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Focus on Littoral Combat Ship (LCS) High-Speed Surface Ship, USA

Sommary

ABSTRACT

Navy will continue with LSI for each class for now

4 LCS are currently in some stage of production, 2 for each builder

One LMCO ship has been accepted by the Navy and is in commission. The second LMCO ship is under construction and will have the same installed systems as the first ship. The second ship is being built under a Fixed Price Incentive Fee contract.

The first GD ship has not been accepted by the Navy yet. GD was recently awarded a contract to build one more ship. Both of these ships will have the same systems installed. The second ship is being built under a Fixed Price Incentive Fee contract.

Both LMCO and GD have submitted bids for the next 3 ships. The award will be made by the end of the year. 2 ships will go to one company and 1 to the other. All three ships will be built under FPI contracts. Each company will build the ships identical to the first two they built with the same systems. No changes will be made to contractor supplied systems.

The Navy intends to migrate to a common combat system for LCS awarded in GFY 11 and beyond. The systems will be procured by the Navy and provided to the builder as GFE.

The Littoral Combat Ship (LCS) is the U.S. Navy's newest surface combatant class. Optimized for shallow seas and operations within 100 miles of shore, but deployable across the ocean, LCS ships are a centerpiece of the USA's new focus on littoral warfare. They will help to counter growing "asymmetric" threats like coastal mines, quiet diesel submarines, global piracy, and terrorists on small fast attack boats. They will also perform intelligence gathering and scouting using helicopters and UAVs, offer some ground combat support capabilities, and share tactical information with other Navy aircraft, ships, submarines, and joint units. Swappable "mission modules," UAV robot aircraft, and robotic UUV and USV vehicles will give these small ships the specialized capabilities they require for each of these roles – and the quick-replace adaptability they need to keep up.

At present, 2 teams are competing for the final LCS design.

- *The General Dynamics team is offering a futuristic but practical high-speed trimaran based on Austal designs and experience.*
- *The Lockheed Martin team offers a high-speed semi-planing monohull based on Fincantieri designs that have set trans-Atlantic speed records.*

Team Lockheed's efforts have run into serious trouble, including cancellation of the contract for their second ship. The General Dynamics/Austal team hit the same rocks soon afterward, in part because of the US Navy's unusual proposal for future business arrangements.

Key Data

Hull Service Life	30 years
Draft at Full Load Displacement	10ft
Sprint Speed in Sea State 3	50kt

Range at Sprint Speed with Full Payload	1,500nm
Range at Economical Speed	4,300nm
Economical Speed	>20kt
Crew Size	15 to 50 core crew

The littoral combat ship (LCS) is the first of a new family of surface ships for the US Navy. The LCS is a fast, highly maneuverable, networked surface combat ship, which is a specialised variant of the family of US future surface combat ships known as DD(X). LCS is designed to satisfy the urgent requirement for shallow draft vessels to operate in the littoral (coastal waters) to counter growing potential 'asymmetric' threats of coastal mines, quiet diesel submarines and the potential to carry explosives and terrorists on small, fast, armed boats.

In May 2004, the United States Department of Defense and the US Navy announced the selection of two separate defense contracting teams led by Lockheed Martin and General Dynamics to each carry out system design and options for the detailed design and construction of two flight 0, or first-generation, LCS ships.

Lockheed Martin received a contract for the first ship, LCS 1, in December 2004. The keel for LCS 1, to be called USS Freedom, was laid in June 2005 at the Marinette Marine shipyard in Wisconsin. It was launched in September 2006.

Builder's sea trials began in July 2008. The LCS was delivered to the USN in September 2008 and was commissioned on 8 November 2008. It is based at San Diego. On 16 February 2010, the USS Freedom left the Naval Station Mayport for its maiden deployment, two years ahead of schedule.

"The littoral combat ship (LCS) is the first of a new family of surface ships for the US Navy."

General Dynamics was awarded the contract for USS Independence, LCS 2, in October 2005. The keel was laid in January 2006 at the Austal USA shipyard in Mobile, Alabama. It was launched in April 2008 and christened in October 2008. The ship completed the builder's sea trials in October 2009 and was delivered to the USN in December 2009. It was commissioned in January 2010.

Lockheed Martin was also to build LCS 3, USS Courage, to commission in 2009. The contract was awarded in June 2006 and the vessel was to begin construction in early 2007.

However, in January 2007, the USN ordered Lockheed Martin to stop work on LCS 3. The USN wished to review the program because of concerns over cost increases incurred in the construction of USS Freedom. In April 2007, the USN terminated the contract for LCS 3.

General Dynamics was also awarded the contract to build LCS 4, USS Liberty in December 2006. In October 2007, the US Navy also terminated the contract for this vessel.

In April 2008, the US Navy issued a request for proposals to the two companies for three LCS ships. It had previously been planned that orders would be placed for nine flight 1 (second-generation) LCS ships during 2008 and 2009, for ship commissioning during the period 2010 to 2012.

The contract for the Coronado, LCS 4, was awarded to General Dynamics in April 2009. The keel was laid in December 2009. It is scheduled for delivery in June 2012.

The numbers of LCS ships is not finalised but there has been speculation of 56 or up to 60 LCS ships, within a total US naval fleet of 375 ships.

The contract option awarded to Lockheed Martin is managed by Lockheed Martin's maritime systems and sensors division in Moorestown, New Jersey. The Lockheed Martin team includes: Marinette Marine shipyard, Bollinger Shipyards, Gibbs and Cox naval architects, Izar of Spain and Blohm & Voss naval shipbuilders.

The contract option awarded to General Dynamics is managed by Bath Iron Works at Bath, Maine.

"The LCS is a fast, highly maneuverable, networked surface combat ship."

The major members of General Dynamics team are: Austal USA, based in Mobile, Alabama (a subsidiary of Austal Ships of Australia); BAE Systems, Rockville, Maryland; Maritime Applied Physics Corporation, Baltimore, Maryland; CAE Marine Systems, Leesburg, Virginia; Northrop Grumman Electronic Systems, Baltimore, Maryland; General Dynamics Armament and Technical Products, Burlington, Vermont; General Dynamics Electric Boat, Gorton, Connecticut; General Dynamics Advanced Information Systems, Washington, DC; and General Dynamics Canada, Ottawa, Ontario.

In April 2005, the US Navy awarded a foreign military sales contract to Lockheed Martin to conduct a nine-month feasibility study to examine possible modifications to the Lockheed Martin LCS design to meet the requirements of the Israeli Navy. The study concentrated on hull, mechanical and electrical system compatibility. The Israeli Navy requirement includes the mk41 vertical-launch system for Barak missiles. The contract was extended in November 2007 to include technical specification and costs for the combat system. In July 2008, Israel requested the foreign military sale (FMS) of up to four vessels of the LCS 1 variant.

Littoral combat ship design

The two designs are quite different, although both satisfy the top-level performance requirements and technical requirements of the LCS programme. Both achieve sprint speeds of over 40kt and long-range transit distances of over 3,500 miles. The Lockheed Martin design is a high-speed semi-planing monohull. The General Dynamics design is a trimaran with a slender stabilised monohull.

The sea frames of both designs accommodate the equipment and crew for core LCS missions and special missions. They are both capable of the effective launch, control and recovery of vehicles for extended periods, however the strategy for launch and recovery for waterborne craft and for aircraft are different in the two designs. The two designs also use very different approaches for incorporating reconfigurable internal volume.

The design approach for the second-generation LCS, flight 1, ship acquisition is flexible and will take into consideration the experience gained in the flight 0 designs. In both designs, the sprint speed of 40kt to 50kt results in the body of the hull being lifted out of the water as much as possible. The Lockheed Martin design of the monohull lifts the body of the hull.

The General Dynamics trimaran design, with the slender stabilised monohull, uses two outriggers which move the displacement upwards and reduce the wetted surface. The shaping of the hull in both design strategies gives signature reduction. The designs of both ships continue to evolve with changes in the design proposals.

Core capabilities of the littoral combat ship

A full load displacement draft of 10ft allows the ships to access very shallow waters. The ships will have a top speed of about 50kt and the range at sprint speed is 1,500nm. At an economical speed of 20kt, the range is 4,300nm.

"Mission packages will be: mine warfare (MIW), anti-submarine warfare (ASW) and anti-surface warfare (SUW)."

The ships are configured with a helicopter deck and hangar. The deck is capable of the launch and recovery of the MH-60R/S helicopter and a tactical unmanned air vehicle. The ships can carry out aircraft launch and recovery in conditions up to sea state 5, i.e. in winds up to 27kt and average wave heights between 6.4ft and 9.6ft. The ships will be capable of launching and recovering watercraft, for example 40ft high-speed boats, within 15 minutes in conditions of sea state 4, i.e. waves up to 5ft and winds up to 21kt.

General Dynamics Robot Systems was awarded a US Navy contract to develop the common launch and recovery system (CLRS) of unmanned and other watercraft for the LCS in July 2008.

The ships will carry provisions for 21 days before replenishments and will also be able to replenish underway. The crew size will be between 15 and 50 and accommodation is provided for up to 75 ship and special mission crew. The operational availability will be 95%.

A core capability will be the deployment of Fire Scout unmanned air vehicle and the unmanned ribbed boat, Spartan unmanned surface vehicle, equipped with a basic payload of navigation radar, infrared camera and video camera.

Littoral combat ship mission modules

The mission modules will have the capability to be changed, tested and working within 24h. Northrop Grumman has been appointed as mission package integrator.

The mission packages will be: mine warfare (MIW), anti-submarine warfare (ASW) and anti-surface warfare (SUW).

The mission modules may be integrated into standard-sized containers that can be installed in the ship and other systems will be transferred onto the ship on pallets. The mission systems will be connected to the ship's network and communicate with the other ship systems and other surface ships and aircraft.

The MIW module includes: the AN/WLD-1 remote minehunting system, AN/AQS-20A sonar mine detecting set, organic airborne surface influence sweep, airborne laser mine detection system and airborne mine neutralisation system.

The ASW module includes the Sea TALON (tactical littoral ocean network) undersea surveillance system, being developed by Lockheed Martin Maritime Systems & Sensors, which integrates a range of acoustic sensors with semi-submersible vehicles and network-centric communications.

Passive sensors include the advanced deployable system (ADS), a rapidly deployable bottom array acoustic surveillance system. The semi-submersible, the AN/WLD-1 with an ASW mission system, tows a remote towed active source (RTAS), a multiband transducer with a remote towed array multi-function sonar.

"A slender stabilised trimaran monohull is the design proposed by the General Dynamics team."

The ASW module also includes systems to be deployed from the MH-60R helicopter (mk54 torpedoes, sonobuoys, Raytheon AN/AQS-22 airborne low-frequency sonar) and unmanned surface vehicles, USVs (dipping sonar, multi-static active sonar and ULITE ultra-lightweight towed array).

General Dynamics Robotics was awarded a contract for four USVs for the ASW module in October 2006.

The 11m Fleet Class USV weighs about 7.7t, has a payload of about 2,270kg, speed of 35kt and is capable of operating continuously for over 24h.

The SUW module includes a General Dynamics mk46 30mm cannon (also used in the rapid airborne mine clearance system and the US Marine Corps expeditionary fighting vehicle), which fires at up to 200 rounds a minute, and a version of the US Army's non-line of sight - precision attack munition missile system. The NLOS launch system and precision attack missile are being jointly developed by Lockheed Martin and Raytheon. The direct attack missile has a dual-mode uncooled infrared and semi-active laser seeker, multimode warhead and range up to 40km. The MH-60R is armed with guns and Hellfire missiles.

Littoral combat ship gun

Both General Dynamics and Lockheed Martin vessels are armed with BAE Systems Land and Armaments (formerly United Defense) mk110 57mm naval gun system. The mk110 fires mk295 ammunition at a rate of 220 rounds a minute to a range of 14km (nine miles).

Littoral combat ship RADAR

Currently, there are two incumbent systems for both the General Dynamics and the Lockheed Martin [LMT] variants of LCS: Sweden's Ericsson Sea Giraffe (AMB 3D C-band multi role radar) and Germany's EADS TRS3D (a multimode, C-band, ship-mounted, air and sea surveillance and target acquisition radar).

Each of the two existing systems, Ericsson and EADS, are built overseas. Lockheed Martin has a license production program with EADS, but they do not have access to the software source code, at least as far as we know at this time.

The Navy's radar road map does not include C-band.

Other companies are proposing / sponsoring different radar equipments

Thales Netherlands Partner with ITT To Get Smart S Band Mk II Radar On LCS

By Geoff Fein (Ott 2009)

ITT [ITT] is hoping its partnership with Thales Netherlands will help land the U.S. company 's Smart S Mk II radar atop the Littoral Combat Ship (LCS).

In January, ITT Gilfillan in Van Nuys, Calif., and Thales Netherlands inked the deal that would enable ITT radar systems the exclusive rights to both market and produce the Smart S Mk II radar system for the U.S. market, Roman Gonzales, senior manager business development ITT, told Defense Daily in a recent interview.

"[That] includes all U.S. government procurements and also any FMS (foreign military sales) opportunities that would come up that need a radar system like this," he said.

ITT officials had traveled to Thales Netherlands' facility to look at the Smart S Mk II production and to see how well the system lined up with what the U.S. Navy is doing on LCS, Gonzales said.

"We felt the audit was a good opportunity in that the system was very well placed to be competitive in the LCS competition," he said.

Thales Netherlands officials also ventured out to Southern California to audit ITT's site, Gonzales added.

The opportunity proved to have mutual benefit, he noted.

"The benefit being that ITT radar systems would get the opportunity to augment our current radar naval product line, which primarily is the STS-48 radar system that's on about 45 naval combatants with their radar system. For [Thales Netherlands], it would give them an opportunity to enter the U.S. market with this U.S. partnership," Gonzales said.

ITT has also made a proposal to General Dynamics [GD] Canada, which is leading the sensor effort for GD's version of LCS, to include the Smart S Mk II on the ship.

ITT responded to a request for information from General Dynamics on the proposed LCS radar system. It was picked and asked to provide further information to the company through a request for proposal, Jeff Foster, product team leader for surveillance radar systems ITT, told Defense Daily.

"We do provide them a very low switching cost to change from one radar to our radar because we are already integrated with their combat management system," he said.

General Dynamics had said a contract would be awarded in the March time frame, however that date has moved, Gonzales said.

"My guess is we won't hear anything until the June time frame or later. All indications are the selection will be made this year. There will be a contract for anywhere between one and 14 systems," he said.

Thales is building their Smart S Mk II for four different countries, and they have a production line going, Gonzales said. "We know we have a very cost competitive radar system for that application, and given the fiscal constraints that are currently imposed on that program, we think this is going to be very beneficial."

One reason why the Smart S Mk II is a better choice for LCS is the way the system is designed, Foster noted.

There are transmit receive amplifiers in the antenna and, as a result, there is no wave guide that runs from the antenna to the below deck equipment, Foster said. "In a typical radar system you have the antenna on the mast and then very close to the mast, very high up in the super structure, you have to put the transmitting and receiving equipment along with the processing equipment.

"With our system, it is a fiber optic interface from the antenna, where all the transit and receive equipment is, and you can move all of the processing equipment 50 meters below deck. The significant benefit for LCS is that in a very space constrained ship, especially in the super structure, you can move the radar equipment down below decks."

By moving equipment below deck, it not only reduces the overall top side weight of the system, but it frees up real estate in the bridge area, Foster added. "Very typically these radar systems are located behind the bridge, which is a high rent district. Everyone is always looking for more [room] in that area, and if you can move the radar system down away from there, that is a key benefit."

Another benefit is that the radar is built to open architecture (OA) standard which allows it to be integrated with other OA systems very simply. For example, Northrop Grumman is developing the Integrated Combat Management System (ICMS) specifically for General Dynamics' LCS. ICMS is based on Thales' TACTICOS combat management system (Defense Daily, Nov. 6, 2006).

"[The Smart S Mk II] was designed specifically to work with that and so the integration of the system with the combat management is very simple," Foster said.

Another benefit Foster points to is that the solid state amplifier technology and the line replaceable unit maintenance philosophy reduces the requirement for onboard skilled technicians. "You can actually maintain the radar system using the built-in test and a minimum amount of LRU (line replaceable unit) parts carried on board. So, for example, with some of the other systems you have to have a heavy 200 pounds TWT (traveling wave tube) in stores on board the ship. With [the Smart S Mk II) system you maybe have to have one to two transmit receive books, literally they are about the size of a book. Again, that is a challenge with LCS, to keep all of that down to a minimum."

Because of the way Smart S Mk II is operated, there are only two operational modes to the radar system that are not dependent on weather or other environmental conditions, Foster explained.

"As a result, you don't have to have a trained radar operator on the ship. You can operate the radar through the combat management system without having to have specific training. The system on board the ships right now are very complex to operate and require a skilled operator who knows how to set various settings in the radar to different parameters depending upon whether it is raining, whether there is a change in sea state, or you are close to land or far from land," he said. "With this radar system there are two modes--they are operational and range dependent. Do you want to look longer range or shorter range and those are really only the two controls you have."

The final benefit comes in the form of the business arrangement ITT has with Thales Netherlands, Foster added. "That is probably the key business discriminator we feel we offer."

"Part of our business arrangement with Thales Netherlands calls for the complete transfer of all intellectual property and technical information on the radar system to ITT for use in the U.S. market. That means in simple terms we are going to get all the software source code for the radar system and then we can make changes to the radar system for the Navy, specifically for the Navy, that do not have to be communicated back overseas to Thales Netherlands," he said.

"We feel for medium- and long-range surveillance in S-band this radar is very attractive because it is very easy to learn, very simple to operate and has a very high MTBF (mean time between failures)," Gonzales said. "This radar is the only one of the group that has a solid state transmitter, which means it gives you a higher mean time between failures."

SELEX Sistemi Integrati and DRS To Get Kronos Radar On LCS

It is clear that the Navy has settled on two different radar systems to be tested during the process, arguably the only two radars in that class that were available at the time. Now there is another radar in the same class, SSI KRONOS.

According to SSI/DRS proposals:

- KRONOS is a more modern design that provides clear operational advantages to either Sea Giraffe or TRS 3D, advantages such as (examples only)
    - Longer MBTF
    - Better detection range
    - Simultaneous tracking of more targets
    - Graceful degradation
    - Greater detection range for sea skimming missiles affording more time to compute a fire control solution
- KRONOS is a better value than the actual Sea Giraffe or TRS 3D
- KRONOS requires lower space, weight, and power requirements, Expensive wave guide installation not required
- KRONOS is industrialized and produced in the U. S. A. (DRS)

General Dynamics trimaran

The slender stabilised trimaran monohull proposed by the General Dynamics team has an overall length of 127.8m, maximum beam of 28.4m and full load displacement of 2,637t. The seaframe is based on Austal's design for the Benchijigua Express passenger / car ferry.

A naval forward looking infrared is fitted above the bridge. The Raytheon SeaRAM anti-ship missile defence system is installed on the hangar roof. SeaRAM combines the sensors of the Phalanx 1B close-in weapon system but replaces the 20mm gun with an 11-missile launcher for the rolling airframe missile (RAM). 50-calibre machine gun mounts are installed port and starboard on the walkway on either side of the hangar and at the stern just below the level of the stern helicopter deck.

The decoy systems include three Super RBOCs and two Nulka decoy launchers. The countermeasures suite will include ES 3601 tactical radar electronic support measures (ESM) from EDO Corp. The towed sonar and towed decoys are launched from the stern of the ship.

Northrop Grumman Electronic Systems will provide the integrated combat management system (ICMS), BAE Systems Electronic Systems will provide the radio communications system and CAE Marine Systems will supply the automated ship control system.

The main mast carries the Link 16, Link 1, CEC, and the Saab Microwave Systems (formerly Ericsson) Sea Giraffe radar.

Lockheed Martin semi-planing monohull

Lockheed Martin's advanced semi-planing seaframe is based on technologies introduced by Italian shipbuilder Fincantieri on the 1,000t Destrier commercial vessel, which holds the transatlantic speed record, and the 3,000t Jupiter class.

The ship has a steel hull with aluminium superstructure and will be powered by two Rolls-Royce MT30 36MW gas turbines and two Fairbanks Morse Colt-Pielstick 16PA6B STC diesel engines driving four large, acoustically optimised Rolls-Royce waterjets.

Four Isotta Fraschini Model V1708 ship service diesel generator sets provide auxiliary power. Fincantieri Marine Systems North America Inc is supplying the ride control system.

"The Lockheed Martin design is a semi-planing monohull."

The ship's maximum speed is 45kt. The overall length is 115.5m. The maximum beam width is 13.1m and the draft is 3.7m.

The vessel has automated stern doors, stern ramp, side launch doors and overhead crane for the launch and recovery of manned and unmanned vessels.

The combat management system is the Lockheed Martin COMBATSS-21, based on open architecture. The ships will be equipped with EADS TRS-3D C-band radar for air and surface surveillance and weapon assignment and the soft-kill weapon system (SKWS) decoy launcher from Terma A/S of Denmark.