

Audit



Report

OFFICE OF THE INSPECTOR GENERAL

**ACQUISITION OF ADVANCED AMPHIBIOUS
ASSAULT VEHICLES**

Report No. 93-116

June 18, 1993

Department of Defense

Acronyms

AAA	Advanced Amphibious Assault
AAAV	Advanced Amphibious Assault Vehicle
AAV	Amphibious Assault Vehicle
ASN(RD&A)	Assistant Secretary of the Navy (Research, Development and Acquisition)
COEA	Cost and Operational Effectiveness Analysis
DAB	Defense Acquisition Board
FAR	Federal Acquisition Regulation
MAA	Mission Area Analysis
MCOTEA	Marine Corps Operational Test and Evaluation Activity
MOPP	Mission Oriented Protective Posture
NBC	Nuclear, Biological, and Chemical
ORD	Operational Requirements Document
OSD	Office of the Secretary of Defense
ROC	Required Operational Capability
R&D	Research and Development
TACOM	U.S. Army Tank-Automotive Command



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DEPARTMENT OF DEFENSE
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June 18, 1993

MEMORANDUM FOR ASSISTANT SECRETARY OF THE NAVY (FINANCIAL
MANAGEMENT)

SUBJECT: Audit Report on the Acquisition of Advanced Amphibious Assault
Vehicles (Report No. 93-116)

We are providing this final report for your information and use. Comments on the draft of this report were considered in preparing the final report. We made the audit a part of our continuing review of major acquisition programs.

This report discusses issues concerning the development of a new amphibious assault vehicle as well as issues pertaining to the existing vehicle. The issues involve requirement deficiencies, human factors, contracting, program coordination, program oversight, testing, and internal controls.

DoD Directive 7650.3 requires that all audit recommendations be resolved promptly. Therefore, the Assistant Secretary of the Navy (Research, Development and Acquisition); Commanding General, Marine Corps Combat Development Command; Commanding General, Marine Corps Systems Command; and Program Manager, Advance Amphibious Assault Program, must provide final comments on the unresolved recommendations by August 18, 1993. See the "Response Requirements for Recommendations" section at the end of each finding for the unresolved recommendations and the specific requirements for your comments.

As required by DoD Directive 7650.3, the comments must indicate concurrence or nonconcurrence in the finding and each recommendation addressed to you. If you concur, describe the corrective actions taken or planned, the completion dates for actions already taken, and the estimated dates for completion of planned actions. If you nonconcur, you must state your specific reasons for each nonconcurrence. If appropriate, you may propose alternate methods for accomplishing desired improvements. Recommendations are subject to resolution in accordance with DoD Directive 7650.3 in the event of nonconcurrence or failure to comment. We also ask that your comments indicate concurrence or nonconcurrence with the internal control weaknesses highlighted in Part I. This report identifies no potential monetary benefits. However, Appendix A summarizes other benefits of the audit.

We appreciate the courtesies extended to the audit staff. If you have any questions on this audit, please contact Mr. Rayburn Stricklin, Program Director, at (703) 614-3965 (DSN 224-3965) or Mr. Roger Florence, Project Manager, at (703) 693-0489 (DSN 223-0489). Appendix C lists the distribution of this report.

A handwritten signature in cursive script that reads "Robert J. Lieberman".

Robert J. Lieberman
Assistant Inspector General
for Auditing

Office of the Inspector General, DoD

Report No. 93-116
Project No. 2AL-0031

June 18, 1993

**ACQUISITION OF ADVANCED AMPHIBIOUS ASSAULT
VEHICLES**

EXECUTIVE SUMMARY

Introduction. The Advanced Amphibious Assault (AAA) Program was the only major acquisition program in the Marine Corps at the time of the audit. The Marine Corps established the AAA Program to develop and procure vehicles to replace the Amphibious Assault Vehicle (AAV) that was fielded in 1972. The AAA Program should satisfy mobility and survivability deficiencies in the AAV as well as provide fast assault capability from extended sea ranges.

The Marine Corps evaluated seven vehicle alternatives to satisfy the deficiencies in the AAV and planned to develop and procure 951 AAA vehicles. The AAA Program had an estimated research and development cost of \$900 million and a procurement cost of \$3.8 billion. Initial fielding of the AAA Program was scheduled for calendar year 2003; however, due to delays in selecting the most cost-effective alternative, the initial fielding of a vehicle under the AAA Program slipped.

Objectives. Our audit objective was to evaluate the acquisition management of the AAA Program regarding program management elements critical for a system preparing for the demonstration and validation phase of the acquisition cycle. We also evaluated the adequacy of internal controls related to the program management elements.

Audit Results. Our audit disclosed seven conditions warranting management action. The conditions pertained to the AAA Program as well as to the AAV Program.

- o The Marine Corps Combat Development Command (the Command) did not consider all operating environments and battlefield conditions in the Mission Area Analysis for the AAA Program. Also, the Command did not include in the operational requirements document for the AAA Program all AAV deficiencies and all performance characteristics necessary to satisfy the deficiencies. As a result, the Marine Corps had not considered all deficiencies in the concept design of the AAA Program. Furthermore, by not considering all deficiencies in the design, the Marine Corps will be faced with the possibility of subsequent modifications. Also, the cost estimates for the AAA Program will be understated (Finding A).

- o The Command and the AAA Program Office had not adequately considered human factors in the concept design of vehicles being evaluated in the AAA Program. As a result, either additional modifications will be necessary to the design for vehicles in the AAA Program or the operational effectiveness of the Marines, who will be using the AAA vehicles, will be limited. Also, the cost estimate for the AAA Program may increase further (Finding B).

- o The Marine Corps Systems Command (Systems Command) as well as the AAA Program Manager did not comply with the Federal Acquisition Regulation concerning competition in contracting. Also, the Systems Command and the AAA Program Office did not comply with certain procedures on contract

administration and on the reporting of expenditures for consulting services. As a result, the AAA Program Manager influenced the acquisition of contractor support services by specifying the contractors or subcontractors to whom an award should be made. A Systems Command contracting officer issued a contractual action for continued program support services that was contrary to a legal opinion of the Systems Command. Also, the Program Office's contract records were incomplete, and the Systems Command did not report \$463,532 of expenditures for consultant services contracts to the Office of the Secretary of Defense officials and Congress (Finding C).

- o The AAA Program Office did not utilize or coordinate with expert resources at the U.S. Army Tank-Automotive Command specific to land mobility and survivability to assist in the product improvements to the AAV or in the conceptual design of a vehicle for the AAA Program. The lack of coordination could have resulted in unnecessary costs from duplication of efforts and in adverse effects on design and developmental efforts (Finding D).

- o The AAA Program Manager planned and executed modifications to the AAV under a Product Improvement Program without the required oversight. Also, the Program Manager initiated a technology demonstrator effort that conflicted with DoD acquisition policy. As a result, the AAA Program Office was developing and procuring modifications that may not be cost-effective, and the developmental efforts could inappropriately affect the design of the AAA vehicle (Finding E).

- o The Systems Command did not arrange for independent testing of product improvements to existing AAVs prior to installation. As a result, the Marine Corps could spend as much as \$125.1 million for modifications without knowing the operational effectiveness and suitability of such modifications (Finding F).

- o The AAA Program Office did not establish an Internal Management Control Program after a major change in the management of the program. As a result, the AAA Program Office did not know whether adequate internal controls existed or whether existing controls were effective and efficient (Finding G).

Internal Controls. We identified internal control weaknesses in the areas of performance requirements for the vehicle, contractual procedures, program coordination and oversight, testing of vehicle improvements, and a program for internal controls. Part I of this report discusses the internal control issues. Finding G addresses specific weaknesses in the AAA Program Office's Internal Control Program.

Potential Benefits of Audit. The audit did not identify quantifiable monetary benefits. However, other benefits of the audit will be derived by improving the processes for determining system requirements, improving contracting procedures, coordinating program development, providing program oversight, ensuring independent testing, and strengthening internal controls. Appendix A summarizes the potential benefits of the audit.

Summary of Recommendations. We recommended actions to improve the process for determining and satisfying vehicle requirements, to use the Army's expertise, to provide for program oversight, to conduct testing, and to establish internal controls.

Management Comments. The Assistant Secretary of the Navy (Research, Development and Acquisition) provided a consolidated management response for the Navy and the Marine Corps. Management's comments to our recommendations were very responsive. Management concurred with 14 of 18 recommendations. Management actions will improve the program in the areas of contracting, coordination, oversight, testing, and internal controls. However, the Navy and the Marine Corps nonconcurred with recommendations concerning the identification of the requirements for the vehicle. We still believe that, during the concept design phase, the vehicle requirements need more attention. Therefore, we have asked the Navy and the Marine Corps to reconsider their positions and to comment again on those recommendations in response to this report. These comments should be provided by August 18, 1993.

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This report was prepared by the Acquisition Management Directorate, Office of the Assistant Inspector General for Auditing, DoD. Copies of the report can be obtained from the Secondary Reports Distribution Unit, Audit Planning and Technical Support Directorate, (703) 614-6303 (DSN 224-6303).

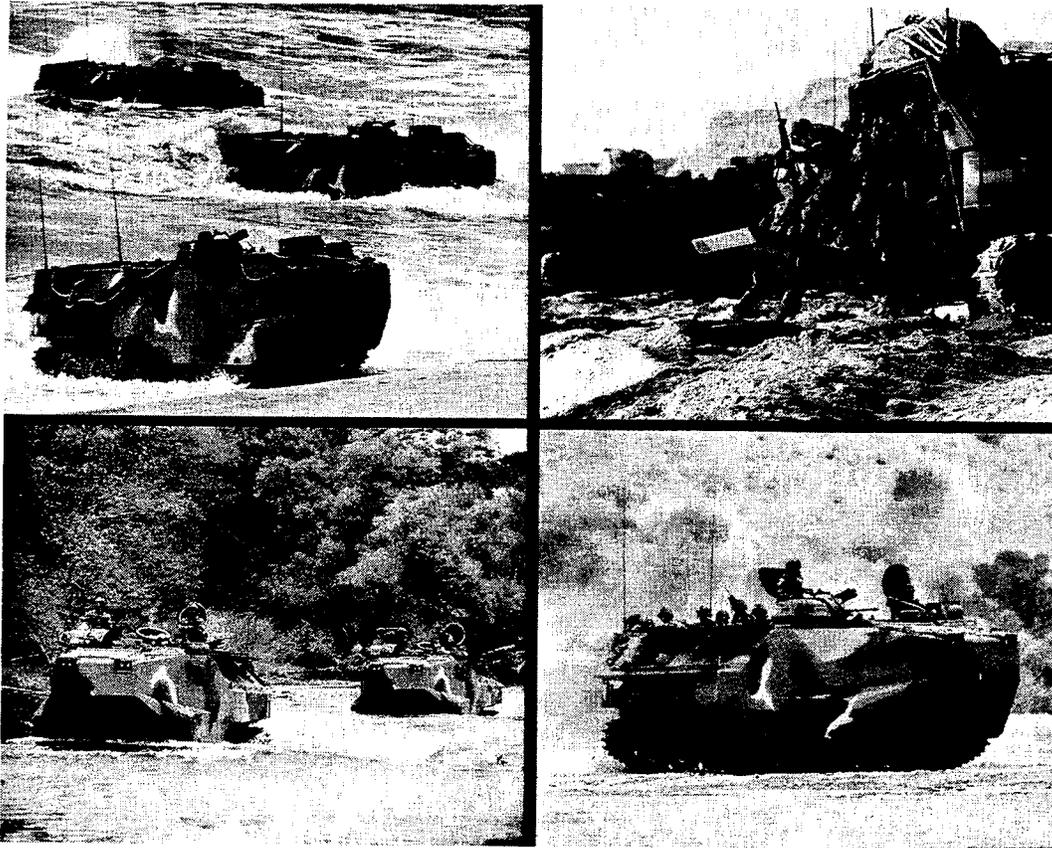
Part I - Introduction

Background

The Marine Corps mission, as stated in the United States Code, title 10, section 5063, is to provide marine forces for seizure of advanced naval bases and to conduct land operations of a naval campaign. The United States Code also states that the Marine Corps will provide amphibious operations capability.

In response to its mission requirement, the Marine Corps developed the Amphibious Assault Vehicle (AAV) in 1972. The AAV in various operating environments is shown in Figure 1.

Figure 1. Amphibious Assault Vehicle



The Marine Corps subsequently enhanced the AAV during a service life extension to improve the vehicle's reliability, maintainability, and durability. The service life extension ended in 1986. The Marine Corps conducted the life extension because several attempts to obtain a replacement vehicle failed due to high cost. In 1987, the Marine Corps also initiated a Product Improvement Program for the AAV to satisfy mission deficiencies in offensive firepower, armor protection, cross-country mobility, slow water speed, and overall crew and system survivability.

In 1988, the Marine Corps received approval from the Office of the Secretary of Defense (OSD) Defense Acquisition Board (DAB) to begin concept studies for a replacement to the AAV, an advanced amphibious assault capability. The Marine Corps sought approval from the DAB because the AAV had mission deficiencies in satisfying the new operational concept "over-the-horizon." The concept of over-the-horizon concerns the Navy's placement of a fleet 25 miles offshore. Another reason the Navy wanted to keep its fleet beyond the horizon was to provide additional protection from enemy shore fire. However, the AAV water speed of 8 miles per hour was incapable of a fast, over-the-horizon amphibious assault without the assistance of another vessel. Under the advanced amphibious assault capability, the Marine Corps would like to develop the capability to depart Naval transport vessels from over-the-horizon locations and travel to the shore within 1 hour.

The DAB, in authorizing the Marine Corps to conduct concept studies for an AAV replacement, directed the Marine Corps to analyze other alternatives to satisfy mission deficiencies. The DAB also directed the Marine Corps to seek commonality with the U.S. Army Vehicle Modernization Program and to assess the Navy's shore delivery vessels as an alternative.

In response to the DAB's direction, the Marine Corps examined 13 alternative systems, which fell into four broad categories: fast-speed amphibians, slow-speed amphibians, non-amphibians, and non-vehicles. The Marine Corps performed cost and operational effectiveness analysis (COEA) on all 13 alternatives for performance, cost, and mission effectiveness. The Marine Corps' analyses concluded that a fast amphibious assault vehicle was the most effective alternative for providing rapid combat power on land and for requiring the fewest Navy shore delivery vessels.

Although the COEA identified the fast amphibious assault vehicle as the most effective, the Marine Corps continued to evaluate 5 of the 13 alternatives. The five alternatives included the development of a new vehicle with fast water speed (the Advanced Amphibious Assault Vehicle [AAAV]); a redesign of the existing AAV with one-half the number of troops to obtain fast water speed; a new slow water speed AAV with improved land performance; a redesign of the AAV to obtain slow water speed with capacity for one-half the number of troops; and continued improvements in the existing AAV without fast water speed. Due to the affordability of the five alternatives, the Advanced Amphibious Assault (AAA) Program Manager proposed two new alternatives, which received most of the Marine Corps' attention. Those alternatives were:

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Modular Approach. The Modular Approach was a new vehicle developed as a fast AAV with reduced quantities, along with concurrent development of a slow AAV that was convertible to a fast AAV. The plan called for 25 percent of the vehicles to have the fast capability.

Block 5 Approach. The Block 5 Approach was five phases, or blocks, of improvements made to the current AAV through a Product Improvement Program. When all five block improvements are complete, the AAV will evolve into a new vehicle with fast or slow capability. The first block improvement consisted of minor changes and was completed. The second block of improvements was in progress with the most significant changes to begin in FY 1993. The last three blocks were in concept development.

The Marine Corps assigned responsibility for the new AAA capability to the AAV Program Manager (the Program Manager). The Program Manager reported to the Assistant Secretary of the Navy (Research, Development and Acquisition) (ASN[RD&A]) for matters that pertain to the AAA Program.

The AAA Program Office (the Program Office) awarded two competing contractors, General Dynamics and FMC Corporation, contracts to develop a concept design for a fast amphibious vehicle. In May 1993, the DAB was to select one of the seven concept alternatives for further development. However, the concept alternative selection has slipped to the spring of 1994. Only one contractor will continue system development after an alternative is selected.

Objective

The audit objective was to evaluate the effectiveness of the acquisition management of the AAA Program to determine whether program officials were adequately evaluating alternative solutions to Defense deficiencies, identifying and quantifying risk factors, and preparing for the demonstration and validation phase of the system's development. We performed the audit in accordance with our critical program management elements approach. Under that approach, we focused our audit on a review of eight program management elements that were critical to the AAA Program in its preparation for the demonstration and validation phase of the acquisition cycle. The eight program management elements are:

- o requirements,
- o concept impact,
- o alternative design analysis,
- o test planning,
- o schedule realism,
- o budget estimates,
- o cost estimating and analysis, and
- o contracting.

We also evaluated the adequacy of internal controls related to those elements.

We limited our review of the following three elements due to the AAA Program's instability and to limited program documentation.

Schedule Realism. The Marine Corps delayed the schedule of the AAA Program because studies and cost analyses of the alternatives were not complete. Assessments of alternatives in the AAA Program caused schedules to change constantly and resulted in the Marine Corps delaying the DAB review and approval for 2 years. We determined that further review of schedule realism would not be beneficial now.

Budget Estimates. Because of the delay in selecting one of the seven alternatives, the Program Office requested a "funding wedge" for the research and development (R&D) budget submission so that concept exploration and definition efforts could continue. The Program Office did not request procurement funds since production was scheduled beyond calendar year 2003. We concluded that there was no reason for further review of budget estimates due to the dynamics of the AAA Program.

Cost Estimating and Analysis. The AAA Program has been in concept development since 1988. The Marine Corps postponed the Milestone I DAB review because the five alternatives under consideration then were too costly. In anticipation of a May 1993 DAB review (the review has slipped to the spring of 1994), the Program Office was developing new cost estimates for all seven proposed alternatives. The Program Office planned for the estimates to be completed in November 1992. Therefore, we were able to make only limited reviews of the estimates.

The audit also did not address the Marine Corps' need for an amphibious assault capability. We did not review this need because United States Code, title 10, section 5063, states that the Marine Corps will provide an amphibious operations capability.

Part II of this report discusses the results of our reviews of the remaining five program management elements, as well as the results of our reviews of internal controls.

Scope

We conducted this economy and efficiency audit from March through November 1992. The audit was made in accordance with auditing standards issued by the Comptroller General of the United States, as implemented by the Inspector General, DoD, and accordingly included such tests of internal controls as considered necessary. We reviewed records and supporting documentation from June 1987 through August 1992. We evaluated program acquisition documentation, test plans and schedules, mission and system requirements documentation, system concept alternative studies, program contracting actions,

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budget and cost estimates, and internal control assessments relating to the AAA Program. Also, during the audit we expanded our scope to include reviews of product improvements to the AAV and a review of the Position Location Reporting System. Appendix B lists activities that we visited or contacted during the audit.

Internal Controls

We reviewed internal controls as deemed necessary for the eight program management elements during the audit survey. Five program elements continued into the audit verification phase. We identified internal control deficiencies in the five program elements, which resulted in six findings. In addition, we included a separate finding in this report discussing the lack of internal control assessments at the Program Office.

Controls Assessed. We evaluated the adequacy of internal controls associated with system requirements, concept impact, alternative design analysis, testing, and contracting. In assessing the internal controls, we evaluated internal control techniques such as management plans, written policies and procedures, and management-initiated reviews.

Results of Assessment. We identified material internal control weaknesses as defined by Public Law 97-255, Office of Management and Budget Circular A-123, and DoD Directive 5010.38. Controls were not effective to ensure that the Marine Corps and the Program Office followed Navy or Marine Corps policy and guidance in the areas of requirement deficiencies, human factors, contracting, program coordination, program oversight, and testing. Recommendations A.1., B.2., C.1., C.2., D.1., E.2, and F.2., if implemented, will correct these weaknesses. In addition, Finding G. discusses the lack of internal controls assessments. Recommendations G.1. and G.2., if implemented, will correct this material control weakness. We determined that monetary benefits will not be realized by implementing these recommendations. However, implementation of the recommendations should improve management and control of the AAA Program and should reduce cost risks associated with the AAA Program. We will provide a copy of this report to the senior official responsible for internal controls within the Marine Corps.

Prior Audit and Other Reviews

Since 1987, there has been one audit of the AAA Program. The audit by the Naval Audit Service was Report No. 021-C-92, "Stratified Charge Rotary Engine Program," January 15, 1992. The Naval Audit Service determined that the Marine Corps was developing a rotary engine that was not required. The Naval Audit Service recommended that the ASN(RD&A) defer further engine

development until the Navy established a firm requirement. Also, the Naval Audit Service recommended that the Navy obtain approval of an Integrated Logistics Support Plan and a Test and Evaluation Master Plan, as required by DoD and Marine Corps guidance.

The ASN(RD&A) acknowledged that there was no specific application for the rotary engine but asserted that there were countless applications for the engine technology. The ASN(RD&A) stated that development of the rotary engine, as an independent program, will be terminated during FY 1993 at the conclusion of its demonstration and validation phase of development. At that time, Marine Corps officials will consider the engine as a candidate for the AAA Program or will consider the engine for an upgrade to the current AAV. The Naval Audit Service concluded that the Navy comments were not responsive to the recommendations and referred the matter to the Secretary of the Navy for mediation on December 22, 1992. Subsequently, the ASN(RD&A) agreed to terminate the rotary engine development after final acceptance of the contracted item. The Naval Audit Service accepted this position.

Other Matters of Interest

During our audit, we examined mine warfare in relation to system requirements because of its threat to an amphibious assault. We also expanded the scope of our audit to include product improvements to the AAV and the acquisition of the Position Location Reporting System.

Amphibious Assault Mission. The success of an amphibious assault for the Marine Corps is dependent upon the concurrent development of a system(s) to defeat mines in very shallow water and landing areas on the beach. Mines damaged two U.S. ships in Operation Desert Storm. Because the mine damage came when the U.S. Navy was threatening an amphibious assault, world perception was that the mines prevented an assault. Therefore, DoD believes that Third World nations will significantly increase the use of mine warfare.

The Congress, DoD, Navy, and Marine Corps have acknowledged the need to develop a more effective mine countermeasure capability. Research and development in mine countermeasure programs were ongoing with joint efforts between the Navy and Marine Corps.

Success of an amphibious assault may be limited due to the presence of mines and the ability to defeat the mines. Development of the AAV and AAA Programs with concurrent mine countermeasures development poses high risk for the Marine Corps.

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Product Improvements. Our initial review disclosed that the Program Manager planned on performing product improvements on all 1,323 AAVs. However, the number of vehicles that the Marine Corps needed decreased due to reductions in the Marine Corps' force structure. Review of the June 1992 budget submission, subsequently submitted by the Program Office, showed that product improvements will be made on fewer than 1,200 vehicles.

Acquisition of the Position Location Reporting System. During the audit, we received an allegation concerning R&D funds that the Marine Corps' Systems Command spent for the development of hardware and software for a Position Location Reporting System Master Station. It was alleged that Hughes Aircraft Company (Ground Systems Group) had a Master Station available that could satisfy the Marine Corps' requirement. Our review disclosed that the Marine Corps had not expended R&D resources to develop a master station but had requested FY 1996 procurement funds to acquire an Army system, currently in development, to satisfy the Marine Corps' requirements. Also, our review determined that the Hughes Aircraft Company's system could not satisfy the Marine Corps' requirements because of incompatible hardware and software.

Part II - Findings and Recommendations

Finding A. Requirement Deficiencies

The Marine Corps Combat Development Command (the Command) did not consider all operating environments and battlefield conditions in preparing the Mission Area Analysis (MAA) for the AAA Program. Also, the Command did not include all AAV deficiencies and all performance characteristics necessary to correct the deficiencies in the operational requirements document for the AAA Program. Even though the Deputy Chief of Staff for Plans, Policies, and Operations, Headquarters Marine Corps, expressed serious concerns regarding inadequacies in the MAA, the Command appeared to have ignored the Deputy Chief's recommendation for a more comprehensive analysis. Also, some critical deficiencies and performance characteristics were not in the requirements document for the AAA Program due to an oversight by Command officials. As a result, the Marine Corps had not considered all deficiencies in the concept design of the AAA Program. Furthermore, by not considering all deficiencies in the design, the Marine Corps will be faced with the possibility of subsequent modifications. Also, the cost estimates for the AAA Program will be understated.

Background

The Marine Corps conducts MAAs to evaluate mission capabilities under various conditions and to identify other countries' capabilities to which the Marine Corps may have to respond. During the MAA, the Service may identify mission deficiencies. As required by DoD Instruction 5000.2, Part 4, Section B, "Evolutionary Requirements Definition," February 23, 1991, such deficiencies become the basis of a Mission Need Statement that proposes the development of a new weapon system. Subsequent to the Mission Need Statement, a Service develops a Required Operational Capability (ROC) document that identifies minimum requirements to correct mission deficiencies. The ROC is the basis for the concept design of the weapon system.¹ DoD Instruction 5000.2, Part 4, Section E, "Cost and Operational Effectiveness Analysis (COEA)," February 23, 1991, requires that a COEA evaluate each alternative in terms of mission performance and estimated costs. Marine Corps policy assigned responsibility for MAA, ROC, and COEA preparation to the Commanding General, Marine Corps Combat Development Command, Quantico, Virginia.

¹The Marine Corps approved the ROC for the AAA Program on May 3, 1991. DoD Instruction 5000.2, Part 4, Section B, changed the title of the ROC to the Operational Requirements Document (ORD). Because the Marine Corps did not officially approve the ORD, our review focused on the ROC. However, the information concerning system requirements of the two documents was essentially the same.

Qualitative Requirements

The Marine Corps based the concept design for the AAA Program on a MAA for an amphibious assault mission and on operational requirements. Our analysis showed that the MAA was incomplete and did not consider certain operational requirements.

Mission Area Analysis. The MAA for the amphibious assault program was an analysis of the AAV's capabilities to travel from Naval transport vessels to the shore and a limited analysis of the vehicle during land operations.

Our review showed that the Command limited the MAA in two areas. First, the environmental conditions used in the MAA were not representative of combat conditions. The Command based the over-the-horizon portion of the MAA on overcast conditions, an air temperature of 59 degrees Fahrenheit, and calm seas. Such an environment was much less severe than expected conditions identified in the Marine Corps' ROC. The ROC stated that the vehicle was expected to transit to the shore in wave heights of 2 feet and to survive in waves of 10 feet. Second, the Command based the land operation portion on a dry and temperate climate, a clear day, and a relatively open and flat terrain. The ROC stated that the vehicle was to function in temperatures between minus 25 and plus 125 degrees Fahrenheit and to operate in many terrains. Although the Marine Corps' mission profile for the AAV identified seven environments that the vehicle was to operate in, the MAA contained only a portion of one environment. The analysis excluded operations in various climatic and operational conditions, such as hot and humid weather, nighttime operations, and mountainous or jungle conditions.

Our review also showed that the Command did not include other conditions in the MAA, including communications, human factors, and firepower. The Command did not include communications capabilities for movements from Naval vessels to shore or during land operations. Communications are necessary to relay battle positions and plans to all forces. Also, the Command did not consider human factors in its assessment of the amphibious assault operations. Such factors include troop capacity, stowage of troop equipment, and air flow in the troop compartment, all essential to troop effectiveness and survivability. In addition, the ship-to-shore analysis, which was part of the MAA, did not address defensive firepower capability that would be needed while approaching the shore. The land operations only included select portions of a battle rather than analyzing operations based on a continuous battle.

The Deputy Chief of Staff for Plans, Policies and Operations, Headquarters Marine Corps, reviewed the MAA and voiced serious concerns regarding its comprehensiveness. The Deputy Chief of Staff stated that land operation deficiencies, identified as a result of the MAA, were not specific. Due to the MAA's incompleteness, deficiencies relating to land operations may not have been identified. The Deputy Chief of Staff also stated that the scenario used in the MAA was limited and not well-suited for identifying land operation

Finding A. Requirement Deficiencies

requirements. He recommended in 1987 that a more extensive analysis be conducted. We found no evidence that the Command performed the additional analysis as recommended.

Operational Requirements. The Command overlooked deficiencies in the AAV and did not specify certain needed performance characteristics while preparing the ROC for the AAA Program. Our review of the ROC and associated documents disclosed that the Command did not include 5 of 22 deficiencies in the AAV. The exclusions were:

- o the absence of filtered air to troops for nuclear, biological, and chemical (NBC) protection;
- o the lack of an environmental system for cooled air to crew and troops during heat stress conditions (see Finding B);
- o the lack of sufficient traction to operate in ice- or snow-covered terrain;
- o the absence of a full terrain view from the weapon station; and
- o an improper vehicle exhaust system.

In addition, the ROC identified five deficiencies but did not specify essential performance characteristics to correct them, as required by DoD Instruction 5000.2. For example, the current vehicle has inadequate ventilation for heat generated by communications equipment. Also, the ROC did not include an accurate or continuous position location system for identifying friendly forces.

Conclusion

The lack of a thorough MAA and an incomplete ROC for the AAA Program prevented the identification of critical mission deficiencies in an amphibious assault operation. As a result, by not considering all deficiencies in the concept design, the Marine Corps will be faced with the strong possibility of subsequent modifications to incorporate systems to correct the deficiencies. Also, the cost estimates for the AAA Program will be understated because all systems needed to satisfy missions needs are not in the current system concept design.

Recommendations for Corrective Action

We recommend that the Commanding General, Marine Corps Combat Development Command:

1. Conduct a detailed Mission Area Analysis to include all factors that would impact the Advanced Amphibious Assault Program prior to a Milestone I decision by the Defense Acquisition Board.

Navy Response. The ASN(RD&A) nonconcurred and stated that two 1991 analyses of mission areas, Ground Tactical Mobility/Countertermobility (Mission Area 22) and Close Combat (Mission Area 23), identified numerous general and specific requirements for the AAA Program. He stated that these analyses superseded the MAA that the Command conducted in 1987 for the AAA Program.

Audit Response. We reviewed the 1987 MAA and the two 1991 analyses. As a part of the 1987 MAA for the AAA Program, Command officials evaluated amphibious mission capabilities by specifically examining the capabilities of the AAVs. Their two 1991 analyses focused on equipment applicable to Mission Areas 22 and 23 but not on the ". . . integral capabilities of the equipment." Our review disclosed that Command officials in neither 1991 analysis specifically examined the capabilities of the AAV. Also, no reference was made in the results of either 1991 analysis that the analysis superseded the 1987 MAA. The 1991 Ground Tactical Mobility/Countertermobility analysis identified 23 general deficiencies in various equipment, of which only 4 were related to the AAV. The Command had already identified those 4 deficiencies in the 1987 MAA and the ROC for the AAV Product Improvement Program. The 1991 Close Combat analysis identified 35 general deficiencies in close combat operations, with 5 deficiencies related to the AAV. The Command had previously identified these 5 mission deficiencies in the MAA and the ROC for the AAV Product Improvement Program.

We still believe a comprehensive MAA is required, based on the limited combat conditions used in the MAA (as discussed in the finding) and the limited scope of the 1991 analyses. Therefore, we request that the Commanding General, Marine Corps Combat Development Command, reconsider his nonconcurrence with Recommendation A.1. and comment again on the recommendation in response to this report.

2. Revise the Required Operational Capability document for the Advanced Amphibious Assault Program to include all deficiencies in the Amphibious Assault Vehicle and specify the performance characteristics necessary to correct all deficiencies.

Navy Response. The ASN(RD&A) concurred with the recommendation. He stated that the ORD will include all deficiencies in the AAV and will specify the performance characteristics necessary to correct all deficiencies. The estimated completion date is the end of the third quarter, FY 1993.

Finding A. Requirement Deficiencies

Audit Response. We consider the ASN(RD&A)'s comments to be responsive to the recommendation. Therefore, no additional comments are required for Recommendation A.2.

3. Prepare Cost and Operational Effectiveness Analyses that include cost estimates for developing and procuring systems that will correct deficiencies in the Amphibious Assault Vehicle.

Navy Response. The ASN(RD&A) concurred with the recommendation but stated that including the suggested items in the COEA was inappropriate for Milestone I. He added that he would include the suggested items in the COEAs for Milestones II and III.

Audit Response. We consider the ASN(RD&A)'s comments to be nonresponsive. We also disagree that the suggested items are inappropriate for a COEA at a Milestone I decision. The purpose of the COEA is to aid decisionmakers in judging alternatives on the basis of military benefit and cost. According to DoD Manual 5000.2M, Part 8, "Cost and Operational Effectiveness Analysis," management should include in the COEA for Milestone I decision the characteristics of each concept that is evaluated and drives costs. These costs include advanced development and engineering development as well as procurement costs. If costs are unknown, the costs are to be expressed in terms of low and high ranges. As identified in this finding and Finding B, a requirement existed for an environmental control system that provides cooling. A system with this capability will have a significant impact on the AAA vehicle in terms of additional weight, required power source, vehicle center of gravity, and additional cost. The Marine Corps needs to include in the COEA the impact of the environmental control system and other requirements. Otherwise, the Marine Corps will not have the cost and operational effectiveness data necessary to accurately evaluate various alternatives. Therefore, we request the Commanding General, Marine Corps Combat Development Command, reconsider his comments on Recommendation A.3. and comment again on the recommendation in response to this report.

Other Management Comments and Audit Response to the Comments

The ASN(RD&A) disagreed with some of the information provided in this finding. The ASN(RD&A) stated that a ROC and an ORD are not essentially the same document. He explained that an ORD is more comprehensive and requires a significant amount of additional information. He also stated the ORD that the auditors reviewed was an initial draft that the Command had not formally coordinated with other organizations. He added that the ORD was basically a reformatted ROC of the AAA Program. The ASN(RD&A) also took exception with our statement that vehicle modifications would be necessary if the Command did not consider all deficiencies that the AAA Program should

Finding A. Requirement Deficiencies

correct. He stated that since the AAA Program is in the Concept Exploration phase and there is no design in this phase, there is nothing to modify. Also, the ASN(RD&A) stated that the Command included the deficiencies that we identified as being "overlooked" in the ORD for the AAA Program. The full text of the ASN(RD&A)'s comments is in Part IV.

We agree that an ORD is a more comprehensive document than a ROC because additional information is required. However, the comprehensiveness of the ORD does not affect the issue in this finding. During the audit, we were informed by an official, who prepared the requirement documents at the Command, that the operational requirements portion of the ORD for the AAA Program will be the same as the approved ROC. Also, during our examination of the requirements, officials in the Marine Corps were aware that we were using the ROC as the basis for requirements in the AAA Program and made no objection.

We agree that the AAA Program was in the Concept Exploration phase and that there was no vehicle design in that phase. However, two competing design contractors developed "concept" designs for a vehicle based upon the operational requirements of the AAA Program. Those designs will require modifications if the Command does not include all requirements in the AAA Program. Finally, we agree the draft ORD included a requirement for an NBC protection and environmental system; however, the ORD did not identify a requirement for "filtered air" for NBC protection and a performance characteristic for an environmental system that provides "cooled air," as discussed in the finding. The Command was aware that both of these deficiencies existed in the current vehicle.

Response Requirements for Recommendations

<u>Number</u>	<u>Addressee</u>	<u>Response Should Cover:</u>				
		<u>Concur/ Nonconcur</u>	<u>Proposed Action</u>	<u>Completion Date</u>	<u>Monetary Benefits</u>	<u>Internal Controls</u>
A.1.	Commanding General, Marine Corps Combat Development Command	x	x	x		x
A.3.	Commanding General, Marine Corps Combat Development Command	x	x	x		

Finding B. Human Factors

The Command and the Program Office had not adequately considered human factors in the concept design of vehicles being evaluated in the AAA Program. These conditions occurred because the Program Office delayed consideration of human factors until after the DAB selects a vehicle alternative at the Milestone I decision point. Also, the Command did not include a requirement for an environmental control system for air cooling in the ROC for the AAA Program, although the Command was aware of the effects of not having a cooling system. As a result, either additional modifications to the design for vehicles in the AAA Program will probably be necessary or the operational effectiveness of the Marines who will be using the AAA vehicles will be limited. Also, the cost estimate may increase further for the AAA Program if modifications occur.

Background

Various DoD policies and procedures require the Services to ensure that human factors become an integral part of the acquisition process for new systems to prevent troop degradation in a hot, NBC environment. In evaluating human factors for a new system's design, the system's threat environment must be considered in determining system requirements.

Policies and Procedures. DoD Instruction 5000.2, Part 6, Section H, "Human Factors," February 23, 1991, requires the Services to identify factors that may adversely affect human performance early in a system's design. Further, DoD Instruction 5000.2, Part 7, Section B, "Human Systems Integration," February 23, 1991, requires the program manager to develop a Human Systems Integration Plan (Human Plan) during the Concept Exploration and Definition (Milestone 0) phase of development to identify critical human factors for each alternative. The intent of the policy was to require consideration of human factors early in the design of Defense systems to improve total system performance and reduce life-cycle costs by eliminating the need for later modifications. The ASN(RD&A) was responsible for ensuring the Program Office comply with these policies. Further, the Assistant Secretary of the Navy (Manpower and Reserve Affairs) was responsible for developing procedures for preparing the Human Plan.

DoD Military Standard 1472D, "Human Engineering Design for Military Systems, Equipment, and Facilities," March 14, 1989, served as the basis for human factors design and stated that a person's environment should be adequately ventilated and air-conditioned at or below 85 degrees Fahrenheit to preclude human performance degradation.

The Marine Corps Order 3900.4D, "Marine Corps Program Initiation and Operational Requirement," January 31, 1991, states that the Command has responsibility for conducting analyses and studies, identifying operational needs, and defining operational requirements. The Command was to identify human factor deficiencies based on lessons learned or from existing systems with similar operational requirements as a means to ensure the elimination of user problems in new programs.

Threat Environments. Heat is an environmental threat to military operations. Troops operating in desert and tropical regions can suffer from debilitating and life-threatening injuries ranging from heat exhaustion (headache, dizziness, and vomiting) to heat stress (dehydration, fatigue, moisture loss, and rise in body temperature beyond which the human body can dissipate heat quickly). Heat quickly degrades physical and mental capabilities and the ability to perform routine tasks.

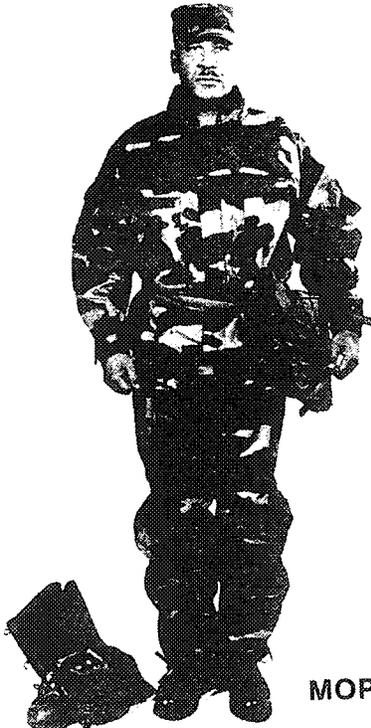
The amount of heat accumulation in a person's body depends upon the amount of physical activity, the type of clothing, and the environmental conditions. In a NBC environment, the troops wear and operate in special protective clothing, called Mission Oriented Protective Posture (MOPP). MOPP clothing is worn over battle uniforms and serves as a barrier between the skin and the environment to protect against hazardous chemical and biological agents. There are four levels of MOPP, with level four being the highest degree of protection, as shown in Figure 2.

Consideration of Human Factors in the AAA Program

Our audit found that the Command and the Program Office had not adequately considered human factors in the concept design of the AAA Program as required by guidance documents. The primary reason that human factors for cooling were not considered in concept design was that the Program Office did not conduct human performance assessments for each vehicle being considered, as required by the Human Plan. The Program Office was delaying human factor considerations until after the DAB approves the selection of one of the seven vehicle concepts being evaluated in the AAA Program.

Another reason that the human factors were not considered in the concept design was that the Command did not include a requirement for an environmental control system that provides air cooling in the ROC for the AAA Program, although strong evidence showed that such a system would be necessary.

Figure 2. Mission Oriented Protective Posture Clothing



MOPP 1



MOPP 2



MOPP 3



MOPP 4

Effects of Not Considering Human Factors

There could be several serious effects of not properly considering human factors for cooling in the concept design of the AAA Program, including subsequent, costly modifications; understated cost estimates; and limited operational effectiveness.

Modifications. Strong evidence showed that the design of the vehicle chosen for the AAA Program will have to be modified to require an environmental control system so that Marines can effectively use the vehicle in a hot, NBC environment.

In 1986, the U.S. Army Natick Research and Development Center (Natick) made studies to determine the human performance effects of hot environmental conditions on troops wearing MOPP protective clothing while in the AAV. Natick's studies concluded that some form of air cooling was needed in the AAV's troop compartment to reduce degradation in the troops' performance. The studies further concluded that ambient air may be sufficient in low humidity environments but would be inappropriate in desert conditions (120 degrees Fahrenheit and 20 percent humidity).

Another study, which was performed in 1981 by the U.S. Army Research Institute of Environmental Medicine (the Army Institute), supports our position that some type of cooling system will be needed for the AAA vehicle. The study was conducted in Yuma, Arizona, and included tests to determine how long troops in MOPP protective clothing could remain in a M-1 Tank with the hatches open before performance degradation. The tests, which were conducted on a partly sunny day with a temperature of 75 degrees Fahrenheit, showed that the troops inside the M-1 Tank began suffering heat stress in about 20 minutes.

Although no similar studies of performance effects on humans in vehicles have been considered for the AAA Program, we believe the results will be the same. The planned space of the troop compartment for vehicles being evaluated for the AAA Program will be similar to the compartment of the AAV. As such, we believe the AAA vehicle will require an environmental control system for cooling. Figure 3 shows the troop compartment of the AAV with 18 Marines wearing MOPP-2 protective clothing.

The Marine Corps Combat Development Command also concluded that the AAV needed an environmental control system to cool the troops. More specifically, the Command stated in the ROC document for the AAV Product Improvement Program that in a hot, NBC environment, temperatures inside the troop compartment cause heat stress and increase the time required for the troops to complete tasks by 30 to 50 percent (depending on the climate and the degree of MOPP protective clothing requirement).

Finding B. Human Factors

Figure 3. Troop Cargo of the Amphibious Assault Vehicle With 18 Troops With Level 2, Mission Oriented Protective Posture Clothing



Unless the Marine Corps adequately satisfies requirements stemming from the Human Plan, the AAA Program could be subject to cost growth or the operational effectiveness of Marines that use the AAAV could be degraded.

Cost Estimates. Modifications stemming from including an environmental control system, as well as the addition of other features needed to satisfy human factors, would have a direct effect on cost estimates for the AAA Program. As an indicator of the effect, the Belvoir Research, Development and Engineering Center estimated that an environmental control system for the AAA vehicle could increase the cost per vehicle by \$20,000 to \$40,000. This estimate was based on individual cooling to the troops. If the entire troop compartment were cooled, the Army Institute estimated that the costs per vehicle could increase by as much as \$250,000.

Operational Effectiveness. To determine the effects on Marine operations, we arranged for the Army Institute to assess the human performance effects on troops with MOPP clothing in an AAA vehicle without cooling. The Army Institute's assessment included biophysical, engineering, and mathematical analyses that predicted the airflow needed for troops in three environmental conditions, which were representative of the mission profile specified in the ROC for the AAA Program. The three conditions were a hot, humid region of 95 degrees Fahrenheit with 70 percent relative humidity; a moderately hot region of 110 degrees Fahrenheit with 20 percent humidity; and a hot, desert region of 120 degrees Fahrenheit with 20 percent relative humidity.

The Army Institute concluded that without sufficient ventilation in the troop compartment of the AAA vehicle and some form of cooling, the troop compartment temperature will not be at or below the 85-degree Fahrenheit requirement of DoD Military Standard 1472D. The above analyses also determined that the thermal insulation effects of MOPP-2, as well as limited troop compartment space, would contribute to physiological heat strain. Without a controlled environment, troops will not dissipate heat gained from the MOPP-2 protective clothing, and the troops may be able to remain effective about 1 hour before suffering from heat exhaustion. MOPP-3 or MOPP-4 would accelerate degradation of performance and induce heat stress casualties.

Recommendations for Corrective Action

1. We recommend that the Commanding General, Marine Corps Combat Development Command, include an environmental control system in the Advanced Amphibious Assault Required Operational Capability document that will provide adequate cooling to ensure troop mission effectiveness in desert; tropical; and nuclear, biological, and chemical environments.

Navy Response. The ASN(RD&A) concurred with the recommendation. He stated that the Marine Corps will include in the draft ORD for the AAA Program a requirement for an environmental control system as identified in the ROC for AAA Program.

Finding B. Human Factors

Audit Response. The ASN(RD&A)'s comments are partially responsive to the recommendation. We agree the draft ORD, as well as the signed ROC, contained a requirement for an environmental control system. However, both documents did not contain a performance characteristic to satisfy the operational deficiency cited in the ROC for the AAV Product Improvement Program, dated May 19, 1990. The ROC for the AAV Product Improvement Program stated that during MOPP-4 conditions, when both the crew and embarked Marines must wear NBC clothing, temperatures inside the vehicle cause heat stress conditions, resulting in a degradation in fighting readiness. The ROC and the draft ORD for the AAA Program did not contain a performance characteristic for maintaining the interior temperature of the vehicle to a specific level when outside temperatures are 125 degrees Fahrenheit. The Army Institute indicated that the inside temperature of the vehicle must be maintained at about 85 degrees Fahrenheit in order for the troops to dissipate the heat gained from the MOPP clothing. The ROC and draft ORD for the AAA Program contained a performance characteristic for maintaining the interior temperature of the vehicle only to above freezing temperatures when the outside vehicle temperature is minus 25 degrees Fahrenheit. We believe the ORD also should include a performance characteristic for maintaining an interior vehicle temperature of about 85 degrees Fahrenheit when the outside vehicle temperature approaches 125 degrees Fahrenheit. Therefore, we request that the Commanding General, Marine Corps Combat Development Command, provide additional comments to Recommendation B.1. stating whether a performance characteristic for interior vehicle cooling of about 85 degrees Fahrenheit will be included in the ORD for the AAA Program.

2. We recommend that the Assistant Secretary of the Navy (Research, Development and Acquisition) direct the Advanced Amphibious Assault Program Office to conduct human performance assessments of the Advanced Amphibious Assault alternatives prior to the Defense Acquisition Board Milestone I decision.

Navy Response. The ASN(RD&A) concurred with the recommendation. He stated that management had made numerous human interface assessments of each of the competing prime contractors' concept designs and will continue to do so.

Audit Response. The comments provided by the ASN(RD&A) were not responsive to the recommendation. We acknowledge that the Marine Corps made human factor assessments of the contractors' concepts designs. However, the Marine Corps focused those assessments on human interface with hardware systems and equipment. The human assessment that we addressed in this finding involves the effects of a hot, NBC environment on human performance. Our examination disclosed that the AAA Program Office did not make this type of assessment. The assessment should be part of the Human Plan which the AAA Program Office must prepare for a Milestone I decision. We request that the ASN(RD&A) provide additional comments on Recommendation B.2. in response to this final report.

3. We recommend that the Assistant Secretary of the Navy (Manpower and Reserve Affairs) review and comment to the Advanced Amphibious Assault Program Manager on the Advanced Amphibious Assault Program Office's Human System Integration Plan. The review should determine whether the Plan adequately addresses human factors and comments should be provided prior to the Defense Acquisition Board Milestone I decision.

Navy Response. The ASN(RD&A) concurred with the recommendation. He stated that, in addition to the Assistant Secretary of the Navy (Manpower and Reserve Affairs), he would give other Army and Navy organizations an opportunity to review the Human Plan.

Audit Response. Comments by the ASN(RD&A) were responsive to the recommendation. However, we request the AAA Program Manager specify in his response to this report when the Human Plan will be submitted to the Assistant Secretary of the Navy (Manpower and Reserve Affairs) for review and comment.

Response Requirements for Recommendations

<u>Number</u>	<u>Addressee</u>	<u>Response Should Cover:</u>				
		<u>Concur/ Nonconcur</u>	<u>Proposed Action</u>	<u>Completion Date</u>	<u>Monetary Benefits</u>	<u>Internal Controls</u>
B.1.	Commanding General, Marine Corps Combat Development Command	x	x	x		
B.2.	Assistant Secretary of Navy (Research, Development and Acquisition)	x	x	x		x
B.3.	Program Manager, Advanced Amphibious Assault Vehicle			x		

Finding C. Contracting

The Marine Corps Systems Command (Systems Command) as well as the Program Manager did not comply with the Federal Acquisition Regulation concerning competition in contracting. Also, the Systems Command and the Program Office did not comply with certain procedures on contract administration and on the reporting of expenditures for consulting services. These conditions occurred because the Program Manager failed to plan for the acquisition of expiring support services and the Program Manager wanted specific contractors to perform technical assessments. Also, contract administrators in the Program Office did not follow the Systems Command's procedures for administering contracts; the Systems Command and the Program Office lacked knowledge of reporting requirements on consultant services. As a result, due to the absence of competition on the support service contracts, there was no assurance that the Program Manager obtained the lowest possible prices for the services, and a Systems Command contracting officer issued a contractual action for continued program support services that was contrary to a legal opinion. Also, the Program Office's contract records were incomplete, and the Systems Command did not report \$463,532 of expenditures for consultant services contracts to OSD officials and Congress.

Background

The Competition in Contracting Act of 1984, as implemented by Federal Acquisition Regulation (FAR), Part 6, "Competition Requirements," requires the use of full and open competition in soliciting and awarding contracts to the fullest extent possible. If full and open competition is not possible, the requesting official is required to prepare a sole source justification. A procuring official should approve the justification. The FAR added that the lack of advance procurement planning is not justification for contracting without full and open competition. Also, the FAR prohibits the avoidance of competition by acquiring services from another agency.

DoD Directive 5000.1, "Defense Acquisition," February 23, 1991, requires Services to obtain all goods and services on a competitive basis to the maximum practicable to achieve fair and reasonable prices and technical benefits.

DoD Directive 4205.2, "Acquiring and Managing Contracted Advisory and Assistance Services," February 10, 1992, requires the activity using contractor support to identify and report the expenditures as Contracted Advisory and Assistance Services. Contractor services include opinions, alternatives, analyses, evaluations, recommendations, and technical advice to support a program or project management.

The Systems Command provided guidance, advice, and support to the Program Office to ensure compliance with the applicable procurement regulations and procedures. The Systems Command assigned a contracting officer to perform all contracting functions for the AAA Program. The Systems Command also provided approval authority for sole source justifications and established procedures for administering contracts.

AAA Support Contracts

Our review found that the Systems Command as well as the Program Manager did not comply with the Federal Acquisition Regulation concerning competition in contracting.

Extension of Support Services. MKI, Incorporated (MKI), provided the Program Office support services on contract N00024-86-C-2072. The MKI contract, issued in May 1986, was a 1-year contract with four 1-year options. The contract required MKI to provide services such as engineering support, logistics support, contract performance monitoring, and life-cycle cost estimates. In May 1991, 2 months before the expiration of the contract, the Program Office prepared a sole source justification for a 1-year extension. The Systems Command's legal counsel, upon reviewing the sole source justification, decided that a 1-year contract extension would violate the Competition in Contracting Act. The legal opinion stated that the contract extension was needed, in part, because of the lack of contract planning by the Program Office. As a result, the Systems Command issued a 6-month contract extension for \$407,086 to allow for continued services and to provide the Program Office time to obtain a competitive follow-on contract by December 1991.

However, the Program Office did not prepare for a competitive follow-on contract and, as a result, needed to obtain another 6-month extension. The Systems Command's contracting officer for the Program Office acquired the additional 6 months of MKI services through a Systems Command's delivery order contract (M67854-90-D-0005, delivery order 0044). The contracting officer and the Program Manager used the delivery order contract because the legal counsel previously denied a 1-year contract extension and the FAR did not require a legal review for issuing orders against a delivery order contract.

Subcontractors. The Program Manager directed the noncompetitive award of two subcontracts that could have been competitively procured. Two prime contractors were directed to issue subcontracts to specific subcontractors to obtain a propulsion assessment and cost-estimating services. Due to the lack of competition, the Program Manager had no assurance that the lowest possible price was obtained for the services.

Propulsion System Assessment. On September 26, 1991, the Naval Surface Warfare Center (Warfare Center) awarded, at the request of the Program Manager, delivery order 0017 on contract N00167-91-D-0019 to the Advanced Marine Enterprises, Incorporated (Marine Enterprises). The Warfare

Finding C. Contracting

Center's contract required Marine Enterprises to conduct trade-off studies and evaluations of propulsion systems for specific vehicles. The delivery order required an assessment of propulsion systems for an amphibious assault vehicle. The Program Manager directed the award of a subcontract to Ricardo Consulting Engineers Ltd. to perform the propulsion assessment because of the company's expertise. Subsequently, Ricardo Consulting Engineers Ltd. received a noncompetitive subcontract from Marine Enterprises to provide the services.

Life-Cycle Cost Estimates. On January 23, 1992, the Systems Command, at the request of the Program Manager, awarded delivery order 0007 on contract M00027-90-D-0015 to Analytical Systems Engineering Corporation (Analytical Systems) for life-cycle cost estimates for the AAA Program. The Program Manager directed Analytical Systems to subcontract with Management Consulting & Research, Incorporated, for the preparation of the cost estimates. The Program Manager wanted to use Management Consulting & Research, Incorporated, because he believed OSD recognized its cost-estimating expertise.

Other Contracting Actions Requiring Management Attention

During our review, we noted problems in two other areas that related to the Program Office's support contracts. The Program Office did not have effective internal controls over contract administration of support contracts. The contracting officer had not reviewed the taskings on the contracts. Also, the Systems Command did not report the support services contracts as Contracted Advisory and Assistance Services, as required by DoD policy.

Contract Administration. The Program Office did not have effective internal controls over its contract administration functions. Contract administration involves the monitoring of a contractor's efforts after contract award to ensure satisfactory performance. Our review found that the contracting officer's technical representative in the Program Office did not maintain controls over contractual taskings. For example, the Program Manager issued task documents, 3 of 31 taskings, to MKI (contract N00024-86-C-2072) after MKI completed the work. As other examples, none of the 31 task statements had final contractor cost estimates, and the Program Office's file of tasking statements disagreed with the file at the contractor's office. Last, the Systems Command's official contract files showed that the contracting officer responsible for the AAA Program never reviewed the task statements, as required by Systems Command's operating procedures. Performance reviews by the contracting officer would have identified the contract administration deficiencies.

Contracted Advisory and Assistance Services. The Systems Command did not identify and report, as required by DoD policy, Contracted Advisory and

Assistance Services used by the Program Office. Our review identified three contracts for support services that required reporting as Contracted Advisory and Assistance Services. Examination of the Marine Corps FY 1992 Project Status Report for the AAA Program report showed that Systems Command did not report any expenditures as contractor support services. As a result, the Systems Command did not report to OSD and Congress \$463,532 of expenditures for three AAA support contracts.

Conclusion

The Program Manager avoided competition by influencing the award of contractual efforts. Also, contractual controls were ineffective to ensure proper contract administration and reporting of expenditures for Contracted Advisory and Assistance Services.

Recommendations for Corrective Action

We recommend that the Commanding General, Marine Corps Systems Command:

1. Require the Director of Contracts and Legal Counsel to review and approve all Advanced Amphibious Assault Program contractual actions, including delivery orders, before award.

Navy Response. The ASN(RD&A) concurred and stated that the Marine Corps Systems Command's Contract Directorate initiated action to require a legal review of all contractual actions for the AAA Program.

Audit Response. We consider the ASN(RD&A)'s comments to be responsive to the recommendation. Therefore, no further comments are required on Recommendation C.1.

2. Direct, in writing, that the contracting officer for the Advanced Amphibious Assault Program is required to review all task statements, prior to their release, for the purposes of determining that the tasks are within the scope of work on the basic contract and that the task statements contain the contractor's cost estimates, are issued on time, and are properly approved.

Navy Response. The ASN(RD&A) concurred and stated that the Marine Corps Systems Command will direct the contracting officer by May 24, 1993, to review all task statements for the AAA Program.

Finding C. Contracting

Audit Response. We consider the ASN(RD&A)'s comments to be responsive to the recommendation. Therefore, no further comments are required on Recommendation C.2.

3. Direct, in writing, the Marine Corps System Command's Comptroller to properly report expenditures by the Advanced Amphibious Assault Program Office for Contracted Advisory and Assistance Services as required by DoD Directive 4205.2, "Acquiring and Managing Contracted Advisory and Assistance Services."

Navy Response. The ASN(RD&A) concurred and stated that the Marine Corps Systems Command is in the process of instituting new procedures to avoid this type of error.

Audit Response. We consider the ASN(RD&A)'s comments to be responsive to the recommendation. However, we request the Commanding General, Marine Corps Systems Command, provide a completion date for the action to be taken in response to this report.

Response Requirements for Recommendations

<u>Number</u>	<u>Addressee</u>	<u>Response Should Cover:</u>					
		<u>Concur/ Nonconcur</u>	<u>Proposed Action</u>	<u>Completion Date</u>	<u>Monetary Benefits</u>	<u>Internal Controls</u>	
C.3.	Commanding General, Marine Corps Systems Command						x

Finding D. Program Coordination

The Program Office did not utilize or coordinate with expert resources at the U.S. Army Tank-Automotive Command (TACOM) specific to land mobility and survivability to assist in the product improvements to the AAV or in the conceptual design of the AAA Program. This condition occurred because the Program Office relied upon contractors and internal resources to develop and support AAV and AAA efforts. The lack of coordination could have resulted in unnecessary costs from duplication of effort and in adverse effects on design and development efforts.

Background

DoD Instruction 5000.2, Part 5, Section C, "Technology Development and Demonstration," February 23, 1991, states that the Under Secretary of Defense for Acquisition², together with DoD Components, shall coordinate technical efforts, exchange resource information, and coordinate program content by technology area. DoD Components share this information to reduce unnecessary duplication of effort, to facilitate technology transition, and to exchange technical information. Also, the development of equipment and systems, as demonstrators of technology, is to be independent from specific Defense acquisition programs.

The U.S. Army Materiel Command assigned TACOM the responsibility for exercising management of tanks, combat vehicles, assault vehicle weapons systems, and other materiel. TACOM's responsibility included the research and development of potential land vehicle systems. TACOM also had responsibility for managing the Research, Development, and Engineering Center (Engineering Center) for science and technology for all tanks and ground vehicles, in support of other Army and DoD organizations worldwide. The Engineering Center had research and development programs in technology areas, such as propulsion systems (engines, transmissions, and electric drive); signature reduction; track and suspension; and NBC protection.

During the audit, we noted instances where the Program Office did not take advantage of the Engineering Center's expertise in those areas. These areas include propulsion technology; signature reduction; track and suspension; nuclear, biological, and chemical protection; and technical evaluations.

²Title changed May 1993 to Under Secretary of Defense for Acquisition and Technology.

Propulsion Technology

The Engineering Center was one of DoD's leaders in propulsion technology and represented the United States on propulsion technology for ground systems. It was responsible for managing and conducting research, advanced development, and systems integration programs prior to forwarding the technology to project managers for continued development and incorporation into specific systems. In addition, the Engineering Center provided technical guidance and engineering support to weapon systems managers, design engineers, program managers, contracting officers, and Government contractors. The Engineering Center had the technological capabilities to meet land mobility requirements for the AAV and AAA Programs for engine assessment and for electric drive.

Engine Assessment. The Program Manager initiated a contract effort, valued at \$246,774, for propulsion system assessments that the Engineering Center could have performed. This effort, issued in September 1991, was to define the risk areas and the levels of risk for three candidates for vehicle propulsion for the AAA Program. The Program Manager did not coordinate with the Engineering Center, which had the resources to assess propulsion technology.

In May 1992, the Program Manager recognized the need to examine existing engine technology after assessing engine development costs and initiated discussions and organization visits with the Engineering Center. Although the Program Manager intended to have the Engineering Center develop a propulsion strategy for the AAA Program, he did not establish a formal agreement.

Electric Drive. Both the Program Manager and the Engineering Center had technology demonstrator programs for an electric drive with FMC Corporation, one of the competing contractors in the AAA Program. The Program Manager's effort was inconsistent with DoD Instruction 5000.2, "Technology Development and Demonstration." According to the DoD Instruction, technology and engineering centers, rather than program offices, should conduct technology demonstrators to ensure technology transitions to multiple military applications. The lack of a cooperative agreement between the Engineering Center and the Program Office prohibited the exchange of technical information.

Signature Reduction

The Program Manager installed additional armor protection on the AAV that may significantly increase the ability of opposing forces to detect the vehicle. The Program Manager installed additional armor on 739 AAVs and planned more vehicle installations. The Engineering Center was responsible for conducting research and development to reduce signatures of ground combat vehicles. (A signature is the detection of the combat vehicle through electronic

or other means.) Engineering experts at the Engineering Center, upon learning of the additional armor protection, stated that installation of the armor may increase opposing forces' ability to detect the AAV by 50 percent.

The Program Manager also planned to install an improved track and suspension system on 1,042 AAVs beginning in FY 1993, as part of the AAV Product Improvement Program. However, engineers at the Engineering Center told us during the audit that the aural signature (noise emitted from the vehicle) of the AAV will probably increase with the addition of the improved track and suspension.

The engineers recommended that the Program Manager assess the effects on the AAV signature prior to installation of the new track and suspension. In May 1992, the Program Manager initiated discussions with the Engineering Center about signature tests for the AAV. The tests will measure the range of detection of the AAV with and without the additional armor protection and with the new improved track and suspension. However, as of November 30, 1992, the Program Manager had not initiated the tests.

Track and Suspension

The Program Manager contracted for track and suspension improvement efforts without coordinating with the Engineering Center. The Engineering Center served as the principal DoD authority for track and suspension technology. It was responsible for design and analysis, development, engineering, demonstration, and test and evaluation of combat vehicle components. Additionally, the Engineering Center supported program managers with suspension engineering expertise, in both the development and production phases of vehicles.

In February 1991, the Program Manager awarded a sole source contract to FMC Corporation for the design, integration, and testing of a new track and suspension in an experimental AAV. The goal was to improve current AAV mobility performance and determine the potential application to the AAA vehicle. Although the Engineering Center had the technological capabilities to perform this effort, the Program Manager used one of the two competing prime contractors, at a cost of \$691,013. Currently, the Program Manager is reviewing a contractor proposal to integrate track and suspension components for four additional AAVs at an additional cost of \$1.1 million, an effort that could be performed by the Engineering Center.

The Engineering Center had other research and development efforts that may benefit the Program Office. For example, the Engineering Center had a Combat Vehicle Track, Wheel, and Suspension project for demonstrating advanced track and suspension technologies to improve performance and reduce weight and life-cycle costs. Specifically, the Engineering Center was looking at decreasing track weight up to 1,300 pounds per combat vehicle, while doubling track life. Also, the Engineering Center was evaluating the possibility of

Finding D. Program Coordination

reducing the weight of the suspension. Track and suspension components of the AAV and AAA were about 20 percent of the vehicle's weight, and the average life of the track was about 2,000 miles. An independent assessment of the AAA Program by the Office of Naval Technology in May 1991 concluded that weight growth was a principal risk in the AAA vehicle and recommended risk-reducing efforts to control weight growth. The lack of coordination precluded the AAA Program from evaluating the potential application of the Engineering Center's efforts to the AAA vehicle.

Nuclear, Biological, and Chemical Protection

The Program Manager relied upon design contractors to develop a solution for a NBC deficiency for the AAA Program. However, DoD Directive 5160.5, "Responsibilities for Research, Development, Acquisition of Chemical Weapons and Chemical and Biological Defense," May 1, 1985, designates the Army as the Executive Agent for the development of NBC equipment. The Vehicle NBC Defense Office at the Engineering Center was the focal point for all NBC defense and life-support matters and served as the coordinator for development and integration of NBC defense equipment and environmental control systems. The Vehicle NBC Defense Office had two NBC projects that could potentially benefit the AAV and the AAA vehicle design. We found that one Engineering Center project was very similar to a NBC system proposed by FMC. The Engineering Center planned to complete the projects between 1994 and 1996 and may provide some near-term solutions.

We also noted that the Program Manager was not acting to correct the NBC deficiency on the AAV. As of FY 1981, Public Law 95-79 requires that all combat vehicles in development or production have a NBC system that provides filtered air to troops inside the vehicle. The ROC for the AAV Program, as well as the ROC for the AAA Program, specified that the AAV did not have a NBC collective protection system, which would allow the troops to survive in NBC environments.

Technical Evaluations

The ASN(RD&A) is responsible for recommending the best approach to satisfy the Marine Corps' amphibious assault mission. The Program Manager was evaluating seven concept approaches for satisfying the fast, over-the-horizon amphibious assault mission. All seven approaches were conceptual vehicle designs, including one concept design (a fast AAV) being developed by two competing contractors. The Engineering Center, one of DoD's leaders for ground vehicles, could provide an independent technical evaluation of all vehicle approaches for the ASN(RD&A)'s consideration.

Conclusion

Development efforts by the Program Manager conflicted with DoD policy that required DoD Components to coordinate technical efforts and reduce unnecessary duplication. TACOM's Engineering Center was the DoD activity for land mobility vehicles and had the resources to facilitate the development of the AAV Product Improvement Program and the concept design for the AAA Program. The Engineering Center had the expertise to assist the Program Manager in evaluating several development efforts. Further, the Engineering Center had the expertise to provide an independent assessment of the contractors' proposals concerning the land mobility and survivability requirements for vehicles in the AAA Program. Coordination with the Engineering Center would have made such expertise available to the Marine Corps and could possibly save resources.

Recommendations for Corrective Action

1. We recommend that the Advanced Amphibious Assault Program Manager establish a liaison office at the U.S. Army Tank-Automotive Command responsible for coordinating research and development on propulsion; vehicle signature reduction; track and suspension; and nuclear, biological, and chemical protection.

Navy Response. The ASN(RD&A) concurred with this recommendation. However, he stated that, rather than establish a new liaison office, the AAA Program Manager(s) will utilize the existing Marine Corps liaison office at TACOM. To identify previous coordination, the ASN(RD&A) cited one study that TACOM had performed for the AAA Program.

Audit Response. We consider the ASN(RD&A)'s comments to be responsive to the recommendation. However, the ASN(RD&A)'s example of past use of TACOM's assistance is misleading. The study, which the ASN(RD&A) referred to, was conducted in 1988 and concerned a transmission failure analysis. The reference to a 1988 effort in response to the finding illustrates the limited coordination with TACOM. We were aware that the Marine Corps had liaison offices at TACOM for other weapon programs. During our audit, officials in the liaison offices informed us that they had not performed any current liaison efforts in support of the AAA Program. However, we agree that those officials could serve as a liaison function, if properly utilized. Therefore, no further comments are required on Recommendation D.1.

Finding D. Program Coordination

2. We recommend that the Assistant Secretary of the Navy (Research, Development and Acquisition) require that the Advanced Amphibious Assault Program Manager obtains, from the Engineering Center, reviews and technical comments on the contractors' proposals for the Advanced Amphibious Assault vehicle concept design prior to the Defense Acquisition Board Milestone I decision.

Navy Response. The ASN(RD&A) concurred with the recommendation. He stated that the AAA Program Office will use TACOM, along with many other DoD laboratories and activities, to evaluate specific portions of the AAA Vehicle concept designs, as well as other program documentation.

Audit Response. We consider the ASN(RD&A)'s comments to be responsive to the recommendation. Therefore, no further comments are required for Recommendation D.2.

Finding E. Program Oversight

The Program Manager planned and executed modifications to the AAV under a Product Improvement Program without the required oversight. Also, the Program Manager initiated a technology demonstrator that conflicted with DoD acquisition policy. The conditions occurred because the charter for the Amphibious Assault Program was ambiguous concerning program oversight responsibility. As a result, the Program Office initiated system developments and procurements that may not be the most cost-effective and development efforts could inappropriately affect the design of the AAA vehicle.

Background

The DoD Instruction 5000.2, "Defense Acquisition Management Policies and Procedures," February 23, 1991, establishes policies and procedures for acquisition programs. The Instruction identifies milestone decision points in the acquisition process that provide a basis for comprehensive management reviews and decisions concerning continued program development and acquisition. Milestones 0 through III are for new systems in development or production, and Milestone IV is for major modifications to existing systems. OSD categorizes systems as either major systems requiring its approval or nonmajor systems requiring Service or lower level approval. The system's category depends upon its sensitivity and estimated cost. System modifications are product improvements and usually are nonmajor efforts.

DoD Instruction 5000.2, Section 5, Part C, "Technology Development and Demonstration," permits the development of equipment or systems as demonstrators of a technology to evaluate their potential for military application. Technology demonstrator programs usually are basic research efforts that advance state-of-the-art technology, are separate and independent from specific Defense acquisition programs, and encourage competition.

Navy Instruction 5000.2, "Major and Non-major Acquisition Program Procedures," November 1, 1988, implements DoD acquisition policies and identifies the ASN(RD&A) as the approving official for nonmajor systems within the Navy and Marine Corps. Approval authority includes the development of new systems, as well as modifications to existing systems.

Navy Instruction 5000.33B, "Program Management Proposal Process," January 12, 1987, requires activities to limit system modifications to essential capabilities and system modifications to be part of block upgrades. The Navy Instruction requires the approving official to review any improvement program as to its usage in comparison to the system's remaining life and to new programs that satisfy a similar operational requirement.

Finding E. Program Oversight

The AAV Product Improvement Program consisted of five block upgrades to correct mission deficiencies. Block 1 upgrades were minor system improvements completed in FY 1990. Blocks 2 and 3 were more significant improvements, intended to improve the AAV's mobility and survivability. Block 2 was still in process, as of November 1992. Block 3 was planned for introduction near calendar year 2001. The majority of the improvements in Blocks 2 and 3 was planned to be used in Blocks 4 and 5.

Oversight of the AAV Product Improvements

The charter for the Amphibious Assault Program identified the Program Manager as responsible for modernization, conversion, advanced development, and life-cycle support of the current AAV. The charter identified the ASN(RD&A) as the oversight authority for the Program Manager concerning AAA vehicle development efforts; however, the charter did not address oversight responsibility for the AAV Program.

Although the Systems Command was responsible for life-cycle management of fielded systems and their modifications, it was not responsible for the AAV Program. Officials in the office of the ASN(RD&A) believed that the Systems Command was responsible for conducting reviews of the AAV modifications because the Systems Command's responsibility was to conduct initial milestone reviews for all nonmajor Marine Corps programs. The Systems Command, however, did not conduct any reviews of the AAV modifications because Systems Command believed that the ASN(RD&A) should conduct the reviews.

Our review showed that the Program Manager planned and executed \$113.4 million of modifications without formal oversight and approval decisions. Also, the Program Manager initiated and managed a technology demonstrator program that should have been managed at the Marine Corps Amphibious Warfare Technology Directorate.

AAV Modifications. The AAV Block 2 upgrades were major improvements to the vehicle for mobility and survivability. These modifications include an improved transmission, a new vehicle suspension system, and a more powerful engine. Although Navy policy required approval of system modifications, our review disclosed that the ASN(RD&A) did not formally approve these improvements.

Vehicle Transmission. Due to AAV mobility deficiencies on all 1,323 vehicles, the transmission required improvement. The vehicle transmission was planned for modifications during FY 1993. Transmission modification kits for 1,120 vehicles were procured for \$11.7 million. The remaining 203 AAVs will be modified when funding becomes available.

Vehicle Suspension. The suspension modification involved the installation of the Bradley Fighting Vehicle suspension on 1,042 AAVs, at an estimated cost of \$82.4 million. Suspension modifications to the remaining

vehicles were dependent upon the availability of funding. This effort required extensive removal of the current suspension from the AAV's hull and the installation of new suspension components. The Program Manager scheduled the modifications to begin in FY 1994, with scheduled completion in FY 1999. The Program Manager intended to use the new suspensions when he installs the new hulls during Block 4 improvements.

Vehicle Engine. The improvement to the AAV's engine involved an engine increase from 400 to 500 horsepower for 1,180 vehicles, at an estimated cost of \$31 million. To fund the 500-horsepower diesel engine, the Program Manager reprogrammed \$4.9 million of FY 1992 funds from the suspension modification program, which caused the suspension effort date to slip from January 1992 to January 1993. The engine improvement is only a temporary solution until the introduction in Block 3 of a rotary engine with a range of 750 to 1,000 horsepower. With the introduction of the rotary engine, the Program Manager planned to dispose of the 500-horsepower engine. However, in Block 4, the Program Manager plans to introduce the 2,500-horsepower engine to achieve the over-the-horizon amphibious assault mission.

Technology Demonstrator. The Program Manager initiated development efforts under a technology demonstrator program for an advanced propulsion system. This effort involved the experimental replacement of the AAV mechanical drive with an electric drive system and the replacement of a diesel engine (of 500 horsepower) with a rotary engine. Management of the technology demonstrator for the advanced propulsion system by the Program Office conflicted with DoD 5000.2 policy regarding technology demonstrators. Also, the effort inhibited the application of engine and electric drive technology to other programs. The DoD policy required that technology and engineering centers conduct technology demonstrator efforts, rather than program offices, to ensure that the technology is considered for all military applications, rather than only for the program sponsoring the effort. The AAV Program Manager spent \$6.5 million for the technology demonstrator, and the contractor proposed an additional \$2.9 million to complete the effort.

The AAV Program Manager also initiated the technology demonstrator for potential application of an electric drive and rotary engines to the AAV or to the AAA vehicle design. The Marine Corps Amphibious Warfare Technology Directorate was responsible for concepts for technology demonstration applicable to amphibious forces. The Program Manager was pursuing these two technology efforts despite the Amphibious Warfare Technology Directorate's mission and despite concerns voiced by the two competing AAA vehicle contractors. Neither contractor proposed the rotary engine in its concept design because of the engine's high technical risks, and only one contractor proposed the electric drive system.

Conclusion

The lack of oversight by the ASN(RD&A) occurred because the charter for the AAA Program was not clear concerning responsibility for oversight of the AAV Program. The ASN(RD&A) believed the Systems Command was reviewing AAV modifications and the Systems Command believed the ASN(RD&A) was reviewing the modifications. As a result, neither organization formally reviewed and approved modifications to the AAV to ensure that they were essential and cost-effective in relation to the remaining life of the AAV. Also, due to the lack of oversight, the Program Manager pursued technologies that used methods of development that conflicted with DoD policy, were risky, and restricted contractors' vehicle designs.

Recommendations for Corrective Action

We recommend that the Assistant Secretary of the Navy (Research, Development and Acquisition):

1. Conduct a Milestone IV review of product improvements in the Amphibious Assault Vehicle Block 2 Program by May 1993 to assess the cost-effectiveness of the Program Manager's plans and actions.

Navy Response. The ASN(RD&A) concurred with the recommendation. He stated a Marine Corps Acquisition Review Board made a recent oversight review of the AAA Program. Also, in June 1993, the ASN(RD&A) will conduct a product improvement review.

Audit Response. We consider the ASN(RD&A)'s comments to be responsive to the recommendation. Therefore, no further comments are required for Recommendation E.1.

2. Clarify the charter for the Advanced Amphibious Assault Program by specifically stating that the Assistant Secretary of the Navy (Research, Development and Acquisition) will formally approve the product improvements for the Amphibious Assault Vehicle Program prior to development or procurement.

Navy Response. The ASN(RD&A) concurred with the recommendation. He stated that he recently reviewed the AAA Program and decided that AAV and AAA Programs will be separated into two programs to provide proper oversight. He added that the charter will be revised by the end of FY 1993 to reflect the change.

Audit Response. We consider the ASN(RD&A)'s comments to be responsive to the recommendation. Therefore, no further comments are required for Recommendation E.2.

3. Withhold future funding of the advanced propulsion system technology demonstrator from the Advanced Amphibious Assault Program Manager and make the Marine Corps Systems Command's Amphibious Warfare Technology Directorate responsible for the effort.

Navy Response. The ASN(RD&A) concurred with the recommendation. He stated that the rotary engine and electric drive efforts had payoffs for potential AAA vehicle designs. He added that no further technology demonstration efforts will be funded for the AAV until the Marine Corps refines the requirement. He also stated that the Amphibious Warfare Technology Directorate will manage and fund any future technology demonstration effort for the AAV.

Audit Response. We consider the ASN(RD&A)'s comments to be responsive to the recommendation. Therefore, no further comments are required for Recommendation E.3.

Finding F. Testing

The Systems Command did not arrange for independent testing of product improvements to existing AAVs prior to installation. This occurred because the Systems Command did not notify the independent test activity of testing requirements for AAV product improvements. As a result, the Marine Corps could spend as much as \$125.1 million for modifications without knowing the operational effectiveness and suitability of such modifications.

Background

The Services conduct operational tests to determine the operational effectiveness and suitability of a system under realistic combat conditions. DoD Instruction 5000.2, "Defense Acquisition Management Policies and Procedures," February 23, 1991, establishes requirements for the acquisition of systems within DoD. The DoD Instruction, Part 8, "Test and Evaluation," requires that:

. . . Alterations that materially change system performance (operational effectiveness and suitability) shall be adequately tested and evaluated. This includes system upgrades as well as changes made to correct deficiencies identified during test and evaluation.

Marine Corps Order 5000.11A, "Testing and Evaluation of Systems and Equipment for the Marine Corps," July 2, 1979, establishes policies and procedures for testing and evaluating systems and equipment, including subsystems and components, used by the Marine Corps. The Marine Corps order states that the Commandant of the Marine Corps will not approve a new system or major modification to an existing system for production, major procurement, installation, or issue until it is independently tested. System tests include developmental and operational tests. The developing agency performs developmental tests to determine if the system is ready for operational testing. An independent activity conducts operational tests to determine if the weapon system or equipment is operationally effective and suitable for performing the mission.

The Marine Corps order identifies the Marine Corps Operational Test and Evaluation Activity (MCOTEA) as the Marine Corps activity responsible for performing operational tests. To ensure its independence, the Commandant of the Marine Corps established MCOTEA as a separate activity from the developing and procuring command. MCOTEA reports directly to the Commandant of the Marine Corps. The Systems Command is responsible for informing MCOTEA of operational testing requirements in order for MCOTEA to develop its 5-year test plan.

Marine Corps Order 3960.2A, "Marine Corps Operational Test and Evaluation Activity," December 20, 1989, redefines the functions of MCOTEA to include the testing of major and nonmajor materiel acquisitions, participating in developmental test planning, and monitoring developmental tests for impact on MCOTEA's operational test requirements.

Modifications

Our review disclosed that the Program Manager planned modifications to the AAV, valued at \$125.1 million, through FY 1999. The Program Manager planned improvements to increase the vehicle's mobility and survivability, both identified as mission deficiencies in the AAV Product Improvement Program requirements document. To correct the deficiencies, he initiated changes in the vehicle's transmission, suspension, and engine horsepower.

Vehicle Transmission. Due to the mobility deficiency in the AAV, the Program Manager initiated improvements to the transmission. The only testing of the transmission was on an experimental vehicle. Our review disclosed that the Systems Command did not request MCOTEA to perform operational tests of the transmission change. Procurement funding for the transmission improvement for 1,120 vehicles during FYs 1991 and 1992 totaled \$11.7 million.

Vehicle Suspension. This effort required the replacement of the AAV's suspension with a suspension used on the Army's Bradley vehicle. The Program Office limited developmental testing of the Bradley suspension to tests on an experimental AAV vehicle. Although the Marine Corps required operational testing, the Program Office did not plan tests for the suspension. Also, the Systems Command did not notify MCOTEA to perform independent operational tests prior to installing the suspension, even though the installation was to begin in FY 1994. The Program Office estimated that the new suspension will cost \$82.4 million for 1,042 vehicles and requested procurement funding of \$49.8 million for FYs 1993 through 1996 to install 620 vehicle suspensions. Operational testing of the Bradley suspension on the AAV was necessary because of differences in weights, centers of gravity, and operating environments of the vehicles, e.g., the AAV operates in a saltwater environment.

Vehicle Engine. To satisfy mobility and survivability requirements, the Program Manager planned to upgrade the AAV's engine from 400 to 500 horsepower. The Program Manager believed this upgrade was necessary because of the increased weight of the AAV (due to the Bradley suspension) and the improved transmission. The Program Manager limited developmental tests to dynamometer testing in a laboratory that only measured horsepower produced. Operational testing of the increased horsepower engine, with the Bradley suspension and improved transmission, was essential to ensure that all systems provided the desired mission mobility enhancements. The Program

Finding F. Testing

Office estimated the increased engine horsepower will cost \$31 million and requested procurement funding of \$25.5 million for improvements to 980 engines during FYs 1992 through 1996.

Master Test Plan

Our review of the Marine Corps' 5-Year Master Test Plan for FYs 1992 through 1996 showed no testing for AAV improvements. MCOTEA was not aware of AAV improvements because the Systems Command did not notify MCOTEA of testing requirements.

Conclusion

The Program Manager stated that the integration of the transmission, suspension, and improved engine represented a total package where each improvement was interdependent to obtain desired mobility and survivability. We believe these improvements represented significant modifications to the AAV that correct recognized mission deficiencies. The expenditure of \$125.1 million of resources without proper testing is inappropriate, is unnecessary, and presents operational and cost risks. Therefore, independent operational testing by MCOTEA prior to the acquisition and installation of the modifications would ensure that the improvements increase mission effectiveness and are operationally suitable.

Recommendations for Corrective Action

1. We recommend that the Assistant Secretary of the Navy (Research, Development and Acquisition) postpone the procurement and installation of improvements for the Amphibious Assault Vehicle until the Marine Corps Operational Test and Evaluation Activity successfully completes operational tests.

Navy Response. The ASN(RD&A) concurred with the recommendation. He stated that improvements to the AAV will have independent operational testing before a production decision.

Audit Response. We consider the ASN(RD&A)'s comments to be responsive to the recommendation. Therefore, no further comments are required for Recommendation F.1.

2. We recommend that the Commanding General, Marine Corps Systems Command, notify the Marine Corps Operational Test and Evaluation Activity of product improvements on the Amphibious Assault Vehicle that require operational testing and develop procedures to ensure that operational tests are scheduled in the 5-Year Master Test Plan.

Navy Response. The ASN(RD&A) concurred with the recommendation. He stated the Marine Corps Systems Command and MCOTEA are coordinating test requirements of the AAV Product Improvement Program and the allocation of resources necessary to satisfy those requirements in MCOTEA's 5-Year Master Test Plan.

Audit Response. We consider the ASN(RD&A)'s comments to be responsive to the recommendation. Therefore, no further comments are required for Recommendation F.2.

Finding G. Internal Controls

The Program Office did not establish an Internal Management Control Program after a major change in the management of the program. The lack of an Internal Management Control Program occurred because the Program Office did not follow established Office of Management and Budget, DoD, Navy, and Marine Corps policies and procedures. As a result, the Program Office did not know whether adequate internal controls existed or were effective and efficient.

Background

An organization establishes internal controls to ensure that programs are efficiently and effectively administered according to applicable laws and management policy. Internal controls also ensure the safeguarding of assets against waste, loss, or unauthorized use.

Office of Management and Budget Circular No. A-123, "Internal Control Systems," as implemented by DoD Directive 5010.38, "Internal Management Control Program," October 3, 1988, and Secretary of the Navy Instruction 5200.35C, "Department of the Navy Management Control Program," January 7, 1991, require that the Services identify potential risks in operations at least once every 5 years or as major organizational changes occur. The assessment of potential risks on new or substantially revised programs should be part of the planning process for establishing the Internal Management Control Program.

Marine Corps Order 5200.24B, "Marine Corps Internal Management Control Program," May 16, 1991, requires that all managers ensure the adequacy of controls and evaluate control systems on an ongoing basis. The primary planning document required by the Office of Management and Budget, DoD, Navy, and Marine Corps regulations for implementation of the internal management control program is the Internal Management Control Plan.

Internal Management Control Plan

The Program Office did not have an Internal Management Control Plan for assessing and reviewing internal controls. An Internal Management Control Plan is a written 5-year plan that indicates the number of risk assessments to conduct, including risk ratings (high, medium, or low), and the number of management control reviews to perform.

Prior to the Program Office being assigned responsibility in 1990 to report directly to the ASN(RD&A), the Program Office relied on its Internal Management Control Plan, risk assessments, and management reviews while under the Naval Sea Systems Command. Establishing the requirement for the Program Office to report directly to ASN(RD&A) and separating management control from a Navy Command were major changes that warranted updating the Internal Management Control Plan. However, our review found that the Program Office did not update its Internal Management Control Plan.

Identifying Assessable Units. The Program Office did not identify or maintain a list of assessable units. An assessable unit is any organizational function, program, or resource that is capable of being evaluated by risk assessment procedures. According to Marine Corps Research, Development, and Acquisition Systems Command Order 5200.3, "Internal Management Control Program," October 30, 1991, assessable units primarily consist of 15 generic functional areas, which include major system acquisition; contract administration; procurement; and research, development, test, and evaluation. Programs that are major system acquisitions should have assessable units covering basic and applied research and exploration, advanced and engineering development, testing, milestone decisions, and acquisition strategy. Marine Corps Order 5200.3 requires managers to determine which of the 15 functional areas are applicable to their programs. The program manager should maintain a list of applicable functional areas and revise the list as program changes occur. For example, the list of assessable units for the AAA Program should include contract administration, procurement, financial management, and acquisition strategy.

Risk Assessments. Marine Corps Order 5200.24B requires each manager to perform a risk assessment of functional areas applicable to his program and assign a risk rating. As a result of not identifying applicable assessable units, the Program Manager was unable to perform risk assessments. The Program Manager believed that risk assessments performed in April 1992 on the AAV Product Improvement Program, Stratified Charge Rotary Engine, AAA Program, and foreign military sales satisfied the requirements. Those risk assessments did not meet the requirements because the assessments did not identify or document specific assessable units applicable to those programs. Furthermore, the responsible manager did not assign a risk rating to individual assessable units applicable to the programs, as required by Marine Corps Order 5200.24B.

Detailed Management Control Reviews. Marine Corps Order 5200.24B required that a program's assessable units have a management control review. Management control reviews are detailed examinations of assessable units to determine whether cost-effective internal controls exist. The responsible manager conducts management control reviews or uses the results of audits, inspections, investigations, and studies performed by external personnel. Our audit showed that the Program Office had not conducted management control reviews since July 1990. The Naval Audit Service reported this condition to management in its report on the Stratified Charge Rotary Engine program.

Finding G. Internal Controls

Naval Audit Report No. 021-C-92, "Stratified Charge Rotary Engine," January 15, 1992, disclosed that the Program Office had not established an adequate system of internal controls to manage the Stratified Charge Rotary Engine Program effectively. The report also noted that the Program Office did not conduct management control reviews. The Naval Audit Service did not make recommendations on internal controls, because the Program Office agreed to perform the required reviews. However, as of November 1992, the Program Office had neither conducted nor planned to conduct an internal management control review of the Stratified Charge Rotary Engine program.

Effects on Internal Controls

The lack of a comprehensive Internal Management Control Program prevented the Program Office from establishing an effective system of internal controls. Our audit disclosed that controls were not effective to ensure adhering to competition in contracting policies, reporting of Contracted Advisory and Assistance Services expenditures, monitoring support contractors' performance, effectively coordinating with other Government activities, approving major modifications, and adequate test planning. Findings in this report address specific recommendations that, if implemented, will correct the internal control weaknesses.

Recommendations for Corrective Action

We recommend that the Advanced Amphibious Assault Program Manager:

1. Develop and execute an Internal Management Control Plan for the Advanced Amphibious Assault Program.

Navy Response. The ASN(RD&A) concurred with the recommendation. He stated that, as part of the improved internal control of the AAV and AAA Programs' restructure, he will reflect revised responsibilities in both a revised charter and an Internal Management Control Plan.

Audit Response. We consider the ASN(RD&A)'s comments to be responsive to the recommendation. Therefore, no further comments are required for Recommendation G.1.

2. Provide training to managers on the responsibilities for establishing and maintaining internal controls.

Navy Response. The ASN(RD&A) concurred with the recommendation and stated that management will coordinate with Marine Corps Systems Command to obtain the appropriate training.

Audit Response. We consider the ASN(RD&A)'s comments to be responsive to the recommendation. However, in response to this report, we request the Program Manager for the AAA Program specify when he will request the Marine Corps Systems Command to provide the training.

Other Management Comments and Audit Response to the Comments

The ASN(RD&A) disagreed with some information provided in the finding. He stated that the AAA Program Office had an Internal Control Management Plan and made periodic assessments. These assessments included regular reviews of the Stratified Charge Rotary Engine, with the latest assessment on September 30, 1992. He also stated that contract administration, procurement, and financial management are responsibilities of the Marine Corps System Command and should not be assessed by the AAA Program Office.

We reviewed all documentation on the Internal Management Control Program for the AAA Program. We found that the AAA Program had not developed an Internal Control Management Plan or made required vulnerability assessments after the AAA Program Office was organizationally separated from the Naval Sea Systems Command. Although officials at the AAA Program Office claimed that they perform vulnerability assessments, they failed to document the assessments. Documentation is an essential element of an Internal Management Control Program.

We found no evidence that the Program Office complied with the Naval Audit Service's recommendation to perform a management control review of the Stratified Charge Rotary Engine Program. In April 1992, the AAA Program Office conducted a vulnerability assessment of the Stratified Charge Rotary Engine Program instead of a management control review. A management control review is a comprehensive assessment; a vulnerability assessment is not an adequate substitute.

In response to the ASN(RD&A)'s comments about the Marine Corps System Command having responsibility for assessing certain functions, the AAA Program Office performed substantial functions related to contract administration, procurement, and financial management. Therefore, the AAA Program Office should be responsible for the internal controls in these areas.

Finding G. Internal Controls

Response Requirements for Recommendations

<u>Number</u>	<u>Addressee</u>	<u>Response Should Cover:</u>				
		<u>Concur/ Nonconcur</u>	<u>Proposed Action</u>	<u>Completion Date</u>	<u>Monetary Benefits</u>	<u>Internal Controls</u>
G.2.	Program Manager, Advanced Amphibious Assault Vehicle			x		x

Part III - Additional Information

Appendix A. Summary of Potential Benefits Resulting From Audit

Recommendation Reference	Description of Benefit	Amount and/or Type of Benefit
A.1.	Internal Controls. Ensures that a comprehensive mission analysis is performed.	Nonmonetary.
A.2.	Economy and Efficiency. Ensures the early identification of all mission deficiencies for consideration during the system design and precludes system modifications after fielding of the system.	Undeterminable benefit.
A.3.	Program Results. Ensures total program cost is addressed during program reviews.	Nonmonetary.
B.1.	Economy and Efficiency. Requires the inclusion of an environmental control system to enhance troop performance and prohibits a later modification of the new vehicle for the environmental system.	Nonmonetary.
B.2.	Internal Controls. Ensures early identification of human factors requirements.	Nonmonetary.
B.3.	Compliance with Regulations. Requires review of the Program Office's plan for human factors considerations.	Nonmonetary.
C.1.	Internal Controls. Ensures oversight review of program office contractual actions.	Nonmonetary.
C.2.	Internal Controls. Ensures proper management controls of the Program Office's contractual taskings.	Nonmonetary.

Appendix A. Summary of Potential Benefits Resulting From Audit

Recommendation Reference	Description of Benefit	Amount and/or Type of Benefit
C.3.	Compliance with Regulations. Complies with DoD policy on reporting consulting services.	Nonmonetary.
D.1.	Internal Controls. Enhances the possibility for program coordination between TACOM and the Marine Corps' Program Office.	Undeterminable benefit.
D.2.	Economy and Efficiency. Ensures that DoD's land vehicle technical office evaluates contractor proposals prior to contract award.	Undeterminable benefit.
E.1.	Economy and Efficiency. Provides acquisition officials oversight in development of the system.	Undeterminable benefit.
E.2.	Internal Controls. Clarifies the approval levels needed for program development.	Undeterminable benefit.
E.3.	Economy and Efficiency. Ensures proper usage of funds.	Undeterminable benefit.
F.1.	Compliance with Regulations. Provides for compliance with DoD independent testing requirements to ensure modifications are operationally effective prior to further investment.	Undeterminable benefit.
F.2.	Internal Controls. Ensures the independent testing activity is aware of testing requirements.	Undeterminable benefit.
G.1.	Internal Controls. Develop and execute internal control plan.	Nonmonetary.
G.2.	Internal Controls. Provides training on establishing and maintaining proper internal controls.	Nonmonetary.

Appendix B. Activities Visited or Contacted

Office of the Secretary of Defense

Office of the Under Secretary of Defense for Acquisition (Tactical Warfare Programs),
Washington, DC
Office of the Assistant Secretary of Defense (Production and Logistics), Washington,
DC
Office of the Assistant Secretary of Defense (Program Analysis and Evaluation),
Washington, DC
Office of the Joint Chiefs of Staff, Director of Logistics, Washington, DC
Defense Science Board, Washington, DC

Department of the Army

Army Communications and Electronic Command, Fort Monmouth, NJ
Army Tank-Automotive Command, Research, Development, and Engineering Center,
Warren, MI
Army Troop Support Command, Belvoir Research, Development and Engineering
Center, Fort Belvoir, VA
Army Chemical, Research, Development and Engineering Center, Army Research
Laboratory, Aberdeen Proving Ground, MD
Army Natick Research, Development and Engineering Center, Natick, MA
Army Research Institute of Environmental Medicine, Medical Research and
Development Command, Natick, MA

Department of the Navy

Office of the Chief of Naval Operations, Surface Warfare, Arlington, VA
Office of the Chief of Naval Research, Arlington, VA
Headquarters, Naval Sea Systems Command, Washington, DC
Naval Surface Warfare Center, Carderock Division, Bethesda, MD
Naval Surface Warfare Center, Dahlgren Division, Panama City, FL
Center for Naval Analysis, Deputy Chief of Naval Operations (Resources, Warfare
Requirements and Assessments), Alexandria, VA
Naval Center for Cost Analysis, Washington, DC
Naval Medical Research and Development Command, Bethesda, MD
Naval Coastal System Center, Space and Naval Warfare Systems Command, Panama
City, FL

Department of the Marine Corps

Headquarters, United States Marine Corps, Washington, DC
Marine Corps Combat Development Command, Quantico, VA
Marine Corps Systems Command, Washington, DC
Marine Corps Operational Test and Evaluation Agency, Quantico, VA

Defense Agency

Defense Advanced Research Projects Agency, Washington, DC

Contractors

Advanced Marine Enterprises, Incorporated, Arlington, VA
Analytical Systems Engineering Corporation, Dumfries, VA
FMC Corporation, San Jose, CA
MKI, Incorporated, Springfield, VA
Value Systems Engineering, Incorporated, Alexandria, VA

Appendix C. Report Distribution

Office of the Secretary of Defense

Under Secretary of Defense for Acquisition and Technology
Assistant Secretary of Defense (Program Analysis and Evaluation)

Department of the Army

Commander, Army Tank-Automotive Command
Commander, Army Medical Research and Development Command

Department of the Navy

Secretary of the Navy
Assistant Secretary of the Navy (Financial Management)
Comptroller of the Navy
Commander, Naval Medical Research and Development Command
Commander, Naval Surface Warfare Center, Carderock Division
Commander, Office of the Chief of Naval Research

Department of the Marine Corps

Commandant of the Marine Corps
Commanding General, Marine Corps Combat Development Command
Commanding General, Marine Corps System Command
Director, Marine Corps Operational Test and Evaluation Agency
Program Manager for the Advanced Amphibious Assault Program

Non-DoD Activities

Office of Management and Budget
U.S. General Accounting Office, National Security and International Affairs Division,
Technical Information Center

Chairman and Ranking Minority Member of the Following Congressional Committees
and Subcommittees:

Senate Committee on Appropriations
Senate Subcommittee on Defense, Committee on Appropriations
Senate Committee on Armed Services
Senate Committee on Governmental Affairs
House Committee on Appropriations
House Subcommittee on Defense, Committee on Appropriations
House Committee on Armed Services
House Committee on Government Operation
House Committee on Legislation and National Security, Committee on Government
Operations

Part IV - Management Comments

Assistant Secretary of the Navy (Research, Development and Acquisition) Comments



DEPARTMENT OF THE NAVY
OFFICE OF THE ASSISTANT SECRETARY
(Research, Development and Acquisition)
WASHINGTON, D.C. 20350-1000

17 MAY 1993

MEMORANDUM FOR THE DEPARTMENT OF DEFENSE ASSISTANT INSPECTOR
GENERAL FOR AUDITING

Subj: DRAFT REPORT ON THE AUDIT OF ACQUISITION OF ADVANCED
AMPHIBIOUS ASSAULT VEHICLES (AAV) (PROJECT NO. 2AL-0031)

Ref: (a) DoDIG memo of 16 Feb 1993

Encl: (1) DoN Response to Draft Audit Report

I am responding to the draft audit report forwarded by reference (a) concerning the Advanced Amphibious Assault Vehicle Program.

The Department of the Navy response is provided at enclosure (1). As outlined in the enclosed comments, the Department has taken, or is planning to take, a number of specific actions to ensure adequate management controls over the Program. In particular, we have taken steps to remove responsibility for the in-service Amphibious Assault Vehicle (AAV) from the AAV program office and reassigned it to the Marine Corps Systems Command. We believe this will provide better focus for both programs.

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DEPARTMENT OF THE NAVY RESPONSE
TO
DODIG DRAFT REPORT
ON
ACQUISITION OF ADVANCED AMPHIBIOUS
ASSAULT VEHICLES
PROJECT NO. 2AL-0031

Other Matters of Interest:

On pages 7 and 8, under the heading of "Other Matters of Interest", the auditors present a case that "success of an amphibious assault may be limited due to the presence of mines and the ability to defeat the mines."

DoN Comments:

The following comments are provided regarding this section of the report:

Mines are a recognized threat to amphibious operations. Recent actions (reorganization of COMINELWARCOM and OPNAV, creation of a Mine Warfare (MIW) Program Executive Office (PEO), and increases in funding, are indications of the increased emphasis being placed on mine countermeasures (MCM). The continuation of an aggressive shallow water mine countermeasures (SWMCM) program is aimed at reducing the risk associated with amphibious operations. Particularly promising is the recent establishment of a SWMCM program that specifically addresses MCM from 200 feet to the craft landing zone (CLZ). There are very promising developments in this area.

The critical link in MIW is mine reconnaissance. Timely and accurate reconnaissance allows the commander to exploit his maneuver assets (LCAC, aviation, and AAA) to avoid the mine barriers or exploit weaknesses in them. The DoN has established mine reconnaissance as its top research and development priority in mine warfare.

The AAA combat capability is a critical ingredient in operational maneuver from the sea. The vehicles high land and water speed, armored protection, and firepower significantly improve the Naval Expeditionary Force's forcible entry capability as this nation's enabling force. Mine barriers, by doctrine, are covered by fire and observation as part of an integrated, anti-landing defense. SWMCM programs are underway to permit an in-stride, deliberate breach of the mine barrier within two hours should avoidance not be possible. This in-stride breaching capability is specifically designed to complement the Operational Maneuver From the Sea concept.

Finding A:

The audit concludes that, "The Marine Corps Combat Development

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Command did not consider all operating environments and battlefield conditions in the Mission Area Analysis (MAA) for the AAA Program. Also, the Command did not include in the operational requirements document for the AAA Program all AAV deficiencies and all performance characteristics necessary to satisfy the deficiencies.

DoN Comments:

On page 10 the report states, "...the Marine Corps approved the ROC for the AAA Program on May 3, 1991. DoDInst 5000.2, Part 4, Section B, changed the title of the ROC to Operational Requirements Document (ORD). Because the Marine Corps did not officially approve the ORD, our review focused on the ROC. However, the elements of the two documents were essentially the same..." This is inaccurate. The DoD Instruction did more than change the title of the ROC. An ORD is a more comprehensive document requiring a significant amount of additional information. The ORD that the DoDIG reviewed was an initial draft that had not been staffed inside or outside of MCCDC. This document was merely the AAA ROC reformatted into a draft ORD. Comprehensive reconciliation between this draft ORD, the appropriate mission area analyses, the AAV7A1 Product Improvement ROC, and the deficiencies identified in paragraph 3c of the ROC is a task that remains to be done prior to formal staffing and approval.

On pages 10 and 13 the report states, "...some critical deficiencies and performance characteristics were not in the requirements document for the AAA Program due to an oversight by Command officials. As a result, the Marine Corps had not considered all deficiencies in the concept design of the AAA Program. Furthermore, by not considering all deficiencies in the design, the Marine Corps will be faced with the possibility of subsequent modifications. Also, the cost estimates for the AAA Program will be understated..." It should be noted that the AAA Program is in the concept exploration phase prior to Milestone I. There is no design in this phase; thus, there is nothing to modify. DoDInst 5000.2 states that an ORD will be developed during the Concept Exploration phase and presented at Milestone I. The ORD is the basis for the concept baseline not the concept design.

On page 12 the report talks about operational requirements and deficiencies that were "overlooked". A number of these deficiencies that were "overlooked" are already in the draft ORD. Examples are the NBC and environmental systems. Any remaining deficiencies will be covered by the reconciliation effort discussed above.

Recommendations:

"We recommend that the Commanding General, Marine Corps Combat Development Command:"

A-1. "Conduct a detailed Mission Area Analysis (MAA) to include all factors that would impact the Advanced Amphibious Assault Program prior to a Milestone I decision by the Defense Acquisition Board."

DoN Position:

Nonconcur. This recommendation is based on a conclusion that "the lack of a thorough MAA and an incomplete ROC for the AAV Program prevented the identification of critical mission deficiencies in an amphibious assault operation". The DoDIG audit references an MAA and a HQMC review, both of which were conducted in 1987 and have been superseded. During 1991, analyses were conducted concerning the capabilities required to perform the mission areas of Close Combat (MA 23) and Ground Tactical Mobility/Counter mobility (MA 22). Both of these analyses addressed numerous general and specific requirements for the AAV Program.

A-2. "Revise the Required Operational Capability document for the Advanced Amphibious Assault Program to include all deficiencies in the Amphibious Assault Vehicle and specify the performance characteristics necessary to correct all deficiencies."

DoN Position:

Concur. A significant amount of additional information is required by the ORD format that was not required in the former ROC format. The ORD is currently in initial draft. It will be updated and staffed during the 2d and 3d quarter, FY-93. The target completion date for the final ORD is the end of the 3d quarter. This document will include all deficiencies in the AAV and specify the performance characteristics necessary to correct all deficiencies discussed in the findings.

A-3. "Prepare Cost and Operational Effectiveness Analyses (COEA) that include cost estimates for developing and procuring systems that will correct deficiencies in the Advanced Amphibious Assault Vehicle."

DoN Position:

Concur. Suggested items to be included in the COEA, while inappropriate for Milestone I, will be included in COEAs supporting Milestone II and III decisions.

Finding B: The audit concludes that, MCCDC "and the AAA Program

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Office had not adequately considered human factors in the concept design of vehicles being evaluated in the AAA Program. As a result either additional modification will be necessary to the design for vehicles in the AAA Program or the operation effectiveness of the AAA vehicles will be limited. Also, the cost estimate for the AAA program may increase further."

DoN Comments:

The following general comments are provided regarding statements made under Finding B of the subject audit: Human factors have been incorporated and included in the draft ORD; the draft ORD does include a requirement for an environmental control system, and because the AAA is in concept exploration, the "design" of the vehicles has not progressed to the point where "modifications" will have to be made.

Recommendations:

B-1. "We recommend that the Commanding General, Marine Corps Combat Development Center, include an environmental control system in the Advanced Amphibious Assault Required Operational Capability document that will provide adequate cooling to ensure troop mission effectiveness in desert; tropical; and nuclear, biological, and chemical environments."

DoN Position:

Concur. This requirement is stated in the former ROC and will be incorporated into the ORD. Paragraph 5a(19)(g) of the ROC states "Environmental Control System. The AAV crew and embarked personnel must be able to carry out tactical functions efficiently and effectively with minimum physical and mental degradation (i.e., changes in body temperature, mental alertness, heart rate, etc.) caused by extremes in environmental conditions. It is required that the NBC and environmental control systems be integrated and capable of operation in outside temperatures from -31.6 degrees C to +52 degrees C (-25 degrees F to +125 degrees F)."

B-2. "We recommend that the Assistant Secretary of the Navy (Research, Development and Acquisition) direct the Advanced Amphibious Assault Program Office to conduct human performance assessments of the Advanced Amphibious Assault alternates prior to the Defense Acquisition Board Milestone I decision."

DoN Position:

Concur. However, it is important to note that numerous human factor assessments of each of the competing prime contractors concept designs have already taken place and will continue. These assessments include Early Operational Assessments (EOAs) of

each contractors full scale mockup by Fleet Marine Force Marines, HARDMAN Analyses, vehicle accommodation analyses using JACK (JACK consists of a task oriented software program which has an integral three dimensional human figure model), Vision Path analyses, Anthropometric analyses, EDCAS analyses, Partitioning analyses, Control and Display analyses using Supercard and Hypercard (Supercard in conjunction with Hypercard provides an ability to readily construct and evaluate human interface with vehicle controls and displays using a wide variety of media, including text, graphics animation, and sound), workload analyses using CREWCUT (CREWCUT is a PC-based combat vehicle workload analyses tool that predicts system and crew performance by quantifying combined effects of a modeled mission, crew station configuration, human operator and system design), and finally numerous and extensive AAV concept design user jury analyses using experienced Marines.

B-3. "We recommend that the Assistant Secretary of the Navy (Manpower and Reserve Affairs) review and comment to the Advanced Amphibious Assault Program manager on the Advanced Amphibious Assault Program Office's Human System Integration Plan (HSIP). The review should determine if the Human Plan adequately address human factors and comments and should be provided prior to the Defense Acquisition Board Milestone I decision."

DoN Position:

Concur. In addition to ASN(MRA), U.S. Army Human Engineering Lab, Naval Training Systems Center, Naval Surface Warfare Center, Carderock, MD, and U.S. Army Chemical Research Development and Engineering Center will be given the opportunity to review the HSIP.

Finding C: The audit concludes that, "the Marine Corps Systems Command (SYSCOM), as well as the AAA Program Manager, did not comply with the Federal Acquisition Regulation concerning competition in contracting. Also, Systems Command and the AAA Program Office did not comply with certain procedures on contract administration and on the reporting of expenditures for consulting services."

Recommendations: "We recommend that the Commanding General, Marine Corps Systems Command:"

C-1. "Require the Director of Contracts and Legal Counsel to review and approve all Advanced Amphibious Assault Program contractual actions, including delivery orders, before award."

DoN Position:

Concur. The Marine Corps Systems Command's Contracts Directorate has initiated action to require legal review of all Amphibious

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Assault Vehicle Program contractual actions, including delivery orders, before award.

Exception is taken to the characterization of the facts surrounding the issuance of the six month delivery order under Contract M67854-90-c-0005 (MKI, Incorporated) as not being compliant with the Competition in Contracting Act. The report fails to acknowledge that the services acquired under Delivery Order 0044 were within the scope of Contract M67854-90-D-0005, and that this indefinite deliver contract was a competitively awarded support service contract.

C-2. "Direct, in writing, the contracting officer for the Advanced Amphibious Assault Program to review all task statements, prior to their release, for the purposes of determining that the tasks are within the scope of work on the basic contract and that the task statements contain the contractor's cost estimates, are issued on time, and are properly approved."

DoN Position:

Concur. The Commander, Marine Corps Systems Command will direct the contracting officer by 24 May 1993 to review all task statements for the Advanced Amphibious Assault Program prior to their release.

C-3. "Direct, in writing, the Marine Corps System Command's Comptroller to properly report expenditures by the Advanced Amphibious Assault Program Office for Contracted Advisory and Assistance Services as required by DOD Directive 4205.2, 'Acquiring and managing Contracted Advisory and Assistance Services.'"

DoN Position:

Concur. The Marine Corps Systems Command Deputy for Financial Management reviewed a summary of the statement of work, but not the actual statement of work prior to contract award. The decision for Contractor Advisory Assistance Services reporting was based on the summary statement of work, rather than the precontract award statement of work. There was a significant difference between the summary and final statement of work. MARCORSYSCOM is in the process of instituting new procedures to avoid this type of error.

Finding D: The audit concludes that, "the AAA Program Office did not use or coordinate with expert resources at the U.S. Army Tank Automotive Command (TACOM) specific to land mobility and survivability to assist in the product improvements to the AAV or in the conceptual design of the AAA Program."

Recommendations:

D-1. "We recommend that the Advanced Amphibious Assault Program Manager establish a liaison office at the U.S. Army Tank Automotive Command responsible for coordinating research and development on propulsion; vehicle signature reduction; track and suspension; and nuclear, biological and chemical protection."

DoN Position:

Concur. Rather than establish a new liaison office, however, the amphibious assault vehicle program manager(s) will utilize the existing U.S. Marine Corps liaison office at the U.S. Army Tank Automotive Command. The technical basis of Block II transmission improvements is a direct result of a TACOM study and recommendation. In addition, the DRPM AAA continues to interact with TACOM and many DoD labs and activities other than TACOM, whose expertise is also important to the program office. The existing Navy and Marine Corps liaison offices in all these activities serve as the single points of contact for coordinating research and development efforts being conducted in support of the AAV program.

D-2. "We recommend that the Assistant Secretary of the Navy (Research, Development and Acquisition) require that the Advanced Amphibious Assault Program Manager obtains, from the Engineering Center, reviews and technical comments on the contractors' proposals for the Advanced Amphibious Assault vehicle concept design prior to the Defense Acquisition Board Milestone I decision."

DoN Position:

Concur. TACOM, along with many other DoD labs and activities, will be used to evaluate specific portions of the AAV concept designs, as well as other program documentation. The Engineering Center will be requested to review those specific portions for which they are deemed to have specific expertise. The next contractor concept design updates are due in June 1993. Portions of those AAV concept design reports will be provided to the Engineering Center, via the existing TACOM Marine Corps liaison office, for review and comment.

Finding E: The audit concludes that, "the AAA Program Manager planned and executed modifications to the AAV under a Product Improvement Program without the required oversight. Also, the Program Manager initiated a technology demonstrator that conflicted with DOD acquisition policy."

Recommendations: "We recommend that the Assistant Secretary of the Navy (Research, Development and Acquisition):"

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E-1. "Conduct a Milestone IV review of product improvements in the Amphibious Assault Vehicle Block 2 Program by May 1993 to assess the cost-effectiveness of the Program Manager's plans and actions."

DoN Position:

Concur. It is anticipated that all Block II upgrades will be tested together on 6 or 7 vehicles as we prepare for a Milestone II decision for the improved suspension and engine up-power. An Acquisition Review Board was convened on 18 December 1992. Participants included MARCORSYSCOM, MCOTEA and MCCDC. The findings and recommendations from that board were that portions of Block II were already approved for production (EAAK and AFSSS), one improvement was strictly a reliability and maintainability improvement outside of the formal review process (I-TRANS), and the remaining items (I-SUSP and EUP) were assessed as more appropriately in the Dem Val phase approaching Milestone II approval. It is anticipated that an ASN(RDA) review of the Block II product improvements will be held in June 1993.

E-2. "Clarify the charter for the Advanced Amphibious Assault Program by specifically stating that the Assistant Secretary of the Navy (Research, Development and Acquisition) will formally approve the product improvements for the Amphibious Assault Vehicle Program prior to development or procurement."

DoN Position:

Concur. ASN(RDA) has recently reviewed the Assault Amphibious Vehicle Programs. To provide proper oversight for the programs, ASN (RDA) will separate the AAV and AAAP programs; with MARCORSYSCOM acting as the MDA for management of the ACAT III AAV improvement program for the ASN(RDA). The Charter will be revised by the end of FY 93 to reflect this change in oversight of the AAV product improvements.

E-3. "Withhold future funding for the advanced propulsion system technology demonstrator for the Advanced Amphibious Assault Program Manger and make the Marine Corps Systems Command's Amphibious Warfare Technology Directorate responsible for the effort."

DoN Position:

Concur. The advanced propulsion demonstrator cited in the report findings was used to address key DRPM AAA risks in the integration of the rotary engine and electric drive to amphibious vehicles. While this effort was primarily to support potential upgrades of the AAV beyond Block II (Block III), it also had pay-offs for potential AAAP designs. Both of these applications were under the DRPM AAA in the past, both future AAV and AAA

developments will be managed separately. No further technology demonstration efforts toward AAV Block III will be funded until requirements are refined by MCCDC. Future technology demonstrations for the AAV will be managed and funded through AWT as were the high water speed technology demonstrator (17 ton) and the propulsion systems demonstrator (30 ton).

Finding F: The audit states that, "SYSCOM did not arrange for independent testing of product improvements to existing AAVs prior to installation."

Recommendations:

F-1. "We recommend that the Assistant Secretary of the Navy (Research, Development and Acquisition) postpone the procurement and installation of improvements for the Amphibious Assault Vehicle until the Marine Corps Operational Test and Evaluation Activity successfully completes operational tests."

DoN Response:

Concur. The Block II AAV PIP will have independent operational testing before a production decision is made.

F-2. "We recommend that the Commanding General, Marine Corps Systems Command, notify the Marine Corps Operational Test and Evaluation Activity (MCOTEA) of product improvements on the Amphibious Assault Vehicle that require operational testing and develop procedures to ensure that operational tests are scheduled in the 5-Year Master Test Plan."

DoN Position:

Concur. MCOTEA is currently coordinating with MARCORSYSCOM in T&E planning for AAV Block II PIP to schedule and allocate resources necessary for the conduct of OT&E in the MCOTEA Five Year Master Test Plan.

Finding G: The audit concludes that, "The AAA Program Office did not establish an Internal Management Control Program after a major change in the management of the program."

DoN Response:

Non Concur. DRPM AAA does have an Internal Control Management Plan. Assessments are on file to include the periods when the program was in NAVSEASCOM (PMS310) and from the establishment of DRPM AAA to the present. Furthermore, the report states that the Program Office did not as of November 1992 conduct a review of the Stratified Charge Rotary Engine Program despite promises to the Naval Audit Service. This is incorrect. Regular reviews have been conducted with the latest having been 30 September

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1992, prior to the DoD IG assertion. Additionally, the DoDIG audit report indicates that any DRPM AAA list of assessable units should contain contract administration, procurement, and financial management. These items are the responsibilities of MARCORSYSCOM and should be part of their list of assessable units not DRPM AAA's.

Recommendations: We recommend that the Advanced Amphibious Assault Program Manager:

G-1. "Develop and execute an Internal Management Control Plan for the Advanced Amphibious Assault Program."

DoN Response:

Concur. As part of the improved internal control resulting from the AAV/AAAV restructuring directed by ASN(RDA), the revised responsibilities of the DRPM AAA will be reflected in both a revised charter and an Internal Management Control Plan.

G-2. "Provide training to managers on the responsibilities for establishing and maintaining internal controls."

DoN Response:

Concur. DRPM AAA will coordinate with MARCORSYSCOM to obtain the appropriate training.

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