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Report to Congressional Committees

April 2018

AMPHIBIOUS COMBAT VEHICLE

Program Should Take Steps to Ensure Manufacturing Readiness

Accessible Version

GAO-18-364

April 2018

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Program Should Take Steps to Ensure Manufacturing Readiness

GAO Highlights

Highlights of GAO-18-364, a report to congressional committees

Why GAO Did This Study

In June 2018, the United States Marine Corps plans to select a contractor and begin low-rate production for the ACV, a vehicle used to transport Marines from ship to shore under hostile conditions. The ACV will replace all or part of the current Assault Amphibious Vehicle fleet.

The National Defense Authorization Act for Fiscal Year 2014 included a provision for GAO to annually review and report on the ACV program until 2018. This report, GAO's last under that provision, assesses the extent to which the Marine Corps is making progress toward (1) meeting cost and schedule goals for the ACV program and (2) demonstrating manufacturing readiness.

GAO reviewed program cost estimates, updated schedules, and program assessments of test results and production readiness, as well as compared ACV acquisition efforts to DOD guidance and GAO-identified best practices. GAO also interviewed program and testing officials, and visited both ACV primary assembly locations.

What GAO Recommends

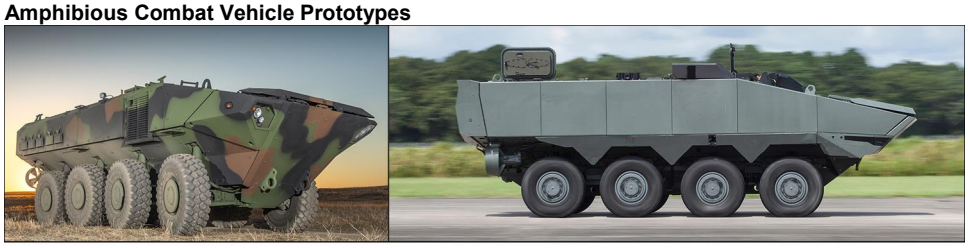
GAO recommends the Marine Corps (1) not enter the second year of low-rate production for ACV 1.1 until after the contractor has achieved an overall MRL of 8 and (2) not enter full-rate production until achieving an overall MRL of 9. DOD partially concurred with both recommendations, but noted that it is reasonable to proceed at lower MRL levels if steps are taken to mitigate risk. GAO made no changes to its recommendations in response to these comments.

View GAO-18-364. For more information, contact Jon Ludwigson at (202) 512-4841or ludwigsonj@gao.gov.

What GAO Found

The first version of the Amphibious Combat Vehicle (ACV 1.1) is on track to meet development cost goals with no additional anticipated delays for major acquisition milestones. With regard to costs, the development phase of ACV 1.1 is on pace to not exceed cost goals that were established at the start of development, based on a recent Navy estimate, the ACV program office, and reporting from the contractors. For example, a September 2017 program progress review reported a Navy estimate of the cost of development at $750.7 million, less than the $810.5 million baseline established at the beginning of development. With regard to schedule, the ACV program has made no major changes to the acquisition schedule since GAO previously reported on the program in April 2017. ACV 1.1 program officials are in the process of preparing to down-select to a single contactor and enter low-rate production in June 2018, start a second round of low rate production the following year, and begin full-rate production in 2020. ACV 1.1 may be followed by the acquisition of other versions (ACV 1.2 and ACV 2.0) with advanced capabilities such as higher water speeds.

Amphibious Combat Vehicle Prototypes



Source: (left to right) ACV 1.1 produced by BAE Systems Land & Armaments, L.P., © BAE Systems, Inc. and ACV 1.1 produced by Science Applications International Corporation, © SAIC (images). Images provided by Marine Corps Systems Command. | GAO-18-364

The ACV program is preparing to start production of ACV 1.1, which includes determining that the contractors' manufacturing capabilities are sufficiently mature. However, program officials are considering entering production with a lower level of manufacturing maturity than called for in Department of Defense (DOD) guidance or GAO identified best practices. The ACV program measures manufacturing maturity with manufacturing readiness levels (MRL) for risk areas such as design, materials, process capability and control, and quality management. DOD guidance for weapons acquisition production recommends that programs achieve an MRL of 8 across all risk areas before entering low-rate production and that a program achieve an MRL of 9 at the start of full-rate production. GAO's previous reviews about manufacturing best practices found that achieving manufacturing maturity and identifying production risks early in the acquisition cycle and assessing those risks prior to key decision points, such as the decision to enter production, reduces the likelihood of quality issues, cost growth, and delays. The Marine Corps contract option for producing the first round of low-rate production for ACV 1.1 will be exercised after June 2018; the contract also contains additional options for production vehicles. Making the decisions to proceed with the second round of low-rate production and for the start of full-rate production before meeting called-for levels of manufacturing readiness criteria increases the risk that ACV 1.1 will witness delays and increased costs.

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Abbreviations

AAV	Assault Amphibious Vehicle
ACV	Amphibious Combat Vehicle
BAE	BAE Systems Land & Armaments, L. P.
DCMA	Defense Contract Management Agency
DOD	Department of Defense
EFV	Expeditionary Fighting Vehicle
MRL	Manufacturing Readiness Level
SAIC	Science Applications International Corporation

U.S. GOVERNMENT ACCOUNTABILITY OFFICE
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April 17, 2018

Congressional Committees

The United States Marine Corps established the Amphibious Combat Vehicle (ACV) program as a way to acquire an enhanced capability to transport Marines from ship-to-shore under hostile conditions. The ACV is envisioned to potentially replace all or part of the current Assault Amphibious Vehicle (AAV) fleet, which has been providing this capability since 1972. According to the Marine Corps, the AAVs fall short of currently needed capabilities such as water and land mobility, lethality, and force protection. Previously, the Marine Corps sought to achieve enhanced capabilities in these areas through the Expeditionary Fighting Vehicle (EFV) program, but due to concerns about the program's affordability, after more than a decade in development and the expenditure of $3.7 billion, the program was cancelled in 2011. Following the cancellation of the EFV program, the Department of Defense (DOD) authorized the Marine Corps to seek a new replacement for the AAVs, emphasizing the need for cost-effectiveness, resulting in the start of the ACV acquisition in 2011. The ACV acquisition approach calls for ACV development in three increments with increasing amphibious capability, referred to as ACV 1.1, 1.2 and 2.0. The program awarded contracts in 2015 to two competing contractors to each design and develop 16 ACV 1.1 prototypes for testing. The program plans to down-select by awarding and exercising the option to one of the two contractors for production, which is scheduled to start in 2018.

The National Defense Authorization Act for Fiscal Year 2014 included a provision that we annually review and report to the congressional defense committees on the ACV program until 2018.[1] This report—our last under that provision—discusses the Marine Corps' progress toward (1) meeting cost and schedule goals for the ACV 1.1 program and (2) demonstrating manufacturing readiness.

To conduct this work, we reviewed program documents such as: the Acquisition Strategy; Test and Evaluation Master Plan; System Engineering Plan; the ACV 1.1 engineering, manufacturing and development contracts; and solicitation for the ACV 1.1 production. These documents were provided primarily by the ACV program office and the

[1] Pub. L. No. 113-66, § 251 (2013).

Marine Corps' Office of the Program Manager for Advanced Amphibious Assault. We identified acquisition best practices based on our extensive body of work, as well as the DOD acquisition guidance, to assess the ACV acquisition approach and acquisition activities to date.[2]

To assess the Marine Corps' progress towards meeting cost and schedule goals for the ACV 1.1 program, we reviewed recent cost estimates, contractor performance reports, and updated program schedules, and interviewed officials from the ACV program office. We compared current program cost and schedule information to cost and schedule goals in the acquisition program baseline established at development and updated information reported in previous GAO reports addressing the ACV.

To review Marine Corps efforts to meet ACV 1.1 production readiness goals, we analyzed results of developmental, live fire, and sustainment reliability testing provided by the ACV program office and the Marine Corps' Combat Development and Integration. We also interviewed testing officials and visited testing facilities at the Aberdeen Proving Ground, Aberdeen, Maryland. We conducted interviews with officials at Science Applications International Corporation (SAIC) and BAE Systems Land and Armaments L. P. (BAE)—the two contractors competing for the production down-select—and visited their production and assembly facilities at North Charleston, South Carolina and York, Pennsylvania, respectively. We reviewed reports about contractor production readiness and interviewed officials from the Defense Contract Management Agency (DCMA) responsible for oversight at the contractors' respective facilities. We also analyzed vehicle acceptance reports for all prototype ACV vehicles delivered to the government. We then applied DOD guidance and GAO-identified best practices to ACV program efforts to prepare for the start of production. In addition to interviewing Marine Corps program officials, we also interviewed officials at the DOD Office of the Director, Operation Test and Evaluation and the Office of the Deputy Assistant Secretary of Defense for Developmental Test and Evaluation.

[2]GAO, Best Practices: DOD Can Achieve Better Outcomes by Standardizing the Way Manufacturing Risks Are Managed, GAO-10-439 (Washington, D.C.: Apr. 22, 2010); Defense Acquisitions: A Knowledge-Based Funding Approach Could Improve Major Weapon System Program Outcomes, GAO-08-619 (Washington, D.C.: July 2, 2008); Best Practices: Capturing Design and Manufacturing Knowledge Early Improves Acquisition Outcomes, GAO-02-701 (Washington, D.C.: July 15, 2002).

Information related to testing results, production readiness, and vehicle quality upon delivery is competition sensitive and is restricted from being presented in a public report. Because the ACV program has not yet concluded the evaluation of the two competitors to determine which will produce the ACVs to be fielded, we are unable to publicly address and include in this report some of our findings relating to information that is considered by DOD to be competition sensitive. However, we agreed to brief staff of the congressional defense committees on those findings at a later date.

We conducted this performance audit from July 2017 to April 2018 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

The ACV is being developed as a partial or full replacement for the AAV, which is a tracked (non-wheeled) vehicle with capability to launch from ships to reach the shore carrying up to 21 Marines at a speed of up to approximately 6 knots. This speed effectively limits its range for traveling from ship to shore to no farther than 7.4 nautical miles. In order to upgrade the AAV to meet current threats and establish a path toward an enhanced platform, DOD and the Marine Corps implemented an incremental approach. The first step was to improve the AAVs' protection from threats such as improvised explosive devices by installing enhanced armor and other equipment—referred to as survivability upgrades—efforts which are currently underway. The second step was to establish a plan to replace the AAV with a new vehicle, the ACV, which would develop and enhance capabilities in three incremental steps:

- **ACV 1.1** would be a wheeled vehicle that provides improved protected land mobility but limited amphibious capability. In operations, it is expected to be part of an amphibious assault through the use of a surface connector craft to travel from ship to shore. This increment would leverage prototypes, demonstration testing, and

other study results from the previously suspended Marine Personnel Carrier program.[3]

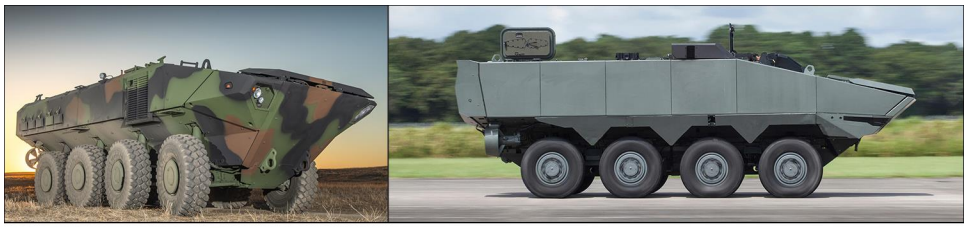
- **ACV 1.2** would have improved amphibious capability, including the ability to self-deploy and swim to shore. The development phase of the second ACV increment (ACV 1.2) is scheduled to begin in February 2019.
- **ACV 2.0** would focus on exploring technologies to attain higher water speed capability.

The ACV 1.1 program was initiated in 2014 and development of ACV 1.1 vehicles started in November 2015. The remainder of this report is focused on development and acquisition of the ACV 1.1, which we will refer to as ACV. The Marine Corps acquisition of the ACV employs a two-phase strategy for selecting a contractor to produce the ACV fleet. In the first phase, the program issued a solicitation for offerors to submit proposals and provided for award of multiple contracts for each contractor to design and develop 16 prototypes for performance assessment. In the second phase, referred to as the down-select process, after testing the prototypes, the Marine Corps intends to select a single contractor to continue into the start of production. The Marine Corps received five initial proposals and ultimately awarded contracts to BAE and SAIC to develop the ACV prototypes. The Marine Corps considered the ACV to be a substantially non-developmental item because both contractors' designs were based on vehicles that were already in production and deployed by other militaries.

Figure 1 depicts the BAE and SAIC prototype vehicles. After testing the prototypes, the Marine Corps plans to select a single contractor to continue into the production phase.

[3]The Marine Personnel Carrier program, suspended in 2013, was intended to provide armor-protected transportation of Marines. According to Marine Corps officials, budget uncertainty led the Marine Corps to determine that it could not afford to have three simultaneous development and procurement programs for armored vehicles, specifically the ACV, the Marine Personnel Carrier, and the Joint Light Tactical Vehicle. After considering strategic priorities, the Marine Corps decided to suspend the Marine Personnel Carrier program and continue with the ACV and Joint Light Tactical Vehicle.

Figure 1: Amphibious Combat Vehicle (ACV) Prototype Vehicles



Source: (left to right) ACV 1.1 produced by BAE Systems Land & Armaments, L.P., © BAE Systems, Inc. and ACV 1.1 produced by Science Applications International Corporation, © SAIC (images). Images provided by Marine Corps Systems Command. | GAO-18-364

The first prototypes were delivered in January 2017 and have since been undergoing developmental, operational, and live fire testing.

Developmental testing assesses whether the system meets all technical requirements and is used to: verify the status of technical progress, determine that design risks are minimized, substantiate achievement of contract technical performance, and certify readiness for initial operational testing. ACV developmental testing includes testing for sustainability, system survivability, and water and land mobility.[4]

Operational testing (assessment) is the field test, under realistic conditions, for the purpose of determining effectiveness and suitability of the weapons for use in combat by typical military users.

Live fire testing is used to demonstrate vehicle capability against a range of ballistic and non-ballistic threats expected to be encountered in the modern battlefield, such as improvised explosive devices among others.

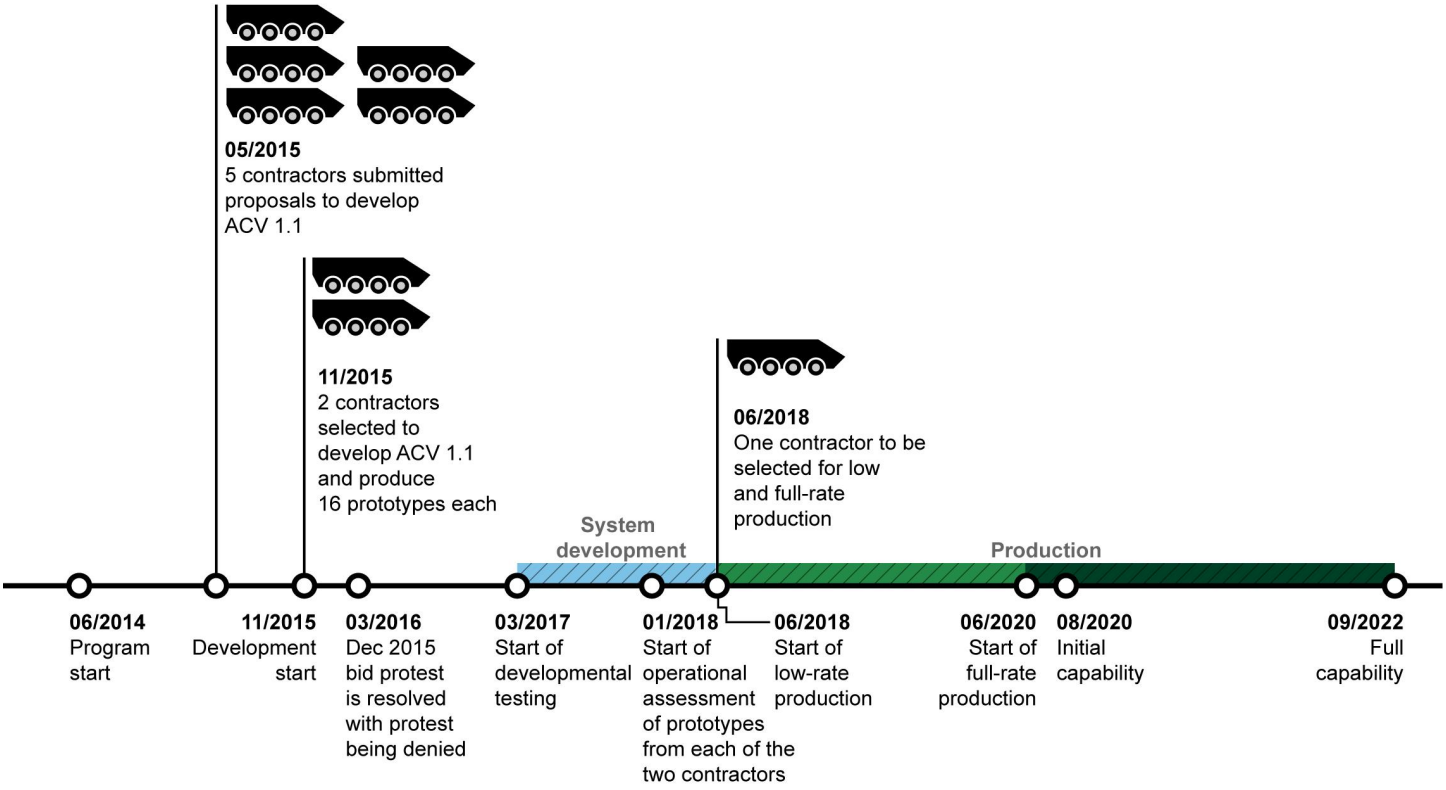
In January 2018 the Marine Corps started an operational assessment, which was scheduled to be completed in March 2018. The assessments consist of field tests, under realistic conditions, to inform the decision to enter production. Ongoing test results, including the operational assessment, will be used to inform the ACV June 2018 production decision.

Figure 2 is a timeline of the ACV program's progress and plans to full capability. The ACV program plans to produce at least 208 vehicles after

[4]Sustainability is the framework necessary to ensure the ability to operate into the future without decline. System survivability is intended to ensure the system maintains its critical capabilities under applicable threat environments.

exercising contract options for 2 years of low-rate production of 30 vehicles each year starting in 2018 and then exercise options for 2 years of full-rate production for the remaining 148 or more vehicles starting in 2020.

Figure 2: Timeline of Amphibious Combat Vehicle (ACV) 1.1 Acquisition



Source: GAO analysis of program schedule data. | GAO-18-364

Note: Low-rate production refers to low-rate initial production, which establishes the initial production base for the system or capability increment, provides an efficient ramp-up to full-rate production, and maintains continuity in production pending operational test and evaluation completion.

In addition to testing the prototype vehicles, the program is holding a production readiness review that started in November 2017 and according to program officials, they will keep the review open until April 2018. During this review, the program will determine whether the designs are ready for production and whether the contractors have accomplished adequate production planning to enter production. Officials from DCMA, which conducts contract performance oversight, have provided support in assessing production readiness. After receiving the proposals for the production down-select, the program will hold a system verification review

in April 2018 to verify that the performance of the ACV prototypes meets capability requirements and performance specifications.

This report represents the last in the series of reports we are to issue in response to the fiscal year 2014 National Defense Authorization Act, which contains a provision that we review and report annually on the ACV program until 2018. Previously,

- In October 2015 we found that the Marine Corps made efforts to adopt best practices and minimize acquisition risk, including: adopting an incremental approach to update capabilities, using proven technologies, increasing competition, and awarding fixed-price incentive contracts for much of the development work.[5]
- In April 2017, we found that DOD's life cycle cost estimate for ACV 1.1 of about $6.2 billion, fully or substantially met the criteria for the four characteristics of a high-quality reliable cost estimate.[6] However, we also found that changes the Marine Corps made to the acquisition schedule — partly in response to a stop work order following a bid protest that was denied by GAO in March 2016 — raised acquisition risk by increasing the overlap between development activities, such as testing of the vehicles, with production.[7] This is a risk we had identified in a previous report.[8] As a result, we recommended that the Marine Corps delay the production decision until 2019. DOD did not concur with that recommendation.

ACV Program Is on Track to Meet Development Cost Goals with No Additional Schedule Delays

Costs for the development phase of ACV are on track to meet cost goals established at the start of development, based on a recent Navy estimate,

[5]GAO, Amphibious Combat Vehicle: Some Acquisition Activities Demonstrate Best Practices; Attainment of Amphibious Capability to be Determined, GAO-16-22 (Washington, D.C.: Oct. 28, 2015).

[6]GAO, Amphibious Combat Vehicle Acquisition: Cost Estimates Meet Best Practices, but Concurrency between Testing and Production Increases Risk. GAO-17-402 (Washington, D.C.: Apr. 2017).

[7]GAO-17-402; B-412525; B-412525.2 General Dynamics Land Systems, Mar. 15, 2016, 2016 CPD ¶ 89.

[8] GAO-16-22.

the ACV program office, and reporting from the contractors. In September 2017, the ACV program's Defense Acquisition Executive Summary Report for ACV provided a Navy cost estimate for development of $750.7 million, less than the $810.5 million baseline established at the start of development in November 2015.[9] Program officials also indicated that the ACV program was on track to meet cost goals. They noted that the contractors have not contacted the government to negotiate an increase in billing prices, as of December 2017. Since both of the contractors have delivered all 16 of their required prototypes and the manufacturing of the prototypes is the largest anticipated portion of ACV development contract costs, most of the costs associated with the manufacturing of the prototypes have likely been realized.

The Marine Corps made efforts to reduce cost risk to the government by adopting a fixed-price incentive (firm target) contract type for the construction of the prototype vehicles. As we previously reported in October 2015, the Marine Corps planned to award hybrid contracts to each of the ACV development contractors, which would apply different pricing structures for different activities.[10] The Marine Corps awarded the contracts in November 2015 as planned. Most critically, a fixed-price incentive contract type is being used for items in the contract associated with the manufacturing of the development prototypes, which was anticipated to be the largest portion of ACV development contract costs. Under this contract type, the government's risk is generally limited to the contract's price ceiling. Incentive contracts are appropriate when a firm-fixed-price contract is not appropriate and the required supplies can be acquired at lower costs by relating the amount of profit or fee to the contractor's performance.

[9]Defense Acquisition Executive Summary Reports were issued regularly by acquisition program offices to update the Under Secretary of Defense for Acquisition, Technology and Logistics about the program in between acquisition milestones. Effective February 1, 2018, the DOD reorganization directed by the National Defense Authorization Act for Fiscal Year 2017 provided for the restructuring of USD(AT&L). Pub. L. No. 114-328 (2016) § 901) (codified at 10 U.S.C. §§ 133a and 133b). The position has been divided into the Under Secretary of Defense for Research and Engineering and the Under Secretary of Defense for Acquisition and Sustainment.

[10]See GAO-16-22 for examples of other different pricing structures for different activities in the ACV development contracts: an incentive for the early delivery of test vehicles was firm-fixed-price and test support, advanced capability improvements, and studies were cost-plus-fixed-fee.

According to Federal Acquisition Regulation, since it is usually to the government's advantage for the contractor to assume substantial cost responsibility and appropriate share of the cost risk, fixed-price incentive contracts are preferred over cost-reimbursement incentive contracts when contract costs and performance requirements are reasonably certain.[11] The fixed-price incentive (firm target) contract type provides for adjusting profit and establishing the final contract price by application of a formula based on the relationship of total final negotiated cost to total target cost. The final price is subject to a price ceiling, negotiated at the outset.[12] If the final negotiated cost exceeds the price ceiling, the contractor absorbs the difference. As we also previously reported, however, the Marine Corps received a waiver to forgo the establishment of a certified Earned Value Management System for the ACV program, which reduces the regularly-available cost, schedule, and performance data available for the program to review.[13]

The ACV program office and DOD also indicated that they anticipate production costs will be within goals established at the start of development, though key production costs have not yet been determined. The program's development contracts with the two competing contractors contain fixed-price incentive options for 4 years of production. The pricing of the production vehicles will not occur, however, until DOD makes a production decision in June 2018 and negotiates the final terms and exercises the production option with one of the contractors.

The Marine Corps has made no major changes to the ACV acquisition schedule since we previously reported on the program in April 2017.[14] In that report we found that the production decision was moved from February to June 2018 after a stop work order was issued to the contractors in response to a bid protest from a vendor that was not selected for one of the ACV development contracts.[15] A senior program

[11]Federal Acquisition Regulation 16.401(c).

[12]For more information about the pricing structure of the ACV 1.1 development contracts, see GAO-16-22.

[13]GAO-17-402.

[14]GAO-17-402.

[15]On December 7, 2015 a bid protest was filed with GAO, resulting in the program issuing a stop work order to the two contractors selected to develop ACV 1.1 prototype vehicles. On March 15, 2016, GAO denied the bid protest and the stop work orders were lifted. B-412525; B-412525.2 General Dynamics Land Systems.

official emphasized the importance of keeping the ACV acquisition on schedule because the capability it provides is complementary to a broader set of capability updates across multiple platforms that the Marine Corps is in the process of procuring.

ACV May Enter Production with Manufacturing Maturity That Does Not Meet Best Practices

The ACV program office is in the process of conducting tests and assessments to determine if the program is on track to meet the criteria to enter production, but program officials told us the Navy—which has the authority to approve major acquisition milestone decisions for the program—may choose to start low-rate production without meeting established best practices for manufacturing maturity. At the start of development, DOD established criteria for entering production in areas such as capability performance and the status of the contractors' manufacturing readiness to manufacture the ACV vehicles. Leading up to the production decision, the program is engaged in a number of activities such as the operational assessment and production readiness review to inform the decision to start production. The production readiness review has a critical role in informing the decision to enter production because it represents an opportunity for the program to determine the maturity of the contractor's manufacturing process and assess potential risks related to cost, schedule, or performance. Our previous reviews about manufacturing best practices found that identifying manufacturing risks early in the acquisition cycle and assessing those risks prior to key decision points, such as the decision to enter production, reduces the likelihood of cost growth and potential delays.[16]

The ACV program has used the DOD Manufacturing Readiness Level (MRL) Deskbook to identify levels of manufacturing capability and establish targets for minimal levels of manufacturing readiness at specific acquisition milestones.[17] The ratings are applied to various risk areas such as design, materials, process capability and control, and quality

[16]GAO Defense Acquisitions: Assessments of Selected Weapon Programs, GAO-17-333SP (Washington, D.C.: Mar. 30, 2017); GAO-10-439; GAO-02-701.

[17]DOD Manufacturing Readiness Level Deskbook Version 2.4 August 2015. Prepared by the OSD Manufacturing Technology Program in Collaboration with the Joint Service/Industry MRL Working Group. DOD has since released a 2017 version.

management. Table 1 shows the basic MRL definitions provided by the Joint Defense Technology Panel.[18]

Table 1: Basic Manufacturing Readiness Level Definitions

MRL	Description
1	Basic manufacturing implications identified
2	Manufacturing concepts identified
3	Manufacturing proof of concept developed
4	Capability to produce prototype components in a laboratory environment
5	Capability to produce prototype components in a production-relevant environment
6	Capability to produce a prototype system or subsystem in a production-relevant environment
7	Capability to produce systems, subsystems, or components in a production-representative environment
8	Pilot line capability demonstrated; ready to begin low-rate production
9	Low-rate production demonstrated; capability in place to begin full-rate production
10	Full-rate production demonstrated; and lean production practices in place

Source: Joint Defense Manufacturing Technology Panel | GAO-18-364

The MRL Deskbook recommends that a program is expected to demonstrate a MRL of 8 by the time of the low-rate production decision. However, GAO's previously identified best practices for managing manufacturing risks recommend programs reach a higher level—MRL-9— for the risk area of process capability and control before entering low-rate production.[19] At MRL-9, a program is expected to have its applicable manufacturing processes in statistical control.[20] The MRL Deskbook recommends that a program achieve an MRL-9 at the start of full-rate production.

[18]The Joint Defense Technology Panel was chartered in 1999 by the Office of the Director, Defense Research & Engineering, the military services, and the Defense Logistics Support Command to conduct joint program planning. It sponsored a joint defense and industry working group, that in 2005 introduced to the defense community introduced MRLs for science and technology and acquisition managers to consider. GAO-10-439.

[19]GAO-10-439, GAO-17-333SP.

[20]To determine that manufacturing processes are in statistical control, the contractor demonstrates that the processes are repeatable, sustainable, and capable of consistently producing parts within the quality standards. See GAO-17-333SP.

The Marine Corps has eliminated manufacturing capability as a criterion for consideration in the down-select production decision. In the solicitation issued to the two competing contractors for the production decision in December 2017, the Marine Corps identified two criteria that would be considered to determine the winner of the down-select competition for the production decision. They are, in descending order of importance: (1) technical performance of the prototype vehicles and (2) the contractors' submitted cost proposals. Previously, the ACV acquisition strategy and development contracts identified five criteria for the selection process, with manufacturing capability as the second most important factor (behind technical performance). The development contracts stipulated that the government reserved the right to adjust the factors and their order of importance prior to the release of the solicitation for the production down-select decision. Program officials said that narrowing the down-select factors to performance test results and cost was in line with the original intent of the program to use the best value tradeoff process described in the Federal Acquisition Regulation and that the revised criteria were appropriate for a non-developmental item such as the ACV.[21]

While the program removed manufacturing capabilities from its criteria for selecting the contractor for production, ACV program officials are still assessing manufacturing readiness to support their production decision. Program officials stated that they could enter production at a lower level of manufacturing readiness than DOD guidance or GAO identified best practices suggest. The program started a production readiness review in November 2017 to determine the contractors' respective manufacturing maturity. According to program officials, they will keep the review open until April 2018, at which point the program will make a determination about the contractors' manufacturing readiness levels. The program office confirmed that the ACV criterion for entering production is to achieve an MRL-8 but noted that it is possible that the program could choose to enter into production without an overall MRL-8. Program officials stated that if there are any specific risk areas that are assessed below that threshold, the program office will define the risk and make a recommendation to the Navy for entry into production based on whether or not they consider the risk acceptable.

[21]The Federal Acquisition Regulation provided that the tradeoff process is appropriate when it may be of the interest of the Government to consider the award to other than the lowest priced offeror or the highest technically rated offeror. FAR 15.101-1.

To help inform its determination, program officials said that they will review the manufacturing readiness assessments produced by the contractors, as well as reviews by the DCMA, which is responsible for assisting with contract oversight. Because the two contractors were still in competition at the time of the release of this report, we are unable to publicly report additional, more detailed, information about production readiness or performance tests. However, we have previously found that programs with insufficient manufacturing knowledge at the production decision face increased risk of production quality issues, cost growth, and schedule delays.[22]

Entering the production phase of the ACV acquisition with manufacturing readiness levels lower than those recommended by DOD guidance and GAO-identified best practices would increase the likelihood of outcomes associated with insufficiently mature manufacturing capabilities, such as production quality issues and schedule delays. The Marine Corps has already been authorized funding to start production and plans to exercise options in 2018 to produce 30 vehicles for the first year of low-rate production.[23] However, the Marine Corps has two upcoming decisions that would provide opportunities to refocus on manufacturing readiness for the ACV—specifically the decision to enter into the second year of low-rate production in 2019 for 30 vehicles, and the decision to enter the first year of full-rate production in 2020 and acquire 56 of the remaining 148 vehicles. Acquiring additional vehicles before ensuring sufficient manufacturing maturity could raise the risk that the contractor may not be sufficiently prepared for continued production, which could result in delays in delivery of acceptable vehicles or additional costs to the government.

Conclusions

The Marine Corps has long identified the need for the enhanced capabilities envisioned through the ACV program and is nearing the potential production of such a vehicle. Following the cancellation of the EFV program after the expenditure of $3.7 billion, the ACV program represents an opportunity to follow a better acquisition approach. It is too early to determine whether the contractors will meet targets for production readiness by the time of the production decision, but the program office is

[22]GAO-17-333SP, GAO-10-439, GAO-02-701.

[23]National Defense Authorization Act of 2018. Pub. L. No. 115-91, §§ 4001, 4101.

considering entering production without meeting the recommended manufacturing maturity levels established by DOD or GAO-identified best practices.

We have already identified the ACV program as adopting an aggressive acquisition schedule in which the amount of concurrent developmental testing and production is more than typical acquisition programs. In fiscal year 2018, Congress authorized funding for the program to start production, but the decision to enter a second year of low-rate production and the decision to start full-rate production represent opportunities for the ACV program to verify the manufacturer has achieved a sufficient level of readiness before commencing production of the bulk of vehicles. If the Marine Corps does not take steps to ensure that the contractor's manufacturing readiness is sufficiently mature, as demonstrated through MRLs, prior to committing to additional production beyond the first year of low-rate production, there is an increased risk for production quality issues, cost growth, and schedule delays.

Recommendations for Executive Action

We are making two recommendations to DOD.

The Secretary of the Navy should take steps to ensure that the Marine Corps not enter the second year of low-rate production until after the Marine Corps has determined that the contractor has achieved an MRL of at least an 8 for all risk areas. (Recommendation 1)

The Secretary of the Navy should take steps to ensure that the Marine Corps not enter full-rate production until the Marine Corps has determined that the contractor has achieved an MRL of at least 9 for all risk areas. (Recommendation 2)

Agency Comments and Our Evaluation

We provided a draft of this product to DOD for comment. In its comments, reproduced in appendix I, DOD partially concurred with GAO's recommendations.

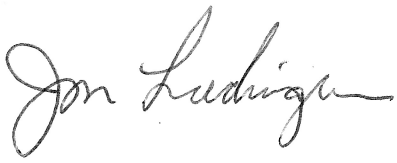
DOD agreed that manufacturing readiness should be assessed prior entering both the second year of low-rate production and the start of full-rate production, and plans to do so. DOD acknowledged that the MRL

Deskbook provides best practices for identifying risks, but noted that the ACV program is not required to follow it. DOD noted that it may be reasonable to proceed into manufacturing at lower MRLs, if steps to mitigate identified risks are taken. However, DOD disagreed that not demonstrating a specified MRL for any individual risk area, in itself, should delay the start of either production milestone. DOD expressed concern that delaying subsequent years of production, if MRLs are not at the levels recommended, could lead to counterproductive breaks in production.

We agree that adopting the MRL Deskbook is not required by DOD and represents best practices to minimize production risk. However, we also believe that demonstrating the MRL levels recommended in the MRL Deskbook for all risk areas mitigates increased risk associated with the aggressive schedule pursued by the ACV program—about which we have previously expressed concerns. We believe our recommendation to achieve an overall MRL-8 by the second year of low-rate production is a reasonable goal, considering it gives the ACV program an additional year after the point at which the MRL Deskbook recommends reaching MRL-8—the start of low-rate production. In addition, ensuring that all manufacturing readiness risk areas are at MRL-9 for the start of full-rate production, as recommended by best practices in the MRL Deskbook, would help further alleviate risks associated with the program's aggressive schedule. We appreciate the DOD concerns about delaying subsequent years of production if MRLs have not reached those identified in the best practices in the MRL Deskbook, but note that not doing so increases the likelihood of production quality issues that could lead to cost growth and schedule delays in future years. Therefore, we made no changes to the recommendations in response to the comments.

We are sending copies of this report to interested congressional committees; the Secretary of Defense; the Under Secretary of Defense for Acquisition and Sustainment; the Secretary of the Navy; and the Commandant of the Marine Corps. This report also is available at no charge on GAO's website at http://www.gao.gov.

Should you or your staff have any questions on this report, please contact me at (202) 512-4841 or ludwigsonj@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. Key contributors to this report GAO staff who made key contributions to this report are listed in appendix II.



Jon Ludwigson
Acting Director, Contracting and National Security Acquisitions

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The Honorable Mac Thornberry
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The Honorable Adam Smith
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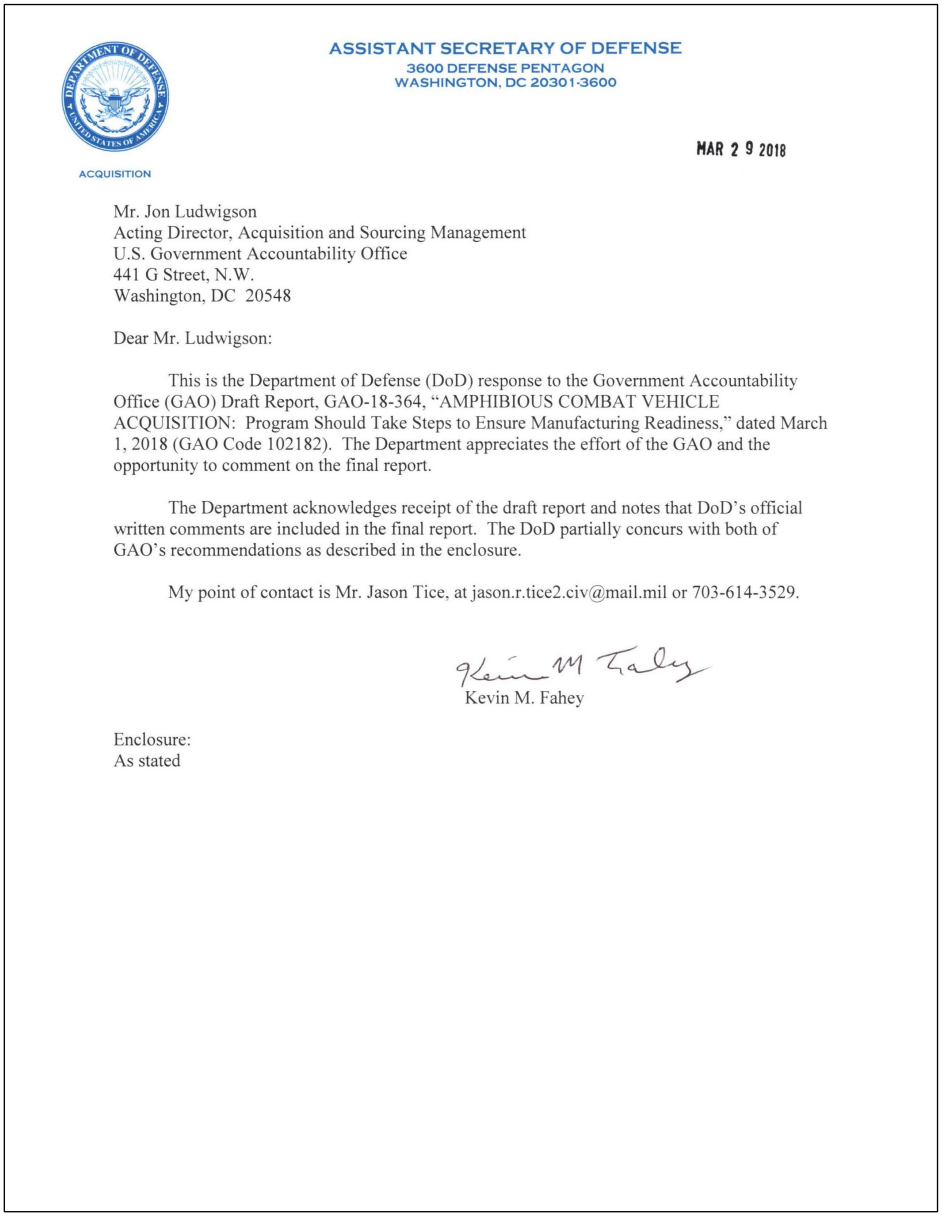
Appendix I: Comments from the Department of Defense



ASSISTANT SECRETARY OF DEFENSE
3600 DEFENSE PENTAGON
WASHINGTON, DC 20301-3600

ACQUISITION

MAR 2 9 2018

Mr. Jon Ludwigson
Acting Director, Acquisition and Sourcing Management
U.S. Government Accountability Office
441 G Street, N.W.
Washington, DC 20548

Dear Mr. Ludwigson:

This is the Department of Defense (DoD) response to the Government Accountability Office (GAO) Draft Report, GAO-18-364, "AMPHIBIOUS COMBAT VEHICLE ACQUISITION: Program Should Take Steps to Ensure Manufacturing Readiness," dated March 1, 2018 (GAO Code 102182). The Department appreciates the effort of the GAO and the opportunity to comment on the final report.

The Department acknowledges receipt of the draft report and notes that DoD's official written comments are included in the final report. The DoD partially concurs with both of GAO's recommendations as described in the enclosure.

My point of contact is Mr. Jason Tice, at jason.r.tice2.civ@mail.mil or 703-614-3529.

Kevin M. Fahey

Enclosure:
As stated

GAO DRAFT REPORT DATED MARCH 1, 2018
GAO-18-364 (GAO CODE: 102182)

"AMPHIBIOUS COMBAT VEHICLE ACQUISITION: PROGRAM SHOULD TAKE STEPS TO ENSURE MANUFACTURING READINESS"

DEPARTMENT OF DEFENSE COMMENTS TO GAO RECOMMENDATIONS

RECOMMENDATION 1: The Secretary of the Navy should take steps to ensure that the U.S. Marine Corps (USMC) not enter the second year of low-rate production until after the USMC has determined that the contractor has achieved a Materiel Readiness Level (MRL) of at least an 8 for all risk areas.

DoD RESPONSE: Partially Concur.

- The Department of Defense (DoD) agrees that MRL should be assessed through an In-Process Review (IPR) prior to the next Amphibious Combat Vehicle Phase 1, Increment 1 (ACV 1.1) Low-Rate Initial Production (LRIP) award decision, LRIP Lot 2. However, the DoD disagrees that an MRL assessment of any individual risk area, in itself, should delay the LRIP Lot 2 contract award.
    - Per the MRL Deskbook, Version 2.4, dated August 2015, "this document is not a DoD requirement and is being offered as a Best Practice." The Program Management Office for Advanced Amphibious Assault (PM AAA) integrated this Best Practice to assess the Contractors' manufacturing readiness in order to identify specific production risks and orient PM AAA and Defense Contract Management Agency (DCMA) attention to higher risk areas. PM AAA is assessing manufacturing risk for LRIP through contract deliverables and manufacturing readiness assessments during the Production Readiness Reviews (PRRs). Initial PRR findings were delivered to the Prime Contractors who provided LRIP manufacturing updates during their System Verification Review (SVR) briefings in February 2018. PM AAA efforts are in compliance with the Best Manufacturing processes as stated in the Deskbook, "During the Engineering and Manufacturing Development (EMD) Phase, program managers will assess the maturity of critical manufacturing processes to ensure they are affordable and executable. Prior to a production decision, the PM will ensure manufacturing and producibility risks are acceptable…"
    - In order to mitigate risks to production, PM AAA has added manufacturing risks to the Program Risk Registry and is proactively managing the risks. Based on the final PRR/MRL results, PM AAA will recommend to the Milestone Decision Authority (MDA) whether the manufacturing risk is acceptable for LRIP. This meets the intent stated in the MRL Deskbook, "The GAO has recommended that DoD adopt the use of MRLs to help manage the manufacturing risk." To demonstrate the effectiveness of risk mitigation plans and mature the MRL, the Prime Contractors must execute the planned improvements and physically build LRIP vehicles to validate that any MRP shortfalls

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have been addressed. PM AAA is managing the risks to minimize cost and schedule impacts and working with the Contractors to achieve the recommended MRL as expeditiously as possible. However, DoD supports PM AAA in the belief that delaying the second year of LRIP if an MRL 8 has not been achieved will cause a counterproductive break in production, realignment of workforce, and/or a restart effort – all of which would reduce manufacturing readiness – rather than allowing PM AAA to manage the risk per the MRL Deskbook.

RECOMMENDATION 2: The Secretary of the Navy should take steps to ensure that the USMC not enter Full-Rate Production (FRP) for ACV 1.1 until the USMC has determined that the contractor has achieved an MRL of at least 9 for all risk areas.

DoD RESPONSE: Partially Concur.

- The DoD agrees that MRL should be assessed through an IPR, PRR, or similar event, prior to the ACV 1.1 FRP decision and corresponding contract award in order to identify any manufacturing-related risks. The DoD disagrees that the MRL assessment of any individual risk area should, in itself, delay or preclude entry into FRP.
    - PM AAA plans to assess the Prime Contractor's MRL through site visits, contract deliverables (e.g., Manufacturing Plan, Manufacturing Readiness Self-Assessment), and work with DCMA. As a result, PM AAA will define any manufacturing risks using the MRL assessment tool and work with the Prime Contractor to mitigate the risks. If any MRL threads are assessed at less than MRL 9, then PM AAA will recommend to the MDA whether the manufacturing risk is acceptable for FRP. Delaying FRP until an MRL of 9 for all threads has been achieved may cause a counterproductive break in production and would significantly impact the Prime Contractor's production execution (e.g., subcontracting, material procurement, and workforce) – all of which would reduce manufacturing readiness.

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Appendix II: GAO Contact and Staff Acknowledgments

GAO Contact:

Jon Ludwigson, (202) 512-4841 or ludwigsonj@gao.gov

Staff Acknowledgments:

In addition to the contact named above, Bruce H. Thomas (Assistant Director), Matt Shaffer (Analyst in Charge), Pete Anderson, Alexandra Jeszeck, Jennifer Leotta, Roxanna Sun, and Marie Ahearn made key contributions to this report.

Appendix III: Accessible Data

Data Table

Data for Figure 2: Timeline of Amphibious Combat Vehicle (ACV) 1.1 Acquisition

- 06/2014, Program start
- 05/2015,5 contractors submitted proposals to develop ACV 1.1
- 11/2015, 2 contractors selected to develop ACV 1.1 and produce 16 prototypes each
- 11/2015, Development start
- 03/2016, Dec 2015 bid protest is resolved with protest being denied
- 03/2017, Start of developmental testing
- 01/2018,Start of operational assessment of prototypes
- from each of the two contractors
- 06/2018, One contractor to be selected for low and full-rate production
- 06/2018, Start of low-rate production
- 06/2020, Start of full-rate production
- 08/2020,Initial capability
- 09/2022,Full capability

Agency Comment Letter

Text of Appendix I: Comments from the Department of Defense

Page 1

Mr. Jon Ludwigson

Acting Director, Acquisition and Sourcing Management

U.S. Government Accountability Office 441 G Street, N.W.

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As stated

Page 2

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