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**Director, Operational Test and Evaluation**  
**Report on the Test and Evaluation Master Plan for**  
**Littoral Combat Ship Seaframes and Mission Modules**  
as directed by Section 124 of the Carl Levin and Howard P. "Buck"  
McKeon National Defense Authorization Act (NDAA)  
for Fiscal Year 2015

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**February 2015**

This report provides the Director Operational Test and Evaluation (DOT&E) response to the following requirement in the Carl Levin and Howard P. "Buck" McKeon National Defense Authorization Act for Fiscal Year 2015:

***SEC 124. REPORT ON TEST EVALUATION MASTER PLAN FOR LITTORAL COMBAT SHIP SEAFRAMES AND MISSION MODULES.***

*(a) IN GENERAL. — Not later than 60 days after the date of the enactment of this Act, the Director Operational Test and Evaluation shall submit to the congressional defense committees a report on the test evaluation master plan for the seaframes and mission modules for the Littoral Combat Ship program.*

*(b) ELEMENTS. — The report required under subsection (a) shall include the following elements:*

*(1) A description of the progress of the Navy with respect to the test and evaluation master plan.*

*(2) An assessment of whether or not completion of the test and evaluation master plan will demonstrate operational effectiveness and operational suitability for both seaframes and each mission module.*

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**Introduction**

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**Progress of Testing Prescribed in the LCS Test and Evaluation Master Plan**

***Background***

The current version of the Littoral Combat Ship (LCS) Test and Evaluation Master Plan (TEMP), covering both seaframes and all increments of the mission packages (MPs), is dated June 2013. DOT&E partially approved the TEMP on August 7, 2013, limiting that approval to the following Operational Tests (OT):<sup>1</sup>

- *Freedom* seaframe with Increment 2 Surface Warfare (SUW) mission package (OT-C1)<sup>2</sup>
- *Independence* seaframe with Increment 1 Mine Countermeasures (MCM) mission package (OT-C2)
- *Independence* seaframe with Increment 2 SUW mission package (OT-C4)

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<sup>1</sup> Director, Operational Test and Evaluation memorandum "Approval of the Littoral Combat Ship (LCS) Test and Evaluation Master Plan (TEMP)," dated 07 August 2013.

<sup>2</sup> OT-C[x] refers to a specific phase of the operational test and evaluation associated with a specific mission package increment and its introduction on a specific seaframe variant.

- *Freedom* seaframe with Increment 1 MCM mission package (OT-C5)
- *Freedom* and *Independence* seaframes with Increment 2 Anti-Submarine Warfare (ASW) mission package (OT-C3 and OT-C6).

DOT&E only partially approved the TEMP because program plans for the out-years were not firm and the TEMP provided only scant details for most tests to be conducted in those years. Hence, the TEMP was considered inadequate for use in detailed test planning and conduct of the following remaining phases of OT:

- *Freedom* and *Independence* seaframes with Increments 3 and 4 SUW mission packages
- *Freedom* and *Independence* seaframes with Increments 2, 3, and 4 MCM mission packages

DOT&E's approval letter further stipulated that the Navy would update the TEMP by the end of FY15 to describe adequate test designs and required resources to plan and conduct all remaining phases of operational testing, assuming no changes to the extant program schedule. Because the Navy believed the Remote Minehunting System could be used to overcome noted shortfalls in the Airborne Laser Mine Detection System's (ALMDS) performance, the approval letter also directed the Navy to conduct testing to evaluate the capability provided by the AN/AQS-20A sonar against near-surface mine threats when operating in its single-pass modes (called overlap testing) as Integrated Testing (IT).<sup>3</sup> The status of that testing as well as other LCS-related mission system testing is included in this report.

In reading the TEMP, it is clear that many different test events – including developmental testing (DT), operational testing (OT), and live fire testing – are necessary to adequately determine system performance, provide feedback to system developers (testing has often been concurrent with development), and characterize mission capability. The reason for the significant number of test events is due to the complexity of the program the Navy has decided to pursue. LCS comprises two different hull variants and each ship class's unique implementation of mission systems aboard each, as well as multiple mission packages, and each of those are composed of several components, many of which are their own programs of record. In addition, the Navy has chosen to split mission packages themselves into multiple increments, so the test program is tailored to examine the capabilities that are being delivered and fielded for each configuration of the package. In most cases, the test program for each component follows the usual sequence of DT and technical evaluation periods (TECHEVALs), followed by an OT period and, in some cases, an operational assessment period to provide early feedback to the

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<sup>3</sup> This report contains multiple references to the use of integrated testing in the LCS test program consistent with Department of Defense Instruction 5000.02, which states that whenever feasible, testing will be conducted in an integrated fashion to permit all stakeholders to use data in support of their respective functions. Integrated testing requires the collaborative planning and collaborative execution of test phases and events to provide shared data in support of independent analysis, evaluation, and reporting by all stakeholders, particularly the systems engineering, developmental (both contractor and government), and operational test and evaluation communities while optimizing the use of test resources.

program during development. Periods of additional testing are added only when circumstances warrant (e.g., poor performance required system changes and a follow-on test period is needed to verify the efficacy of the fixes; alternatively, a knowledge gap might be uncovered in a test event so a subsequent event is scheduled to obtain essential information about the system's performance). In every case, DOT&E has sought to find testing efficiencies by combining periods of DT with OT (i.e., Integrated Test, or IT) so that fewer events are conducted to satisfy the data collection needs of all of the stakeholders.

DOT&E has also advised the Navy that, because of the complexity of the test program and test programs of the associated programs that are integrated into the LCS mission packages, that future testing of all components should be articulated completely in the LCS TEMP alone, vice in separate and possibly incongruous subsystem TEMPs. The practice, to date, of writing separate TEMPs for LCS and all of the component programs of record does not add value, and introduces the potential for conflicting schedules or test descriptions/objectives that are inconsistent between the multiple documents. Furthermore, maintaining multiple TEMPs adds an unnecessary administrative burden. DOT&E will continue to advise the Navy to construct a consolidated TEMP, especially as the LCS program begins to solidify its plans for system development and fielding of future mission package increments and their associated components.

#### ***Test Program Challenges***

The Navy is finding it difficult to fulfill the plan detailed in the approved TEMP. The integration of concurrently developed components into the MCM mission package has not been as easy as originally planned and the Navy has appropriately decided to conduct additional developmental testing after making system changes. The cases where this has occurred are indicated below, and these additional test periods are driven by the need to verify that fixes made to correct deficiencies were effective. Furthermore, several tests have been postponed – some by multiple years – most often because the LCS seaframes have not been and are not expected to be available when needed to support the test schedule prescribed in the TEMP. Some delays can be attributed to the early seaframes' lack of maturity at delivery and the resulting requirements for unplanned repairs and modifications. Leadership decisions to include the ships in major fleet exercises and to press for establishment of a continuous, multi-LCS presence in Singapore in FY17 are also reducing the pool of ships available to participate in the test program. This deficit is exacerbated by the demands of the Navy's 3:2:1 ship/crew rotation plan, which is designed to permit three crews to staff two ships, one of which is continuously forward deployed. The forward deployed ship is obviously not available to participate in testing, but the availability of the non-deployed ship is also affected by this policy because it must support the training of the non-deployed crews. Consequently, the Navy is finding it difficult to meet the simultaneous demands for LCS fleet operations, both forward deployed and in home waters, as well as mission package development and the needed DT and OT.

#### ***Evaluation of Effectiveness, Suitability, and Survivability***

The current approved TEMP was only adequate to describe the testing for the Increment 1 MCM mission package, Increments 1 and 2 SUW mission package, and Increment 2

ASW mission package. The Navy is in the process of updating the TEMP to cover the remainder of the increments and planned upgrades. DOT&E will approve the updated TEMP once it is adequate. If the Navy executes the operational testing as prescribed in that TEMP and in subsequent operational test plans approved by DOT&E, there will be sufficient data at the end of the test program to assess whether the ships and their mission packages are operationally effective, operationally suitable, and survivable. Completion of the test program, however, will not guarantee that DOT&E will evaluate the ships to be operationally effective, operationally suitable, and survivable and that the mission packages are operationally effective and operationally suitable. Those evaluations will depend upon whether the test results indicate Sailors can successfully use the ships and mission packages to perform the combat missions the Navy has prescribed for the programs.

#### ***Structure of this Report***

This report provides a description of all LCS-related test events, starting with the LCS testing originally scheduled for FY13/14 execution. The report is divided by year; hence, this report contains the details on the progress of completing testing for FY14, FY15, and a separate section on anticipated testing for FY16 and beyond. Each section describing LCS testing is followed by the details for the individual components of the MCM mission package. The MCM mission package is composed of several components, called mission systems, each of which have their own program office (and often a separate TEMP) that schedules testing separate from the LCS program and coordinates testing of that subsystem aboard the LCS. For completeness, this report also provides those details, sorted by the year of intended execution.

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#### **Status of LCS Testing Scheduled for Completion in FY13/14**

The status of seaframe and mission package testing scheduled for completion in FY13 and FY14 is summarized in Table 1 and discussed below. Although it would be appropriate to require that the TEMP be modified and re-approved for every schedule change, such changes are rarely practical in the year of execution because of the administrative burden within the Navy. Instead, minor schedule changes are documented and approved in the individual operational test plans. It is of note that the test program prescribed in the TEMP does not include a dedicated OT for every mission package increment on both seaframes. For example, it calls for an OT of the Increment 1 MCM mission package on an *Independence* variant seaframe, but not aboard a *Freedom* variant seaframe. However, since each increment of a mission package generally builds on its predecessor, an OT of a later increment will pick up the "skipped OT." In the case of the earlier example, OT of the Increment 2 MCM mission package will be conducted in a *Freedom* variant seaframe. If the Navy were to deploy a *Freedom* seaframe with an Increment 1 MCM mission package before that configuration had been operationally tested, DOT&E would submit the Early Fielding Report required by Title 10.

**Table 1. Status of Seaframe and Mission Package Testing Scheduled for Completion in Fiscal Years 2013 and 2014**  
(colors indicate testing associated with a particular mission package or seaframe)

Event	TEMP Scheduled Date	Description	Status	Reasons for deviation from TEMP
DT-AS <sup>a</sup>	FY12-13	Post-Delivery Tests and Trials and Combat System Ship Qualification Trials in Independence variants (LCS 2 & LCS 3)	Partially completed; continuing in FY15	Limited LCS 2 availability because of maintenance and priority on MCM tests. LCS 4 was not commissioned until April 2014.
DT/IT-B1, Phase 2	4QFY13	Increment 2 SUW mission package testing in Freedom variant seaframe (LCS 3)	Completed 1QFY14	Delayed ship availability
DT/IT-B2, Phase 4, Period 1	4QFY13	Increment 1 MCM mission package testing in Independence variant seaframe	Completed 4QFY13	
DT/IT-C1	1QFY14	Freedom variant seaframe and Increment 2 SUW mission package testing (LCS 3)	Completed 2QFY14	Delayed by starboard steering water jet casualty and subsequent repairs
OT-C1	2QFY14	OT of Freedom seaframe with Increment 2 SUW mission package (LCS 3)	Completed 2-3QFY14	Delay in completion of DT/IT-C1 and need for additional crew training delayed start. Equipment problems and scheduling conflicts delayed completion.
DT/IT-C2-SF	2QFY14	Independence variant seaframe testing (LCS 2)	Seaframe DT/IT shifted to DT/IT-C4, 3QFY15 in LCS 4	Program Executive Office states that the continuing resolution and sequestration caused one year delay, but LCS 2 would not have been ready to participate in test as scheduled.
OT-C2-SF	2QFY14	Independence seaframe OT	Shifted to OT-C4, 4QFY15	Program Executive Office states that continuing resolution and sequestration caused one year delay, but LCS 2 would not have been ready in the scheduled timeframe.
TSST	2QFY14	Freedom seaframe Total Ship Survivability Trial (TSST)	Completed 1QFY15	Lack of Freedom seaframe availability and additional time required for test preparations
ET-138 <sup>b</sup>	3QFY14	Enterprise Air Warfare self-defense testing in production-representative Independence class seaframe	Delayed to 1QFY15	Program Executive Office cites continuing resolution, sequestration, and monitoring on aerial target use in manned ship testing.
DT/IT-B4	4QFY14	Increment 2 SUW mission package testing in an Independence seaframe	Phase 1 (DT) completed 4QFY14. IT delayed to 3QFY15	Program Executive Office cites LCS 2 participation in RIMPAC with SUW mission package and LCS 4 conduct of Naval Strike Missile Demonstration. Post-shakedown shipyard availability added to delay.
DT/IT-C4	4QFY14	Increment 2 SUW mission package TECHEVAL in an Independence seaframe	Delayed to 3QFY15	Delay in completion of prerequisite testing
DT-B2 Phase 4, VCD	Not Scheduled in TEMP	Verification of Correction of Deficiencies (VCD) noted during Phase 4, Period 1	Completed 3QFY14	Phase of testing added to verify that communications, launch, and recovery problems noted during Period 1 had been corrected
DT/IT-B2, Phase 4, Period 2	4QFY14 - 1QFY15	Increment 1 MCM MP testing in Independence variant seaframe (LCS 2)	Completed 1QFY15	LCS 2 engineering problems caused a minor delay in the start of Period 2.
Early-DT of ASW mission package ADM	Not scheduled in TEMP	Engineering test of Advanced Development Model (ADM) of ASW Escort Module in LCS 1	Completed 4QFY14	Early-DT of ASW module ADMs discussed in TEMP but not included in formal schedule.

<sup>a</sup> A comparable phase of testing, DT-AS, was concluded in FY12 aboard Freedom variant seaframes (LCS 1 & LCS 3).

<sup>b</sup> Enterprise Air Warfare Self-Defense Testing is governed by a separate TEMP but is included here for completeness.

***DT-A6 -- Post Delivery Tests and Trials and Combat System Ship Qualification Trials in Independence Variant Seaframes (Continuing)***

The Navy conducts Post-Delivery Tests and Trials (PDT&T) in new construction ships to characterize their performance and signatures, validate maintenance and operation of the ship's hull, mechanical, and electrical systems, uncover latent deficiencies, and identify any required modifications. In LCS 2, this testing also included initial evaluation of the ship's performance during MCM mission system launch, handling, and recovery operations. Combat System Ship Qualification Trials (CSSQT) focus on evaluation of the installation, integration, maintenance, and operation of the ship's core combat systems.<sup>4</sup> CSSQTs also provide an opportunity to train the ship's crew in the operation and maintenance of these systems. These trials commenced in FY10 and continued into 2QFY15 for LCS 2. For USS *Coronado* (LCS 4), the trials began in FY14 and are scheduled to conclude in FY15. Less extensive PDT&T and CSSQT will likely be conducted in follow-on ships, but the trials in follow-on ships are not usually documented in the TEMP unless they also serve as DT events. Planned SUW self-defense tests that were to be conducted as IT in January 2015 were cancelled because of unresolved surface gunnery performance anomalies, and will be rescheduled later in FY15 aboard LCS 4. After a delay caused by LCS 2 engineering problems, DT events were completed with firing engagements against a non-maneuvering towed target and a single High Speed Maneuvering Surface Target (HSMST).

***DT/IT-B1 Phase 2 -- Increment 2 SUW Mission Package in a Freedom Variant Seaframe (Completed 1QFY14)***

The Navy conducted DT/IT-B1 Phase 2 to verify that the Increment 2 SUW mission package functioned as designed when integrated aboard a *Freedom* variant seaframe and to train the ship's crew, mission package detachment, and aviation detachment in SUW operations.<sup>5</sup> The Increment 2 SUW mission package included two 30mm gun mission modules (GMMs), a maritime security module (MSM) comprising two 11-meter rigid-hull inflatable boats (RHIBs), a 19-man mission package detachment, and berthing modules for the additional personnel.<sup>6</sup> The mission package also included an aviation mission module consisting of one MH-60R helicopter, which can be equipped with Hellfire missiles and a machine gun for SUW missions, and a 23-man detachment to operate and maintain it.

As with many other tests discussed in this report, phase 2 of the test included IT events designed to yield data to serve the needs of both developmental and operational testers while conserving test resources and avoiding unnecessary duplicative testing. Originally scheduled to be completed in 4QFY13, all testing was conducted aboard USS *Fort Worth* (LCS 3) in port and in the Southern California operating areas during 1QFY14. Along with subsequent IT and OT events, this test provided data on the ship's small boat detection, tracking, classification, and

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<sup>4</sup> Core systems are those resident in the seaframe.

<sup>5</sup> The first phase of the test was completed as DT in USS *Freedom* (LCS 1) during 3QFY12 before the ship deployed to Singapore.

<sup>6</sup> *Fort Worth* had not yet been modified to increase the berthing capacity at the time of the test.



engagement performance that was used to support an operational evaluation of the ship's SUW performance.

***DT/IT-B2 Phase 4 Period 1 – Increment 1 MCM Mission Package Testing in Independence Variant Seaframe (Completed 4QFY13)***

The DT-B2 series of tests focused on evaluation of the performance of the Increment 1 MCM mission package systems and the overall mission package performance when integrated into the seaframe. Phases 1, 2, and 3 were conducted in 2011 and 2012 aboard USS *Independence* (LCS 2) and were designed to progress in complexity from basic off-board vehicle launch and recovery operations to completion of end-to-end MCM mission scenarios; however, that plan proved to be overly ambitious given the state of seaframe and mission package maturity.

The Increment 1 MCM mission package currently includes: a Remote Minehunting Module consisting of two Remote Multi-Mission Vehicles (RMMVs) and three AN/AQS-20A sensors; a Near-Surface Detection Module consisting of two Airborne Laser Mine Detection Systems (ALMDS); an Airborne Mine Neutralization Module consisting of two Airborne Mine Neutralization Systems (AMNS); and an Aviation Module consisting of one MH-60S Block 2B or later Airborne Mine Countermeasures (AMCM) helicopter outfitted with an AMCM system operator workstation and a Carriage, Stream, Tow, and Recovery System (CSTRS) to handle the mission systems. Initial tests of this MCM mission package and seaframe uncovered a host of problems, including significant difficulties with launch and recovery of the RMMV. Because of these difficulties, an additional period of testing (to verify the correction of deficiencies) was added to the plan (discussed below).

***DT/IT-C1 – Freedom Variant Seaframe SUW & Air Defense (AD) Self-Defense with Increment 2 SUW Mission Package (TECHEVAL) (Completed 2QFY14)***

Although delayed one quarter by a propulsion system casualty, the Navy completed DT/IT-C1 in 2QFY14 aboard USS *Fort Worth* (LCS 3). DT/IT-C1, also described as a TECHEVAL (Technical Evaluation), was conducted to validate that previous deficiencies had been corrected and that the ship and mission package could meet the Navy's performance requirements and were ready for OT. Testing focused on Maritime Interdiction Operations and self-defense against anti-ship cruise missile (ASCM) and small boat attacks. Planned aerial target (ASCM surrogate) tracking events were cancelled because of a suspension of their use in testing against manned ships after a BQM-74 target struck USS *Chancellorsville* (CG 62) during testing in November 2013. As with DT/IT-B1 Phase 2, selected events were conducted as integrated tests to provide data needed for the operational evaluation. After reviewing the results of this test, Navy authorities determined that the crew needed additional training in swarm engagement tactics and procedures and delayed the start of the OT by one week.

***OT-C1 – OT of FREEDOM Variant Seaframe with Increment 2 SUW Mission Package (Completed 2-3QFY14)***

The Navy completed OT-C1 from March 10, 2014, through April 17, 2014, aboard USS *Fort Worth* (LCS 3). OT-C1 was conducted to assess the operational effectiveness and

suitability of the *Freedom* variant seaframe when equipped with the Increment 2 SUW mission package. The configuration of the ship and embarked mission modules was the same as discussed above for DT/IT-B1 Phase 2.

OT-C1 tested the *Freedom* variant's cybersecurity posture and the ship's performance during surface gunnery engagements against small boats, aircraft tracking events, Maritime Interdiction Operations, and other routine shipboard evolutions. Taken together, DT/IT-B1 Phase 2, DT/IT-C1, and OT-C1 provided an opportunity to monitor the reliability, maintainability, and operational availability of the ship's systems over a period of 204 days. Data from OT-C1 were combined with data from DT-B1 Phase 2 and DT/IT-C1 to support DOT&E's evaluation of the *Freedom* seaframe's surface self-defense effectiveness when the Increment 2 SUW mission package is embarked and when no mission package (or some other mission package) is embarked.<sup>7</sup>

Although not all aspects of operational effectiveness and suitability could be examined during OT-C1, the test identified significant shortcomings and vulnerabilities in cybersecurity, air defense, reliability and endurance. Planned aerial target tracking events were cancelled because of the continuing moratorium on their use in manned-ship testing. Tactical aircraft tracking events demonstrated that in some scenarios the SPS-75 (TRS-3D) air search radar is unable to detect and track some types of air threats in operationally realistic environments. The ship was able to defeat a small number of Fast Inshore Attack Craft (FIAC) under the particular conditions specified by the Navy's reduced incremental requirement and after extensive crew training and tailoring of the tactics described in Navy doctrine; however, testing conducted to date has not been sufficient to demonstrate LCS capabilities in more stressing scenarios consistent with existing threats. The test confirmed earlier observations that, except for the ships' lack of endurance, the *Freedom* class LCS is well suited for Maritime Security Operations.

#### ***DT/IT-C2-SF – Independence Variant Seaframe Testing (Postponed to 3QFY15)***

When the TEMP was prepared, the Navy intended to split DT/IT-C2 into two segments – a seaframe segment to be conducted on the West Coast during 2QFY14 aboard LCS 2 and an MCM mission package segment to be conducted in the Gulf of Mexico during 2-3QFY15 aboard LCS 2. Navy leadership subsequently decided to conduct the *Independence* variant seaframe testing during DT/IT-C4 aboard LCS 4 in 3QFY15. That decision eliminates DT/IT-C2-SF and broadens the scope of DT/IT-C4 to include both SUW mission package and seaframe testing.

#### ***OT-C2-SF – Operational Test of Independence Variant Seaframe (Postponed to 4QFY15)***

As with DT/IT-C2, the Navy expected to split OT-C2 into two segments – a seaframe segment to be conducted on the West Coast during 2QFY14 aboard LCS 2 and an MCM mission package segment to be conducted in the Gulf of Mexico during 3QFY15, also aboard LCS 2. Navy leadership subsequently decided to conduct the *Independence* variant seaframe OT during OT-C4 aboard LCS 4 in 4QFY15. That decision eliminates OT-C2-SF and broadens the scope of OT-C4 to include both SUW mission package and seaframe OT.

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<sup>7</sup> DOT&E's FY14 Annual Report and forthcoming OT-C1 report provide additional information.

### ***Freedom Variant Total Ship Survivability Trial (TSST) (Completed 1QFY15)***

The Navy completed a Total Ship Survivability Trial (TSST) of the *Freedom* variant in October 2014 aboard USS *Fort Worth* (LCS 3) in the Southern California operating area. TSSTs are conducted to evaluate the crew's capability to escape damaged compartments and join with other crewmembers to control and minimize the spread of damage and maintain and restore combat capability and mission readiness when the ship takes a hit or otherwise suffers battle damage. The test team imposed a series of simulated hits by the types of threat weapons described in the Navy requirements document along with resulting damage during a tactical scenario. DOT&E observed the TSST and has reviewed and commented on a draft test report prepared by the Navy. The draft report identifies 28 design observations and potential improvements. These findings are related to the Machinery Plant Control and Monitoring System (MPCMS), Ship Structure, Damage Control Systems, Power Systems, Closed Circuit Television System and Compressed Air System. Some of the problems related to MPCMS were reported by DOT&E in the FY14 Annual Report. Since the Navy's draft report omitted essential data such as mission capability recovery timelines, DOT&E will be unable to conduct a detailed assessment of the trial results until these and similar data become available.

### ***ET-13B – Enterprise Air Warfare Self Defense Test in Production-Representative Independence Variant Seaframe (Postponed to FY16)***

The Navy developed the Capstone Enterprise Air Warfare Ship Self-Defense approach to consolidate all shipboard air-defense testing under a single authority in order to assess the air-defense capabilities of multiple ship classes and to reduce costs. For each new class of ships, the assessment process is based on a triad of complementary tests consisting of (1) live testing aboard a manned ship of the class, (2) live testing using the Navy's unarmed Self-Defense Test Ship (SDTS) equipped with essential elements of the ship's combat system, and (3) robust modeling and simulation using the ship class' probability of raid annihilation test bed. Lack of access to the proprietary designs of the foreign radars used in both variants is adversely affecting the development of the LCS test beds, particularly for the *Freedom* variant, which is totally dependent on the TRS-3D radar. The inclusion of the U.S. Phalanx system radar in the *Independence* variant's SeaRAM system reduces the dependence on the performance of the seaframe's Sea Giraffe air search radar and simplifies that test bed development. However, since the SeaRAM radar does not provide 360 degree coverage, the ship will have to rely on its Sea Giraffe radar to detect and track targets in SeaRAM blind zones. The first LCS Enterprise Test, ET-13B, was scheduled in 3QFY14 (originally scheduled to be completed by 4QFY12 in the 2006 Enterprise TEMP) but has since been delayed until 1QFY16 so that the test can be conducted aboard LCS 6, which will be the first "production-representative" ship of the *Independence* class. Planned tests include tracking runs and simulated engagements against maneuvering BQM-74 targets and two SeaRAM firing engagements against presentations of non-maneuvering BQM-74 targets.

***DT/IT-B4 – Increment 2 SUW Mission Package Testing in Independence Variant Seaframe (Continuing)***

LCS 4 completed the first phase of DT/IT-B4 as DT (no operational tester participation) in FY14 before she was diverted to participate in the West Coast segment of RIMPAC with an embarked MCM mission package and then conduct a demonstration firing of the Norwegian Naval Strike Missile. This was followed by the ship's Post-Shakedown Availability (PSA) in the shipyard. LCS 4 is scheduled to complete a second phase of the test during 3QFY15. The objective of this testing is the same as that of DT/IT-B1, which was described earlier, except that the testing will be conducted aboard an *Independence* seaframe instead of a *Freedom* seaframe.

***DT/IT-C4 – TECHEVAL of Independence Variant Seaframe with Increment 2 SUW Mission Package (Postponed to 3QFY15)***

The Navy has delayed DT/IT-C4 from 4QFY14 to 3QFY15 to match the availability of an *Independence* seaframe (LCS 4) and, as explained above, has expanded the scope of this test to evaluate the full range of *Independence* seaframe performance characteristics in addition to the effectiveness and suitability of the Increment 2 SUW mission package when employed in the *Independence* seaframe. The design for this test will closely parallel the design of DT/IT-C1 – TECHEVAL of the *Freedom* variant seaframe and the Increment 2 SUW mission package; however, the Navy plans to enhance the test design with unmanned aerial target tracking and unmanned aerial vehicle (UAV) tracking and engagement events. This test will include IT events designed to provide data that will contribute to the evaluation of the core seaframe's SUW effectiveness and the SUW effectiveness of core seaframe and mission package systems combined.

***DT-B2 Phase 4 VCD – Additional Testing to Verify Correction of Deficiencies (Completed 3QFY14)***

Because of continuing problems with launch and recovery and communications between LCS and the RMMV during DT-B2 Phase 4 Period 1, the Navy conducted a follow-on test in 3QFY14 to verify the correction of deficiencies (VCD) after making additional modifications to the launch and recovery hardware and procedures.

***DT/IT-B2 Phase 4 Period 2 – Increment 1 MCM Mission Package Testing in Independence Variant Seaframe (Completed 1QFY15)***

The DT/IT-B2 series of MCM mission package tests concluded in 1QFY15 after minor delays caused by LCS 2 air conditioning equipment and propulsion system failures. The test was designed to evaluate the crew's capability to conduct end-to-end MCM missions without assistance of civilian subject matter experts and technicians. However, the operators were unable to complete operationally realistic end-to-end mine clearance missions without intervention by testers who knew where the targets were actually located. RMMV launch and recovery operations proceeded with fewer problems than had been observed in earlier testing, but still resulted in several instances of equipment damage that delayed or prevented the recovery of an off-board RMMV. The Navy is investigating the cause of new problems with target position

errors and incorrectly dropped contacts discovered in this final LCS DT before the TECHEVAL and OT scheduled in FY15.<sup>8</sup>

***Early DT of ASW Escort Module Advanced Development Model (ADM) in Freedom Variant Seaframe (Completed 4QFY14)***

Although a specific test event was not listed in the approved TEMP's schedule, the Navy conducted a test of an Advanced Development Model (ADM) of the ASW Escort Module aboard LCS 1 in September 2014. Testing focused on integration of the Variable Depth Sonar and Multi-Function Towed Array with the LCS seaframe and included measurement of pull stresses and evaluation of stern door effectiveness with penetrating systems. Testing also included limited long-range passive and active ASW search in deep water against a U.S. nuclear submarine. As was appropriate for early integration efforts, the test was highly scripted and thus the results cannot provide any basis for projection of the operational performance of the system under realistic combat conditions. The test was conducted with full knowledge of the target submarine's position throughout the test, and the operators focused their search only in the region where the submarine was known to be located.

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**MCM Mission Package Component Systems' Testing Scheduled for Completion in FY 2014**

The MCM mission package is composed of several component systems (also referred to as mission systems), each of which require testing separate from an LCS. Table 2 summarizes the status of MCM mission system testing scheduled for completion in FY14. Most of these test events were not conducted aboard an LCS, but were essential test periods for the subsystems that comprise the MCM mission package. Many of these test events were prerequisites for the follow-on LCS and mission package testing, and others were added as a result of problems discovered during previous test periods or inadequate completion of planned testing.

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<sup>8</sup> The Navy conducted an additional period of Remote Minehunting System DT to examine the performance of a newer variant of the AN/AQS-20 sensor employed with that system. This testing is described in a subsequent section of this report. Because of performance problems, the Navy reverted back to the sensor variant used in DT-B2 Phase 4 Period 2 for use in the upcoming TECHEVAL and OT.

**Table 2. Status of MCM Mission Package Component Systems' Testing Scheduled for Completion in FY 2014**

Event	TEMP Scheduled Date	Description	Status	Comment
RMS DT-IG	Not specified in LCS TEMP (2QFY14 in RMS TEMP)	Shore-based DT/IT	Completed 1QFY14	Prerequisite for RMS OT-B1 (see (see below). System operating time and failure data were collected as integrated test data to bolster confidence in OT-B1 reliability assessment.
RMS OT-B1	Not specified in LCS TEMP (2QFY14 in RMS TEMP)	Shore-based OA	Incomplete / deferred to RMS DT-B1	Delayed to conduct test in configuration planned for LCS OT-C2 (LCS MCM mission package Increment 1 OT). TEMP lists test completion as an OT-C2 entrance criterion. In 1QFY15, DOT&E agreed to complete testing as DT/IT during RMS DT-B1.
RMS DT-B1	Not specified in LCS TEMP	Shore-based DT/IT (included two variants of AN/AQS-20)	Attempted in 1-2QFY15 but aborted due to performance problems	Test delayed multiple times because of AN/AQS-20B delivery and development delays. Not listed in LCS TEMP, but was expected to satisfy objectives of RMS OT-B1 (see above).
RMS DT/IT event	FY14/15 (TBD)	RMS performance against near-surface targets (overlap test)	Not scheduled, but expected to occur in mid-FY15	Test to be performed with version of AN/AQS-20 that will be used in LCS MCM mission package OT to examine capability in region of overlap with ALMDS. This testing is needed to complete the operational evaluation of the Increment 1 MCM mission package.
AMNS DT/IT event	Not specified in LCS TEMP	Shore-based DT/IT	Completed 3QFY14	Testing was designed to close knowledge gaps against stealthy bottom mines and deep water moored mines not expected to be fulfilled by Increment 1 MCM mission package testing in the same environment.
AMNS OA Phase A	Not specified in LCS TEMP	OA Phase A (shore-based)	Completed 4QFY14	Test delayed multiple times to correct problems discovered in DT. TEMP lists test completion as an LCS OT-C2 entrance criterion.
AMNS OA Phase B	Not specified in LCS TEMP	OA Phase B (LCS-based)	Completed 1QFY15 (concurrent with MCM MP OT)	Limited availability of test platform (LCS 2) led to concurrent DT/OT. TEMP lists test completion as an LCS OT-C2 entrance criterion.
AMNS OA Phase A VCD	Not specified in LCS TEMP	Verification of Correction of Deficiencies following Phase A OA	Not scheduled	Need for test currently under discussion. Scope of the program's corrections to the system is unclear.
AMNS Medium Current Testing	Not specified in LCS TEMP	Characterization of performance in moderate currents	Not scheduled	Insufficient data were collected in water conditions with moderate currents. Additional data required to complete operational evaluation.
ALMDS OA Phase B	Not specified in LCS TEMP	OA Phase B (LCS-based)	Completed 1QFY15 (concurrent with MCM MP OT)	Limited availability of test platform (LCS 2) led to concurrent DT/OT. TEMP lists test completion as an LCS OT-C2 entrance criterion.
KnifeFish IT-B1	1-3QFY14	Sonar characterization testing, battery qualification, mission package developmental laboratory/ MEDAL/EPMA integration	3QFY14-4QFY15	Early testing of Increment 4 MCM mission package component system. Although labeled IT, these events were early DT and were not operationally realistic. They will not be used for an operational assessment.
KnifeFish IT-B2	1QFY14	Electromagnetic interference and environmental testing	4QFY15	
KnifeFish IT-B3	1QFY14	Grade B shock testing	4QFY15	
COBRA Block I OA	Not specified in LCS TEMP (3QFY14 in LCS Test Sequence Network*)	Shore-based OA	Cancelled	Non-availability of test platform (MQ-8B) following Antares rocket explosion. COBRA Block I mission system OT was not included in the LCS TEMP because the program was not on DOT&E oversight at that time.

\* LCS Test Sequence Network refers to the Program Executive Officer for LCS's (PEO LCS) tool for tracking and scheduling specific test events.

***Remote Minehunting System (RMS) DT-IIG (Combined Developmental and Operational Testing) (Completed 1QFY14)***

In 1QFY14, following two phases of RMMV reliability improvements, the Navy completed two phases of developmental testing (DT-IIG) of the RMS (consisting of a version 4.2 (v4.2) RMMV and an AN/AQS-20A sensor) from a shore base at the contractor's facility in West Palm Beach, Florida. The second phase of testing was executed as IT to collect reliability data to augment a period of OT that was expected to follow. A third phase of testing described by the RMS TEMP as an opportunity to assess risk of the interfaces with the LCS, including cybersecurity, was not conducted. The Navy cited lack of LCS availability as the rationale for cancellation of this phase, but incompatibility of the v4.2 RMMV with LCS was also a factor.

***Remote Minehunting System (RMS) Operational Assessment (Incomplete/Deferred)***

In 2QFY14, DOT&E disapproved the Navy's plan to conduct an operational assessment of the RMS because the proposed testing was no longer necessary for the following reasons:

- The proposed test article was not representative of the system the Navy plans to employ in the first increment of the LCS MCM mission package and therefore would not provide data necessary to augment the operational testing of an LCS equipped with that mission package;
- Test limitations would have precluded an operational evaluation of key phases of the end-to-end mission;
- Conduct of the test would have delayed vehicle upgrades necessary to support testing of the system the Navy expects to field.

DOT&E recommended that the Navy dedicate the resources that would have been expended on this unnecessary test to appropriate IT and OT of the version of the system that the Navy intends to include in the Increment 1 MCM mission package. DOT&E further advised the Navy that this testing should commence as soon as that system configuration was available since the data from this testing are needed for the operational evaluation of the Increment 1 MCM mission package.

The Navy subsequently identified the RMS configured with the newly integrated v6.0 RMMV and improved AN/AQS-20B sensor as its intended test article for LCS OT with the first increment of MCM capability. The Navy also acknowledged that it would "off ramp" to the system consisting of the v6.0 RMMV and AN/AQS-20A, if necessary (as discussed below, this is in fact what occurred). To expedite collection of the data required, DOT&E advised the Navy in 1QFY15 that the planned operational assessment, whenever it was rescheduled, could be conducted as IT if the standards of operational realism were met. The Navy decided to execute the rescheduled operational assessment during a new period denoted DT-B1, which is discussed below.

***Remote Minehunting System (RMS) DT-B1 (Developmental and Integrated Testing)  
(Attempted but Aborted)***

The Navy developed a test plan for DT-B1 describing testing of both system variants that was sufficient to satisfy the objectives of the planned operational assessment (OT-B1 discussed above), regardless of which system configuration it decided to field. The Navy commenced the integrated phase of RMS DT-B1 in 1QFY15. Following emergent problems with the new AN/AQS-20B sonar and continued RMMV reliability problems, the Navy suspended integrated testing in 2QFY15 before testing of either system variant was completed. In January 2015, the Navy formally decided that the v6.0 RMMV and the AN/AQS-20A combination would be the RMS test article for the upcoming LCS OT. Because of the aborted testing, the data that would have been collected during this test period are still required for an adequate operational evaluation; however, the Navy has not yet scheduled testing to collect missing RMS data that are required to characterize MCM mission package performance. DOT&E approved the Navy's Data Management and Analysis Plan (DMAP) identifying the need for these data on December 11, 2014. This testing must be completed before DOT&E would consider the operational evaluation of the Increment 1 MCM mission package to be complete.

***Remote Minehunting System (RMS) "Overlap Testing" (not yet scheduled)***

The results of ALMDS testing to date show that the system is not meeting its required detection depth. The LCS TEMP identifies testing to evaluate whether the RMS detection/classification envelope (with either sensor variant) can be extended upward to overlap with the demonstrated ALMDS envelope. As noted earlier, DOT&E's TEMP approval memorandum stipulated that overlap testing employing the AN/AQS-20A sonar should be planned and executed as an integrated test. The Navy completed a developmental test using a surrogate ship to tow the sonar and subject matter experts to review sonar data and make mine detection calls, but has not yet scheduled an integrated test that includes Fleet-representative systems and operators. This testing must be completed before DOT&E would consider the operational evaluation of the Increment 1 MCM mission package to be complete.

***MH-60S and Airborne Mine Neutralization System (AMNS) DT/IT (Completed 3QFY14)***

In a continuation of DT/IT described in the LCS TEMP, the Navy attempted 19 AMNS attack runs against mine targets in the Panama City operating area in 2-3QFY14. Testing was designed to collect data on system performance against stealthy bottom mines and deep water moored mines that the Navy did not intend to collect during Increment 1 MCM mission package testing in the same environment. Test results revealed neutralizer tracking problems, depth indication errors, fiber-optic breaks, and tactics shortcomings that had not been identified in earlier testing (that did not include operationally realistic contact position errors).

***MH-60S and Airborne Mine Neutralization System (AMNS) Operational Assessment  
(Phase A and Phase B) (Completed 1QFY15)***

The Navy conducted Phase A of an AMNS operational assessment in 3-4QFY14 with the MH-60S helicopter operating from Naval Air Station, Oceana, Virginia. Testing examined the ability of an operator located in the helicopter to reacquire moored and bottom mine targets



detected by another system, guide the battery-powered neutralizer (mini-torpedo) into position, and detonate its warhead to damage and render each target ineffective. Explosive neutralizers and inert training neutralizers were employed against mine target positions representative of RMS contact localization accuracy observed in RMS DT-III. During Phase A, the system and its operators were unable to achieve the Navy's requirement for mine neutralization success, with some severe shortfalls relative to the requirement for neutralization under some crucial operational conditions. Frequent loss of fiber-optic communications between the aircraft and the neutralizer was the primary cause of unsuccessful attack runs. Failures of the host MH-60S aircraft's systems and its associated mission kit also limited AMNS mission availability.

The Navy completed the shipboard phase of the assessment (Phase B) concurrently with LCS DT in 1QFY15. An embarked Aviation Detachment conducted 9 AMNS sorties and attempted 21 attack runs against a combination of mine targets and other objects. In some cases, contacts passed from RMS to AMNS included significant localization errors that made it necessary for the test team to intervene to facilitate AMNS engagements with mine targets. Nonetheless, the results of testing continued to show that the system is not meeting Navy requirements for probability of success during AMNS operations conducted from an LCS at sea.

#### *Airborne Mine Neutralization System (AMNS) Verification of Correction of Deficiencies*

Following the Phase A assessment, the Navy initiated an engineering investigation in search of the root cause of problems that contributed to the large number of AMNS fiber-optic communications losses. The results of the engineering investigation did not identify a smoking gun, but did offer a number of recommendations for short- and long-term system improvements. Although the Navy expects longer-term initiatives to provide the most significant performance improvements, it implemented several near-term changes in hopes of reducing the recurrence of the failures observed during Phase A. DOT&E and the Navy are discussing the need for testing to evaluate the effectiveness of the recent changes.

#### *Airborne Mine Neutralization System (AMNS) "Medium Current" Testing (Not Yet Scheduled)*

The LCS TEMP describes AMNS DT/IT to evaluate the system in a high current environment. The Navy completed this testing in 2QFY13 and identified lack of destructor control authority and insufficient run time as deficiencies that limit system performance in swift current environments. After analyzing the results of the Navy's shore-based DT, DOT&E assessed that the probability of a successful AMNS attack run decreases in relatively low currents, and noted that even stronger currents are expected in some potential operating areas. Based on deficiencies identified in DT and the lack of data in some water current conditions, DOT&E advised the Navy that system performance must be characterized under operationally-realistic conditions in the "medium current" environment to evaluate operational effectiveness of the system and Increment 1 of the MCM mission package under expected combat conditions. The Navy has planned land-based tank testing and surrogate-platform testing, but has not yet planned operationally realistic testing representative of the system it intends to field. Operationally realistic testing must be completed before DOT&E would consider the operational evaluation of the Increment 1 MCM mission package to be complete.

***MH-60S and Airborne Laser Mine Detection System (ALMDS) Operational Assessment (Phase B) (Completed 1QFY15)***

The Navy completed the shipboard phase (Phase B) of the ALMDS operational assessment concurrently with MCM mission package DT in 1QFY15. Testing focused on the shipboard compatibility of the ALMDS and supporting systems as the embarked Aviation Detachment executed six search flights and two reacquisition flights. These flights revealed continued ALMDS reliability shortcomings and problems in both the planning and evaluation of ALMDS missions. No mine targets were present in the search area for this test event.

***Knifefish Integrated Testing (IT-B1 through IT-B3)***

Knifefish is an unmanned undersea vehicle (UUV) equipped with low-frequency broadband sonar to detect, classify, and identify mine-like objects throughout the water column, including buried mines, a capability that no other MCM system currently has. The Navy intends to include the Knifefish UUV in Increment 4 of the MCM mission package. Appendix E of the LCS TEMP describes three phases of Knifefish integrated testing, designated as IT-B1 through IT-B3, that the Navy expected to complete in FY14. The events include sonar characterization testing, battery qualification, integration with planning and evaluation tools, electromagnetic interference testing, and grade B shock testing, and all three have been delayed by at least a year. The Navy cites insufficient funding as the cause of these delays.

***Coastal Battlefield Reconnaissance and Analysis (COBRA) Block I Operational Assessment***

The Coastal Battlefield Reconnaissance and Analysis (COBRA) Block I system is a passive, multi-spectral sensor system expected to provide a capability for daytime detection of surface-laid mine lines and obstacles in the beach zone. The Navy cancelled a scheduled operational assessment of COBRA Block I after an Antares rocket exploded just after lift-off from the Wallops Island launch pad on October 28, 2014. Although all test preparations had been completed, both MQ-8B Fire Scout Vertical Takeoff and Landing Unmanned Aerial Vehicles (VTUAVs) that were to host the COBRA system during the test suffered shrapnel damage from the rocket explosion. The Navy plans to introduce COBRA Block I in the second increment of the MCM mission package following a shore-based Initial Operational Test and Evaluation (IOT&E) of the system in FY16.

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**Status of LCS Testing Scheduled in FY15**

The status of seaframe and mission package integrated developmental and operational testing (DT/IT) and OT scheduled for completion in 2015 is summarized in Table 3 and discussed below. Several of the events below are marked as "tentatively delayed" since the program office and PEO have not yet finalized their desired test schedules.

**Table 3. Status of LCS Testing Scheduled in FY15**  
(colors indicate testing associated with a particular mission package or seaframe)

Event	TEMP Scheduled Date	Description	Status	Reasons for deviation from TEMP
LFT&E of Aluminum Structure	FY14/ FY15	A Multi-Compartment Aluminum Structure, which is representative of the Independence Class structure and Freedom Class superstructure, will be subjected to internal detonations and fire	Scheduled 4QFY15 – 1QFY16	Delay caused by time required to construct the test article
DT/IT-B5	1QFY15	Increment 2 MCM mission package testing in Freedom seaframe	Tentatively delayed to Q1FY16 in LCS 9	PEO cites test priorities and limited ship availability resulting from deployments that support national objectives.
OT-C4	1QFY15	Seaframe & Increment 2 SUW mission package OT in Independence seaframe (LCS 4)	Scheduled 4QFY15	Delayed completion of prerequisite events and Post Shutdown Availability
TSST	1QFY15	Independence variant TSST	Scheduled 1QFY16	PEO cites test priorities.
ET-118	2-3QFY15	Enterprise Air Warfare testing in self-defense test ship with Independence configuration	Delayed to 2-3QFY16	Availability of Self-Defense Test Ship (SDTS) and funding
DT/IT-B4A	2-3QFY15	Increment 3 SUW mission package Surface-to-Surface Missile Module (SSMM) testing in Independence seaframe (LCS 4)	Tentatively delayed to 4QFY16	PEO cites selection of different SSMM with different targeting requirements
DT/IT-C2-MP (Now DT/IT-C2)	2-3QFY15	Increment 1 MCM mission package testing in Independence seaframe (LCS 2)	Scheduled 3QFY15	
DT/IT-C5	3QFY15	Increment 2 MCM mission package testing in Freedom seaframe	Tentatively delayed to Q2FY16 in LCS 9	PEO cites test priorities and limited ship availability resulting from deployments that support national objectives.
OT-C2-MP (Now OT-C2)	3QFY15	Increment 1 MCM mission package OT in Independence seaframe (LCS 2)	Scheduled 4QFY15	Additional crew work-up training inserted in schedule.
DT/IT-B3	3-4QFY15	Inc. 2 ASW mission package testing in Freedom seaframe	Tentatively delayed to 3QFY17 in LCS 7	PEO cites test priorities and limited ship availability resulting from deployments that support national objectives.
DT/IT-B8	4QFY15	Inc. 3 MCM mission package testing in Independence seaframe	Tentatively delayed to 2QFY16 in LCS 6	PEO cites test priorities and limited ship availability resulting from deployments that support national objectives.
OT-C5	4QFY15	Inc. 2 MCM mission package OT in Freedom seaframe	Tentatively delayed to 2-3QFY16 in LCS 8	PEO cites test priorities and limited ship availability resulting from deployments that support national objectives.

#### ***LFT&E of Multi-Compartment Aluminum Structure***

In this test, an aluminum structure that is representative of the *Independence* variant structure and *Freedom* variant superstructure will be subjected to internal detonations and fire. The blast tests will be conducted to gather data that characterize the damage to aluminum ship structure caused by internal detonations. The fire tests will be conducted to investigate the strength and stability degradation of an aluminum ship structure exposed to fire. Both of these areas were identified by the Navy as vulnerability knowledge gaps. The data are needed to validate LFT&E vulnerability analyses. These tests are expected to be conducted in 4QFY15 and 1QFY16.

#### ***DT/TT-B5 – Increment 2 MCM Mission Package Testing in Freedom Seaframe***

The LCS Program Executive Office (PEO(LCS)) estimates that DT/TT-B5 will be delayed to 2QFY18. Unless the Navy alters the composition, Increment 2 of the MCM mission package is expected to add an MQ-8B Fire Scout Vertical Take-off and landing Unmanned Aerial Vehicle (VTUAV) equipped with the COBRA Block I system, which is being designed to detect land mines and obstacles on the beach and further inland in light foliage. COBRA has not yet been operationally tested. The operational assessment of COBRA Block I scheduled in 1QFY15 was aborted after the test assets were damaged by shrapnel resulting from an Antares rocket mishap at Wallops Island, Virginia. The COBRA program office expects to conduct a land-based operational test of COBRA Block I during 4QFY16.

#### ***OT-C4 – OT of Independence Seaframe with Increment 2 SUW Mission Package***

The first operational test of an *Independence* seaframe is scheduled to commence in August 2015 aboard USS *Coronado* (LCS 4). *Coronado* will embark with the Increment 2 SUW mission package for the test. The test will be focused on the Flight 0 *Independence* seaframe's core capabilities in self defense against surface and air threats and in the conduct of routine shipboard evolutions, as well as the SUW mission package capabilities (including Maritime Security Operations and small-boat swarm defense). It will also include cybersecurity testing of the seaframe and mission package and the first test of either variant's capability to defeat a small, slow-flying aircraft. DOT&E will report the results of this testing in FY16.

#### ***Independence Seaframe Total Ship Survivability Trial (TSST)***

The Navy has delayed this TSST from 1QFY15 to 1QFY16 when USS *Coronado* (LCS 4) will be available to participate in the trial. Although differing in many details because of the stark differences between *Freedom* and *Independence* designs, this trial will be similar in concept to the TSST conducted aboard USS *Fort Worth* (LCS 3).

#### ***ET-11B – Enterprise Air Warfare Testing of Independence Configuration in Self-Defense Test Ship***

The second leg of the Enterprise Air Warfare Testing of the *Independence* seaframe's combat system was originally scheduled during 2-3QFY15 aboard the SDTS, but has been delayed until 2-3QFY16 to match the availability of funding and the SDTS. The test will include SeaRAM engagements of targets representing subsonic and supersonic ASCM threats. The

Navy and DOT&E will use the data from this test, as well as from ET-13B, to validate the modeling and simulation test bed.

***DT/IT-B4A – Test of Interim Surface-to-Surface Missile Module (SSMM) in an Independence Seaframe***

The Navy expects to conduct this standalone test of the Longbow Hellfire interim short-range Surface-to-Surface Missile Module (SSMM) during 4QFY16. Although the SSMM is described as a component of the Increment 3 SUW mission package, the other systems in that package are not included in this test. The TEMP states that the Navy intends to use the results of this test to field a single, stand-alone SSMM as a Rapid Deployment Capability. Under that plan, once deployed, the module would be moved from ship to ship to keep the capability forward deployed as the ships rotate back to the U.S. However, the plan for acquisition and deployment of the SSMM will likely change if the Longbow Hellfire missile proves to be effective against the small boat threat.

***DT/IT-C2 – TECHEVAL of the Increment 1 MCM Mission Package in an Independence Seaframe***

The Navy plans to commence TECHEVAL of the first increment of the MCM mission package aboard USS *Independence* (LCS 2) in April 2015. This testing will be conducted as integrated testing and will support DOT&E's operational evaluation in 4QFY15. Testing will exercise the ship and its mission systems in the conduct of MCM operations to detect, classify, and localize targets simulating moored and bottom mines. During this phase of testing, the Navy expects to demonstrate that the Increment 1 MCM mission package sustained area coverage rate requirements can be met and that the system is ready to proceed into OT.

***OT-C2 – OT of the Increment 1 MCM Mission Package in an Independence Seaframe***

The Navy expects to commence the first operational test of the Increment 1 MCM mission package in July 2015 aboard USS *Independence* (LCS 2). The ship's performance will be evaluated during a period of 45 days of intensive MCM operations designed to complement the earlier TECHEVAL scenarios conducted under differing environmental conditions. LCS 2 will be tasked to employ established tactics, techniques, and procedures while conducting end-to-end MCM operations against mine threats in shallow and deep waters utilizing mission package planning and evaluation tools, ALMDS and RMS minehunting assets, and the AMNS to simulate mine neutralization. Although the test will be focused on MCM operations, the crew will be required to maintain preparedness in other areas and may need to defend the ship against manned aircraft and boats simulating air and surface attacks. Equipment failure and repair data will be collected to evaluate the reliability, maintainability, and availability of critical ship and mission package systems.

DOT&E will use the data from OT-C2, the TECHEVAL, and supporting mission system test events to assess the operational effectiveness and suitability of the ship and MCM mission package for minehunting and mine clearance operations. The test is also expected to permit an assessment of the endurance of the ship's core crew, mission package detachment, and aviation personnel during a protracted period of medium- to high-intensity operations; the reliability,

maintainability, and availability of the seaframe and mission package; and the effectiveness of LCS training.

***DT/IT-C5 – TECHEVAL of Increment 2 MCM Mission Package in a Freedom Seaframe***

The Navy has delayed DT/IT-C5 to 2QFY18 because of limited test assets and higher testing priorities. Like DT/IT-B5, this test is expected to focus on the effectiveness and suitability of the COBRA Block I system when integrated into the LCS MCM mission package and any other changes in the composition or configuration of mission package systems since the previous MCM mission package OT.

***DT/IT-B3 – Increment 2 ASW Mission Package Testing in a Freedom Seaframe***

PEO(LCS) estimates that DT/IT-B3 will be delayed to 3QFY17 because of limited test assets and higher testing priorities. This test will focus on ASW operations with the Increment 2 ASW mission package in various environmental and sea state conditions. Unlike other mission package increments, the Increment 2 ASW mission package will entirely replace the first version of the ASW mission package, which the Navy shelved prior to DT after concluding that it would not meet their requirements. Unless the Navy alters the composition, the Increment 2 ASW mission package will include an Escort Module consisting of a Variable Depth Sonar (VDS) capable of continuous as well as pulsed transmissions and a Multi-Function Towed Array for receiving return echoes from the VDS and other acoustic signals. It will also include a Torpedo Defense Module that includes two Light Weight Tow (LWT) torpedo countermeasures, an Aviation Module (MH-60R with the AN/AQS-22 Airborne Low-Frequency Sonar (ALFS) and torpedoes and a Fire Scout VTUAV), and a Decision Support System. The Navy plans to exercise the host ship and mission package in barrier search and escort roles during Combat System Ship Qualification Trials (CSSQT). This testing will provide an initial assessment of the ship's capability to meet established performance requirements when operating with the ASW mission package.

***DT/IT-B8 – Increment 3 MCM Mission Package Testing in an Independence Seaframe***

The Navy also projects that DT/IT-B8 will be delayed to 2QFY18 because of limited test assets and higher testing priorities. Unless the Navy alters the composition or configuration, this test will examine the capabilities of an MCM mission package that has been upgraded with the Fire Scout VTUAV with COBRA Block I (added in Increment 2 but not yet tested in an *Independence* seaframe) and an Unmanned Influence Sweep System (UISS) capable of sweeping magnetic and acoustic influence mines (new in Increment 3). The test will also examine any improvements that the Navy has made to address aspects of LCS MCM performance found to be deficient in earlier MCM OT.

***OT-C5 – OT of Increment 2 MCM Mission Package in a Freedom Seaframe***

PEO(LCS) projects that this first OT of a *Freedom* seaframe with an MCM mission package will be delayed to 2-3QFY18 because of limited test assets and higher testing priorities. The Increment 2 mission package will include the Increment 1 systems (RMS and an MH-60S MCM helicopter with ALMDS and AMNS) plus a Fire Scout VTUAV with COBRA Block I.

The plan for this test has not yet been solidified, but will likely be similar to the OT-C2 test plan, with additional events designed to evaluate the contributions of the newly added systems.

## MCM Mission Package Component Systems' Testing Scheduled for Completion in FY 2015

Table 4 summarizes the status of MCM mission package component systems' testing scheduled for completion in FY15.

**Table 4. Status of MCM Mission Package Component Systems' DT/IT and OT Scheduled for Completion in FY 2015**

Event	Scheduled Date	Description	Status	Comment
ALMDS (Increment 1) IOT&E	3QFY15	LCS-based IOT&E (concurrent with LCS OT-C2, Increment 1 MCM mission package OT)	Scheduled 4QFY15	Results of test are expected to support Initial Operational Capability (IOC) and Full-Rate Production (FRP) decision
AMNS IOT&E	3QFY15	LCS-based IOT&E (concurrent with LCS OT-C2, Increment 1 MCM mission package OT)	Scheduled 4QFY15	Results of test are expected to support IOC and FRP decision
COBRA Block I IOT&E	Not specified in LCS TEMP	Shore-based IOT&E	Scheduled 4QFY16	COBRA Block I mission system OT was not included in the LCS TEMP. The program was not on DOT&E oversight at that time.
UISS DT/IT-B2	2QFY16 - 1QFY16	Unmanned integration and system performance testing	Not scheduled	UISS plan described in LCS TEMP was notional because UISS TEMP had not yet been developed.
UISS DT/IT-B3	3QFY15	LCS Freedom variant integration testing	Not scheduled	UISS plan described in LCS TEMP was notional because UISS TEMP had not yet been developed.
UISS DT/IT-B4	3QFY16	LCS Independence variant integration testing	Not scheduled	UISS plan described in LCS TEMP was notional because UISS TEMP had not yet been developed.
KnifeFish IT-B4	4QFY14 - 2QFY15	DT/IT period	1-3QFY16	Data expected to be used to support operational assessment report and low-rate initial production (LRIP) decision
KnifeFish IT-B6	2-3QFY15	TECHEVAL	3QFY16	Data expected to be used to support operational assessment report and LRIP decision

### *Airborne Laser Mine Detection System (ALMDS) Increment 1 IOT&E*

The Navy plans to complete ALMDS Increment 1 IOT&E concurrently with OT of LCS equipped with the first increment of MCM mission package in FY15. Although the Increment 1 system is required to achieve a reduced detection depth threshold, the Navy expects to use the results of testing to proceed to an ALMDS full-rate production (FRP) decision.<sup>9</sup> Appendix F of the LCS TEMP indicates the Navy commenced an ALMDS pre-planned product improvement

<sup>9</sup> It is noteworthy that even if RMS near-surface detection performance compensates for reduced ALMDS detection depth, a favorable FRP decision in FY15/16 would commit the Navy to the full complement of ALMDS pods without demonstrating end-to-end LCS MCM capability throughout the water column. Because the first increment of LCS MCM capability lacks a near-surface neutralization system, the FY15 LCS OT will not be able to demonstrate that mines detected and classified by ALMDS can be cleared in the time required to achieve LCS MCM requirements specified in the requirements documents.

(P3I) program designed to achieve full detection depth (ALMDS Increment 2) capability and planned to deliver the upgrades in FY17. Operational testing of system upgrades is not yet planned and the Program Executive Office indicates it no longer expects to deliver ALMDS P3I by FY17.

#### ***Airborne Mine Neutralization System (AMNS) IOT&E***

The Navy plans to complete AMNS IOT&E concurrently with OT of LCS equipped with the first increment of MCM capability in FY15. The Navy anticipates making an AMNS FRP decision despite the fact that only modest improvements have been made to address the performance problems observed in DT and operational assessment test periods. A favorable FRP decision in FY15/16 would commit the Navy to the full complement of AMNS launch and handling systems and associated MH-60S mission kits before implementing improvements necessary for the integrated system to perform effectively or demonstrate LCS MCM performance even approaching Capability Development Document requirements. Operational testing of future system upgrades to correct deficiencies or potentially expand neutralization capability into the near-surface regime is not yet planned.

#### ***Coastal Battlefield Reconnaissance and Analysis (COBRA) Block I IOT&E***

The LCS TEMP did not address COBRA Block I IOT&E. The Navy now plans to conduct this phase of testing from a shore-base in 4QFY16 in preparation for introduction in the second increment of the MCM mission package.

#### ***Unmanned Influence Sweep System (UISS) Integrated Testing (DT/IT-B2/B3/B4, etc.)***

The LCS TEMP includes notional plans for DT and OT of the UISS, which is expected to provide LCS with an acoustic and magnetic mine sweeping capability. At the time the Navy approved the LCS TEMP, the UISS program had not yet developed its TEMP. At the time of this report, the UISS TEMP has been drafted and is nearly complete; however, the Navy has not yet signed it and DOT&E has not approved it. The current strategy proposed by the UISS program would supersede all DT and IT of UISS described in the LCS TEMP.

#### ***Knifefish Integrated Testing (IT-B4 and IT-B5)***

The LCS TEMP describes two periods of Knifefish IT that the Navy expected to complete in FY15 to collect data that could be applied to the operational evaluation of the system. IT-B4 is expected to include evaluations of system endurance, MCM performance, cybersecurity, and LCS dockside integration (pending LCS availability). The final phase of integrated testing, IT-B5, is expected to serve as the system's TECHEVAL. The Navy plans to conduct LCS dockside integration testing, maintenance demonstrations, and initial end-to-end LCS at-sea testing to verify that the system can be fully integrated with the LCS support systems and meet threshold performance requirements in preparation for IOT&E. The TEMP also indicates the Navy will issue an operational assessment report at the conclusion of the IT phase of testing to support a Knifefish low-rate initial production (LRIP) decision. The Navy now intends to complete Knifefish IT in FY16.

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### Operational and Live Fire Testing Expected in FY 2016 and Beyond

The Navy plans to field LCS mission package capabilities incrementally as they become available; hence, the sole ASW mission package and more capable versions of the SUW and MCM mission packages will be introduced and operationally tested through the remaining years of this decade. Since the current LCS TEMP contains only scant details on the out-year tests, the Navy plans to flesh out those plans in the next TEMP update. That update was expected to be completed before the end of 2015, but is now likely delayed, primarily because the Navy has not yet provided the details on its plans to finish development of the components of the future increments. While the composition of mission packages, mission system configurations, and schedules will likely change, the Navy plans to conduct the following live fire tests and operational tests of new capabilities between 2016 and 2020 (after completing the usual sequence of DT, TECHEVALs, and, in some cases, program of record testing prior to integration with the mission packages). As previously noted, the Navy also expects to delay tests to future years that were originally scheduled during FY14 and FY15. PEO(LCS) advises that those delays and other schedule changes discussed in the following bullets are tentative and remain subject to review. Those postponed tests constitute a bow wave of work that will add to the following list.

- **Freedom Seaframe Full Ship Shock Trial (FSST).** The TEMP schedules the *Freedom* seaframe FSST in 3QFY16, and the Navy indicates that the test will be conducted on schedule. LCS 5 is the designated test ship. The ship shock trial is a key component of the Live Fire Test and Evaluation (LFT&E) program. LCS 5 will be exposed to shock from a series of underwater explosions to assess the reaction of the ship's structure and its installed systems.
- **Independence Seaframe FSST.** The Navy also indicates that the *Independence* seaframe shock trial, which is scheduled to be conducted in 4QFY16 is on track. The trial will be conducted in the same manner as the LCS 5 FSST, using LCS 6 as the test ship.
- **Increment 2 ASW mission package in *Freedom* seaframe (OT-C3).** The TEMP placed OT-C3 in 3QFY16, but the Navy now expects to conduct the test in 2QFY18 in LCS 7. As there are no planned follow-on ASW increments, this will be the only operational test of the *Freedom* variant's ASW capability unless the Navy pursues system upgrades or the test identifies deficiencies that must be corrected. Either could result in a corresponding requirement for follow-on operational testing (FOT&E).
- **Increment 3 MCM mission package in *Independence* seaframe (OT-C8).** This test was also scheduled in 3QFY16, but has tentatively been postponed until 3QFY18 in LCS 10. It will examine the capabilities of the MCM mission package after being upgraded with the Fire Scout VTUAV with COBRA Block I (added in Increment 2 but not previously test in an *Independence* seaframe) and a UISS capable of sweeping magnetic and acoustic influence mines (new in Increment 3). Until recently, the Navy was considering including an upgrade to AMNS in the Increment 3 MCM

mission package to enable it to neutralize near-surface mines, a capability that it lacks in the Increment 1 mission package; however, the program is not funded to develop this upgrade and its future is unknown.

- **Increment 4 MCM mission package in *Independence* seaframe (OT-C10).** The TEMP placed OT-C10 in 2QFY17, but the Navy now indicates that the test will likely not be conducted until 4QFY19 in LCS 12. The Navy plans to add buried mine detection capability and other mine detection enhancements provided by the Knifefish UUV. The mission package might also include new production RMMVs.
- **Increment 2 ASW mission package in *Independence* seaframe (OT-C6).** The Navy originally planned to test the ASW capability of the *Independence* seaframe and mission package in 3QFY17, but has tentatively postponed the test until 2QFY19. In addition to providing the first (and possibly only) look at the *Independence* variant's ASW capability, this test will also provide an opportunity to reexamine any aspects of mission package performance found to be deficient during the earlier *Freedom* variant test. The Navy does not currently plan to conduct any FOT&E of either variant with the ASW mission package after this test is complete. However, as upgrades are introduced, DOT&E will require adequate OT commensurate with the specific changes introduced, not unlike any other modernization program.
- **Increment 3 MCM mission package in *Freedom* Seaframe (OT-C7).** The TEMP scheduled this test, designed to evaluate an enhanced mission package with a new minesweeping capability, to occur during 1QFY17, but the Navy indicates that the test will likely be delayed until 3QFY19 in LCS 11.
- **Increment 4 MCM mission package in *Freedom* seaframe (OT-C9).** The TEMP indicates that the Navy plans to complete testing of the LCS MCM capability with this test of the Increment 4 package onboard a *Freedom* seaframe during 3QFY18; however, PEO(LCS) advises that the test will likely be postponed until 3QFY19 in LCS 11. Unless the Navy alters the composition of the Increment 4 mission package, Knifefish will augment the systems in the Increment 3 mission package. DOT&E will not be able to assess how well an LCS equipped with the complete MCM mission package meets the Capability Development Document requirements, and more importantly, can support the operational commanders' MCM requirements until completion of this test and the companion test on the *Independence* seaframe.
- **Increments 3 and 4 SUW mission package in *Independence* seaframe (OT-C12).** This will be the first operational test of the capability enhancements provided by the interim SSMM and VTUAV(s) added in Increment 3 aboard an *Independence* seaframe. PEO(LCS) now expects to complete Increment 3 OT in 4QFY18. If the Navy opts to improve the SUW mission package with an extended-range SSMM in Increment 4, that increment will be tested during 2QFY20 in LCS 6.
- **Increment 4 SUW mission package in *Freedom* seaframe (OT-C11).** Although scheduled for completion in 3QFY19 in the TEMP, PEO(LCS) indicates that the

Navy may choose to eliminate Increment 4 of the SUW mission package if Increment 3, which will have the Longbow Hellfire SSMM, provides the needed capability. If development of Increment 4 is continued, the Navy projects that it will be tested during 1QFY20 in LCS 3.

- Mine susceptibility trials will be conducted using the Advanced Mine Simulation System (AMISS) to evaluate the LCS seaframes' susceptibility to mines and to validate the Navy's Total Mine Simulation System (TMSS) using AMISS. These trials have not yet been scheduled, but are expected to occur after FY16.

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#### **Operational Testing For MCM Mission Package Components Expected in FY 2016 and Beyond**

Table 5 summarizes the plans to conduct MCM mission package component systems' testing in FY16 and later. In most cases, the IOT&E's of each of these subsystems would coincide with the operational evaluation periods for the applicable increment of the MCM mission package. Plans for each of these will be tied closely to the decisions the Navy makes regarding the composition and desired scheduling of Increments 2, 3, and 4 of the MCM mission package and when each ship class is available for the needed testing.

**Table 5. MCM Mission Package Component Systems' DT/IT and OT Scheduled for Completion in FY 2016 or Beyond**

System	Schedule Date	Description	Status (Notes)	Comments
UISS OT-B1	2QFY16	LCS-based phase of Operational Assessment (OA)	No longer planned; however, first phase of UISS OA scheduled 2QFY17 from shore or LCS surrogate	Planned to support LRIP decision (if engineering design model (EDM) is not certified as production-representative)
UISS OT-B2	2QFY16	LCS-based phase of OA (on the ship class not tested in previous phase)	No longer planned; however, a second phase of UISS OA scheduled 2-3QFY17 to assess LCS integration of both LCS variants	Planned to support LRIP decision (if EDM is not certified as production-representative)
UISS DT/IT-C1	2QFY17	LCS Freedom variant TECHEVAL	Tentatively scheduled for FY17 on an available LCS variant	Current draft UISS TEMP does not specify an LCS hull variant
UISS DT/IT-C2	2QFY17	LCS Independence variant TECHEVAL	Tentatively scheduled for FY17 on an available LCS variant	
UISS OT-C1a	4QFY17 - 2QFY18	LCS-based IOT&E	UISS OT (Phase A) scheduled in 3-4QFY17/19	Required to support FRP decision; focused on examining mine sweep performance
UISS OT-C1b	3-4QFY18	LCS-based IOT&E (for the other ship not tested in OT-C1a)	Tentatively scheduled for FY18	Moved to an FOT&E period; focused on UISS integration with the other LCS not tested in UISS IOT&E (see above)
UISS OT-C2a	2QFY16	LCS-based vulnerability evaluation and penetration testing	UISS OT (Phase B) 3QFY17/19 (on one LCS variant)	Required to support FRP decision; focused on cybersecurity testing
UISS OT-C2b	4QFY18	LCS-based vulnerability evaluation and penetration testing (for the other ship not tested in OT-C2a)	FY18/20 during UISS FOT&E	UISS FOT&E focuses on the LCS variant not tested during UISS IOT&E
UISS OT-C4	1QFY19	Live-on-Live testing	Tentatively scheduled during UISS FOT&E, FY18/20	Originally planned in the LCS TEMP; however, UISS TEMP draft suggests this test event will occur as part of UISS FOT&E
RMS OT-C1	Not specified in LCS TEMP (2QFY17 in RMS TEMP)	LCS-based phase of IOT&E	Estimated schedule FY19/20	Pending availability of new LRIP units; efficiencies can be achieved if the Navy elects to align this phase of testing with OT of LCS Freedom variant with the Increment 4 MCM mission package
RMS OT-C2	Not specified in LCS TEMP (2QFY17 in RMS TEMP)	LCS-based phase of IOT&E (conducted on other class)	Estimated schedule FY19/20	Pending availability of new LRIP units; efficiencies can be achieved if the Navy elects to align this phase of testing with OT of LCS Independence variant with the Increment 4 MCM mission package
Kratos OT-C1a	1-2QFY16	LCS Freedom-variant phase of IOT&E	3QFY17	Efficiencies can be achieved if the Navy elects to align this phase of testing with OT of LCS Freedom variant with the Increment 4 MCM mission package
Kratos OT-C1b	2QFY16	LCS Independence-variant phase of IOT&E	4QFY17	Efficiencies can be achieved if the Navy elects to align this phase of testing with OT of LCS Independence variant with the Increment 4 MCM mission package
Kratos OT-C1c	4QFY16	Ship of opportunity / craft of opportunity phase of IOT&E	1QFY18	
COBRA Block II IOT&E	Not specified in LCS TEMP	IOT&E	Not scheduled	Program, if the Navy decides to pursue it, will be covered under separate TEMP from COBRA Block I.

\* Dates reported here are stated in the component system's current, but draft, TEMPs (especially Kratos and UISS), which have not been signed/approved by DOT&E. These dates do not coincide with the LCS mission package program office's current estimates, and are likely to change.

### ***Unmanned Influence Sweep System (UISS) Operational Assessment, TECHEVAL, and IOT&E***

The LCS TEMP included notional plans for phases of UISS operational assessments, a TECHEVAL, and IOT&E aboard both LCS seaframe variants. However, this strategy no longer reflects the Navy's plans and has been superseded by recent development of a UISS TEMP. The draft UISS TEMP indicates IOT&E will be completed in either FY17 or FY19, pending the outcome of a review to determine whether an engineering design model (EDM) of the system is production-representative. Although the Navy indicates that it still intends to introduce UISS in the Increment 3 MCM mission package, its plans must be reconciled with the strategy described in the UISS TEMP in future LCS TEMP updates.

### ***Remote Minehunting System (RMS) OT-C1 Phase of IOT&E***

Appendix E of the LCS TEMP describes the first phase of RMS IOT&E as an end-to-end test aboard one of the LCS seaframe variants. Testing is expected to evaluate the new LRIP AN/AQS-20C sonars (production P31 units) fully integrated with new LRIP RMMVs in the execution of shallow and deep water minehunting missions. The Navy now expects to complete this testing in FY19 or FY20, pending availability of LRIP units. DOT&E has advised the Navy that efficiencies could be achieved by aligning this phase of testing with testing of LCS with the Increment 4 MCM mission package.

### ***Remote Minehunting System (RMS) OT-C2 Phase of IOT&E***

Appendix E of the LCS TEMP describes the second phase of RMS IOT&E as primarily an integration and suitability test from the alternate LCS seaframe variants. Testing is expected to evaluate the production-representative version of the RMS as employed by Fleet operators to complete at least two shallow and deep water minehunting missions. The Navy also expects to complete this phase of testing in FY19 or FY20 to support an FRP decision for the RMS.

### ***Knifefish IOT&E***

Appendix E of the LCS TEMP indicates the Knifefish IOT&E would be conducted in three phases during FY16. Although schedules are still not firm, current schedules indicate the Navy expects to complete Knifefish IOT&E in early FY18. The first two phases of IOT&E (Phases A and B) are expected to evaluate the system in end-to-end minehunting missions in threat-representative scenarios from each LCS variant. The third phase of IOT&E (Phase C) is expected to provide data necessary to make an assessment of the system in a standalone expeditionary mode when launched, operated, and recovered from a craft or ship of opportunity. The Navy still plans to add Knifefish to LCS capability in Increment 4 of the MCM mission package, which is consistent with the plan described in the LCS TEMP.

### ***COBRA Block II IOT&E***

The LCS TEMP did not describe any independent operational testing of COBRA Block II. However, the Navy notionally planned to introduce COBRA Block II, which retains Block I capability and adds night-time minefield and obstacle detection capability and day/night detection capability in the surf zone, in the fourth and final increment of the MCM mission

package. The Program Executive Office now indicates system development is behind schedule and it no longer expects to include the improved system in the Increment 4 MCM mission package.