

Amphibious Combat Vehicle (ACV)

Executive Summary

- The Marine Corps awarded contracts to BAE Systems and SAIC in November 2015, utilizing two vendors to facilitate a competitive Engineering and Manufacturing Development (EMD) phase. Each vendor delivered 16 prototypes for testing during the EMD phase. The Amphibious Combat Vehicle 1.1 (ACV 1.1) program conducted LFT&E from May 2017 to January 2018 and an operational assessment (OA) from January to March 2018 with both vendors participating.
- In June 2018, the Marine Corps selected BAE Systems as the vendor to build ACV.
- During the OA, the ACV-equipped unit demonstrated the ability to maneuver to an objective, conduct immediate action drills, and provide suppressive fires in support of dismounted infantry maneuver in a desert environment. The ACV-equipped unit was able to maneuver in the littorals; embark aboard a landing craft air cushioned (LCAC), transit the open ocean and surf zone, and debark from the LCAC. The ACV demonstrated water mobility and the ability to self-deploy from the beach, cross the surf zone, enter the ocean, swim, and return to the beach.
- Based on data from the OA, reliability is below the program reliability growth curve (58 hours Mean Time Between Operational Mission Failures (MTBOMF)). BAE vehicles demonstrated 24.9 hours MTBOMF. There were no systemic problems identified that indicate a major redesign is required.
- The EMD LFT&E program demonstrated that the EMD ACV design met Key Performance Parameter force protection requirements.

System

- The Marine Corps intends to field a vehicle capable of providing expeditionary protected mobility and general support lift to the Marine Infantry Battalion as part of a Ground Combat Element-based maneuver task force.
- The ACV 1.1 will serve to mitigate a shortfall in protected mobility by providing effective land and tactical water mobility (shore-to-shore), precise supporting fires, and high levels of force protection. This protection is intended to provide survivability against blasts, fragmentation, and kinetic energy threats while supporting combat-loaded marines as they close with and destroy the enemy, respond to crises, and/or conduct security and stability operations. The ACV 1.1



is a partial replacement for the legacy Amphibious Assault Vehicles (AAVs) fielded to the Assault Amphibian battalion within the Marine Division.

Mission

- Commanders intend to employ ACV-equipped units to land and maneuver the surface assault elements of the landing force in order to seize inland objectives and conduct mechanized operations in subsequent actions ashore.
- ACV-equipped units will provide protected mobility to embarked infantry and will deliver precision support-by-fire effects in support of dismounted infantry maneuver. ACV-equipped units will operate effectively with M1 series main battle tanks and conduct mounted security operations in urban or restrictive terrain alongside other wheeled vehicles within the Marine Division.

Major Contractor

BAE Systems – York, Pennsylvania

Activity

- The U.S. Army Aberdeen Test Center conducted live fire testing for EMD prototype ACVs from May 2017 to January 2018 at Aberdeen Proving Ground, Maryland, in accordance with DOT&E-approved test plans. EMD

LFT&E focused on a limited number of tests to demonstrate specification compliance. Testing was adequate to support the Milestone C decision.

FY18 NAVY PROGRAMS

- The Marine Corps Operational Test and Evaluation Activity (MCOTEA) conducted a pre-Milestone C OA from January 2 to March 26, 2018, at Camp Pendleton, California, and the Marine Corps Air Ground Combat Center (MCAGCC) Twenty-Nine Palms, California, in accordance with DOT&E-approved Test and Evaluation Master Plan and test plan. The OA was adequate to support an evaluation of the ACV 1.1.
- The Program Manager conducted cybersecurity testing prior to the OA in the form of a Cooperative Vulnerability and Penetration Assessment (CVPA) and MCOTEA conducted the Adversarial Assessment during the OA.

Assessment

- This assessment is confined to the BAE ACV as it was the vendor selected to enter the Production and Deployment Phase. A full assessment of both vendors is contained in the June 2018 DOT&E OA report.
- The ACV section was successful in 15 of 16 missions and demonstrated the capability to negotiate terrain in the desert and littorals, operate with tanks and light armored vehicles, and maneuver to achieve tactical advantage over the opposing threat force. ACV crews, supported infantry, and the opposing force noted that the vehicles performed better than the legacy vehicle in a wide variety of areas.
 - On land, the ACV section was able to move in tactical formations, observe adjacent vehicles, and hold positions in formation.
 - During littoral operations, the ACV section was able to cross through the surf zone to enter the ocean, swim, and then come ashore through the surf zone. During one of the littoral missions, crews demonstrated the ability to load an ACV onto an LCAC, transport the ACV on the LCAC in the ocean and on land, and unload from the LCAC. LCAC crews noted that the BAE vehicle “bounced up and down” on the LCAC deck despite calm seas. This has the potential to cause the vehicle to break free of its tie-down chains in higher sea states.
- Tire failures and damage by battlefield debris delayed movement at times. One vehicle was damaged when concertina wire wrapped around drive train components, resulting in a cut brake line, damage to the inner sidewall of a tire, and damage to the central tire inflation system.
- The weight, height, and size of the ACV made recovery challenging and time consuming. When vehicles sustained severe damage to steering/suspension components or became mired, the unit relied on the M1A1 tank recovery vehicle (the M88A2) for recovery. Marine Corps M88A2s are assigned to the Tank battalion and Maintenance battalions within the Marine Division to support heavy wheeled and tracked vehicle recovery.
- The ACV threshold requirement for quantity of personnel carried is 3 crewmen and 10 embarked infantry with full combat loads, including 2 days of supply and combat essential equipment. The ACV accommodated 3 crew and 13 embarked

- infantry, but accommodations were cramped, which made it difficult for infantry to egress from the vehicle.
- Infantry troop commanders had difficulty moving between the hatch and their seat. Aligning the hatch with the seat could allow the commanders to stand up with their heads out of the hatch, but then drop down inside the vehicle to operate the troop commander’s video display screen, talk to their marines, and prevent exposure to incoming fire.
- The Program Manager, Advanced Amphibious Assault provided a maritized remote weapons station (RWS) to both vendors as government-furnished equipment. The RWS offered several advantages over the legacy AAV reliability, availability, maintainability/rebuild to standard (RAM/RS) Ungunned Weapon Station, to include a dedicated gunner, weapon and sight stabilization, a laser range finder, and a fire control system. These features provide the capability to distinguish friendly forces from the enemy during both day and night and engage with greater precision than the legacy vehicle.
- During the OA, the BAE vehicles demonstrated an MTBOMF of 24.9 hours (50 OMFs during 1,242.6 hours of mission time), which was less than the 58-hour MTBOMF growth curve point estimate. The RWS, which is government-furnished equipment, was the source of the largest number of OMFs. The ACV program plans to continue reliability growth efforts after Milestone C.
- The CVPA focused on components in the vehicle that interacted with the Controller Area Network (CAN) bus. Test results confirmed that electronic segmentation of subsystems minimized the attack surface. Testing during the AA focused on six scenarios designed to assess time to detect, time to recover, and mission effects of cyber compromise. The classified appendix to the June 2018 DOT&E report provides additional details on the cyber vulnerabilities and recommendations.
- EMD LFT&E focused on a limited number of tests to demonstrate specification compliance and demonstrated that the ACV met all Tier 1 underbody force protection requirements (Key Performance Parameters). The classified appendix to the DOT&E June 2018 report details vulnerabilities and recommendations.

Recommendations

The following is a summary of key recommendations for the ACV. A complete list of recommendations for both vendors is contained in the June 2018 DOT&E OA report. The Program Manager, Advanced Amphibious Assault should:

1. Modify the infantry troop commander’s station to make it easier to move between the hatch and seat.
2. Assess the capability of all existing Marine Corps recovery assets to recover the ACV.
3. Investigate options for preventing damage to steering/suspension when encountering battlefield debris, such as concertina wire.