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Report to the Chairman, Legislation and National Security Subcommittee, Committee on Government Operations, House of Representatives

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UNMANNED AERIAL VEHICLES

Performance of Short-Range System Still in Question

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The Honorable John Conyers, Jr.
Chairman, Legislation and National
Security Subcommittee
Committee on Government Operations
House of Representatives

Dear Mr. Chairman:

The Department of Defense (DOD) is acquiring the Short-Range Unmanned Aerial Vehicle (UAV) at an estimated cost of $4.1 billion to meet the needs of the military services for reconnaissance, surveillance, target acquisition, and intelligence missions. As you requested, we evaluated the Short-Range UAV's performance capability as demonstrated in recent testing.

Background

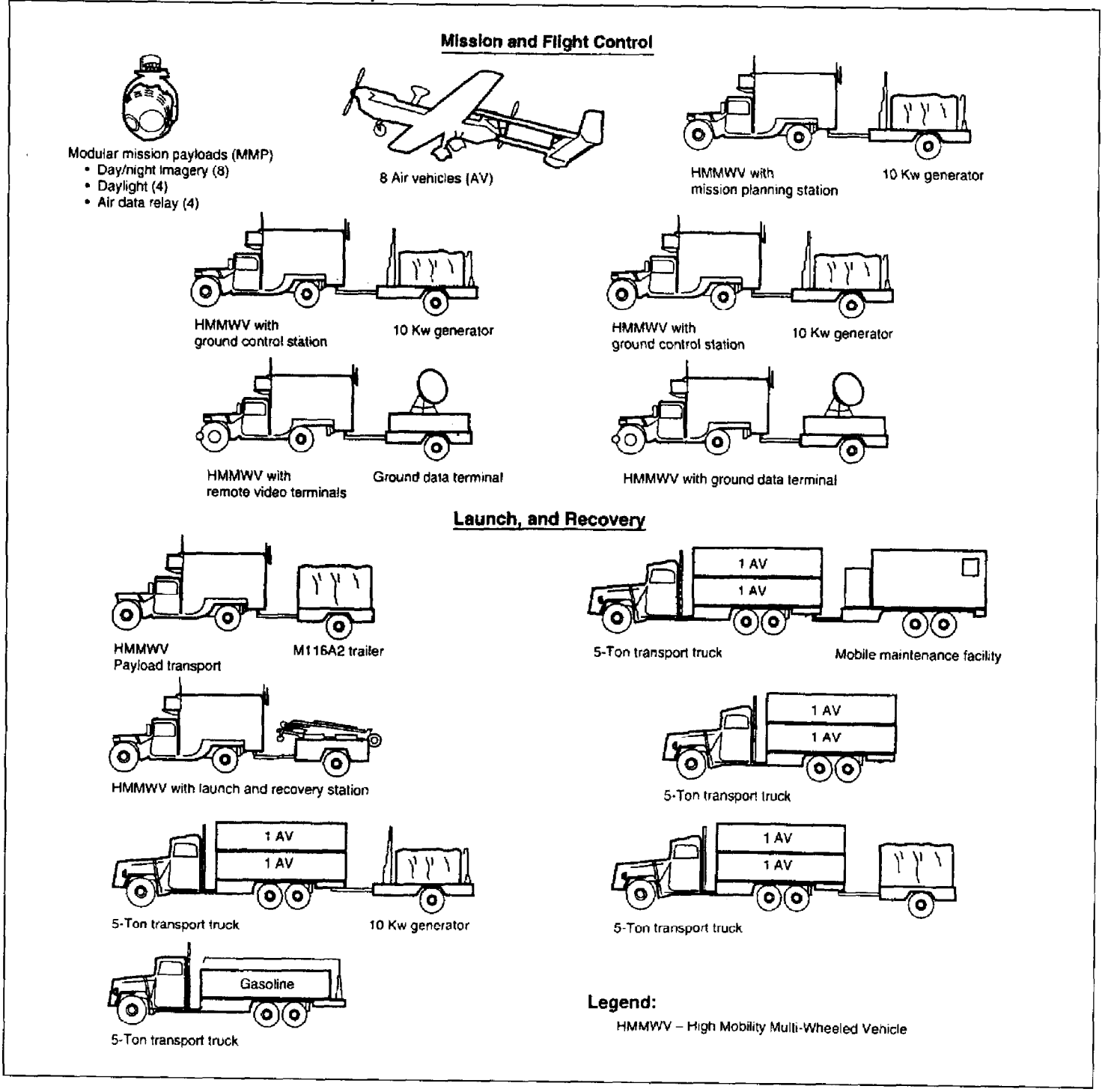
The Short-Range UAV is a pilotless aircraft resembling a small airplane that can be controlled from a ground station. (See fig. 1.) It is to accomplish its various missions by flying over enemy territory and transmitting video imagery back to ground stations for use by military commanders.

DOD initiated acquisition of the Short-Range system in 1989 by procuring candidate systems for competitive testing. In early 1993, after completing the testing, DOD approved initiation of the winning system's low-rate production and awarded a $171-million contract to produce seven systems. Each system is to include eight air vehicles with payloads, a launch and recovery station, ground stations for controlling flight and processing information from the air vehicles, and other related equipment as shown in figure 2.

Figure 1: Short-Range UAV

Source: U.S. Army.

Figure 2: Short-Range UAV System Description



The preproduction test program included tests to determine the system's technical performance capability as well as "limited user tests." The limited user tests, which were conducted by the services' operational test agencies, were to determine the system's ability to satisfy user requirements.

We focused primarily on the results of limited user tests because they closely approximate an evaluation of a system's operational effectiveness and suitability. Operational testing is scheduled to be conducted before full-rate production begins in 1995.

Results in Brief

Although DOD considered the Short-Range system's preproduction test results to be sufficient to justify its low-rate production, the detailed test results showed deficiencies that could jeopardize the system's capability to meet military requirements. In addition, several important performance requirements were either not tested or were tested under unrealistic conditions, further compounding the uncertainty about system performance.

Thus, DOD has committed to acquiring an unproven and possibly deficient system. This condition occurred because DOD allowed the Short-Range program to be driven by schedule requirements rather than by demonstrated accomplishments, as required by DOD's stated policy. Moreover, DOD is continuing to allow the program to be schedule-driven and may begin the system's full-rate production without adequate assurance of the Short Range UAVs performance capability.

Preproduction Testing Reveals Deficiencies

System test results showed that the Short-Range UAV has several deficiencies that, if not corrected, will result in unsatisfactory performance. The system failed to demonstrate that it could successfully operate at distances required for most projected missions of the Army and Marine Corps units that will use the system, could not adequately support targeting for friendly artillery, and was too large to be airlifted as required. In addition, the system showed questionable reliability.

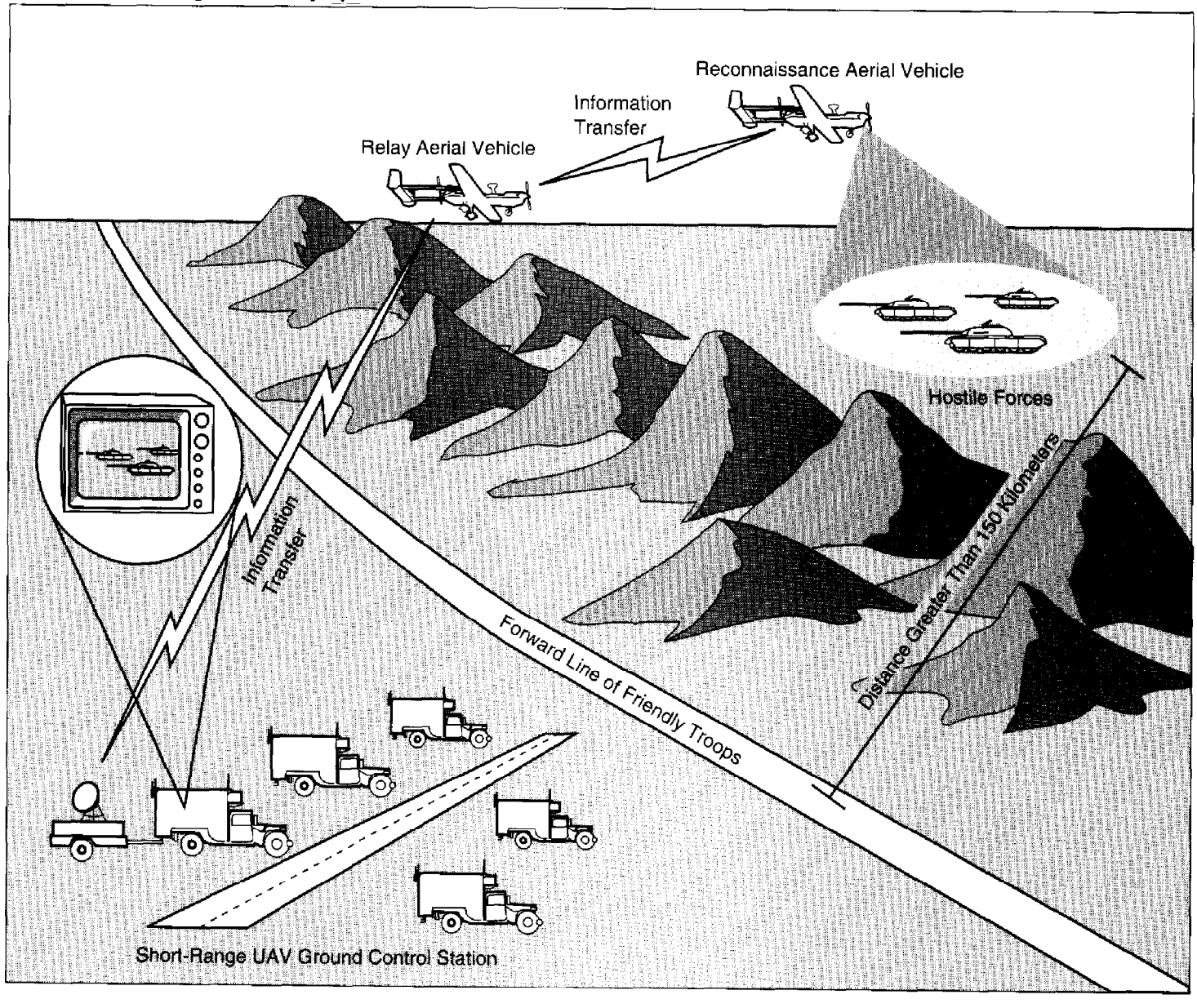
Short-Range UAV Failed Relay Requirements

Most of the projected missions of the Army and the Marine Corps units using the Short-Range system will require that UAVs operate at a range greater than that at which they can be controlled by the ground station.

DOD expects to overcome this limitation through a process called "relay operations."

Relay operations involve controlling a UAV at long range through a second UAV operating at a closer range, as shown in figure 3. This technique is to be accomplished by the ground station transmitting commands to and receiving video imagery from the air vehicle operating at long ranges through relay equipment of the UAV operating at a closer range.

Figure 3: Short-Range UAV Relay Operations



Most of the limited user tests planned to demonstrate this relay operation capability failed because of engine failures or other problems with the air vehicle and relay component. Test results showed that the system successfully completed only 4 of 11 relay flights. Furthermore, only 20 percent of the total flight time was in relay mode instead of 84 percent, as the Short-Range UAV is required to perform. The test agency concluded that the system's ability to transmit video imagery during relay operations was also unacceptable for a fielded system.

System Failed to Meet Time Standards for Supporting Artillery Operations

The Short-Range system is supposed to identify and locate targets so that they can be engaged by artillery fire. The system is also required to detect where artillery lands in relation to the target so that the artillery can be adjusted. To be effective, these tasks must be done quickly so that the targets can be hit before they are able to take cover or move.

Accordingly, the Short-Range system is required to notify the artillery operator of the target location within 4.25 minutes from the time the target is initially identified. The time allowed for subsequent adjustments of artillery fire is 10 seconds.

The Short-Range system failed both requirements. It required over 11 minutes to provide the artillery operator with the target location and 60 seconds to provide data for adjusting artillery fire. The test agency concluded that the system was not sufficiently timely and may never meet Army time standards.

Transportability Requirements Were Not Achieved

The Short-Range system's requirements state that it must be transportable by the C-130 and other larger aircraft, such as the C-5. The importance of being able to use C-130s was demonstrated during Operation Desert Storm when larger aircraft were not always available to transport the Pioneer UAV, DOD's currently deployed short-range UAV.

With respect to use of the C-130, the Short-Range system is supposed to be capable of being driven on and off the aircraft while loaded on trucks. However, tests showed that the system was too large to meet this requirement. The system's 5-ton truck and loaded UAV container were too high, even with the tires deflated, to fit inside a C-130 aircraft. To transport the Short-Range system on this aircraft, the air vehicles must be removed from the 5-ton trucks. DOD's analysis showed that more than 14 C-130 plane loads would be required to transport one complete Short-Range system, which the test agency concluded was unsatisfactory.

Short-Range System's Reliability Is Questionable

Test results showed that the Short-Range system was unreliable in several critical areas. The system required frequent unanticipated repairs; the air vehicle engine performance was unacceptable; and the built-in test equipment was inadequate.

System Required Frequent Unanticipated Repairs

According to DOD's report on lessons learned during Operation Desert Storm, the frequent failure of the Pioneer UAV showed that systems must be reliable to adequately support combat operations. To ensure that the Short-Range UAV is reliable and does not create an excessive maintenance burden, its requirements specify that the system may require no more than one unanticipated repair every 4 hours. However, during limited user testing, the system required 154 unanticipated repairs during 182 hours of operation, or 1 repair every 1.2 hours.

Despite these results, the test agency determined that the system achieved its overall reliability threshold. However, in making this determination, the test agency excluded most failures because they did not result in a complete breakdown that prevented the system from performing the mission. For example, if in attempting a mission, an air vehicle failed and another was available to take its place, the system was not charged with a failure. Of the 154 failures occurring during the tests, only 10 were counted against the system.

Air Vehicle Engines

The air vehicle engines, two in each air vehicle, were particularly unreliable and had a short life. Of the 154 unanticipated repairs, almost 30 percent were due to engine-related problems. Because of the repeated engine failures, the project manager directed the contractor to replace all engines with modified versions. Although the new engines showed some improvement, frequent failures continued.

According to the test agency, each UAV unit equipped with 2 systems could be required to replace from 3 to 10 of the modified engines per week. The test agency concluded that the frequent engine replacements could overburden the services' logistics systems.

Built-in Test Equipment

Test officials concluded that the built-in test equipment, which is supposed to identify system problems needing repair, consistently failed to meet its requirements and required redesign to correct the deficiencies. During the testing, the built-in test detected only 11 of 154 problems and isolated the cause of only 2 of the 11 faults detected. The test agency concluded that the inadequate built-in test design significantly hampered system maintenance and increased the time to correct problems.

The importance of built-in test equipment is illustrated by DOD's experience with the Airborne Self-Protection Jammer, a major electronic warfare system for aircraft protection. That system was recently terminated in part because of continuing problems with its built-in test equipment.

Key Performance Requirements Were Not Evaluated or Were Not Tested Under Realistic Conditions

Because of limited preproduction testing, uncertainty exists about whether the Short-Range UAV will satisfy some of its other performance requirements. Several important requirements were not evaluated during the system's preproduction testing or were tested under unrealistic conditions.

System Survivability Not Evaluated

According to DOD acquisition policy, survivability is a critical system characteristic that must be addressed during the acquisition process. The policy requires system developers and test agencies to evaluate critical survivability characteristics as early as possible. Threats to be considered include conventional weapons, such as anti-aircraft weapons, and advanced threats, such as high-power microwave and directed-energy weapons.

Despite this policy, survivability of the Short-Range UAV system was not assessed during limited user testing. Limited aspects of survivability were addressed during technical testing, but the results were considered inconclusive. Thus, the adequacy of the Short-Range system's survivability characteristics is unknown.

Electromagnetic Compatibility Not Adequately Tested

Electromagnetic compatibility refers to the capability of electric or electronic systems to operate in their intended environments without causing or suffering from interference with other systems. DOD policy requires that systems be designed to have this capability and that its adequacy be verified through testing in the intended operational environment.

Electromagnetic compatibility was proven to be a critical operational capability during Operation Desert Storm. According to the Joint Project Office, electromagnetic interference caused the loss of two Pioneer UAVs

and severe damage to two others. Furthermore, electromagnetic interference created by emissions from microwave towers and other systems resulted in temporary loss of control of the air vehicle and prevented video imagery from being transmitted to the ground control station.

Nevertheless, the Short-Range system's limited user tests conducted prior to limited production did not address this issue. In fact, to avoid any potential interference problems, test officials took steps to ensure that the test area was free from electromagnetic interference.

An electromagnetic interference assessment of the Short-Range system was done during technical tests but was considered inadequate. The system was subjected to emissions from 10 threat radars, but because of errors in pretest calculations, the radar radiation levels were too low. Test officials concluded that the tests were inadequate to determine the true electromagnetic impact on the system. However, even at the low radiation levels, 4 of the 10 radars created interference in the air vehicle's video imagery transmission.

Preproduction Testing Was Conducted in Unrealistic Environment

Based on the Short-Range system's deployment plans, the system has not been tested in a realistic environment. To determine the operational effectiveness and suitability of weapon systems to meet requirements, DOD policy requires that system performance be evaluated under realistic tactical conditions. Such testing is DOD's primary means for predicting weapon system performance.

As we reported in 1992,[1] the Short-Range system is required to operate in areas marked by hilly or mountainous terrain with dense forests and other vegetation and by varied climatic conditions such as cloudy weather, rain, snow, and other factors. The limited user tests, however, were conducted only in the arid environment of Fort Huachuca, Arizona, a typical desert terrain with only sparse vegetation and generally clear weather. (See fig. 4.) When we viewed the test area in 1992, targets that the system was supposed to detect were easy to locate. The system's ability to identify targets under other environmental conditions, such as in more densely covered terrain, has not been tested.

[1]Unmanned Aerial Vehicles: More Testing Needed Before Production of Short-Range System (GAO/NSIAD-92-311, Sept. 4, 1992).

Figure 4: UAV Test Range

The system's ability to operate in the rain is also questionable. During technical tests, the system was subjected to simulated rainfall inside a chamber. The rain environment interfered with the air vehicle's ability to transmit information to the ground control station. Test officials concluded that further testing in a real rain environment was required to determine the exact effects of rain on the system.

During limited user testing, a brief but heavy thunderstorm occurred on one of the flight tests. System operators, unable to establish a relay during

the thunderstorm, canceled the mission. Test results concluded that the thunderstorm caused the unsuccessful attempt to establish a relay.

Despite the system's performance requirements and recommendations from testing officials, DOD has not established plans to test the system's in other than a desert environment. Plans to conduct a second phase of limited user testing of the system's operation in a different environment were canceled because of delays caused by performance problems that occurred after the system entered low-rate production.

Threat Ignored During Test of System's Target Location Capability

Test results showed that the Short-Range system can locate enemy targets under certain conditions. However, no attempt was made to determine if the system could perform these operations in a realistic hostile environment. In evaluating the tests, the DOD Director of Operational Test and Evaluation stated that system operators ignored the potential capability of the enemy air defenses in planning missions, navigating the flight route, and searching target areas. Further, the UAV was allowed to loiter in predicted target areas well within the engagement range of defense systems for extended periods of time. The DOD Director of Operational Test and Evaluation concluded that these actions adversely affected the credibility of the test results.

Launch and Recovery Testing Was Unrealistic

Preproduction testing of the Short-Range system's launch and recovery operations was not conducted according to system requirements. The stated requirements for the Short-Range UAV specify that the system must be capable of operating from an unimproved flat grass or dirt surface measuring 200 by 75 meters. Nevertheless, two runways with improved surfaces were used during the Short-Range system's limited user testing. While unpaved, the runways were graded and packed by heavy road construction equipment. (See fig. 5.) No operations were conducted from unimproved areas. The importance of this requirement was illustrated during Operation Desert Storm, which showed that the need to construct hard surfaced runways was a severe constraint to operating the Pioneer UAV and required considerable cost, time, and manpower.

Figure 5: Improved Runway at UAV Test Site

Furthermore, the dimensions of both runways exceeded the required distances. One runway measured 1,500 by 30 meters, while the other measured 300 by 75 meters. Test results showed that distance required for most recoveries of the air vehicle exceeded the 200-meter limitation.

In response to our 1992 report, the UAV Joint Project Office Director acknowledged that the runways used during limited user testing were improved surfaces but stated that using engineering battalions in combat to construct runways would meet requirements. However, during Operation Desert Storm, the Army found that rather than using scarce

engineering equipment to construct UAV airfields in a combat environment, it needed a UAV system that could operate from unimproved surfaces. Whether the Short-Range system can fulfill this need is uncertain.

Contractor Provided All Maintenance

Although DOD plans for the Short-Range system to be maintained by military personnel, all maintenance during the preproduction test program was done by contractor technicians. Thus, DOD has no assurance that military personnel will be able to maintain the system.

Short-Range Program Management Is Inconsistent With DOD Policy

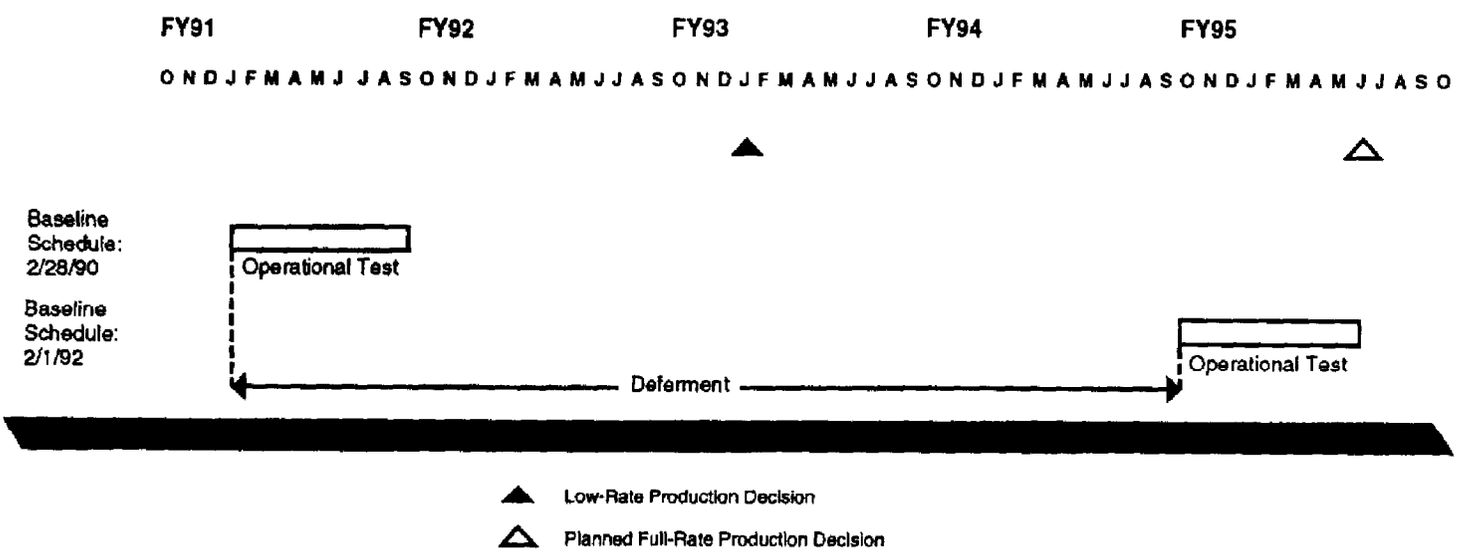
Contrary to its stated policy, DOD's management of the Short-Range program has been driven by DOD's perceived need to begin production and deploy the system as quickly as possible. DOD's stated policy establishes a disciplined management approach for acquiring systems that satisfy user needs. It provides that acquisition strategies shall be event-driven and link major contractual commitments and milestone decisions to demonstrated accomplishments in testing. The policy requires that results to be accomplished, referred to as exit criteria, shall be established and achieved before a program can proceed to the next phase. However, DOD's management of the Short-Range system has not been consistent with these policies.

System Acquisition Is Schedule-Driven

The lack of a commitment by DOD management to ensure procurement of an adequate system is evidenced by the schedule-driven acquisition strategy DOD has followed throughout the Short-Range program's existence. For example, during our 1990 review of the Short-Range program, DOD agreed to subject the system to one phase of operational testing before beginning production.[2] Subsequently, when technical problems were encountered, DOD deferred operational testing for 3 years but delayed low-rate production only 9 months. (See table 1.) As a result, DOD began low-rate production without first conducting operational testing that could have reduced some of the uncertainty about the system's performance.

[2]Unmanned Aerial Vehicles: Realistic Testing Needed Before Production of Short-Range System (GAO/NSIAD-90-234, Sept. 4, 1990).

Table 1: Deferment of Operational Testing



Despite recent breakdowns in the system's performance, DOD has not delayed the system's full-rate production decision date. In April 1993, after award of the low-rate production contract, a Short-Range air vehicle crash on private property resulted in grounding the system. Flights resumed about 6 weeks later but were stopped again shortly thereafter because a critical component failed, nearly causing the air vehicle to crash again. The system remained grounded as of the end of June 1993. Instead of delaying the system's full-rate production decision to resolve these problems, DOD canceled tests and kept the 1995 full-rate production date. This creates further uncertainty about the adequacy of testing planned to support the production decision.

System Did Not Meet Exit Criteria

DOD approved the system's low-rate production even though it failed to meet established exit criteria for proceeding into low-rate production. The system was supposed to demonstrate launch and recovery operations from unimproved areas measuring 200 by 75 meters; however, as stated previously, all launch and recovery operations were performed on constructed runways that did not meet size requirements.

In addition, the exit criteria require the system to display video data, using the system's relay capability, at distances up to 200 kilometers from the control station. Although the system demonstrated the capability to meet the relay air vehicle maximum distance requirement during two flights, the overall quality of the video data was poor. The system suffered from software errors, loss of video picture, and lack of focus. Test results show that video problems were significant enough at times that the system operator stopped using the relay capability.

Recommendation

We recommend that the Secretary of Defense require that an event-driven acquisition strategy be established and adhered to for the Short-Range UAV that includes demonstration of satisfactory performance in diverse, realistic operational environments before proceeding with further production.

Matter for Congressional Consideration

Because of the significant performance deficiencies, inadequate testing, and DOD's heretofore unwillingness to defer production decisions until the system functions properly, Congress may wish to restrict the obligational authority for acquiring the Short Range UAV until the Secretary of Defense certifies that the system meets all essential operational requirements.

Agency Comments

As requested, we did not obtain agency comments on this report. However, we discussed its contents with officials from the Office of the Secretary of Defense, the Joint Project Office, and the Short-Range UAV Project Office. These officials generally agreed with the factual accuracy of this report. They stated that actions had been or were being taken that were designed to correct most of the Short-Range system's problems, but acknowledged that testing had not been done to ensure that all essential operational requirements were met.

Scope and Methodology

To accomplish our objective, we focused primarily on the results of limited user tests conducted by operational test agencies of the military services. These agencies used military personnel to operate the system during testing. We also examined the results of technical tests that assessed some other aspects of the system's performance. In addition, we reviewed (1) evaluations done by the DOD Director of Operational Test and Evaluation, (2) test plans and schedules, (3) performance requirements

documents, (4) acquisition plans, and (5) other records bearing on the Short-Range UAV's status and potential effectiveness.

We interviewed and obtained information from officials of the Office of the Under Secretary of Defense for Acquisition, Tactical Warfare Programs; Department of the Navy, Program Executive Office for Cruise Missiles and UAV Joint Project; Short-Range UAV Project Office; Army Operational Test and Evaluation Command; DOD Director of Operational Test and Evaluation; and the Marine Corps Combat Development Command.

We performed our work from September 1992 to September 1993 in accordance with generally accepted government auditing standards.

Unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from its issue date. At that time, we will send copies to other interested congressional committees; the Secretaries of Defense, the Army, and the Navy; and the Director, Office of Management and Budget. We will make copies available to others upon request.

Please contact me at (202) 512-4841 if you or your staff have any questions concerning this report. Major contributors to this report were Jackie B. Guin, Assistant Director; Pam Greenleaf, Evaluator-in-Charge; and Deena M. DeVane and Charles A. Ward, Evaluators.

Sincerely yours,

Louis J. Rodrigues
Director, Systems Development
and Production Issues

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