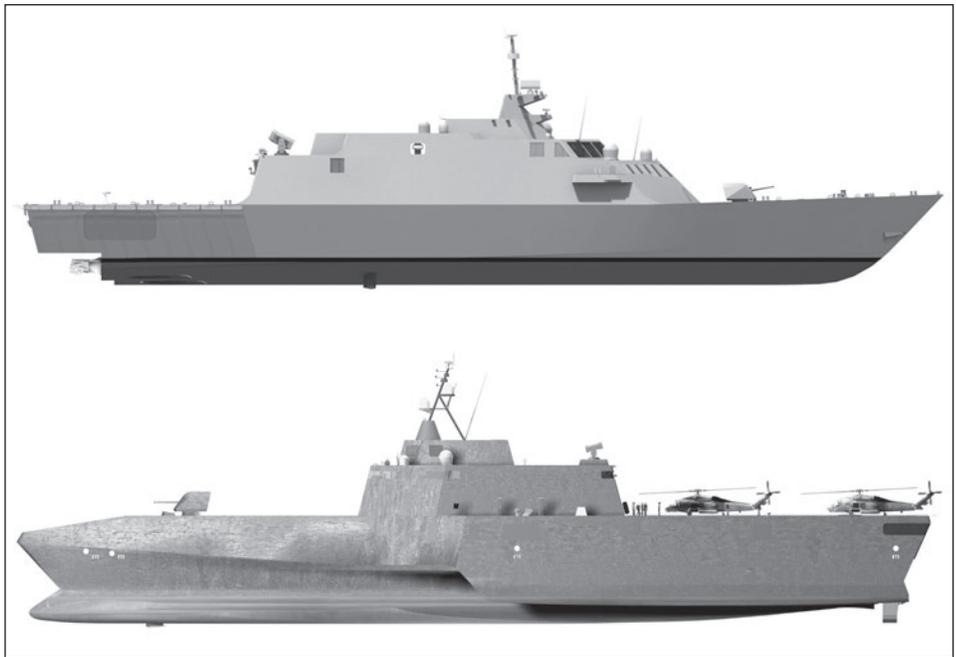
Delaying FRP of Mine Warfare Systems that have met all the FRP criteria would result in gaps in industrial production, cost increases and delays in delivering Mine Warfare (MIW) capability to operational forces. The modular capabilities inherent in the Mine Countermeasure Systems under development will provide the flexibility to operate these systems from a number of alternative ship and aircraft platforms. Mine Countermeasure Systems intended for employment from MH-60S and/or FIRESCOUT do not require the LCS to continue testing and development. Although designed to operate from LCS, a MIW equipped MH-60S or FIRESCOUT will have the ability to operate from a variety of sea and land based platforms. In addition, the training concepts employed for the LCS Mission Packages requires full training and proficiency qualifications to be met prior to reporting onboard LCS. For the Organic Airborne Mine Countermeasure Systems, this requires sufficient assets to train and qualify air detachments prior to initial deployment. Current production profiles are required to meet this demand. Any reduction in procurement quantities will have a significant operational impact on the ability to deploy initial and future MIW Mission Packages. Delaying full-rate production is neither economically or operationally prudent.

Appendix III: Overview of Littoral Combat Ship Design and Production Challenges

The Littoral Combat Ship is a new class of warship to address the challenges of operating U.S. military forces in the shallow waters close to shore, known as the littorals. The three principal threats it is expected to address are from mines, small surface boat attacks, and submarines. The Littoral Combat Ship differs from existing types of Navy surface warships in two critical ways. First, it will accomplish its mine, anti-submarine, and surface warfare missions primarily through the use of helicopters, unmanned vehicles, and other systems that operate at a distance from the ship itself. Second, the systems used to conduct each main or focused mission will be contained in mission packages; for example, one mission package will consist of the systems needed for detecting, engaging, and neutralizing mines. The mission packages will be interchangeable, so that the Littoral Combat Ship can be rapidly reconfigured for different missions.

The Navy is developing the Littoral Combat Ship using an evolutionary acquisition approach. Capabilities are delivered by “flight,” with the first eight ships referred to as Flight 0 and the next increment of capability as Flight 1. Flight 0 will provide an initial limited capability from two platform designs to experiment with the critical mission technologies and test the overall concept. Illustrations of the two seaframe designs are shown in figure 1. Flight 1 will provide greater capability and serve as the basis for learning lessons that will be incorporated into additional follow-on ships.

Figure 1: Littoral Combat Ship Seaframe Designs



Source: Lockheed Martin (top), General Dynamics (bottom).

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

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

The Navy acknowledges that the Littoral Combat Ship program was hampered by an unwavering focus on achieving schedule and performance goals, a fact that dissuaded industry from identifying cost growth in a timely fashion. Moreover, prior to September 2006, poor earned value management processes and reporting in the shipyard led the Navy to incorrectly conclude that the first Littoral Combat Ship remained within budget and was executing to that level.

The Navy also stated that it had initially lacked a sufficient number of personnel in the shipyard to review and manage cost and schedule performance of the first Littoral Combat Ship. This oversight responsibility was allocated to the Navy Supervisor of Shipbuilding, which had challenges allocating sufficient numbers of staff among the competing demands of different shipbuilding programs it oversees.

The Navy is taking steps to restructure the Littoral Combat Ship program to better balance government and contractor cost risk. These changes include restructuring contract terms with industry, increasing Littoral Combat Ship construction time from 24 to 32 months to improve stability, and requiring increased government oversight of contractor performance.

Appendix IV: GAO Contact and Staff Acknowledgments

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