

## Amphibious Combat Vehicle (ACV) Family of Vehicles

### Executive Summary

- From June to September 2020, the Marine Corps Operational Test and Evaluation Activity (MCOTEA) conducted the IOT&E for the Amphibious Combat Vehicle (ACV).
- During IOT&E, the ACV-equipped unit demonstrated the ability to maneuver, conduct immediate action drills, and provide suppressive fires in support of dismounted infantry in a desert environment. The ACV demonstrated water mobility and the ability to self-deploy from the beach, cross the surf zone, enter the ocean, and embark aboard amphibious shipping. The infantry rifle company equipped with the ACV was able to deploy from amphibious shipping, maneuver on the beach, and conduct subsequent offensive and defensive operations ashore.
- While the ACV demonstrated good operational availability and maintainability during IOT&E, it did not meet its 69-hour mean time between operational mission failures (MTBOMF) threshold. The program intends to conduct follow-on reliability testing and implement fixes into future vehicles to improve reliability.
- BAE Systems remains on track to meet vehicle delivery requirements. Temporary closures and reduced staffing at the York, Pennsylvania, facility due to the coronavirus (COVID-19) pandemic resulted in vehicle delivery delays during 3QFY20.
- In December 2018, the Marine Corps started the ACV full-up system-level (FUSL) live fire test series at the Army's Aberdeen Test Center, Maryland. The test series included 26 events using 4 low-rate initial production (LRIP) and 3 engineering and manufacturing development (EMD) ACVs to support the evaluation of the survivability of the ACV and its crew in projected combat scenarios. In August 2020, the Aberdeen Test Center completed all test events in accordance with DOT&E-approved test plans.

### 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 is a family of vehicles that includes a personnel, command and control, recovery, and 30-mm gun variants. The ACV Program Office is focusing current procurement efforts on the personnel variant.
- The ACV is a modern generation, eight-wheeled, armored personnel carrier with a combat-loaded gross vehicle weight of 70,000 pounds. The primary weapon on the ACV is a single mount Remote Weapons System (RWS) equipped with an MK 19 automatic grenade launcher or M2 .50 caliber heavy machine gun.



- The Marine Corps intends the ACV to operate with Marine Air Ground Task Force maneuver formations, and achieve up to 6 knots while operating at sea. The ACV will carry a crew of 3 operators and 13 embarked infantry Marines with 2 days of supplies and combat essential equipment.
- The Marines desire the ACV to provide effective land and tactical water mobility (ship-to-shore and shore-to-shore), precise supporting fires, and high levels of force protection. The Marines intend 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 conduct stability operations.
- The planned acquisition objective of 632 ACVs will replace the legacy Amphibious Assault Vehicles (AAVs) fielded to the Assault Amphibian battalion within the Marine Division. The previous acquisition objective of 1,122 has been reduced in accordance with Marine Corps Force Design 2030 modernization efforts.

### Mission

- Commanders will employ ACV-equipped units to land the surface assault elements of the landing force in order to seize inland objectives and conduct mechanized operations in support of subsequent actions ashore.
- Assault Amphibian Battalions equipped with the ACV will provide task-organized units to transport personnel, equipment, and supplies ashore from amphibious shipping;

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execute ship to-shore and riverine operations; support breaching of barriers and obstacles; and provide embarked infantry with armor-protected firepower, extended communications capabilities, and mobility on land and sea.

- ACV-equipped units will provide protected mobility to embarked infantry and deliver precision support-by-fire effects in support of dismounted infantry maneuver. ACV-equipped

units will conduct mounted security operations in urban or restrictive terrain alongside other vehicles within the Marine Air Ground Task Force or Marine Division.

## Major Contractor

BAE Systems – York, Pennsylvania

## Activity

- In June 2018, the Marine Corps awarded the ACV Family of Vehicles LRIP contract to BAE Systems. The performance of the ACV1.1 program during its developmental testing and operational assessment led to the consolidation of the ACV 1.1 and ACV 1.2 programs in January 2019.
  - The Program Manager, Advanced Amphibious Assault (PMAAA) conducted, and MCOTEA observed, an ACV Logistics Demonstration (LOGDEMO) in December 2019 to validate and correct technical manuals, repair procedures, and tooling in accordance with operator and maintenance tasks.
  - DOT&E approved the ACV IOT&E plan in June 2020.
  - From June 1 to September 5, 2020, MCOTEA conducted IOT&E at Camp Pendleton, California, and the Marine Corps Air Ground Combat Center, Twenty-Nine Palms, California, in accordance with the DOT&E-approved test plan. The test consisted of a Marine Rifle Company (approximately 200 marines) embarked on a platoon of 18 ACVs conducting operationally representative missions based on the ACV Operational Mode Summary/Mission Profile.
  - MCOTEA conducted a cooperative vulnerability and penetration assessment (CVPA) followed by an adversarial assessment (AA). Both the CVPA and AA were rescheduled during IOT&E due to the COVID-19 pandemic, and conducted in accordance with the DOT&E-approved test plan.
  - In December 2018, the Marine Corps began the execution of the ACV FUSL live fire test series at the Army Aberdeen Test Center, Maryland. The test series included 26 events using 4 LRIP and 3 EMD ACVs to support the evaluation of the survivability of the ACV and its crew in projected combat scenarios. In August 2020, the Aberdeen Test Center completed all test events in accordance with DOT&E-approved test plans.
  - DOT&E approved the Event Design Plan for the ACV command and control variant in August 2020. LFT&E activity for the command variant is scheduled to begin 2QFY21.
  - DOT&E published an IOT&E and LFT&E report in November 2020 in support of the Full-Rate Production decision.
- 12 of 13 missions and demonstrated the capability to operate across both desert and littoral environments. Vehicle crewmen operated the ACV alongside Joint Lightweight Tactical Vehicles (JLTVs), Light Armored Vehicles (LAVs), and other tactical vehicles to maneuver and achieve tactical advantage over the opposing force. Marines involved with the test noted that the ACV performed better than the legacy vehicle across all mission profiles. The ACV modern interface, including cameras, intercom, and RWS improved the unit's situational awareness and ability to locate and suppress the enemy.
  - On land, the ACV platoon was able to maneuver into tactical formations, observe adjacent vehicles and interoperate with other tactical vehicles (LAV, Logistics Vehicle Replacement (LVSR), and JLTV. The ACV demonstrated the capability to negotiate terrain in the desert and littoral areas, and maneuver to achieve tactical advantage over the opposing force.
  - During amphibious operations, the ACV platoon was able to self-deploy from the beach, cross the surf zone to enter the ocean, and return through the surf zone to the beach. With a Marine Infantry company embarked on the ACVs, the ACV platoon was able to launch and recover from an amphibious ship, conduct a 12-nautical mile open ocean swim, cross the surf zone, and continue to inland objectives.
  - The ACV RWS equipped with the M2 .50 caliber heavy machine gun provided the dismounted infantry company with accurate, sustained, direct fire support across all land mission profiles. The RWS offers several advantages over the legacy AAV Up-gunned Weapons Station, to include a dedicated gunner, weapons and sight stabilization, a laser range finder, and a modern fire control system. During gunnery live-fire against stationary targets, ACV sections hit 91 percent of targets when the ACV was stationary, and 97 percent of targets while the ACV was on the move.
  - ACV land mobility in the desert environment was often degraded by tire failures, which led to 2-hour mission delays while crews replaced or swapped tires. The ACV platoon did not have a hydraulic jack or other means to lift the ACV without an LVSR Wrecker. Some tire failures could be attributed to incorrect tire pressure settings in the Central Tire Inflation System (CTIS) on the ACV. As crews actively monitored CTIS settings, tire failures were less frequent.
  - The weight, height, and size of the ACV made recovery of a disabled ACV challenging and time consuming, at times requiring additional LVSR support. When vehicles sustained

## Assessment

- The IOT&E was adequate to support an evaluation of the ACV.
- The Marine Infantry Company and attached Assault Amphibian platoon equipped with the ACV was successful in

severe damage to suspension components or became mired, one or more LVSRs were required to recover the ACV.

LVSRs are on the Table of Organization for the Assault Amphibian Battalion, and Marine Corps Maintenance Battalions. Additional LVSRs may be required to support future ACV platoon or company-level operations.

- The ACV threshold requirement for quantity of personnel carried is 3 crewmen and 13 embarked infantry with full combat loads, including 2 days of supply and combat essential equipment. The ACV accommodated 3 crew and 13 embarked infantry. Due to the placement and number of blast mitigating seats, interior space within the ACV is limited, making rapid ingress and egress difficult.
- Infantry troop commanders were able to task organize marines and equipment within the ACV to meet specific mission requirements (i.e., mortar teams, machine gunners, anti-tank missile operators, and unmanned aerial system teams). Infantry leaders were able to manage available seats to preserve combat power if an ACV was not able to continue the mission.
- Infantry Marines noted that the troop seats were not contoured to fit body armor configurations, leading to discomfort during long range ship-to-objective missions.
- Effective unit maintenance training prior to IOT&E during the New Equipment Training phase led to high operational availability during IOT&E.
- The ACV demonstrated an MTBOMF of 39.0, which is less than the 69-hour MTBOMF reliability requirement. The RWS, which is government-furnished equipment, was the source of the largest number of operational mission failures (OMFs). Other subsystems with a high failure rate included suspension components, hatch and ramp sensors, and switches. The ACV program plans to continue reliability improvement efforts beyond full-rate production.

- The CVPA focused on components in the vehicle that interacted with the Controller Area Network bus. Test results were consistent with 2018 findings within the 2018 DOT&E Operational Assessment report, and confirmed that electronic segmentation of communications and automotive subsystems minimized the attack surface. Testing during the AA focused on scenarios designed to assess time to detect, time to recover, and mission effects of cyber compromise. ACV operators demonstrated the ability to defend and recover against some insider and nearsider cyberattacks.
- The survivability evaluation of the baseline ACV is detailed in the classified annex of the November 2020 DOT&E report. It documents vulnerabilities demonstrated during LFT&E and provides detailed recommendations to improve survivability and force protection against kinetic threat engagements.

## Recommendations

The following is a summary of key recommendations for the ACV. A complete list of recommendations is contained in the November 2020 DOT&E report. The Marine Corps and the Program Manager, Advanced Amphibious Assault should:

1. Mitigate the vulnerabilities documented in the classified annex of the DOT&E IOT&E and LFT&E report in order to improve ACV survivability and force protection against kinetic threats.
2. Continue to improve ACV reliability by implementing corrective actions on future LRIP vehicles to reduce failure rate and maintenance demand.
3. Develop and provide equipment that allows more efficient tire changes in an expeditionary environment, and consider adding a spare tire kit at the section level.
4. Consider the modification of troop seat pad to accommodate infantry body armor.

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