

DOCUMENT RESUME

00097 - [A0751348]

Status of the Remotely Piloted Aircraft Programs. PSAD-77-30; B-163058. February 18, 1977. 9 pp.

Report to the Congress; by Elmer B. Staats, Comptroller General.

Issue Area: Military Preparedness Plans (800); Federal Procurement of Goods and Services (1900); Federal Procurement of Goods and Services: Notifying the Congress of Status of Important Procurement Programs (1905).

Contact: Procurement and Systems Acquisition Div.

Budget Function: National Defense (050); National Defense: Weapon Systems (057).

Organization Concerned: Department of Defense; Department of the Air Force; Department of the Army; Lockheed Aircraft Corp.; Boeing Co.; Teledyne Ryan Co.

Congressional Relevance: House Committee on Armed Services; Senate Committee on Armed Services; Congress.

In the next 5 years, about \$700 million will be spent on remotely piloted vehicles (RPV), primarily for two Air Force projects--Compass Cope and Multimission--and one Army RPV--Aquila. These are being developed because Department of Defense officials believe RPVs are able to perform high-risk and politically sensitive missions more practically and inexpensively than piloted aircraft. Compass Cope is a large, high-altitude, long-range RPV, which is being developed at a cost of \$160 million. The multimission RPV, called BGM-34C, medium-sized and shortrange, is being developed to replace single-mission, electronic warfare and reconnaissance RPVs. An advanced RPV is also being planned to replace the BGM-34C. The Army's Aquila RPV is being developed to demonstrate the use of small RPVs for tactical surveillance and target identification. Findings/Conclusions: The Compass Cope is in the developmental stage, but production is planned for 1981, if funds are available. The Defense Systems Acquisition Review Council, which is supposed to review all major new systems three times during development, has not reviewed Compass Cope. The Tactical Air Command, primary user of this RPV, has questioned the need for it, indicating that existing aircraft can do the task as well and as cheaply. Compass Cope may also have air-rights flyover problems, but the countries involved and the Air Force think the problem can be solved, possibly by onboard sensors to avoid collisions. Half of the test flights of the BGM-34C have resulted in missed midair retrieval, because of parachute failure, but the damage has been minor. Preliminary performance tests show the BGM-34C to fly faster and higher, and carry more than the RPVs it will replace. Preliminary cost studies indicate that the BGM-34C is comparable to the RPVs it is replacing. Development of its replacement is scheduled for 1980. After initial testing failures, the Army's Aquila was modified and has been successfully tested, including seven automatic launch and

recovery flights. Testing with TV camera, laser and other equipment has not been completed. Recommendations: The Defense Systems Acquisition Review Council should review the Compass Cope program and other RPV programs to provide the three services involved in their development with the benefit of such reviews. Determination should be made as to the need for Compass Cope and whether it is cost effective since there are existing aircraft to perform its functions. The issue of potential flight restrictions should be resolved. Because of problems encountered and the planned use of Aquila with Army weapons, the basic concepts, such as launch and recovery, should be proven before the program is allowed to proceed further. (Author/SS)

# REPORT TO THE CONGRESS

BY THE COMPTROLLER GENERAL  
OF THE UNITED STATES

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## Status Of The Remotely Piloted Aircraft Programs

### Departments of the Air Force and Army

Unmanned aircraft piloted by remote control are being developed by the Air Force and Army to perform some missions now flown by men in planes. The Department of Defense has budgeted over \$700 million to develop and produce remotely piloted vehicles over the next 5 years.

The Air Force began, and is continuing, the Compass Cope program without resolving questions on mission and cost effectiveness. The Air Force awarded a contract for full-scale development in August 1976. The Army's Aquila program has been plagued with design and procedural difficulties which have led to cost growth and schedule delays.

GAO recommends that the Secretary of Defense closely monitor remotely piloted vehicle programs to make sure that basic mission, procedural, and cost-effectiveness questions are resolved.



COMPTROLLER GENERAL OF THE UNITED STATES  
WASHINGTON, D.C. 20548

B-163058

To the President of the Senate and the  
Speaker of the House of Representatives

This report presents our views on the major issues concerning the Remotely Piloted Aircraft Programs. For the past several years, we have annually reported to the Congress on the status of selected major weapons systems. This report is 1 of a series of 29 reports that we are furnishing this year to the Congress for its use in reviewing fiscal year 1978 requests for funds.

A draft of this report was reviewed by agency officials associated with the program and their comments are incorporated as appropriate.

We made our review pursuant to the Budget and Accounting Act, 1921 (31 U.S.C. 53), and the Accounting and Auditing Act of 1950 (31 U.S.C. 67).

We are sending copies of this report to the Director, Office of Management and Budget, and the Secretary of Defense.

A handwritten signature in black ink, appearing to read "James B. Stets".

Comptroller General  
of the United States

## C o n t e n t s

		<u>Page</u>
DIGEST		i
CHAPTER		
1	INTRODUCTION	1
	Scope	1
2	AIR FORCE RPV PROGRAMS	2
	Compass Cope	2
	Program status	2
	Observations	3
	Multimission RPVs	5
	Program status	6
	Advanced multimission RPV	6
	Conclusions and recommendations	7
3	ARMY RPV PROGRAMS	8
	Aquila	8
	Program status	8
	Conclusions and recommendations	9

### ABBREVIATIONS

GAO	General Accounting Office
RPV	remotely piloted vehicle

D I G E S T

The Army, Navy, and Air Force are developing unmanned aircraft piloted by remote control for reconnaissance, surveillance, and communication missions now flown by men in planes.

The Department of Defense thinks remotely piloted vehicles can fly some missions at less cost and can accomplish other missions that are impractical for manned aircraft. They have budgeted over \$700 million to develop and produce remotely piloted vehicles over the next 5 years.

In fiscal year 1977 they budgeted about \$105 million for these programs, \$77 million of which was for the Air Force's Compass Cope and BGM-34C and the Army's Aquila remotely piloted vehicles.

The Compass Cope is a high-altitude, long-endurance, relatively large aircraft that is being developed by the Boeing Company. It is being designed to carry changeable equipment for different missions, such as battle area surveillance, communication, target location, and signal intelligence.

The BGM-34C is a multimission, medium-sized remotely piloted vehicle being developed by Teledyne Ryan. It is designed for short-range electronic warfare and reconnaissance missions. The Air Force is also studying ways to use this aircraft for carrying offensive weapons.

The Army's Aquila is a 135-pound aircraft with a 35-pound payload being developed by the Lockheed Missile and Space Company. Launched from a truck-mounted catapult, it is designed for surveillance, reconnaissance, and targeting missions.

GAO found that the Air Force did not follow established procedures for developing new systems and that the Army Aquila program has incurred major cost and schedule overruns. Specifically:

--The Air Force began developing the Compass Cope without first resolving issues on mission, need, and cost effectiveness, and the need for the system was questioned by the Tactical Air Command as late as April 1976. (See pp. 3 and 4.)

--The Compass Cope program still has not been reviewed by the Defense Systems Acquisition Review Council and its cost effectiveness has not been resolved. Due to a change in Department of Defense practices this program may not be reviewed by the Defense Systems Acquisition Review Council. (See pp. 3 and 4.)

--The Air Force has not resolved Federal Aviation Administration and international restrictions which may restrict some routine Compass Cope operations. (See pp. 4 and 5.)

--The Army's Aquila program has been plagued with design and procedural difficulties which have led to cost growth and schedule slippage. (See p. 9.)

GAO recommends that the Secretary of Defense determine if the Air Force needs the Compass Cope and if it is cost effective to deploy a new weapon system when there are existing aircraft which may be able to perform the Compass Cope mission.

Also, the matter of flight restrictions imposed by the United States or foreign governments should be resolved.

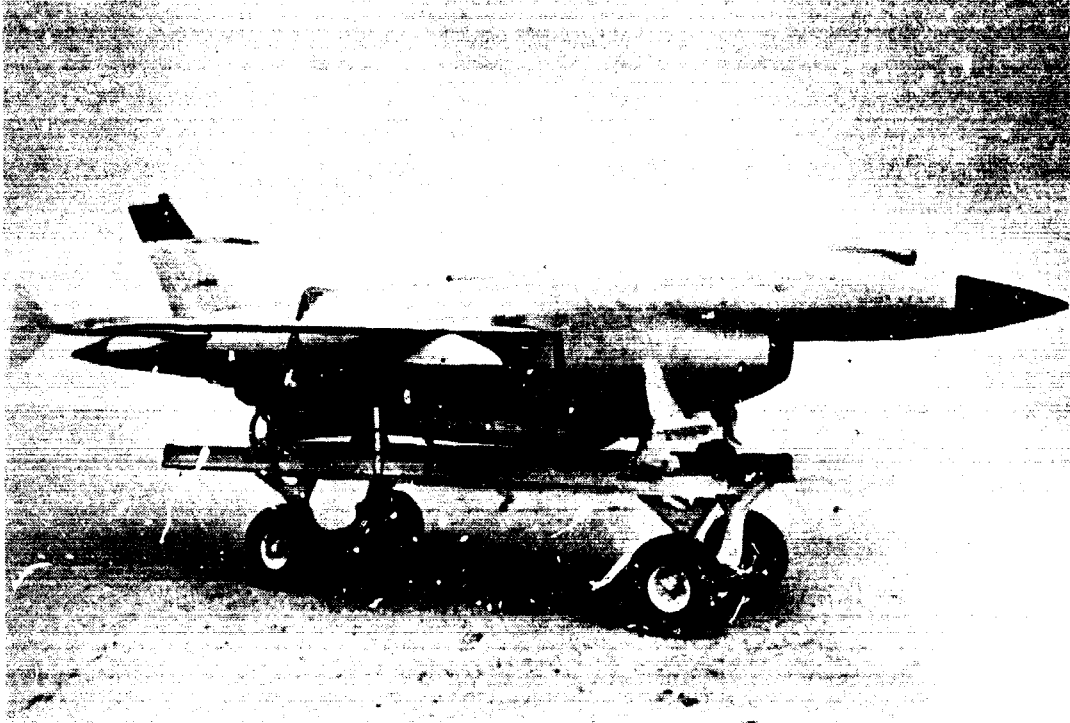
The Secretary of Defense should also direct the Defense Systems Acquisition Review Council to review the Compass Cope program, as well as other remotely piloted vehicle programs, to provide the three services

involved in remotely piloted vehicle development programs the benefits of such reviews.

Because of the problems encountered and the planned use of remotely piloted vehicles with Army weapons, such as the cannon launched guided projectiles, GAO recommends that the Secretary of Defense make sure the basic concepts, such as launch and recovery, are proven before the Aquila program is allowed to proceed further.

A draft of this report was reviewed by agency officials associated with management of the programs and their comments have been incorporated as appropriate.

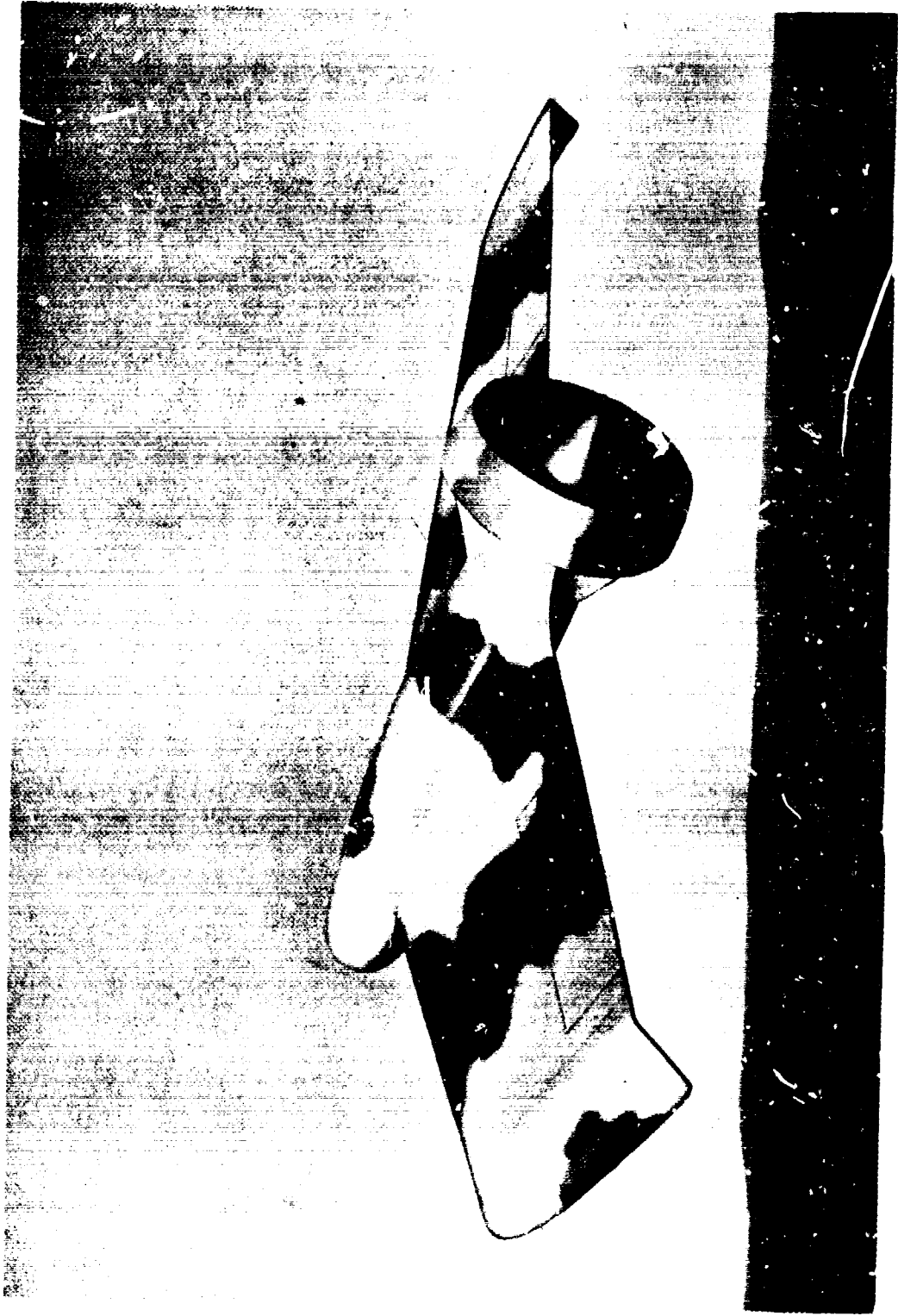




**AIR FORCE BGM-34C MULTIMISSION RPV**



**(PHOTO COURTESY OF U.S. AIR FORCE) AIR FORCE COMPASS COPE RPV**



**ARMY AQUILA RPV**

(PHOTO COURTESY OF LOCKHEED MISSILE & SPACE COMPANY, INC.)

## CHAPTER 1

### INTRODUCTION

The Department of Defense plans to spend over \$700 million in the next 5 years to develop and produce remotely piloted vehicles (RPVs) with about \$105 million requested for fiscal year 1977. Over 70 percent of the requested funds were for two Air Force programs--the Compass Cope and Multimission--and one Army program--the Aquila.

The Air Force, Army, and Navy have used RPVs as airborne target drones for the past 20 years. The Air Force has successfully used them for reconnaissance and electronic warfare. The last major RPV development programs were in the late 1950s and early 1960s. The Army spent about \$300 million on five different programs to develop reconnaissance drones but the programs were unsuccessful. The Navy spent more than \$250 million to develop and purchase 750 drone anti-submarine helicopters which, after 411 crashed, were removed from service. RPVs are being developed because Department of Defense officials believe RPVs may be able to perform high-risk and politically sensitive missions more practically and at less cost than piloted aircraft.

### SCOPE

This review was done to document the status of the Compass Cope, Multimission, and Aquila RPV programs, and to provide data for helping the Congress evaluate RPV programs and budget requests. We reviewed records, documents, and reports, and held discussions with responsible officials. The work was done at the Pentagon; Wright-Patterson Air Force Base, Dayton, Ohio; Army Aviation Systems Command, St. Louis, Missouri; and the Army Mobility Research and Defense Laboratory, Fort Eustis, Virginia.

A copy of this report was reviewed by agency officials associated with management of the program and their comments have been incorporated as appropriate.

## CHAPTER 2

### AIR FORCE RPV PROGRAMS

The Air Force plans to spend \$831 million to develop and produce five RPV programs through fiscal year 1983. The major programs are the Compass Cope and the Multi-mission RPV, designated the BGM-34C. The status of these programs and our observations are discussed below.

#### COMPASS COPE

The Compass Cope is a large, high-altitude, long-endurance unmanned aircraft. Its potential missions include (1) battle area surveillance, (2) communication, (3) targeting, and (4) signal intelligence. Work on the Compass Cope began in 1971 and 1972 after the Air Force received unsolicited proposals from the Boeing Company and Teledyne Ryan offering to demonstrate a high-altitude long-endurance aircraft. The Air Force awarded contracts to each company to demonstrate the technology necessary to build such an aircraft. During 1971 to 1975 each company designed, built, and tested prototypes of their aircraft.

#### Program status

Following the tests, the Air Force decided to enter full-scale development with the Compass Cope. After a competitive phase between Teledyne Ryan and Boeing, the Air Force selected Boeing as the contractor. In August 1976 the Air Force awarded them a \$77.2 million cost plus incentive fee development contract to design, build, and test three aircraft, including the necessary supporting equipment, by late 1980. The Air Force said that the contract is a two phase contract covering subsystem development as well as development of the full production system; Boeing is currently limited to subsystem design and test effort. The total development program, including Air Force and contractor costs, was estimated at \$160 million.

The Boeing development contract also gives the Air Force the option to buy 20 production aircraft and 2 ground command systems. The estimated unit flyaway cost of these 20 aircraft is \$4.5 million with a total production program cost of about \$202 million. Production is planned to start in early 1981 provided development is successfully completed and funds are available. Although only 20 aircraft are now planned for production, an Air Force official said they may purchase up to 108 of these aircraft.

## Observations

The Defense Systems Acquisition Review Council was established as an advisory body to the Secretary of Defense on acquisition of major systems. The council is supposed to review new systems at least three times: before programs are started, before full-scale engineering development, and again before production starts. In part, the council evaluates the program and satisfies itself that:

- A military need has been demonstrated for the new system.
- Mission, performance requirements, and specifications are adequately defined and economically plausible.
- Major problems, issues, and risks are identified and suitably resolved.
- Future support costs, including comparisons with current systems, have been evaluated.

In the case of Compass Cope, two reviews should have taken place because it is now in the full-scale engineering development phase. The council, however, has not reviewed the program. A review was initially scheduled in October 1975, but was delayed because Department of Defense officials believed the Air Force's justification was not sufficiently defined. Another review was scheduled for the spring or early summer of 1976, but the Air Force still had not completed its justification.

As of February 1976, the Air Force intended to obtain a Secretary of Defense decision through the Defense Systems Acquisition Review Council. In the fall of 1976, this approach was changed to call for an Air Force review in March 1977, rather than a Defense Council review. This is in line with current Defense Department desires to decentralize reviews of certain weapon systems. The Air Force review does not eliminate the possibility of a Defense Council review.

Review of the Compass Cope program by the Defense Systems Acquisition Review Council is necessary because the need for and cost effectiveness of the system have not been fully established. The Tactical Air Command, which is expected to be the primary user, questioned the need for the Compass Cope as late as April 1976. In a message to the Air Force

Vice Chief of Staff, the Vice Commander of the Tactical Air Command said:

- There was no operational need for the Compass Cope System because there was no firm vehicle requirement.
- Alternative aircraft, such as the U-2, T-39, and RF-4 should be considered for the Precision Location Strike System and Side Looking Airborne Radar.
- Development and procurement funds planned for the Compass Cope program are needed for more critical programs.

The Vice Chief of Staff agreed that piloted aircraft could do many of the missions which may be assigned to the Compass Cope but said the Compass Cope development program should be continued until the Air Force had fully investigated the program and its cost effectiveness.

The Air Force completed a cost-effectiveness study for the Compass Cope as a carrier for the Precision Emitter Location Strike System, which is one of the potential missions. They compared it with 10 existing manned aircraft and concluded from their study that no one system dominated the others on the basis of cost, effectiveness, and survivability. The Air Force later concluded from the study that Compass Cope and U-2 were the most effective carriers of the Precision Emitter Location Strike System and contracted for a cost comparison of the two aircraft. That study showed that the Compass Cope could operate at a lower life cycle cost as a carrier of the Precision Emitter Location Strike System. The Air Force is studying the cost of other potential Compass Cope missions but the studies have not been completed.

Another issue is whether the Compass Cope may be restricted during some routine operations. The Air Force expects to operate the aircraft in the United States, Germany, Belgium, The Netherlands, United Kingdom, and Italy. In the United States, the Federal Aviation Administration permits RPV operations in positive control airspace (all airspace above 18,000 feet), and in restricted and warning areas. When RPVs are flying outside these areas, they must comply with the "see and avoid" concept or be accompanied by a chase plane which can communicate with the control source.

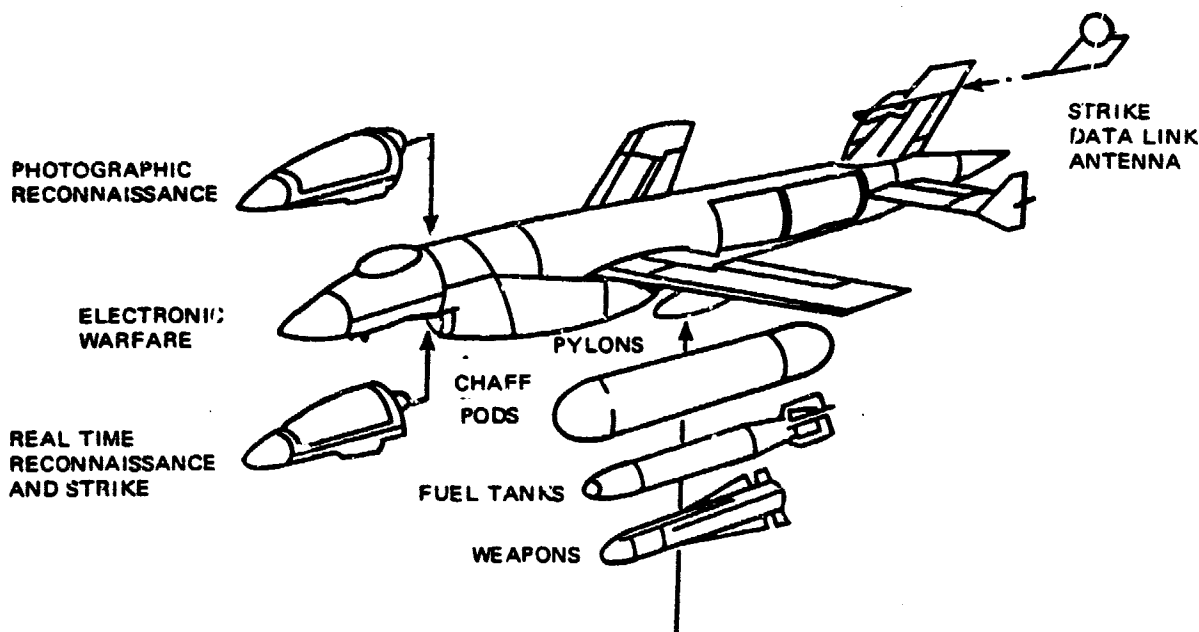
Air Force officials said the restrictions should not severely affect U.S. operations because of the limited number of Compass Cope aircraft and operating bases. They are also considering onboard sensors, such as a television camera or a collision avoidance system, which could ease existing restrictions. Air Force officials said that the British, Italian, and Dutch governments think Compass Cope can be integrated into their air traffic control systems without major problems. The Belgian and German governments have not yet provided official opinions.

### MULTIMISSION RPVs

The Air Force is developing a multimission, medium-sized, short-range RPV, designated the BGM-34C, to replace single-mission electronic warfare and reconnaissance RPVs. An interchangeable modular nose section is added for either electronic warfare or reconnaissance flights. The BGM-34C will also be tested for carrying offensive weapons.

The Teledyne Ryan Company, under a development contract awarded in November 1974, is developing the BGM-34C. The drawing below shows the planned design.

DRAWING OF BGM-34C SHOWING EQUIPMENT  
USED FOR VARIOUS MISSIONS



## Program status

The contractor began flight testing in September 1976, and four test flights have since been completed. Midair retrieval, the planned method of recovery, failed during the second flight because the engagement parachute did not inflate properly. Using the main parachute, the RPV landed and was damaged. Program officials said damage was minor and the aircraft was repaired. They also reported no major problems on the remaining three flights.

The Air Force began flight testing on November 15, 1976. Two flights have been completed with both ending in missed midair retrievals and damage to the aircraft. Program officials said the engagement parachute again failed to open properly and that damage to both RPVs was minor and the aircraft would be repaired. The contractor and Air Force plan to complete testing in May 1977. Preliminary performance estimates show the BGM-34C, under most conditions, is faster, will fly higher, and carry more than the RPVs it will replace. The Air Force also projects the maintenance time between missions will be reduced by about 50 percent.

The contractor's estimated development cost is \$20.6 million (the initial estimate was \$13.8 million). A program official attributed the cost growth to changes the Air Force has directed and to projected contractor overruns.

A production decision will be made for the electronic warfare model in March 1977 and the reconnaissance model in September 1977. Air Force officials said that either additional single-mission or BGM-34C RPVs will have to be bought to fulfill projected requirements. The Air Force has not completed life cycle cost studies. Preliminary comparisons of single-mission RPVs and a mixed force of single-mission and BGM-34C RPVs show procurement costs are about the same and the mixed force will have about a 6-percent lower life cycle cost.

The Air Force plans to buy 136 production model BGM-34C RPVs at a total estimated cost of \$195.5 million.

## Advanced Multimission RPV

The Air Force is working on an Advanced RPV which will eventually replace the BGM-34C. The Advanced RPV will perform



reconnaissance, electronic warfare, and strike missions. In April 1976 three contractors completed conceptual studies which identified missions, defined performance requirements, and established initial designs.

The Advanced Multimission RPV program is just getting started. The Air Force plans to spend about \$5.9 million during fiscal year 1977 through 1980 for additional studies. Development is expected to cost at least \$159 million and start in the early 1980s.

### CONCLUSIONS AND RECOMMENDATIONS

The Compass Cope program has entered full-scale development although basic questions concerning mission, need, flight restrictions, and cost effectiveness have not been resolved. Furthermore, the Compass Cope program has neither been reviewed by the Defense Systems Acquisition Review Council nor is it included in the selected acquisition reporting system. We believe the proposed Air Force review may not provide sufficient review of this program. Further, since RPV work is being carried out by the Army and Navy, we recommend that the Secretary of Defense:

- Direct the Defense Systems Acquisition Review Council to review the Compass Cope program as well as other RPV programs, at the appropriate time, to provide the three services involved in RPV development programs the benefits of such reviews.
- Determine if there is a valid requirement for the Compass Cope and whether it is cost effective to deploy another new weapon system when there are existing aircraft which may be able to perform the Compass Cope mission.
- Resolve potential flight restrictions.

## CHAPTER 3

### ARMY RPV PROGRAMS

The Army's principal RPV program is the Aquila, which is to demonstrate the use of small RPVs for tactical surveillance and target identification. The Army plans to develop an operational RPV (Little Scout) incorporating technology gained on the Aquila and other related programs.

#### AQUILA

The Aquila is a small RPV, weighing about 135 pounds, with a 35-pound payload. It is launched from a truck-mounted catapult, cruises at 75 to 120 knots, and is recovered by flying into nets suspended several feet above the ground. The Aquila can be programmed to fly a course or can be remotely controlled.

The Lockheed Missile and Space Company is developing the system under a contract awarded in December 1974.

#### Program status

Lockheed began testing the Aquila in December 1975, with six successful test flights. These aircraft were remotely controlled and equipped with landing gear for conventional takeoff and landings. The landing gear was removed for testing on catapult launchers and for recovery using arresting wires and nets.

Flight testing between January and September 1976 was plagued with design and procedural problems on the recovery and other systems, and eight out of nine aircraft crashed. Because of these crashes the Aquila has been modified and the landing apparatus changed. The program had 13 successful flights from October 4 through December 16, 1976, and one flight was parachute recovered. Seven of the flights included automatic launch and recovery. The last three flights were conducted by military personnel.

All flight testing to date has been on the basic RPV system, including propulsion, airframe, launch and recovery, and control stations. Testing of the RPV with equipment, such as television camera, target locator, and laser, to be used for planned missions has not been completed.

The Aquila program has been extended 13 months and costs have increased from the initial estimate of \$7.6 million to \$14 million. The schedule slippage and the cost increase were primarily caused by the problems experienced during testing. The Army is funding the contractor from week to week until the necessary changes are made in the system. Testing is scheduled to be completed by the contractor in May 1977. The Army will start field testing in June 1977.

#### CONCLUSIONS AND RECOMMENDATIONS

Delays in completing the Aquila program, caused by design and procedural difficulties identified during testing, have led to \$6.4 million in cost growth. To date, testing has been concentrated on proving the Aquila can be launched and recovered. Tests to show that an Aquila-type RPV can do the missions it is being designed for have not been completed.

Because of the problems encountered and the planned use of RPVs with Army weapons such as the cannon launched guided projectiles, we recommend that the Secretary of Defense make sure the basic concepts, such as launch and recovery, are proven before the Aquila program is allowed to proceed further.