

Littoral Combat Ship (LCS)

Executive Summary

- In July 2020, DOT&E issued an operational test report on the *Freedom* variant equipped with the Surface Warfare (SUW) Increment 3 Mission Package (MP), based on the results of operational testing from July 2018 to June 2019.
- In November 2019, the Navy conducted an operational assessment on the Unmanned Influence Sweep System (UISS) as part of the Mine Countermeasures (MCM) MP. See the UISS Annual Report article on page 169 for details.
- In December 2019, the Navy completed analysis of the lethality of Littoral Combat Ship (LCS) weapon systems against a spectrum of small boat threats.

System

Seaframes

- The LCS is designed to operate in shallow waters that limit the access of larger ships.
- The Navy is procuring two LCS seaframe variants:
 - The *Freedom* variant (odd-numbered ships) is a monohull design constructed of steel (hull) and aluminum (deckhouse) with two steerable and two fixed-boost waterjets driven by a combined diesel and gas turbine main propulsion system.
 - The *Independence* variant (even-numbered ships) is an aluminum trimaran with two steerable waterjets driven by diesel engines and two steerable waterjets driven by gas turbine engines.
- Both LCS variants are approximately the same size and displacement, though the composition, configuration, and arrangement of mission and auxiliary systems are different for each design.
- The LCS *Freedom* and *Independence* variant baselines will include a newly developed Light Weight Tow (LWT) to provide torpedo defense capability. However, the LWT is not funded.

Mission Packages

- LCS seaframes are designed to host specific warfare MPs. The Navy has installed individual MCM, SUW, and Anti-Submarine (ASW) MPs semi-permanently on the seaframes, dedicating specific ships to specific missions. The three MPs consist of the following components:
 - SUW MP (including Increment 3--the final increment of SUW MP)**
 - Gun Module: two MK 46 30-mm guns and one MK 110 Mod 0 57-mm gun.
 - Aviation Module: one MH-60S Armed Helicopter Weapon System and one MQ-8 Fire Scout.
 - Maritime Security Module: two 11-meter rigid-hull inflatable boats with launch and recovery equipment.



Freedom Variant (LCS 1)



Independence Variant (LCS 2)

- Surface-to-Surface Missile Module (SSMM): 24 Longbow HELLFIRE missiles modified for the maritime environment.

MCM MP

- Near Surface Detection Mission Module (MM): one Airborne Laser Mine Detection System unit for employment on the MH-60S multi-mission helicopter.
- Remote Minehunting (RMH) MM: two minehunting sonar units and one MCM Unmanned Surface Vehicle (USV) for minehunting capabilities. The Navy is integrating the AN/AQS-20C minehunting sonar systems for use from the MCM USV. The Navy has implemented several Engineering Change Proposals to the UISS surface craft as the production baseline for the MCM USV.
- Buried Minehunting MM: two battery-powered, autonomous, Knifefish Block I Unmanned Undersea Vehicles, employing a low frequency, broadband, synthetic aperture sonar to detect and classify mines moored in the ocean volume, laying on the ocean bottom, or buried in bottom sediment.
- Coastal Mine Reconnaissance MM: one Coastal Battlefield Reconnaissance and Analysis System Block I

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integrated with the MQ-8B Fire Scout. Fire Scout is a Vertical Take-off and Landing Tactical Unmanned Aerial Vehicle for daytime unmanned aerial tactical reconnaissance to detect and localize mine lines and obstacles in the beach zone.

- Airborne Mine Neutralization MM: two Airborne Mine Neutralization System (AMNS) units for employment on the MH-60S multi-mission helicopter.
- Near Surface Neutralization MM (projected for FY24): the Barracuda Mine Neutralization System completed preliminary design review in June 2019. The system may begin developmental testing (DT) in FY24, and if successful, augment AMNS in other portions of the water column. The Navy plans to deploy Barracuda from LCS using the MCM USV.
- Unmanned Minesweeping MM: one UISS composed of one MCM USV and the sweep payload deployment system to detonate acoustic-, magnetic-, and combined acoustic/magnetic-initiated mines moored in the ocean volume, laying on the ocean bottom, or buried in bottom sediment.
- Aviation MM: consists of one MH-60S multi-mission helicopter with the AMCM mission kit and one MQ-8B Fire Scout.

ASW MP

- Escort Mission Module: multi-function towed array (MFTA) and variable depth sonar (VDS) with the AN/SQQ-89A(V)15 Surface Ship Undersea Warfare Combat System. MFTA and VDS provide submarine search, detection, localization, and track capability. MFTA also

supports incoming torpedo detection and is the catalyst for LCS torpedo evasion.

- Aviation Mission Module: An MH-60R helicopter provides submarine prosecution capability with MK 54 torpedoes.

Mission

- The Maritime Component Commander will employ LCS to conduct MCM, ASW, or SUW tasks depending on the MP installed in the seaframe. Because of capabilities inherent to the seaframe, commanders can employ LCS in a maritime presence role with any MP supporting deterrence and maritime security operations. In addition, with the Maritime Security Module installed as part of the SUW MP, the ship can conduct Maritime Security Operations including Visit, Board, Search, and Seizure of ships suspected of transporting contraband.
- The Navy employs LCS alone or in company with other ships to prepare the environment for joint force access to critical littoral regions by conducting MCM, ASW, and SUW operations, possibly under an air defense umbrella.

Major Contractors

- *Freedom* variant
 - Prime: Lockheed Martin Maritime Systems and Sensors – Washington, D.C.
 - Shipbuilder: Marinette Marine – Marinette, Wisconsin
- *Independence* variant
 - Prime for LCS 6 and subsequent even-numbered ships: Austal USA – Mobile, Alabama
 - Shipbuilder: Austal USA – Mobile, Alabama

Activity

LCS Program

- The Navy has neither resourced nor conducted any air warfare test events against anti-ship cruise missile surrogates planned as part of the DOT&E-approved Capstone Enterprise Air Warfare Ship Self-Defense Test and Evaluation Master Plan (TEMP) or the LCS TEMP. The Navy's Program Executive Office for Integrated Warfare Systems halted all work to develop a Probability of Raid Annihilation (PRA) modeling and simulation (M&S) suite of the combat systems in FY15 and has not yet restarted the effort.
- The program is currently in the initial planning stages for conducting cybersecurity testing of the seaframes with the three mission packages.
- DOT&E is still working with the Navy to identify and resolve root causes of the poor statistical correlation between mine susceptibility M&S predictions and the data from the mine susceptibility trial conducted in 2019.

SUW

- The Navy completed DT of the SUW Increment 3 MP on the *Independence* variant in November 2019. Testing included radar tracking events and live missile

firings against fast inshore attack craft (FIAC) surrogate targets. The testing culminated in a live-fire swarm attack defense event against 10 surrogate targets. This final event was designed as an integrated test event, to provide data for both the developmental and operational test programs. However, testing was not conducted in accordance with the DOT&E-approved test plan and was therefore not operationally representative.

- The Navy has not scheduled the final two small-boat swarm defense operational testing events required for the *Independence* variant equipped with the SUW Increment 3 MP due to the non-availability of surrogate targets, range time, and ship availability.
- In December 2019, the Navy completed Advanced Joint Effectiveness Model runs to support the lethality evaluation of the SSMM (part of Increment 3 of the SUW MP) against FIAC targets for a range of engagement conditions.

ASW

- In September 2019, the Navy embarked the ASW MP on board the LCS 3 to support DT. The Navy intended to complete DT in April 2020; however, several material

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failures delayed its completion. The Navy expects to complete DT in 1QFY21.

- The Navy intends to conduct operational testing in 2021.
- The Navy determined the risk of losing the towed body during operational testing of the torpedo evasion capability to be unacceptable. Although the likelihood of the towed body interacting with the incoming exercise torpedo during the test is low, the loss of the Navy's only test asset would significantly delay follow-on test events. Therefore, the Navy will conduct the torpedo evasion evaluation by simulating the towed body being deployed and prompting evasion based on historical capability of a similar torpedo detection system.
- The Navy deferred testing the search capability of LCS with ASW MP against diesel submarines (SSKs) and midget diesel submarines (SSMs) to FOT&E due to the unavailability of test assets during the planned IOT&E period.
- The Navy deferred testing the torpedo evasion capability of LCS with ASW MP against wake-homing torpedoes to FOT&E when an LWT is available for test.

MCM

- The Navy conducted an operational assessment on the UISS in November 2019. See the UISS Annual Report article on page 169 for details.
- The Navy continued integration of UISS and Knifefish components on the *Independence* variant throughout 2020 and began integration on the *Freedom* variant.

Assessment

SUW

- DOT&E issued a classified operational test report on the *Freedom* variant equipped with the SUW Increment 3 MP in July 2020 encompassing the results of testing from July 2018 to June 2019. The system was effective for defense against swarms of small boats at long ranges, but was not operationally suitable due to frequent ship propulsion failures. The classified operational test report has additional details.
- There has been no operational testing of the *Independence* variant equipped with the SUW Increment 3 MP. The integrated testing conducted in November 2019 was intended to inform DOT&E's evaluation, but deviations from the DOT&E-approved test plan precluded its use in an operational evaluation. In particular, problems observed with the ship's tactical radar modes caused the crew to shift to a non-operationally representative radar mode for the duration of the test. Determining how those radar problems potentially degrade operational performance is critical for DOT&E to assess the effectiveness of the SUW Increment 3 MP on the *Independence* variant. Consequently, the ability

of the ship's radar to support missile engagements was not assessed.

- While the Navy did not conduct the lethality assessment of the SSMM against all of the FIAC surrogate targets, as outlined in the DOT&E-approved Live Fire Strategy, testing and M&S supported the conclusion that SSMM can be lethal against a spectrum of small boat threats in more benign engagement conditions (e.g., smaller swarm size, lower speed).

ASW

- DOT&E has no operational test data and cannot assess system performance. However, system reliability is a concern due to the observed failures throughout DT and the limited opportunity for reliability growth before operational evaluation.
- The lack of an LWT degrades the capability of the LCS with ASW MP to defeat an incoming torpedo. DOT&E has no data to quantify this degradation; however, the LCS with ASW MP will operate with greater wartime risk until the LWT is available.

MCM MP

- See the UISS Annual Report on page 169 for complete details.
- DOT&E has no data at this time to assess the integration of the UISS and Knifefish Components on the *Independence* variant.

Recommendations

The Navy should:

1. Fund and conduct end-to-end mission operational testing of the LCS *Independence* variant with SUW Increment 3 MP, to include resourcing the threat target surrogates required for operational testing.
2. Resource and conduct the air warfare test events against anti-ship cruise missile surrogates planned as part of the DOT&E-approved Capstone Enterprise Air Warfare Ship Self-Defense TEMP and LCS TEMP.
3. Resource the development of the LCS PRA combat system M&S suite.
4. Use the LCS Advanced Mine Simulator System (AMISS) trial data to determine the root cause of discrepancies between the trial results and the Total Mine Simulation System (TMSS) predictions (e.g., sensitivity to threat, environmental, and ship variables).
5. Fund the development and delivery of the LWT as soon as feasible to minimize risk to the LCS with ASW MP from incoming torpedoes.
6. Proceed with the planning and resourcing of the cybersecurity testing of the seaframes with the three MPs installed.

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