

September 1998

# ARMY AVIATION

## Apache Longbow Weight and Communication Issues



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United States  
General Accounting Office  
Washington, D.C. 20548

National Security and  
International Affairs Division

B-278882

September 15, 1998

The Honorable William S. Cohen  
The Secretary of Defense

Dear Mr. Secretary:

We reviewed the Army's Apache Longbow helicopter program to determine if its operational requirements will be met. Specifically, we determined whether the Apache Longbow will meet (1) the validated key performance requirement for vertical rate of climb (VROC) and (2) the requirement to transfer target data between Apache Longbow helicopters.

## Background

The Apache Longbow helicopter is designed to conduct precision attacks in adverse weather and on battlefields obscured by smoke, automatically engage multiple targets, and provide fire-and-forget missile capability. The Apache Longbow configuration consists of a modified airframe, a fire control radar, and a new Longbow (radio frequency) Hellfire missile. The Army plans to upgrade the entire fleet of 758 Apache helicopters to the Apache Longbow configuration but outfit only 227 with the radar and a more powerful 701C engine. The remaining 531 non-radar-equipped Apache Longbows will be equipped with the less powerful 701 engine, even though they will be reconfigured to accept the radar and upgraded 701C engine. In its fiscal year 2000-2005 program plan, the Army has proposed a reduction in the number of Apaches that will be converted to the Apache Longbow configuration.

The April 1994 Apache Longbow's operational requirements document (ORD) prescribes performance capabilities required for the system's survivability and lethality. These capabilities include meeting the vertical flight requirement, carrying the Longbow Hellfire missile, and passing target data when in line of sight and not in the line of sight. For the Apache Longbow, the Army has identified performance objectives (desired capabilities) and performance thresholds (minimum capabilities). The Army designated selected thresholds as key performance parameters. According to the Department of Defense's (DOD) acquisition guidelines, key performance parameters are those capabilities that are so significant that failure to meet the threshold can be a cause for the program to be reassessed or terminated.

The Apache Longbow ORD prescribes that, for survivability in the combat mission configuration, the system is required to achieve a VROC of at least 450 feet per minute at 4,000 feet and 95 degrees Fahrenheit while carrying 4 air-to-air missiles, 8 Hellfire missiles (4 semiactive laser Hellfire missiles and 4 Longbow Hellfire missiles), 320 rounds of 30-millimeter ammunition, and a full fuel load. VROC indicates the helicopter's ability to climb vertically from a hover position and its ability to conduct lateral maneuvers. Both lateral and vertical acceleration provide the agility a helicopter needs to extricate itself from threatening situations.

In October 1994, the Joint Requirements Oversight Council validated the ORD's VROC requirement of 450 feet per minute as a key performance parameter. The Council also made 12 Longbow Hellfire missiles a key performance parameter, replacing the ORD's combat mission requirement for 8 Hellfire missiles. In November 1994, the Army directed the Training and Doctrine Command's Apache Longbow system manager and the Program Executive Officer for Aviation to update the ORD to reflect the changed requirement. The Apache Longbow ORD and contract reflect the VROC requirement but not the revised Hellfire requirement.

The ORD describes non-line-of-sight communications capability as a critical system performance objective, but not a key performance parameter, of the Apache Longbow helicopter. The non-line-of-sight radio gives the radar- and non-radar-equipped Apache Longbow helicopters the ability to transfer targeting data when not in direct line of sight. Both the design and use of the fire control radar depend on the ability of the radar-equipped Apache Longbow to utilize terrain and vegetation for concealment, rise above a tree line or hill to acquire target data, return to a concealed position to transfer the target data to another Apache Longbow, and fire the Longbow Hellfire missile. The Army plans to use the ARC-220 radio to meet this requirement.

## Results in Brief

The Apache Longbow program needs to be reassessed because the helicopter does not meet two key user requirements. The Army's 227 radar-equipped Apache Longbow helicopters will be too heavy to achieve the validated VROC requirement of 450 feet per minute in the combat mission configuration when carrying a full fuel load and 12 missiles. According to the ORD, if the VROC requirement is not met, the helicopters will not have acceptable levels of maneuverability and agility to successfully operate in combat. Army plans to modify the helicopter will add weight and therefore exacerbate this problem. Weight increases will

have a greater impact on the non-radar-equipped Apache Longbow's vROC performance because it has less powerful engines.

At initial operational capability, the Apache Longbow will not have a radio that will allow it to transfer target data between helicopters when concealed or not in the line of sight. Unresolved technical issues have delayed the radio's development. More importantly, the Army plans to install the non-line-of-sight radio on only one-half of the total Apache Longbow helicopter fleet. The 50-percent reduction in planned radio procurement quantities will result in the Apache Longbow's lethality being reduced due to the inability to transfer target data between Apache Longbow helicopters and its survivability being decreased because of the helicopter's greater exposure to hostile forces.

## Apache Longbow Will Not Meet the Rate-of-Climb Requirement

The 227 radar-equipped Apache Longbows will not be able to achieve the combat mission vROC requirement of 450 feet per minute when carrying 12 missiles with a full fuel load. Thus, the system's survivability will be adversely impacted.

The contractor reports that, in the combat mission configuration, the Apache Longbow weighs 16,535 pounds after burning off 1,084 pounds of fuel. At this weight, the contractor reports that the Apache Longbow can achieve a vROC of 895 feet per minute, exceeding the required 450 feet per minute. From Army and contractor records, we identified those items that would have to be added to the helicopter to meet the ORD's combat mission requirement. When the reported Apache Longbow weight of 16,535 pounds is increased by the fuel burn off weight of 1,084 pounds to meet the ORD's full fuel load requirement, the helicopter's weight is 17,619 pounds. When the contractor's reported weight is increased by the weight associated with meeting the Hellfire missile requirement of 12 instead of 8 (430 pounds), the necessary launcher and pylon to carry them (207 pounds), and a full fuel load (1,084 pounds), we determined that the weight of the Apache Longbow would be about 18,256 pounds. According to Army engineers, an increase in weight of one pound causes a corresponding decrease in vROC of 0.839 feet per minute. With an increase in weight of either 1,084 or 1,721 pounds, the Apache Longbow would be incapable of meeting the validated vROC requirement of 450 feet per minute at 4,000 feet and 95 degrees Fahrenheit.

To achieve the validated vROC requirement of 450 feet per minute and carry the required 12 Hellfire missiles, aircraft weight must be reduced. Since

the Apache Longbow's 701C engine is operating at 100-percent maximum-rated power in the combat mission configuration when vROC is measured, no reserve engine power is available. In describing the Apache Longbow's ability to meet the vROC while carrying the 12 Hellfire missiles, the Army stated, in its November 1995 acquisition program baseline, that the helicopter can only achieve the vROC requirement by reducing weight, such as ordnance and/or fuel load. According to Army officials, reduced vROC performance will decrease the helicopter's ability to evade enemy fire, thereby decreasing survivability. Also, if the mission ordnance load is reduced to lower weight and, therefore, achieve desired vROC, lethality will be decreased because less ammunition and/or fewer missiles will be available for use against enemy targets. If the mission fuel load is reduced for the same purpose, mission range and/or loiter time will be decreased.

On the basis of the Army's planned system enhancements, the contractor expects the Apache Longbow's weight to increase by another approximately 1,000 pounds when existing requirements, such as improved avionics equipment, the non-line-of-sight radio, and fixes for systemic problems (including a new transmission and main gear box) are added to the helicopter. Also, based on new requirements, the contractor projects that weight will increase by an additional 500 pounds for items, such as, sensor improvements, a redesigned rotor system, an advanced weapon suite, and improved crew seats. With the additional 1,500 pounds, the Army will be further challenged to find ways to meet the Apache Longbow's vROC requirements.

The Apache Longbow ORD also requires that the 531 non-radar-equipped helicopters have a vROC equal to or greater than the radar-equipped aircraft to ensure that combat effectiveness is maintained. The non-radar-equipped helicopter has a less powerful engine, and the contractor reports that this helicopter has significantly less vROC capability than the radar-equipped helicopter. To improve vROC and corresponding maneuverability on non-radar-equipped aircraft, the Army plans to upgrade the 701 engines on these aircraft to the more powerful 701C engines. According to the Army, this upgrade will cost about \$1.1 million per aircraft, or about \$600 million for 531 helicopters. This requirement is included in the Army's future funding plans.

The additional power provided by the 701C engines may not provide the lift capability the non-radar-equipped Apache Longbow will need for the combat mission. Removing the radar will decrease weight by about 450 pounds. However, fuel and missile load requirements for the combat

mission will increase weight by about 1,721 pounds. The incremental increase of 1,271 pounds would have an adverse impact on the non-radar-equipped Apache Longbow's already limited VROC performance.

## Apache Longbow Will Be Fielded Without Required Communication Capability

At initial operational capability in October 1998, the Apache Longbow will not be able to meet the requirement to transfer target data to other helicopters when out of line of sight, as required. The Army plans to provide this capability through the ARC-220 radio but because of funding and developmental problems, it does not know when this required capability will be available. The ORD requires that all Apache Longbow helicopters be able to transmit, receive, and coordinate battlefield information. The Apache Longbow must interface with existing and planned Army command, control, communications, and intelligence systems. The communications system must support the transfer of mission data from ground units to aircraft, aircraft to aircraft, and aircraft to ground units. This communications capability requires airborne and ground non-line-of-sight communications.

As of May 1998, unresolved technical issues, including the amount and severity of electrical interference generated, have affected the radio's development. The ARC-220 Army project manager did not know when radio delivery would begin. The Army plans to address this and other concerns with additional testing; however, the Army does not currently plan to start testing the ARC-220 radio in the Apache Longbow until fiscal year 2000. According to the ARC-220 project manager, no other radio can provide the non-line-of-sight communications capability for the Apache Longbow.

Also, the Army has decided to equip only one-half, or 379, rather than all 758 helicopters with the ARC-220 radio due to changing Army funding priorities. Therefore, 50 percent of the Apache Longbow fleet will be unable to transfer or receive targeting data when out of the line of sight. The 50-percent reduction in planned radio procurement quantities will result in decreased lethality of the Apache Longbow fleet due to the inability to transfer target data between Apache Longbow helicopters. Also, the fleet's survivability will be decreased because of the helicopter's greater exposure to hostile forces.

## Conclusions

The Army's 227 radar-equipped Apache Longbow helicopters will be too heavy to achieve the validated VROC requirement of 450 feet per minute in

the combat mission configuration when carrying a full fuel load and 12 missiles. According to the ORD, if the vROC requirement is not met, the helicopters will not have acceptable levels of maneuverability and agility to successfully operate in combat. Army plans to modify the system will add weight and therefore exacerbate this problem. The impact of increased weight on the ability of non-radar-equipped Apache Longbow helicopters to achieve vROC performance requirements is even greater because of their less-powerful engines.

At initial operational capability, the Apache Longbow will not have a radio that will allow it to transfer target data between helicopters when concealed or not in the line of sight. Unresolved technical issues have delayed the radio's development. More importantly, the Army plans to install the non-line-of-sight radio on only one-half of the total Apache Longbow helicopter fleet. The 50-percent reduction in planned procurement quantities will result in decreased lethality of the Apache Longbow fleet due to the inability to transfer target data between Apache Longbow helicopters. Also, the fleet's survivability will be decreased because of the helicopter's greater exposure to hostile forces.

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## Recommendation

We recommend that the Secretary of Defense reassess the Apache Longbow program to determine whether its performance capabilities will be sufficient to meet its critical warfighting missions.

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## Agency Comments and Our Evaluation

In written comments on a draft of this report, DOD partially concurred with the findings but nonconcurred with the recommendation. DOD's comments are reprinted in their entirety in appendix I, along with our evaluation of them.

In disagreeing with our recommendation, DOD contends that past analyses have shown that the Apache Longbow, can meet its performance requirements and, therefore, it can meet its critical warfighting missions. DOD believes there is no need to repeat these analyses. However, it noted that it plans to reassess the program as specified in the full-rate production Acquisition Decision Memorandum.

The Army has identified vROC and Hellfire missile load among the most critical Apache Longbow performance characteristics—key performance parameters. While the Apache Longbow may have met performance requirements in earlier analyses, it does not currently meet the vROC and

missile load key performance parameters required to execute its combat and primary missions. DOD Regulation 5000.2 clearly defines the importance of key performance parameters as those capabilities or characteristics so significant that failure to meet them can be cause for the program to be reassessed or terminated. The Acquisition Decision Memorandum requires that the program manager evaluate cost, schedule, and performance tradeoffs to minimize the cost of ownership; it does not require a fundamental reassessment of the program, as we are recommending. Therefore, based on the issues raised in this report and DOD's guidance, we disagree with DOD's position on our recommendation and continue to maintain that the Apache Longbow program should be reassessed.

## Scope and Methodology

To determine whether Apache Longbow performance requirements and operational capabilities, including the ability to transfer data when not in the line of sight, will be met, we interviewed cognizant officials and reviewed relevant Army and DOD documents related to the development and acquisition of the Apache Longbow. These documents include Defense Acquisition Executive Summaries, the Apache Longbow's ORD and Acquisition Program Baseline, key performance parameters, system specifications, Selected Acquisition Reports, and the Acquisition Decision Memorandum. In addition, we reviewed contractor data, such as project progress reviews, and selected documents related to the original Apache helicopter.

To calculate aircraft weights, we used the weights shown in the Weight and Balance Reports prepared by the contractor after the actual weighing of each remanufactured aircraft. The Army uses these weights in accepting aircraft, and they are the basis for all subsequent modifications to each helicopter. We did not independently verify these weights. We calculated VROC utilizing accepted factors and methodologies provided by engineers from the Army's Aviation Research, Development, and Engineering Center. We also used data from these officials illustrating how various factors, such as weight, altitude, temperature, and flight duration, affect helicopter performance under different mission scenarios. In addition, we received information from these officials on power requirements, velocities, and fuel consumption rates that supported our calculations of VROC. We discussed our methodology with Army engineering officials, and they agreed that it would provide a basis for evaluating the impact of weight increases on VROC.

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We conducted our work at the Program Office for Aviation, the Apache Attack Helicopter Project Management Office, and the Office of the Executive Director for Aviation Research, Development, and Engineering Center at the Army's Aviation and Missile Command, Huntsville, Alabama; the Joint Chiefs of Staff, Washington, D.C.; the Office of the Assistant Secretary of the Army for Research, Development, and Acquisition, Washington, D.C.; the U.S. Army Office of the Deputy Chief of Staff for Operations and Plans, Washington, D.C.; and the Army's Training and Doctrine Command, Fort Rucker, Alabama. In addition, we interviewed officials at the Boeing Company and Defense Contract Management Command in Mesa, Arizona.

We conducted our review from January to June 1998 in accordance with generally accepted government auditing standards.

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As you know, the head of a federal agency is required by 31 U.S.C. 720 to submit a written statement of actions taken on our recommendations to the Senate Committee on Governmental Affairs and the House Committee on Government Reform and Oversight not later than 60 days after the date of this report. A written statement must also be submitted to the Senate and House 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 Chairmen and Ranking Minority Members, Senate and House Committees on Appropriations, Senate Committee on Armed Services, House Committee on National Security, Senate Committee on Governmental Affairs, and the House Committee on Government Reform and Oversight; the Director, Office of Management and Budget; and the Secretary of the Army. We will also provide copies to others upon request.

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Please contact me at (202) 512-4841 if you or your staff have any questions concerning this report. Major contributors to this report were Robert J. Stolba, Charles Burgess, Nora Landgraf, William T. Woods, and Margaret L. Armen.

Sincerely yours,

A handwritten signature in cursive script that reads "Louis J. Rodrigues". The signature is written in black ink and is positioned below the "Sincerely yours," text.

Louis J. Rodrigues  
Director, Defense Acquisitions Issues

# Comments From the Department of Defense

Note: GAO comments supplementing those in the report text appear at the end of this appendix.



ACQUISITION AND TECHNOLOGY

## OFFICE OF THE UNDER SECRETARY OF DEFENSE

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28 JUL 1998

Mr. Louis J. Rodrigues  
Director, Defense Acquisitions Issues  
National Security and International  
Affairs Division  
U.S. General Accounting Office  
Washington, D.C. 20548

Dear Mr. Rodrigues:

This is the Department of Defense response to the General Accounting Office (GAO) draft report, "ARMY AVIATION: Apache Longbow Doesn't Meet Requirements," July 6, 1998 (GAO Code 707319/OSD Case Number 1645). The Department partially concurs with the findings in the draft report, but does not concur with the recommendation.

The GAO report cites Apache Longbow as not meeting two requirements, vertical rate of climb (VROC) and long-range, non-line of sight (NLOS) communications. The GAO recommends that the Secretary of Defense reassess the Apache Longbow program to determine whether its performance capabilities will be sufficient to meet its critical warfighting missions.

Regarding VROC, the GAO found that the Apache Longbow helicopters are too heavy to achieve the JROC-validated VROC requirement of 450 feet per minute in the combat mission configuration when carrying the required 12 Longbow Hellfire missiles and a full fuel load. The GAO incorrectly combined the requirement for VROC and the separate requirement for an ordnance load of 12 Longbow Hellfire missiles. These two requirements should be evaluated independently. When VROC is measured at takeoff with four laser Hellfire, four Longbow Hellfire missiles, 1.83 hours of fuel, and with actual delivered aircraft weights, VROC is approximately 459 feet per minute. The Acquisition Program Baseline (APB), approved in conjunction with full-rate production approval, stipulates the above conditions. According to Army and Joint Staff representatives, the APB provides the detailed assumptions necessary to measure VROC in accordance with the JROC's intent. The Army is taking steps now to update the Operational Requirements Document (ORD), which has not yet been updated to reflect changes made in the course of the full-rate production milestone.

Non-radar-equipped Apache Longbows will not achieve the VROC performance of aircraft equipped with the fire control radar and the more powerful T-701C engines. However, the current ORD states a desired capability to be no worse (or better) than the radar-equipped aircraft.



See comment 1.

See comment 2.

See comment 3.

Appendix I  
Comments From the Department of Defense

See comment 4.

The GAO focuses on the lack of the ARC-220 high-frequency radios, which transfer target data between helicopters when concealed or not in line of sight. They cite the radio development delays, and the fact that the Army plans to install the ARC-220 radio on only one-half of the total Apache Longbow helicopter fleet, to conclude that this will result in a reduction in lethality and survivability. The ORD requires a capability to transmit, receive, and coordinate battlefield information, including NLOS. The ARC-220 has the capability to transmit voice and small amounts of data over extended distances. Although this limited capability will be delayed by approximately one and one-half years beyond Initial Operational Capability, the intent for this NLOS capability was for Command and Control purposes only and not for high-volume targeting data. High-volume targeting data are currently transmitted over the existing communications suite, and there was never an intent or requirement to transmit such data via NLOS links. Therefore, the GAO conclusion on degradation of overall lethality and survivability without the ARC-220 radio is invalid.

See pp. 6-7.

The Department will reassess the warfighting missions and potential enhancements and will evaluate tradeoffs among cost, schedule, and performance parameters to minimize cost of ownership to the Department, as specified in the full-rate production Acquisition Decision Memorandum. Program documentation will be updated, as required.

The Department appreciates the opportunity to comment on the draft report.

  
George R. Schneider  
Director  
Strategic and Tactical Systems

Appendix I  
Comments From the Department of Defense

GAO DRAFT REPORT DATED JULY 6, 1998  
(GAO CODE 707319) OSD CASE 1645

“ARMY AVIATION: APACHE LONGBOW DOESN’T  
MEET REQUIREMENTS”

DEPARTMENT OF DEFENSE COMMENTS TO  
THE GAO RECOMMENDATION

Now on p. 6.

GAO RECOMMENDATION: The GAO recommended that the Secretary of Defense reassess the Apache Longbow program to determine whether its performance capabilities will be sufficient to meet its critical warfighting missions. (p. 12/GAO Draft Report)

See pp. 6-7.

DOD RESPONSE: Nonconcur. Past analyses have consistently shown that the Apache Longbow, given that it meets its performance requirements--which it does--can meet its critical warfighting missions. There is no need to repeat those analyses. However, the Department will reassess the warfighting missions and potential enhancements and evaluate tradeoffs among cost, schedule, and performance parameters to minimize cost of ownership to the Department, as specified in the full-rate production Acquisition Decision Memorandum. Program documentation will be updated, as required.

The following are GAO's comments on the Department of Defense's (DOD) letter dated July 28, 1998.

## GAO Comments

1. We are not persuaded by DOD's assertion that the key performance parameters for VROC and missile load should be evaluated independently. While DOD's documentation for the Apache Longbow program has been inconsistent in discussing Apache Longbow requirements, the ORD, Acquisition Program Baseline, Defense Acquisition Executive Summaries, Selected Acquisition Reports, and the aircraft production contract itself are uniform in that they simultaneously address VROC and missile load in discussing the Apache Longbow's operational missions and, therefore, clearly demonstrate the interrelationship of VROC and missile load. DOD's response attests to this interrelationship when it refers to VROC and missile load in the Acquisition Program Baseline as the basis for its VROC calculation.

2. Our analysis clearly shows that the Apache Longbow cannot meet the VROC requirement in the combat mission configuration when carrying a full fuel load and 12 missiles—either as specified in the ORD or validated by the Joint Requirements Oversight Council. The issue addressed in our report is whether or not the Apache Longbow can meet its required VROC while carrying the necessary missile load to accomplish its required mission. Our report documents that the Apache Longbow with the required full fuel load is too heavy to meet the VROC requirement for the combat mission specified in the ORD. The VROC requirement in the ORD is 450 feet per minute—the key performance parameter. This ORD key performance parameter remains the same whether VROC is measured with 4 air-to-air missiles and 8 Hellfire missiles or the validated requirement for 12 Longbow Hellfire missiles. The VROC cannot be met under either condition.

DOD did not present support for its contention that the Acquisition Program Baseline shows that the Apache Longbow can achieve the required VROC. In fact, DOD is incorrect in its assumption that the November 1995 full-rate production Baseline calls for the calculation of VROC based only on eight Hellfire missiles. The Baseline that DOD cites refers to only one mission—the primary mission. According to the October 1995 Acquisition Decision Memorandum, the full-rate production Baseline should have defined this mission based on the VROC and missile load key performance parameters validated by the Joint Requirements Oversight Council in October 1994. Significantly, the Army recognized in the Baseline that the required VROC in the primary mission with 12 Longbow

Hellfire missiles could not be achieved unless fuel or ordnance are reduced. Without these reductions, the helicopter's VROC, in the primary mission, would be significantly lower than 450 feet per minute.

While the Army did not update the ORD to reflect the key performance parameters, it did modify the Apache Longbow Selected Acquisition Report, as early as December 1994, to reflect the VROC and missile load key performance parameters that the Council validated. Finally, the September 1995 Army Material System's Analysis Activity's independent evaluation of the Apache Longbow weapon system reported that neither version of the airframe could meet VROC requirements without reducing weight by about 590 pounds.

3. We disagree with DOD's assertions regarding the VROC performance of the non-radar-equipped Apache Longbow. The ORD states that an adequate VROC to ensure combat effectiveness must be maintained with or without the radar. Further, when discussing the Apache Longbow's maneuverability and agility, the ORD states that the performance of the non-radar-equipped aircraft should equal or exceed that of the radar-equipped aircraft.

4. The ORD and the Director, Operational Test and Evaluation's report on the Apache Longbow show that the Army expects to use the non-line-of-sight radio for transferring targeting data between aircraft. The ORD states that the primary use of digital data will be for targeting purposes. This data can then be shared with other non-radar-equipped helicopters for warfighting, situational awareness, and to coordinate battlefield information. The ORD specifies that this communication capability requires non-line-of-sight communications, and the Army plans to provide this capability with the ARC-220 radio.

The Director's 1995 report states that varied or obstructed terrain caused significant communication problems, which indicates that the lack of non-line-of-sight communications capability resulted in the inability to pass target data from radar-equipped Apache Longbows to non-radar-equipped helicopters. In another phase of operational testing, the flat, open terrain, which afforded clear line-of-sight communications, was cited as the main reason for a lack of communication problems. Furthermore, DOD's assertion that the helicopter can transfer high-volume targeting data over the existing communications suite is only applicable when aircraft are in line of sight. Without the non-line-of-sight communications capability that the ARC-220 radio provides, the Apache

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**Appendix I**  
**Comments From the Department of Defense**

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Longbow will continue to experience target handover problems when operating in environments other than a flat, open terrain. Because of the Army's plan to reduce ARC-220-equipped helicopters by 50 percent and evidence that indicates the fielding delay will be longer than DOD reports, we continue to believe that there will be an overall reduction in the Apache Longbow's planned lethality and survivability.

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