

Littoral Combat Ship (LCS)

Executive Summary

- The Navy has proposed ordering 20 Littoral Combat Ships (LCS) in a split buy between the two competing variants. If the proposal does not gain congressional approval, the Navy will continue with their plans to select one hull from the two competing ship designs of the LCS in FY11.
- Regardless of the final acquisition strategy, the Navy intends to employ the ships through their operational service life, so the current test and evaluation strategy reflecting comprehensive testing for both designs will remain applicable.
- LCS 1 critical ship control systems essential to support the crew have performed well in testing; however, several systems required for self-defense and mission package support have demonstrated early reliability problems.
- LCS 2 completed part one of Acceptance Trials and deferred several events to a second Acceptance Trial in early 2011. The ship was found to be incomplete; several systems and spaces have not been accepted by the government.
- The Navy designated LCS a Survivability Level 1 ship. Consequently, its design is not required to include survivability features necessary to conduct sustained operations in a combat environment. As such, LCS is not expected to maintain significant mission capability if hit by a weapon.



LCS 1



LCS 2

System

- The LCS is designed to operate in the shallow waters of the littorals where larger ships cannot maneuver as well. It can accommodate a variety of individual warfare systems (mission modules) assembled and integrated into interchangeable mission packages.
- There are two competing basic ship (seaframe) designs:
 - LCS 1 is a semi-planing monohull constructed of steel and aluminum.
 - LCS 2 is an aluminum trimaran design.
- Common characteristics:
 - Combined two diesel and two gas turbine engines with four waterjet propulsors
 - Sprint speed in excess of 40 knots, draft of less than 20 feet, and range in excess of 3,500 nautical miles at 14 knots
 - Accommodate up to 76 personnel (air detachment, mission module personnel, and core crew of no more than 50)
 - A Common Mission Package Computing Environment (MPCE) for mission module component transparency across Mission Packages.
 - Hangars sized to embark MH-60R/S with multiple Vertical Take-off Unmanned Aerial Vehicles (VTUAVs)
 - 57 mm BOFORS Mk 3 gun with dissimilar gun fire control systems.
- The designs have different combat systems for self-defense against anti-ship cruise missiles
 - LCS 1: COMBATSS-21, an Aegis-based integrated combat weapons system with a TRS-3D (German) Air/Surface search radar, Ship Self-Defense System Rolling Airframe Missile (RAM) interface (one 21-cell launcher), and a DORNA (Spanish) Electro-Optical/Infrared (EO/IR) for 57 mm gun fire control.
 - LCS 2: Integrated combat management system (derived from Dutch TACTICOS system) with a Swedish 3D Air/Surface search radar (Sea Giraffe), one RAM (11-cell) launcher integrated into Close-In Weapons System (Mk 15 CIWS) search and fire control radars (called SeaRAM), and Sea Star SAFIRE EO/IR for 57 mm gun fire control.
- More than a dozen individual programs of record involving sensor and weapon systems and other off-board vehicles make up the individual mission modules, including the following:
 - Remote Multi-Mission Vehicle, an unmanned semi-submersible that tows a special sonar to detect mines
 - Organic Airborne Mine Countermeasures, a family of systems employed from an MH-60S designed to detect, localize, and neutralize all types of sea mines

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- Unmanned Surface Vehicles, used in both mine and anti-submarine warfare applications
- VTUAV, specifically the Fire Scout (MQ-8B)
- The Navy plans to acquire a total of 55 LCSs, the first four being a mix of the two competing designs, followed by a split buy of 10 vessels of each design.

Mission

- The Maritime Component Commander can employ LCS to conduct Mine Warfare, Anti-Submarine Warfare, or Surface Warfare, based on the mission package fitted into the seaframe. With the Maritime Security Module installed, the ship can conduct sustained Level II (Non-Compliant, free board less than 25 feet) Visit Board Search and Seizure (VBSS) Maritime Interception Operations. Mission packages are designed to be interchangeable, allowing the Maritime Component Commander flexibility to reassign missions.
- Commanders can employ LCS in a maritime presence role regardless of the installed mission package based on capabilities inherent to the seaframe.

- The Navy can deploy LCS alone or in conjunction with other ships.

Major Contractors

LCS 1

- Prime: Lockheed Martin Maritime Systems and Sensors – Washington, District of Columbia
- Shipbuilder: Marinette Marine – Marinette, Wisconsin

LCS 2

- Prime: General Dynamics Corporation Marine Systems, Bath Iron Works – Bath, Maine
- Shipbuilder: Austal USA – Mobile, Alabama

Mission Packages

- Future Mission Package Integration contract awarded to Northrop Grumman – Los Angeles, California

Activity

- DOT&E published the LCS-1 Early Fielding Report in July 2010. DOT&E will submit an Operational and LFT&E report upon completion of IOT&E and prior to a full-rate production decision.
- DOT&E approved the LFT&E Management Plan in August 2010. This plan serves as the alternative LFT&E strategy that accompanies the Navy's request for waiver from full-up, system-level survivability testing.
- LCS 1:
 - USS *Freedom* (LCS 1) with initial increment of the Surface Warfare Mission Package, including two 30 mm gun mission modules, deployed nearly two years early to U.S. Southern Command and participated in Rim of the Pacific Exercise 2010.
- LCS 2:
 - Completed Acceptance Trials (part I) in November 2009 and deferred several events to a second Acceptance Trial tentatively scheduled for early 2011.
 - The Navy accepted delivery in December 2009.
 - The Navy commissioned LCS-2 on January 16, 2010.
 - The Navy completed OT&E of LCS 2 Electronic Chart Display and Information System – Navy (ECDIS-N).
- Mine Counter Measures (MCM) end-to-end Phase III testing scheduled onboard surrogate ship *Seafighter*. Testing was delayed by the Deepwater Horizon oil spill and subsequently moved to the south Florida range where testing was hindered by deteriorated sea conditions caused by several hurricanes passing the vicinity in September of 2010. Chase boats and unmanned vehicles were both limited by Sea States (SS) greater than three.

- The Navy has proposed ordering 20 LCSs in a split buy between the two competing variants. If the proposal does not gain congressional approval, the Navy will continue with their plans to select one hull from the two competing ship designs of the LCS in FY11.
- The Navy is conducting a study to determine if the Non-Line-of-Sight (NLOS) missile will be necessary to meet the LCS requirements. The Army cancelled the NLOS in FY10.
- The Navy is in the process of establishing a Service-wide 30 mm and 57 mm ammunition Live Fire Integrated Product Team. This team will address the lethality of each round with respect to each program's target set. The Navy will submit LFT&E Management Plans in FY11.
- Testing was conducted in accordance with DOT&E-approved test plans.

Assessment

- LCS 1:
 - Critical ship control systems essential to support the crew have performed well in testing; however, several systems required for self-defense and mission package support have demonstrated early reliability problems.
 - The crew appears to be operating at nearly full capacity during routine operations, and the Navy is still assessing whether the crew is "right-sized" to cope with the workload. The ship does not have sufficient installed berthing to accommodate the nominal crew complement,

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- nor is the installed refrigerated food storage capacity sufficient to meet the prescribed provision endurance.
- LCS 2:
 - Builder trials were initially delayed due to leaks at the gas turbine shaft seals. More testing identified additional deficiencies related to the main propulsion diesel engines, further delaying completion of the trials until October 2009.
 - During Acceptance Trials, the ship was found to be incomplete. Several spaces and critical systems were incomplete and had not been accepted by the government. Spaces and systems that were accepted had various levels of documented material deferrals necessitating a second Acceptance Trial, which is tentatively scheduled for early 2011.
 - LCS is not expected to be survivable in terms of maintaining a mission capability in a hostile combat environment. This assessment is based primarily on a review of the LCS design requirements. The Navy designated LCS a Survivability Level 1 ship; the design of the ship just allows for crew evacuation. Consequently, its design is not required to include survivability features necessary to conduct sustained operations in a combat environment. The results of early live fire testing using modeling and simulation, while not conclusive, have raised concerns about the effects weapons will have on the crew and critical equipment. Additional live fire testing and analysis is needed to fully assess the survivability of the LCS class of ships. Additional information is available in the classified LCS 1 Early Fielding Report.
 - The LFT&E Management Plan describes the major tests and analyses that will serve as the basis for DOT&E's survivability assessment. To address the vulnerability implications of building ships with aluminum structure to commercial standards, relevant to both ship designs, the LFT&E program will include the following surrogate tests: fire-induced structural collapse test of a multi-compartment aluminum structure, internal blast test of a multi-compartment aluminum structure, and an underwater explosion-induced inelastic whipping test of a surrogate ship.
- ### Recommendations
- Status of Previous Recommendations. Two recommendations from FY05 and FY06 remain; recommendations concerning a risk assessment on the adequacy of Level I survivability, and detailed manning analyses to include mission package support. The Navy has partially addressed one FY09 recommendation to develop an LFT&E program with the approval of the LFT&E Management Plan; however, the recommendation will not be fully addressed until the details of the surrogate testing and the lethality testing are developed.
 - FY10 Recommendations.
 1. LCS 1: The Navy should implement all recommendations from DOT&E's Combined Operational and Live Fire Early Fielding Report.
 2. LCS 2: The Navy should address all deficiencies noted in the Navy's Board of Inspection and Survey Acceptance Trials report.

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