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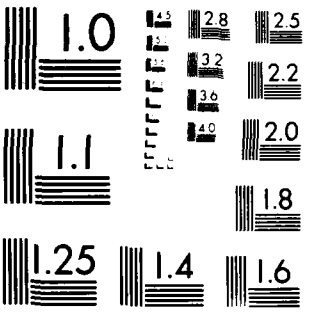

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BY THE U.S. GENERAL ACCOUNTING OFFICE

Report To The Secretary Of Defense

Results Of Forthcoming Critical Tests Are Needed To Confirm Army Remotely Piloted Vehicle's Readiness For Production

For several years, the progress of the Army's remotely piloted vehicle program was slow because of relatively low funding and numerous technical problems. Better progress has been made in the past year. Several technical problems appear to be resolved, although not yet demonstrated in system flight tests. The Army has intensified the system's development and is expanding its planned role on the battlefield. This expansion is being done through through several system enhancements now in development which could increase program costs well beyond the current $2.4 billion estimate.

Critical system flight testing has just begun and is not due to be completed until just before the planned initial production contract award in July 1985. This schedule would require the Congress to approve production funds in 1984 before most of the critical testing is under way. It appears prudent for the Army to delay its request for initial production funds until fiscal year 1986, except for long lead items. This would delay the production of the first units by as little as 3 months and would give the Congress the benefit of critical test results before approving production funds.

GAO/NSIAD-84-72
APRIL 4, 1984

UNITED STATES GENERAL ACCOUNTING OFFICE
WASHINGTON, D.C. 20548

NATIONAL SECURITY AND
INTERNATIONAL AFFAIRS DIVISION

B-205804

The Honorable Caspar W. Weinberger
The Secretary of Defense

Dear Mr. Secretary:

This report charts the changes and progress made in the Army's remotely piloted vehicle program over the last 2 years, as well as the work that remains ahead. It cautions against requesting production funds before government tests and evaluations are conducted.

For the past several years, we have reported annually on the status of selected major weapon systems. This report is one in a series for use in reviewing fiscal year 1985 requests for funds.

This report contains recommendations to you. As you know, 31 U.S.C. § 720 requires the head of a federal agency to submit a written statement on actions taken on our recommendations to the House Committee on Government Operations and the Senate Committee on Governmental Affairs not later than 60 days after the date of the report and to the House and Senate Committees on Appropriations with the agency's first request for appropriations made more than 60 days after the date of the report.

We are sending copies of this report to the Director, Office of Management and Budget; the Chairmen, House Committee on Government Operations, Senate Committee on Governmental Affairs, and House and Senate Committees on Appropriations and on Armed Services; and the Secretary of the Army.

Sincerely yours,

Frank C. Conahan
Director

GENERAL ACCOUNTING OFFICE
REPORT TO THE
SECRETARY OF DEFENSE

RESULTS OF FORTHCOMING CRITICAL TESTS ARE NEEDED TO CONFIRM ARMY REMOTELY PILOTED VEHICLE'S READINESS FOR PRODUCTION

D I G E S T

The Army's remotely piloted vehicle (RPV) is a small aircraft piloted by remote control. The Army is developing the RPV to fly over enemy territory to collect combat information, locate targets, and in some cases guide munitions to targets. The RPV relays the information it collects immediately back to supporting ground units. In February 1982, we reported to the Congress that the RPV system showed promise of significantly enhancing the Army's combat capability but that its development had been slowed by major technical difficulties, program instability, and a lack of commitment by both the Army and the Department of Defense (DOD) to fielding this system. The Senate Appropriations Committee, in a report dated September 23, 1982, repeated these concerns. GAO undertook its current review to assess the Army's progress toward successful development and employment of the RPV system. (See pp. 1 to 4.)

SCHEDULE IS TIGHT FOR DEMONSTRATING RPV'S PERFORMANCE AS AN INTEGRATED SYSTEM

Designing some of the most critical subsystems has proven particularly difficult. They include (1) the data link through which the air vehicle communicates with the ground station and (2) other electronic and target acquisition components carried on board the vehicle. An infrared vision system which is just beginning development to permit RPV flights at night and during adverse weather conditions faces a similar problem. Most of the subsystems which experienced earlier technical difficulties have shown good progress when tested individually. How well they will perform as an integrated unit and whether there are no longer any serious technical problems to inhibit RPV's going into initial production in July 1985, as planned, will be disclosed during flight testing which began in December 1983 and is to run through October 1984. (See pp. 5 to 7 and pp. 8 and 9.)

GAO/NSIAD-84-72

Other significant problems which developed in the past year involved (1) the software, which was overtaxing the main computer's internal communication capacity, and (2) the air vehicle's weight. The RPV weighs about 260 pounds, almost 20 pounds heavier than the maximum acceptable weight. Whether the weight will affect flight performance will be determined in the upcoming tests, and in the meantime the contractor is studying weight reduction possibilities. (See pp. 7 and 8.)

The program, which has already experienced a 27-month delay since it entered full-scale development in 1979, is on a very tight schedule which allows little room for further major setbacks. Development tests conducted by the government are not scheduled to begin until August 1984, and operational tests are not scheduled to begin until January 1985. Operational testing is scheduled for completion in March 1985, about 3 months before the Army's production decision in July 1985, while the independent evaluation of those tests is not due until the same month as the decision. (See pp. 9 to 11.)

COSTS HAVE GROWN AND COULD INCREASE FURTHER WITH NEW EMPLOYMENT CONCEPT

The RPV program is now estimated to cost $2.44 billion, an increase of $1.9 billion since the original baseline estimate was made in May 1978. About $1.5 billion of this increase had been reported by August 1982 and was primarily due to (1) technical problems and reduced funding allocations which nearly doubled the length of the program's schedule and (2) the addition of the infrared vision system. The remaining $400 million of the estimated increase is attributable to a change in the RPV's employment concept, whereby the Army is investigating potential future missions and product enhancements.

Under the original concept, the RPV's role of acquiring targets and surveying the battlefield for artillery units was clear. Under the new concept, the RPV's main role is more vague since it now contains several missions in addition to artillery and more are expected. The change in the RPV's employment concept centralized control of launch and recovery at the

division level rather than the battalion level. While this change enabled the Army to reduce the number of air vehicles in the program from 995 to 548, the procurement saving has been more than offset by the cost of developing system enhancements needed to expand mission capabilities.

The current $2.4 billion program estimate does not reflect the full cost impact of the RPV's expanded missions. Procurement costs for the enhancements initially selected for development are not included in the estimate. Several additional enhancements are also being actively considered. Because not all the missions to be added have been selected, it is too early to estimate how much higher costs will rise, but the potential exists for substantial increases. Because the number of enhancements being considered may represent too ambitious a program if pursued in total, GAO believes that the Army should determine the cost effectiveness and affordability of new missions before they compete for scarce resources. Procurement costs are made further uncertain by the fact that the Army has not determined whether the smaller number of air vehicles under the new employment concept will provide enough flight-hours of air coverage to perform the original artillery mission as well as newer missions. (See pp. 12 to 17.)

THE CONGRESS HAS BEEN ASKED TO FUND PRODUCTION BEFORE GOVERNMENT TEST RESULTS ARE AVAILABLE

The Congress has been asked to provide funds for the RPV's initial production in the fiscal year 1985 budget so that the Army can award the production contract in July 1985. It may not be prudent to ask the Congress to provide production funds more than a year ahead of the production award, when most of the critical testing is still to be done. If the Army delayed the contract award 3 months to the beginning of fiscal year 1986 and delayed its request for production funds until the fiscal year 1986 budget hearings, the Congress would have much more information on how the system performed in the tests before acting on the request. It does, however, appear reasonable to fund the procurement of long lead items in fiscal year 1985, so that if no significant problems are encountered in testing, those

items can be procured in time for the start of production. (See p. 11.)

RECOMMENDATIONS

GAO recommends that the Secretary of Defense delay the initial RPV production contract award until the beginning of fiscal year 1986 and withdraw RPV production funds from the fiscal year 1985 budget request, except those needed for long lead items.

GAO also recommends that the Secretary of the Army analyze the planned RPV system enhancements to determine their cost effectiveness and affordability before including them in future budget requests and determine whether current quantities will provide enough flight-hours of air coverage for the artillery and other missions.

AGENCY COMMENTS AND GAO'S EVALUATION

DOD agreed with GAO's recommendation that the Secretary of the Army determine the cost effectiveness and affordability of planned system enhancements before including them in future budget requests.

DOD did not agree with GAO's recommendation to delay the start of RPV production from fiscal year 1985 to fiscal year 1986. DOD maintained that such an action would result in a 6- to 12-month delay in the entire program, because the Congress would not likely fund long lead items in fiscal year 1985 if initial production were deferred until fiscal year 1986. DOD based its concern on the Congress'--particularly the House Appropriation Committee's--practice of not funding long lead items a fiscal year ahead of initial production for equipment funded under the Other Procurement, Army appropriation--the account from which RPV procurement would be funded.

DOD offered other arguments against a delay. DOD believes (1) technical progress has been satisfactory, (2) a delay would negate DOD's efforts to accelerate the program's pace and show the strong commitment to the program desired by the Congress, and (3) its Defense Systems Acquisition Review Council, which has oversight over major weapon programs, could be

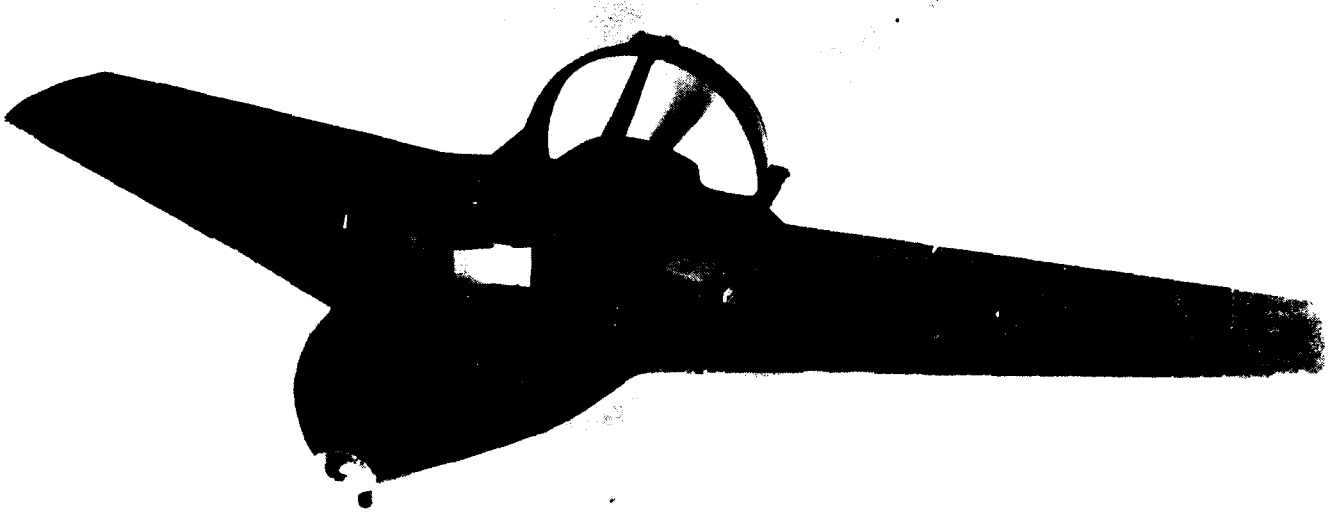
counted on not to recommend beginning production if the RPV were not ready, even if procurement funds had been appropriated.

Based on its examination of a 1983 report by the House Appropriations Committee and its discussions with committee staff members, GAO believes that the Congress might make exceptions to its past practice of not funding long lead items a fiscal year ahead of initial procurement from the Other Procurement, Army appropriation in instances where such actions are warranted. GAO does not believe technical progress has been sufficient to support requesting procurement funds for the RPV in fiscal year 1985. Flight tests to demonstrate the RPV's performance as an integrated system have fallen behind, and the remaining tests and evaluations run the risk of not being completed by the time the production decision is due.
(See pp. 19 to 21.)

Contents

ABBREVIATIONS

FLIR	forward-looking infrared
DOD	Department of Defense
GAO	General Accounting Office
MICNS	Modular Integrated Communication and Navigation System
RPV	remotely piloted vehicle



Army remotely piloted vehicle.

CHAPTER 1

INTRODUCTION

The Army's remotely piloted vehicle (RPV) is an aircraft piloted by remote control. The RPV is being developed to give the Army a capability that it now lacks--conducting battlefield surveillance and target acquisition over enemy territory and communicating this information as it is being collected. Specifically, the system is planned to detect and identify targets, provide accurate target locations to adjust artillery fire, designate targets for precision-guided munitions by using a laser beam, perform reconnaissance, and assess damage from firing on enemy positions. The Army is planning to add several new missions to the RPV, including radio communications relay, jamming, and electronic surveillance.

The system, when fielded, should extend the division commander's sight beyond the front lines to the full range of artillery weapons where ground-based systems cannot see and where the risk to piloted observation aircraft is high because of the enemy's sophisticated air defense systems.

WHY THE REVIEW WAS MADE

In February 1982 we reported to the Congress[1] that the RPV system showed promise of significantly enhancing the Army's combat capability but that its development had been slowed by major technical difficulties, program instability, and a lack of commitment by both the Army and the Department of Defense (DOD) to fielding this system. The Senate Appropriations Committee, in a report dated September 23, 1982, repeated these concerns.

In its response to our report, DOD indicated that RPV technology would be vigorously pursued and a commitment made to fully fund the system's development and deploy it by late 1987. We undertook our current review to assess the Army's progress toward successful development and employment of the RPV system.

SYSTEM DESCRIPTION

The RPV system consists of an air vehicle, a ground control station, a remote ground terminal antenna, launch equipment, recovery equipment, and general support and maintenance equipment. The RPV is a mobile system with all its equipment mounted on or contained in a fleet of trucks or trailers.

Army requirements call for an air vehicle weight of 240 pounds, a maximum flight speed of 110 miles per hour, and a normal flight altitude of about 4,900 feet. The air vehicle has

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[1]The Army's Remotely Piloted Vehicle Shows Good Potential but Faces a Lengthy Development Program (GAO/C-MASAD-82-8, Feb. 26, 1982).

a wing span of 13 feet. The airframe, made of Kevlar-epoxy material, is powered by a 2-cylinder 26-horsepower engine and carries a flight control electronics subsystem, a communications terminal, and a mission payload consisting primarily of a TV sensor and a laser rangefinder/designator. The latter is a device that focuses a laser beam on a target to measure how far away it is, as well as to guide laser-seeking munitions to the target. This payload allows for only daytime operations. The Army plans to begin developing a forward-looking infrared (FLIR) payload in April 1984 to provide night and limited adverse weather capability. There is only enough space and weight aboard the air vehicle to accommodate one payload at a time. Thus, when different payloads become available, Army troops will be able to interchange them in the field prior to each launch, according to the planned mission.

Operationally, the air vehicle and its payload are to be controlled from the ground control station through a jam-proof data communications link, known as the Modular Integrated Communication and Navigation System (MICNS). The two major components of the MICNS are a ground antenna and a data terminal in the air vehicle. The launch system catapults the vehicle into the air, and when the mission is completed, an automated system guides the air vehicle into a vertical net for recovery.

The RPV system is being developed to assist artillery and other missions. According to Army officials, their ability to obtain real-time battlefield information and targeting data beyond the front lines without the RPV system is limited. They believe that penetration into enemy territory by aircraft flown by pilots could result in costly losses in personnel and equipment when fired on by enemy air defense systems. Because of its small size, the RPV would be harder for air defense weapons to detect or hit. Further, if hit, the RPV would involve no loss of life and would be a much less costly aircraft to lose than a piloted aircraft. In addition, current target acquisition systems cannot designate targets for precision-guided munitions much beyond the forward observer's line of sight, thereby limiting their effectiveness.

RPV DEVELOPMENT HISTORY

The Army has been developing the current RPV system and its technology since February 1974. At that time, an advanced development program was begun that demonstrated the technical and tactical feasibility of flying a pilotless air vehicle equipped with a small television camera to look over the next hill and gather target information. This very basic RPV concept was proven during the early development phase, and the program moved into full-scale engineering development when the Army awarded a contract to Lockheed Missiles and Space Company in August 1979. At that time, a 43-month engineering development program was envisioned before the system could move into

production. After the RPV entered development, the program was stretched to 52 months because of technical problems with the data link and then to 85 months because limited funding was provided. In 1982, the Army and DOD began a concerted effort to accelerate RPV development and established the current 70-month program. Army officials consider this a realistic schedule estimate. A comparison of the program schedule when the RPV entered full-scale engineering development with the program schedule as of January 1984 is shown below.

January 1984 Schedule Compared With

Schedule at August 1979 When

RPV Entered Full-Scale Engineering Development

Event	Schedule at August 1979	Current schedule
First flight	August 1981	July 1982[a]
First flight (with MICNS)	-	December 1983[a]
Begin development testing	March 1982	August 1984
Complete development testing	-	December 1984
Advance procurement contract award	-	October 1984
Begin operational testing	November 1982	January 1985
Complete operational testing	December 1982	March 1985
Production decision	April 1983	June 1985
Full-scale production award	April 1983	July 1985
First production delivery	March 1984	October 1986
Initial operational capability	August 1984	September 1987

[a]Actual date of accomplishment.

OBJECTIVES, SCOPE, AND METHODOLOGY

The objectives of our review were to evaluate

--the current status of the program, including cost, schedule, and quantity changes;

--technical progress and performance of the antijam data link, a critical RPV subsystem;

--the status of other RPV technical developments and deficiencies;

--planned operational concepts and system utility; and

--the progress made toward acquiring a FLIR capability and other system enhancements.

In conducting our review, we examined internal and external analytical studies; program cost, schedule, and performance data; records of briefings and meetings; and contracts. Also, we interviewed cognizant officials in the RPV project office at the U.S. Army Aviation Systems Command, St. Louis, Missouri, as well as officials of the following organizations:

--MICNS product office, Fort Monmouth, New Jersey;
--Army Field Artillery Center, Fort Sill, Oklahoma;
--Army systems coordinator, Deputy Chief of Staff for Research, Development and Acquisition, the Pentagon, Washington, D.C.;
--Lockheed Missiles and Space Company, Sunnyvale, California; and
--Harris Corporation, Melbourne, Florida.

Our review was performed in accordance with generally accepted government auditing standards. We began our review in April 1983 and completed it in October 1983. Since then, we periodically updated the status of planned contractor flight tests. All cost estimates in this report are presented in escalated dollars (which include the effect of inflation).

CHAPTER 2

MAINTAINING THE RPV'S TIGHT

TESTING SCHEDULE POSES A FORMIDABLE CHALLENGE

The Congress has been asked to make procurement funding decisions long before any key government tests and evaluations of the RPV are completed and before the system's critical anti-jam capability is demonstrated. Flight tests of the fully integrated system are just beginning, and government development and operational tests, which will not begin for several months, will not be completed until early 1985. Technical problems have forced program stretch-outs and the present schedule for completing the 70-month development program is now very tight. During the program's first 4 years, many subsystems experienced technical problems, and they are just now showing promise of working properly. Both contractor and Army officials acknowledge that the success and timely completion of the contractor flight tests will directly affect the Army's ability to maintain the development program's schedule.

In order to give the Congress the benefit of additional test results before funding initital RPV procurement, we believe the initial production contract award for air vehicles and related equipment should be deferred 3 months--from July 1985 until October 1985, the beginning of fiscal year 1986.

DEVELOPMENT PROBLEMS HAVE HINDERED PROGRAM PROGRESS

Technical problems in developing some of the critical subsystems for the RPV have slowed the program's progress. Problems with the MICNS and mission payload system contributed to past program delays. New technical problems with system software, the engine, and overall weight have developed in the past year, adding still more to system delays.

The Army is confident that many of the technical deficiencies have been resolved. However, the development program has not advanced sufficiently to provide tangible evidence of technical success. Fully integrated flight testing, started in December 1983 and planned to run through October 1984, should confirm whether technical deficiencies have been solved and whether the current schedule is achievable.

Slow MICNS data link deliveries have delayed the RPV's development

Technical problems with the MICNS, which is being developed by Harris Corporation of Melbourne, Florida, have been a major contributor to delays in the RPV program and to increased system costs. Technical difficulties relating to reducing the size of

sophisticated electronics to fit within the stringent space and weight limitations of the air vehicle have slowed delivery of the MICNS hardware to Lockheed and have consequently delayed the entire RPV program. Lockheed has had problems integrating the MICNS delivered to date with the RPV system.

Since 1979, when the MICNS development started, MICNS contract costs increased from $15 million to $90 million. The first MICNS unit was delivered in September 1982. As of October 31, 1983, Harris had delivered two air data terminals for use in the flight tests. The Army considers this the absolute minimum number necessary for flight testing.

Harris is having difficulties in obtaining high quality materials for some components. Some of the equipment already delivered has not met all specifications regarding video quality and ability to operate at temperature extremes. Some of the more difficult problems occurred after the hardware was delivered when Lockheed began testing the MICNS with an RPV system. Lockheed, for example, could not maintain continuous communication between the air vehicle and the ground station due to electromagnetic interference. Discovering the source of the interference and correcting it has proven elusive.

MICNS antijam capability falls short of requirements

The MICNS is intended to provide antijam communication between the air vehicle and ground control station. Government and contractor officials agree that the MICNS currently does not, and may never, entirely meet the stringent antijam specifications established for it. Army officials have not yet quantified the effects of the antijam deficiency on RPV operations, but they plan to study and test more fully the extent and effect of the system's antijam performance. The Army and its contractors are currently concentrating on delivering MICNS hardware and solving the integration problems before tackling antijam performance. They believe a redesign to overcome this deficiency may prove costly, and they may instead simply lower the antijam specifications and accept the lesser performance.

Adequacy of corrections to mission payload problems must be demonstrated in flight testing

As with the MICNS, problems with the mission payload, another key RPV subsystem, have continued to slow program progress. The mission payload system, being built by Westinghouse under subcontract to Lockheed, is composed of a daylight television camera, a laser rangefinder/designator electronics unit, composite optics, a sensor electronics chassis, and a turret. Early development of the mission payload was driven by problems

with the composite optics which are used by both the laser and television camera and are fundamental to mission operations. Later problems which developed during attempts at system integration have also slowed the program.

The initial composite optics contract was terminated because of development problems, but a second contractor has successfully built and delivered the composite optics. The primary difficulty had involved accurately spacing and aligning the 50 pieces of glass which compose the composite optics.

Despite improvements in the composite optics area, Westinghouse is still about 2 months behind the revised delivery schedule due to technical problems which arose in trying to integrate the mission payload with the RPV system. The difficulties with the mission payload system relate primarily to combining the optical and laser rangefinder/designation system into one mechanism within the size and weight limitations of the air vehicle. According to the RPV program manager, while the contractor is still behind on its overall delivery schedule, it has delivered enough mission payload units to begin engineering development tests and has devised corrections for all the technical problems. The adequacy of the corrections remains to be fully demonstrated in flight tests.

Software development has been difficult

According to RPV officials, developing the software for controlling RPV navigation, flight, and other necessary functions has proven more difficult than originally envisioned. The RPV contains several computers and 12 separate computer programs composed of over 1,100 software modules. The computers must perform many functions normally handled by a pilot. Because of the large volume of software, Lockheed encountered technical problems, which included exceeding the memory capacities of the ground station's main computer and the air vehicle computer's memory board and overtaxing the main computer's internal communication capability. Lockheed solved these problems after some initial difficulty, basically by adding additional memory capacity.

Lockheed must certify that all system software meets government specifications, before the government can verify and accept the software. The computer system's design, integration, processes, and programs must be fully documented to facilitate certification and verification and to provide configuration control. This process is very time consuming and has involved more effort than originally envisioned by Lockheed and the Army. According to the project manager, software development, as well as the documentation and verification process, must be completed before government development tests can be started in July 1984.

Effect of weight increase still to be determined

Lockheed has experienced significant weight growth in the air vehicle. The Army established 242 pounds as the maximum acceptable weight with a goal of 220 pounds, thus allowing the contractor some latitude in making design tradeoffs, yet still meeting all performance objectives. Currently Lockheed estimates the air vehicle will weigh nearly 260 pounds with a mission payload, which is well over the Army's maximum. A major portion of the weight growth has involved the government-furnished MICNS, which has grown from 16 to 24 pounds, and the Westinghouse mission payload system, which has grown from 45 to 61 pounds.

Lockheed officials believe the RPV can still meet performmance specifications despite the large weight increase, but they have not defined the precise degradation in flight performance for each added weight increment. The flight tests should enable quantifying the performance effects, if any, of the added weight. Lockheed is still looking at possibilities for reducing weight before beginning production. Company officials believe, however, that any substantial weight cuts may prove too costly compared to the benefits they might produce.

Engine carburetor experienced fuel leakage

Lockhead has encountered persistent minor problems with the carburetor throughout much of development. During early flight testing in 1982, fuel leaked from the carburetor during net recovery and the engine performed erratically at the low speeds necessary for proper recovery. Lockheed is evaluating a new carburetor with an improved design in an effort to overcome the problem. Meanwhile, fuel leaks have continued to occur in recent tests.

FLIR development poses a technical challenge

The 40-month FLIR development program effort, which overlaps but is not a part of the 70-month program, is just getting started and is estimated to cost $99 million. The FLIR payload is necessary to provide night and adverse weather capability. While FLIR and laser technology have been demonstrated, miniaturization and weight limitations necessary to fit this technology into the air vehicle are pushing the state of the art. As an example, FLIR specifications require a maximum acceptable weight of 60 pounds, including the laser rangefinder/designator. While preliminary analyses by contractors indicate that this requirement is achievable, there is no conclusive evidence--and no operating hardware--to substantiate these claims. The Army's program manager views the FLIR development within the size and weight constraints as a tough technical challenge.

Other technical hurdles include fitting the payload within the air vehicle's size constraints at a proper center of gravity and maintaining adequate stabilization.

The start of FLIR development has slipped 8 months to April 1984, due primarily to funding cuts by the Army. The Army now plans to enter production with the FLIR in September 1987. Initial deployment with the RPV is planned for March 1989, 18 months after the RPV's day-television version is deployed. Although the development effort is viewed as challenging, several teams of contractors are expressing interest in competing for the FLIR development program. The Army's Night Vision and Electro-Optics Laboratory in Fort Belvoir, Virginia, the cognizant government office for managing the procurement, is at present soliciting proposals. The laboratory will provide FLIR payloads as government-furnished equipment to the RPV prime contractor.

PROGRAM SCHEDULE LEAVES LITTLE ROOM FOR FURTHER TECHNICAL SETBACKS

To minimize technical risks during development, system testing and evaluation must adequately assess total system performance. Critical to the RPV's successful development are integration and operation of key subsystems, such as the antijam data link, the mission payload package, and the flight control electronics package. Demonstrating subsystem integration poses the greatest technical risk to the RPV development program. As of December 1983--52 months into the 70-month development program--neither the Army nor Lockheed had demonstrated total integrated system performance in flight tests. There is no slack time available in that schedule to resolve any major problems which might be disclosed during those tests. Thus, overcoming the existing problems and conducting all government development and operational tests and related analyses within the time remaining in the 70-month schedule could prove difficult.

Testing accomplished

The testing performed during the first 4 years of development has been a building block of increasingly sophisticated tests. All testing to date has been controlled and run by the contractor. Testing performed during the first 3 years of development included component bench testing using hardware models and some actual system hardware. This same equipment was then tested during a 17-flight test series at Fort Huachuca, Arizona, from June through November 1982. These tests were flown without the jam-proof data link and the required mission payload.

Both the Army and Lockheed reported that the 1982 flight test series met test objectives and was an overall success.

Although one air vehicle crashed, mainly due to software deficiencies, the other 16 flights demonstrated some key elements of RPV system operation that we believe are critical measures of the program's successful progression through development. Key demonstrations performed successfully included catapult launch of an air vehicle, automatic net recovery, computer-controlled navigation, television telemetry, and air vehicle flight performance parameters.

Planned future testing

During the next year the Army is to assess critical measures of the RPV's total system performance. The jam-proof data link will be flight tested for the first time with all the other RPV subsystems. Similarly, the important day-mission payload subsystem will be flight tested in its operational configuration with the MICNS subsystem.

Contractor flight testing of the fully integrated RPV system is to run through October 1984. During this period, Lockheed plans to conduct 48 flight tests of increasing complexity that should enable the RPV to be evaluated as a total system. In August 1984, 2 months before the contractor's test series is completed, the Army plans to begin its own series of about 20 development flight tests which will run through December 1984. Army project management officials admit the testing concurrency involves some risk, but they believe it is necessary to preserve the 70-month schedule. The tightness of this schedule is underscored by the fact that the independent evaluation of the operational testing, barring major testing problems, is now scheduled to be completed in June 1985, immediately before the production decision.

Development schedule may not be achievable

Slack time is no longer available in the program, and the program schedule leaves no room for major deficiencies to arise during integrated flight tests. The 70-month program represents a 27-month slip from that envisioned at the program's beginning in 1979. Technical problems with the MICNS, mission payload, and system software which have delayed the program in the past are not totally resolved. Initiation of flight tests has already slipped 2 months. Further, the first flight test held in December 1983 stopped prematurely due to an elecrical power failure, and a tail structure failure on the second flight, held in February 1984, resulted in a crash. These were the first flight tests of a fully integrated RPV and included the critical MICNS subsystem. It would be unduly optimistic to anticipate a trouble-free flight test program or even one with few problems that would not affect the already tight schedule.

An Army risk analysis prepared in February 1983 estimated the mean completion time for research and development at 79

months, with 90-percent confidence for completion within 82 months. Since the analysis was completed, the program manager has changed the training schedule to allow for some concurrent development and operational personnel training in anticipation of the forthcoming tests. This may cut about 3 months from the test program. Even with this change, the risk analysis still shows the schedule will likely be longer than stated in official program documents. Lockheed also agrees that any unanticipated problems will cause the schedule to slip further.

LIMITED TEST INFORMATION WILL BE AVAILABLE BEFORE CONGRESSIONAL DECISIONS ON PROCUREMENT FUNDS

The Army's request for fiscal year 1985 RPV procurement funds in the amount of $161.3 million will be considered in the authorization and appropriation hearings in early 1984. Of that amount, about $30 million is for a procurement contract for long lead items to be awarded in October 1984. The balance, $131.3 million, is for 32 air vehicles, related ground control equipment, and spares. The Army decision to move from development to procurement is scheduled for June 1985, and the initial production contract is scheduled for award in July 1985.

Government development testing does not begin until August of 1984 at which time contractor development flight tests of the fully integrated system will still have 2 months to run. Army operational tests will not begin until January 1985. Thus, the congressional decision to fund the RPV's initial production will have to be made at a time when little or no government testing of the completed system will have occurred and before contractor testing is completed.

It appears prudent to defer asking the Congress to fund the procurement of initial vehicles and related equipment until fiscal year 1986 so that more test results will be available on which to base such a decision. Deferring the funding need only delay the program as little as 3 months, from July 1985 to the beginning of fiscal year 1986.

It does seem reasonable to provide procurement funding for long lead items in fiscal year 1985. According to the Army, such items need to be ordered some 9 months prior to beginning work on the vehicles and equipment. Therefore, funding long lead items in fiscal year 1985 would allow the Army to begin vehicle production in early fiscal year 1986 if the RPV does not encounter significant problems in testing.

CHAPTER 3

PROGRAM COSTS MAY CONTINUE RISING

The RPV program's scope has changed substantially in the last year. A revised employment concept has enabled the Army to cut the number of air vehicles nearly in half. However, research and development costs have nearly doubled to finance several enhancements in line with a proposed expansion of the RPV's role to missions other than the field artillery mission. Thus, despite decreases in the quantity of vehicles, program costs have risen to $2.4 billion. This includes advanced development costs for numerous system enhancements but contains no engineering development or procurement costs for the hardware associated with these enhancements. Because the missions to be added are still not decided, it is too early to estimate how much higher than the current $2.4 billion estimate program costs will rise when procurement costs of the enhancements are added.

TECHNICAL PROBLEMS AND FUNDING SHORTAGES HAVE DRIVEN UP COSTS IN THE PAST

An appreciation of the program's cost growth before the expansion and changes in the employment concept can be gained by comparing the first baseline program cost estimate made in May 1978 with the August 1982 estimate, the last one made before the program's scope was increased.

	May 1978 estimate	August 1982 estimate	Increases
	(millions)		
Research and development	$123	$ 590	$ 467
Procurement	440	1,425	985
Military construction	-	24	24
Total	$563	$2,039	$1,476

The $467 million research and development cost increase was due primarily to (1) technical problems and funding cuts by the Army which, together, stretched the schedule from 43 to 70 months and (2) addition of the FLIR mission payload system.

The development contract price with Lockheed for the RPV has increased almost threefold since the program began, from $101 million in 1979 to the current price of $287 million. While about half of this $186 million cost growth was due primarily to stretching out the program schedule, Lockheed has experienced cost growth of $83 million above what it originally proposed. Lockheed's cost growth can be attributed to technical development problems and inaccurate cost estimating. The Army

recently capped contract costs at $287 million, meaning that Lockheed is to absorb all costs above the $287 million ceiling.

Between 1978 and 1982, estimated procurement costs grew from $440 million to $1,425 million. These increases resulted primarily from (1) an increase in the air vehicle quantity from 780 to 995 when the FLIR program was added and (2) stretching out the schedule.

NEW EMPLOYMENT CONCEPT HAS INCREASED DEVELOPMENT COSTS AND PORTENDS FURTHER PROGRAM COST INCREASES

The Army has revised its original RPV organizational and operational concept to provide a structure more capable of expanding from an artillery role to a multimission role. The Army believes the new concept, in addition to supporting more types of users while providing as much or more mission capability, will increase system survivability, allow forward units to be moved more quickly, and shorten logistic lines. If the new concept works out as planned, air vehicle quantities will be cut nearly in half. However, attendant savings will be more than offset by additional costs to acquire new mission capabilities.

The original organizational and operational concept called for an RPV battery with 20 air vehicles to be assigned to each of 14 divisions. A battery was to be divided into 4 autonomous sections, each assigned to a separate artillery unit within the division and equipped for launching, monitoring, controlling, and recovering its own air vehicles. Command and control of the section was to rest principally with the field artillery battalion commander and would be oriented to the artillery mission. Other missions, such as intelligence surveillance, were to be given a secondary role, if performed at all.

After reevaluating potential uses, missions, organization, and operation of the RPV the Army, in 1983, arrived at a new organizational concept which focuses operational control over RPV assets at the division, rather than the battalion. This allows for more flexibility in specific mission assignments. The new concept calls for each of 13 divisions to have a battery with 13 air vehicles. The battery will have two centralized launch and recovery sections. One air vehicle can be launched from each of the central sections and passed for control to any of 3 forward control sections attached to artillery or other units. This new employment procedure makes it possible to reduce the number of vehicles in each battery from 20 to 13.

These changes largely account for the $404 million increase in program cost to $2.4 billion since August 1982. Research and development costs rose $487 million to a new total of $1,071

million, primarily due to the RPV enhancements. A funding profile by fiscal year of estimated research and development costs, prepared from Army documents, is shown below.

RPV Research and Development Funding Profile

	Fiscal year						
	Prior to 1983	1984	1985	1986	1987	To completion	Total
	(millions)						
Day television	$284	$103	$69	$ 2	$-	$-	$458
MICNS	37	9	6	4	4	-	60
FLIR	-	29	35	24	11	-	99
System enhancements	52	6	6	24	13	141	241[a]
Unspecified enhancements	-	-	-	5	6	201	212
Total							$1,071[a]

[a]Does not add due to rounding.

The change in the RPV's conceptual deployment centralized launch and recovery of the air vehicles in each platoon. This permitted a reduction in the number of vehicles but required increases in other equipment. These changes resulted in a reduction in the recurring hardware cost estimate of about $280 million, which was offset by increases in spares, automatic test equipment, and other categories, leading to a net procurement estimate reduction of $77 million for a total procurement cost estimate of $1,347.5 million. The major hardware changes were a reduction in the number of RPVs from 995 to 548, with commensurate reductions in the mission payload, and an increase in the number of ground stations from 74 to 80. The following schedule shows the major equipment quantity changes brought about by the change.

	Number of units		Percent reduced (increased)
	Old concept	New concept	
Air vehicle and MICNS air data terminal	995	548	45
Mission payload:			
Day system	398	227	43
FLIR	597	353	41
Launcher system	71	38	46
Recovery system	69	35	49
Maintenance shelter	70	22	69
Ground control station	74	80	(8)
MICNS ground data terminal	78	83	(6)

Employment concept uncertainties

The new employment concept hinges rather strongly on successfully demonstrating the ability of ground stations to pass control of the air vehicles to one another. If this hand-off feature cannot be adequately achieved, the program may revert to the previous organizational and operational concept with attendant equipment quantity and cost increases. Uncertainties also exist as to (1) how many productive flight-hours the new concept will provide and (2) how many flight-hours are really needed to provide sufficient air coverage.

The new concept requires the rear launch and recovery unit to maintain control of the vehicle until it can be handed off to the forward control station. Army officials advised us that this handoff is not easy. In order for the air vehicle to establish communication with the station assuming control, the air vehicle must rotate its antenna toward that station and away from the station relinquishing control. This rotation causes temporary loss of contact. Because of the narrow broadcast beam employed in the MICNS, its sending and receiving antennas must be pointed with a stringent degree of accuracy to preclude loss of contact for any significant length of time. Only limited demonstration of this capability has occurred using aircraft flown by pilots.

The Army claims that the new concept provides each division increased flight-hours per day and allows five rather than four air vehicles to be airborne at one time. Our evaluation of Army documents indicates the new concept does provide a very slight increase in flight-hours per day per division, but since RPVs will be launched from distances much farther from front lines, the flight-hour advantage disappears. Under the old concept all four vehicles could be involved in front line missions. Under the new concept, only three of the five are likely to be involved routinely in front line missions while the remaining two would primarily be involved behind the front lines. Since a rear station can control only one vehicle at a time, the station

must recover its air vehicle before recovering or launching one for forward stations. This will restrict the type and length of rear-controlled missions.

In addition, the Army has not determined how many flight-hours it needs to provide sufficient air coverage. There has been no analysis of the actual hours of air coverage necessary for the artillery mission, let alone the newer missions being contemplated. There is a good probability that quantities of air vehicles and ground station equipment will change as these requirements become better understood and developed.

RPV role to be expanded through several enhancements

The Army's program estimate includes some $450 million of research and development funds to increase the types of missions the RPV can perform and to improve the performance of the basic system. Together with the FLIR program, these enhancements now account for more than half of the RPV's research and development costs.

Although some missions have been initially selected for development, the full range of missions has not been established. In any case, the RPV's $2.4 billion cost estimate includes no engineering development or procurement funds for these enhancements. Procurement costs could rise substantially when all the new missions are selected, due not only to equipment modifications and new payloads, but to a possible need for more air vehicles as well. Although the Army has created a three-tier management organization to screen and rank proposals for new missions, no cost-benefit studies have been done to determine which enhancements are most promising. Furthermore, the Army has not determined whether it can afford to procure all the enhancements being considered for development.

In addition to the $99 million FLIR effort, $241 million is included in the estimate for developing system enhancements, such as additional mission payloads. The Army plans to spend most of this after fiscal year 1986. Army officials advised us that raising mission control to the division level provides a basis for incorporating such payloads. The Army screened some 80 suggested additional mission uses for the RPV and has identified several initial mission payload candidates it plans to start developing in the future. These candidates are listed below in the Army's order of preference:

1. Communication retransmission.
2. Electronic intelligence.
3. Noncommunication jamming.
4. Communication jamming.
5. Meteorological application.

Included in the $241 million are the estimated research and development costs of two key improvements to the system which will enhance RPV operations regardless of which payload is involved. These are incorporation of a multicontrol capability and extension of the vehicle's range. With present equipment limitations, Army personnel can fly only one air vehicle per ground control station. Multicontrol capability would allow Army personnel to control more than one air vehicle at a time with a single ground control station and related equipment. Extending the range of the RPV is not a crucial improvement to satisfy the artillery role according to Army officials, but rather is important for intelligence and other future roles where deeper penetration into enemy territory is desired. The principal problem in extending the range is maintaining communication with the air vehicle.

In addition to including the estimated development costs of the system enhancements, the Army has included another $212.4 million in its development estimate for future unspecified improvements to its RPV system in later years. The $212.4 million represents a transfer of some procurement funds from fiscal years 1988 and 1989 into the development budget made possible by the production quantity reductions. These funds will be used to develop ideas and proposals for new missions and related equipment anticipated over the years. There have already been proposals for new developments. For example, the Army's Vice Chief of Staff has directed development efforts in these four areas:

1. Developing and packaging a ground control system for use with the RPV in light infantry units.

2. Developing a communication retransmission payload.

3. Developing a less expensive air vehicle for training purposes.

4. Developing a backup recovery system.

Under the old organizational concept, the primary mission of the RPV was quite clear--filling the target acquisition designation and reconnaissance role in artillery support. Under the new concept, the role is being expanded, but as yet the extent and impact of this expansion are vague and undefined. The RPV is still focused on the artillery role but is subject to other emerging missions and priorities.

CHAPTER 4

CONCLUSIONS, RECOMMENDATIONS, AGENCY COMMENTS, AND OUR EVALUATION

CONCLUSIONS

In the last 2 years, DOD and the Army have dramatically increased their level of commitment to the RPV program. The program has received funding support at all levels of the decision-making process, and the Army has tried to stabilize the schedule of the initial day-television system. The Army has also begun moving toward fuller exploration and exploitation of the RPV system's utility by revising its operational and organizational concept and by identifying system enhancements which would allow expansion of the RPV role.

We believe the program acquisition cost estimate of $2.4 billion will increase substantially if the Army pursues the development and acquisition of many of the new missions and system enhancements being explored. Affordability issues should dictate caution in the choice of these new pursuits. An early step in exercising that caution should be the preparation of an accurate assessment of the quantities and cost of equipment needed to fulfill the roles for which the RPV system will be used. Beyond that, new missions proposed for the future and related equipment requirements should be subjected to early cost and operational effectiveness analyses before they compete for the Army's scarce resources. The number of enhancements being considered may represent too ambitious a scope of effort if pursued in total. The quantities needed are more uncertain in view of the fact that the Army has not determined whether the number of air vehicles planned under the new employment concept will provide enough hours of air coverage for the RPV's initial artillery mission or newer missions.

The RPV production contract award is currently scheduled for July 1985, the 10th month of that fiscal year. It may not be prudent to ask the Congress to provide production funds more than a year before the contract award, when the results and evaluations of key government flight tests will not be available at that time.

Considering that until such tests are conducted, there will be little in the way of reliable evidence that critical technical problems have been overcome and considering the extreme tightness of the schedule, we believe it may be desirable to move the production contract award back 3 months, into the beginning of fiscal year 1986. This would provide some slack in

the testing cycle to deal with problems that seem reasonable to anticipate in view of the system's technical complexity. If the production award were moved to early fiscal year 1986, the Congress would not have to consider the procurement funding request until early 1985, allowing another full year in which to evaluate the RPV's performance in critical testing. At that time, there should be a greater degree of confidence in the system, assuming the tests disclose no major deficiencies. On the other hand, we do believe it is prudent to continue with plans to fund the procurement of long lead items in fiscal year 1985 in view of the length of time needed to order the lead items and obtain delivery.

RECOMMENDATIONS

We recommend that the Secretary of Defense

--reschedule the initial RPV production contract for award in fiscal year 1986 and

--withdraw RPV production funds from the fiscal year 1985 budget request except for the $30 million needed for long lead time production items.

We further recommend that the Secretary of the Army

--analyze the planned RPV system enhancements to determine their cost effectiveness and affordability before including them in future budget requests and

--determine, through analysis, whether the number of air vehicles under the new employment concept provides enough flight hours of air coverage for the artillery mission and other missions being contemplated.

AGENCY COMMENTS AND OUR EVALUATION

The Department of Defense, in commenting on a draft of this report, provided some updated information on the RPV program and suggested some changes to the text in the interest of accuracy. We have incorporated these in the report, as appropriate.

DOD agreed with our recommendation that the Secretary of the Army determine the cost effectiveness and affordability of planned RPV system enhancements before including them in future budget requests and noted that the Army had established a program advisory council to review the costs and effectiveness of such future RPV program enhancements.

DOD did not agree, for a number of reasons, with our recommendation to delay the start of RPV production from fiscal year 1985 to fiscal year 1986. Citing the fact that the RPV is

funded from the Other Procurement, Army appropriation, DOD contended that consistent with the full funding policy, it has been the practice of the Congress--in particular, the House Committee on Appropriations--not to fund the procurement of long lead items from that appropriation in a year earlier than the fiscal year it was asked to fund initial production. Therefore, DOD would have to delay its budget request for long lead items to fiscal year 1986 if it agreed to defer the start of production to that year. Considering the 9-month interval that would be needed after ordering long lead items before production could start, the start of RPV production would most likely have to be delayed 6 to 12 months beyond the current schedule. DOD maintained that such a delay would not only increase program costs but would result in a loss of vendor expertise.

DOD also disagreed with a program delay because it would negate its efforts to accelerate the program's pace and show the strong commitment to the program desired by the Congress. It also maintained that its Defense Systems Acquisition Review Council that would convene at the July 1985 production decision could be counted on to recommend against the RPV going into production if judged not ready, even if the Congress had appropriated production funds. In addition, DOD believes the RPV's development is proceeding satisfactorily and that there are no technical reasons for a delay.

We believe that in this instance there is reason to believe the Congress would make an exception to its past practice and fund long lead items for the RPV in fiscal year 1985, if warranted. In its report on the fiscal year 1983 DOD appropriation, the House Committee on Appropriations stated that it was proper to request advance procurement of long lead items for major weapons whose estimated procurement costs would exceed $1 billion or whose development cost would exceed $300 million. The RPV program meets both criteria. Our discussions with Committee staff members confirmed that an exception that would permit funding long lead items in fiscal year 1985 and delay starting production until fiscal year 1986 was possible. While circumstances of the RPV program might warrant such an exception, we do not believe requesting advance procurement from the Other Procurement, Army appropriation should be done routinely.

Apart from the concern over funding long lead items, we do not believe technical progress has been sufficient to support requesting procurement funds for air vehicles and related equipment in fiscal year 1985. Tests and evaluations of the RPV as an integrated system are tightly scheduled and run the risk of being incomplete at the time of the scheduled production decision. Tests in the 15 months of development still remaining have already slipped. Where 16 to 20 flights were planned from October 1983 to March 1984, only 2 flights had actually taken place as of February 15, 1984, and neither was successful.

We agree that DOD has made major strides toward complying with the congressional desires to move the program toward production and deployment. However, we believe that it would be preferable for the Congress to have the results of the key government tests when it decides whether to fund initial production.

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