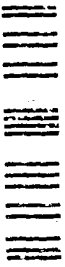


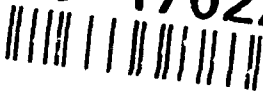
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National Security and
International Affairs Division

B-240822

December 10, 1990

The Honorable Sam Nunn
Chairman, Committee on Armed Services
United States Senate

The Honorable Les Aspin
Chairman, Committee on Armed Services
House of Representatives

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As required by the fiscal year 1989 National Defense Authorization Act (P.L. 100-456), we evaluated the performance of the Army's line-of-sight forward heavy air defense system during operational testing. The act requires that the Secretary of Defense certify that the system meets or exceeds the Army's operational test performance criteria before the Secretary of the Army obligates procurement funds after fiscal year 1989. Accordingly, our objective was to determine whether the system had adequately demonstrated its operational suitability and operational effectiveness. We are reporting on the classified test results in a separate document.

Results in Brief

Operational testing did not demonstrate that the line-of-sight forward heavy air defense system was operationally suitable. The system fell far short of its availability requirements, in large part because many system components were unreliable. In addition, other suitability measures were either not tested or not met.

The system did not meet a number of effectiveness requirements during operational testing. These include the individual fire unit criterion for destroying threat aircraft within a specified engagement area and detection requirements. In addition, we believe that platoon-level and response time requirements for the system—although met—may have been set too low.

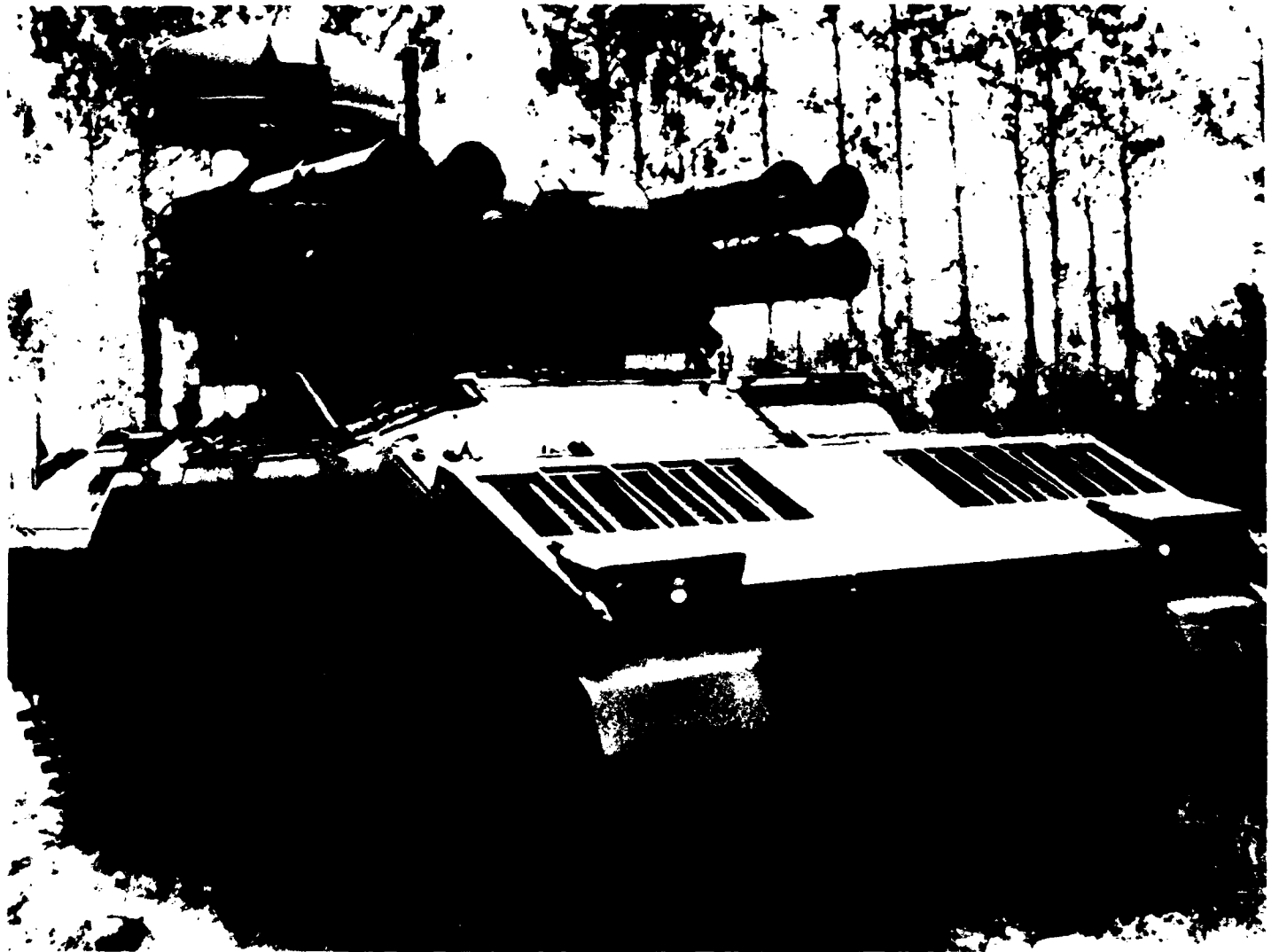
The Army has acknowledged the system's reliability problems; however, it believes that the system demonstrated sufficient operational effectiveness to support continuation of the program. In August 1990, the Army decided to defer production of the system for 2 years. During that time, the Army hopes to resolve the system's reliability problems and demonstrate its suitability for combat.

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Because the system has not demonstrated that it can meet established requirements, by law the Secretary of the Army may not obligate any procurement funding after fiscal year 1989 until the system meets or exceeds the Army's operational test performance criteria.

Background

In November 1987, the Army chose its current line-of-sight forward heavy air defense system, trade-named the "Air Defense Antitank System" (ADATS), to provide needed air defense to the maneuver force (see fig. 1). ADATS was selected partly because it was in production in Canada and therefore could move quickly into production to satisfy Army requirements. An early Army estimate of the system's unit cost was about \$11.2 million.

Figure 1: The Air Defense Antitank System

ADATS is one of five components in the Army's planned Forward Area Air Defense System, which together are expected to meet the Army's forward air defense needs. ADATS' mission is to defend tanks and infantry fighting vehicles. The Army expects ADATS to significantly enhance its current air defense capability because of the system's extended ranges and its ability to operate in adverse environments. The system consists of a launcher and eight missiles that are guided by a laser beam and mounted on a modified Bradley Fighting Vehicle chassis. The system must be positioned so that it has a line of sight to enemy

aircraft. A shoot-on-the-move capability was not part of the system's requirement.

The Army conducted two phases of operational testing, which were completed in May 1990. In the first, individual ADATS units fired live missiles against drone aircraft at White Sands Missile Range, New Mexico. In the second phase, the Army conducted a series of tests that replicated ground battles at Fort Hunter-Liggett, California, during which firings by air and ground weapon systems were simulated by lasers.

ADATS' Operational Availability Is Not Adequate to Complete Its Mission

Operational availability measures the proportion of time a system will be available to successfully conduct assigned missions. Such availability depends on the reliability of component parts and the time it takes to maintain them, to acquire needed spare parts, and to repair or replace broken component parts.

The Army's operational tests showed that the ADATS system did not meet its requirements for overall operational availability or for the reliability of individual components. Further, we believe that the test results overstate actual availability because the Army excluded important data from its calculations. In addition, ADATS exceeded the maintenance time allotted for each hour of the system's operation. Moreover, the Army did not design these tests to collect certain information necessary to fully evaluate the Army's ability to maintain or logistically support ADATS.

Availability and Reliability Requirements Were Not Met

The operational availability requirement for fielding ADATS is 71 percent. For operational testing, the Army set an interim availability requirement of 55 percent and reported an adjusted availability of 39 percent during the tests.

The system also fell far short of its requirements for the reliability of individual components. Reliability is measured by the average time between operational mission failures, which include crew performance-related failures, and between failures solely caused by equipment. In both cases, requirements were set and tested for the overall fire unit and for the missile weapon subsystem.

For the fire unit, the average time required between operational mission failures is 60 hours at the time of fielding and 38 hours for the operational tests. However, the system demonstrated an ability to operate for

only about 9 hours before it failed. For the weapon subsystem, the fielding requirement is 92 hours, and the interim test requirement is 56 hours. The subsystem demonstrated about 8 hours. This performance also represents a decline from 1987 tests in which the demonstrated average time between operational mission failures was 16 hours for the fire unit and 17 hours for the weapon subsystem.

The system's performance, as measured by the average time between equipment failures, has also worsened despite Army efforts to improve it. The demonstrated average time between equipment failures decreased from 17 hours in 1987 to about 12 hours for the fire unit and to 11 hours for the weapon subsystem during the operational tests.

Army Results Overstate Availability

In calculating an operational availability of 39 percent, the Army excluded some critical test data and made certain erroneous assumptions. We did not quantify the cumulative effect of all the problems that we found in the Army's calculation. However, on the basis of the effects that we did calculate and the discrepancies outlined below, we believe that the actual availability of ADATS is lower than reported by the Army.

For example, the Army's calculations did not include any test data from one of two test phases—the missile firings. This phase was critical because it was the only time during testing that the entire system was actually in operation. Our calculations, using the methodology the Army applied for the force-on-force test results, show an operational availability of 33 percent for the missile-firing phase.

In addition, although the system requirements stipulate that all unscheduled maintenance time be included in test calculations, the Army included only corrective maintenance time associated with operational mission failures. For example, as a result of a malfunction with the system's radar—a mission-critical piece of equipment—about 6 hours were needed to repair the subsystem over a 4-day period. Because the malfunction was not scored as an operational mission failure, however, the maintenance time was not included in the calculation. Likewise, unscheduled maintenance time needed to replace a unit that affects the turret's movement was not included. In total, the Army performed 145 hours of unscheduled maintenance that were not included in the force-on-force availability calculation.

Mission-Essential Failures Not Adequately Defined

Army requirements documents define the "mission-essential" functions that an air defense system must perform to successfully defend the heavy maneuver force. These include, for example, the ability to shoot, move, and communicate. Identifying the component failures that result in a loss of mission-essential functions is critical because test calculations of operational availability include the failure of and logistical support needed for only those component failures. The Army did not clearly define these operational mission failures until tests were underway and after partial scoring results were already known. We believe that these definitions should have been approved before testing began. Waiting until after some scores were known provides the appearance of affecting the outcome of test results by deciding the criteria to be used after the fact.

We believe that the definitions used to evaluate ADATS' operational availability inappropriately eliminated the failure of some components that were essential for ADATS to perform its mission. For example, after the tests were underway, the Army decided not to consider the failures of the laser range finder to be operational mission failures, even though (1) soldiers used it as an integral part of the test missile's firing sequence; (2) the Army determined that the range finder's faulty performance was responsible for missed targets during the missile-firing phase of operational testing; and (3) test procedures required that the range finder, as a key component, be operational for the start of each missile-firing test. If these data had been included in the Army's calculations, the number of operational mission failures would have been higher, and ADATS' operational availability would have been lower.

Finally, built-in test equipment messages, designed to alert the ADATS crew to component failures, were not always treated as indications of operational mission failures, as is required by test procedures. Doing so would further reduce the system's availability rate.

Limited Maintenance Capability Demonstrated During Testing

The ADATS schedule calls for contractor maintenance support above the organizational level, or that level immediately above the crew's maintenance responsibility, until the system is fielded outside of the United States. Because there are legal prohibitions on contractor involvement in

operational testing,¹ the Army decided to evaluate the maintenance provided only at the organizational level during operational tests. The test results showed a limited Army capability to maintain ADATS at the organizational level. Army maintenance personnel demonstrated their capability to meet one of the two maintenance-related requirements, but fell far short of meeting the other.

The average time to correct equipment failures at the organizational level—or the mean time to repair—was 0.62 hours, a figure that was well within the requirement of 1.5 hours. However, not all organizational maintenance tasks were tested; criteria for the time associated with each task have not been established; and the allocation of tasks among various levels of maintenance was not based on firm requirements. Therefore, the value of this information is limited.

The second measure of performance—people and time allotted to organizational level maintenance per system operating hour, or maintenance ratio—was set at 0.094 maintenance hours per system operating hour. This requirement was not met. The system demonstrated a ratio of 0.56, or, in other words, the maintenance support needed for each hour of system operation was almost 500 percent more than allowed by the requirement. This poor performance resulted in part from the system's numerous reliability failures.

Without clearly defined tasks and associated repair times identified at all maintenance levels, the Army will not have a clear understanding of the maintenance needed to support the system.

Logistics Support Not Tested

The Army performed a qualitative assessment rather than a test of the logistics support that will be required for ADATS because it has not yet determined ADATS logistics support requirements. The test calculations assumed that waiting for spare parts, maintenance personnel, and transportation services involved in correcting operational mission failures would take an average of 14 hours. The actual time may change after the Army conducts its logistics support analysis. Any increase in time spent waiting for parts, personnel, or other services would decrease ADATS' availability. In similar, previous testing of an air defense weapon, the Sergeant York, a 23-hour delay was assumed.

¹Contractor involvement during operational testing of a major defense acquisition system is prohibited by statute unless the contractor is to be involved in the operation, maintenance, and support of the system when it is deployed in combat.

ADATS' Operational Effectiveness Is Questionable

The Army reported that ADATS demonstrated superior mission performance for conditions under which it was tested during operational testing. The system did not, however, meet its requirements for an individual fire unit's performance against targets within a certain engagement boundary, nor for the detection of threat aircraft. We are reporting on the specific results in a separate classified document.

In addition, we question the system's effectiveness because

- some requirements might have been set too low and
- the operational tests did not demonstrate all of the required performance capabilities.

The tests were based on two measures of operational effectiveness—the ability of an individual fire unit to destroy a target within certain boundaries and the ability of a platoon of four fire units to defeat enemy air attacks. The fire unit criterion is contained in the Army's required operational capability statement for the line-of-sight forward heavy air defense system, which predates the selection of ADATS. Test officials from the Army and the Office of the Secretary of Defense determined that a more operationally accurate measure of effectiveness would be at the platoon level against all attacking targets regardless of boundaries. Therefore, they derived a second criterion from the cost and operational effectiveness analysis that had been performed for the Forward Area Air Defense System program.

For both the fire unit and platoon-level criteria, requirements for the system's effectiveness were set against fixed-wing and rotary-wing aircraft. A number of additional performance measures, some of which had quantitative requirements, also were identified.

Operational Effectiveness Requirement May Be Understated

Although ADATS met its overall platoon-level effectiveness requirement, we believe the requirement might have been set too low to accurately reflect the conditions expected when the system is fielded. The cost and operational effectiveness analysis, from which the criterion was derived, contained several assumptions, such as the following, that we believe understate the requirements for ADATS' effectiveness:

- The analysis assumed that ADATS would always be available, that is, that its availability would equal 100 percent. This availability rate is greater than the requirement of 71 percent and much greater than ADATS' demonstrated performance of 39 percent or less.

- The simulated battle on which the minimum platoon requirement was based showed that artillery made a significant contribution to the outcome of the battle, yet artillery was not used in the operational tests. Further, the analysis assumed that ADATS had a gun, which contributed to its performance in battle. The Army currently has no firm plans to produce a gun for ADATS.
- The analysis did not address a number of threats to ADATS.

Another indication that the ADATS platoon-level effectiveness requirement may be too low is that it can destroy as many or more friendly aircraft than threat aircraft and still meet the requirement. In addition, the requirement against primary targets is not only lower than the requirement against secondary targets, but also significantly lower than that required for an individual fire unit. There is no direct correlation between the criteria contained in the required operational capability documents and used for fire units and the lower criteria developed for operational testing for platoons.

Some Required Performance Capabilities Were Not Demonstrated

The Army had planned to use the operational tests to assess ADATS' performance under a variety of realistic conditions. However, because of safety considerations and other factors, the tests did not sufficiently demonstrate some capabilities critical to performance on the battlefield. Some capabilities were not tested, while others were tested but did not meet requirements.

Shortcomings were especially critical in the missile-firing phase. The Army allocated 11 missiles for the operational tests and actually fired only 9. These limited tests were not adequate to demonstrate all required performance capabilities.

Test and performance problems are summarized as follows:

- During live missile firings, only one successful shot was fired against a hovering helicopter. Our analysis of test data indicates, however, that the helicopter never hovered, flew too high, and remained exposed too long to truly represent the threat.
- The Army did not measure the system's performance against maneuvering targets during either the live missile firings or the ground battle testing, although there is a requirement for such a capability.
- Testing under adverse weather conditions did not take place.

- Information on the system's capability at night was not sufficient because safety concerns prevented threat helicopters from using realistic tactics.
- Force-on-force tests of the laser range finder were not conducted under realistic battle conditions. However, data gathered during the missile-firing phase of testing showed that the range finder's poor performance was responsible for one missed firing and one missed engagement. In addition, according to Army officials, data on the range finder from the force-on-force trials could not be analyzed.
- The ranges allowed during the ground battles for simulated missile firings exceeded those that had been demonstrated under realistic test conditions. Because the laser range finder could not be used during most of the force-on-force testing, target range data was sometimes unavailable to the ADATS crew. To compensate, ADATS was allowed to fire at ranges up to almost twice as far as those demonstrated in the missile-firing phase and was given credit for these simulated kills. Army officials believe, however, that technical test firings are sufficient to demonstrate range capabilities.
- The requirement for firing a certain number of missiles per time period was tested and demonstrated in only one live missile firing.
- The requirement that crew members reload and rearm the system's missiles was tested but not achieved. Although soldiers met the time requirement, the loaded missiles were not available for firing in sufficient quantities.

The Army's New Program Proposal May Not Overcome Problems

The Army has decided to defer ADATS production, has developed a new schedule, and is developing associated quantity and cost data for the program. Production is being postponed for at least 2 years; quantities will decrease; and initial estimates of unit costs show an increase of over \$3.6 million per unit. The Army hopes to resolve the system's reliability problems and demonstrate its operational suitability through a follow-on evaluation before the next production decision. However, the Army has not yet determined the full scope of testing in the proposed schedule and may not conduct additional operational testing before the full-rate production decision.

Congressional Funding Actions

The Army received \$54.8 million in research, development, test, and evaluation funding for fiscal year 1990. It also requested, and Congress appropriated, \$208.9 million in procurement funding that cannot be obligated until the Secretary of Defense certifies that ADATS successfully completed operational testing. For fiscal year 1991, the Army requested

\$271.8 million in procurement funding and \$9.1 million in research, development, test, and evaluation funds for ADATS-related product improvements.

Since the completion of our review, the conference committees on defense authorization and on defense appropriations have denied the Army's request for procurement funding in fiscal year 1991. The conference committee on defense appropriations also rescinded those procurement funds that had been appropriated in fiscal year 1990.² However, the Army requested and funds were authorized and appropriated in the amount of \$92 million for continued research, development, test, and evaluation of ADATS. Because of continuing congressional concerns about ADATS performance, the conference committee report on defense appropriations restricts half of that funding until other studies are completed.

Agency Comments and Our Evaluation

The Department of Defense (DOD) provided official comments on the contents of our draft report. (See app. I.) It did not address the specific findings in the report, but recognized the seriousness of them. DOD also pointed out that further testing and DOD reviews of the restructured ADATS program will take place prior to a full-rate production decision.

In light of the severity of reliability, availability, and maintainability problems, escalating system costs, and the compressed 2-year schedule within which the Army plans to identify and resolve problems and test fixes, the Chairman of the House Armed Services Committee has requested that we review the Army's new ADATS program. In addition, the report of the House Committee on Appropriations on the fiscal year 1991 defense budget requests that we evaluate the planned testing program.

Appendix II sets forth the objectives, scope, and methodology of this review. As arranged with your office, 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 the Chairmen of the Senate Committees on Appropriations and on Governmental Affairs and the House Committees on Appropriations and on Government Operations, the Secretaries of Defense and the Army, and

²These funds were identified for potential reductions in our report Defense Budget: Potential Reductions to the Army and Navy Missile Programs (GAO/NSIAD-90-302BR, Sept. 1990).

the Director of the Office of Management and Budget. Copies will also be made available to other interested parties on request.

Please call me at (202) 275-4141 if you or your staff have any questions. Major contributors to the report are listed in Appendix III.

A handwritten signature in cursive script that reads "Richard Davis".

Richard Davis
Director, Army Issues

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Figure 1: The Air Defense Antitank System

Abbreviations

ADATS	Air Defense Antitank System
DOD	Department of Defense

Comments From the Department of Defense



OFFICE OF THE DIRECTOR OF
DEFENSE RESEARCH AND ENGINEERING

WASHINGTON, DC 20301

27 SEP 1990

Mr. Frank C. Conahan
Assistant Comptroller General
National Security and
International Affairs Division
U.S. General Accounting Office
Washington, DC 20548

Dear Mr. Conahan:

This is the Department of Defense (DoD) response to the General Accounting Office (GAO) draft report, "Army Acquisition: Operational Testing of the Air Defense Antitank System Reveals Serious Weaknesses", dated 13 September 1990 (GAO Code 393345/OSD Case 8461).

The DoD recognizes your concern with the seriousness of the findings specified in the draft report. It is not possible to address each finding specifically because the final Army test data is not yet available. Upon receipt of that data we will examine it in detail.

The Army has approved a restructured program to correct reliability problems with the system. Additional testing is an integral part of the restructured program. We have scheduled Conventional Systems Committee (CSC) and Defense Acquisition Board (DAB) reviews on 31 October 1990, and 16 November 1990, respectively, to assess the viability of the restructured Line of Sight-Forward-Heavy program. Further testing as well as cost, performance, schedule, and supportability are to be addressed in that process.

Assuming Congressional authorization and appropriation of the necessary funds, authority to proceed into full rate production will be contingent upon approval by the Defense Acquisition Board. Based upon successful completion of the RAM Maturation Phase, which includes a Follow-On Evaluation (Operational Test), certification will be provided per the fiscal year 1989 Defense Authorization Act (P.L. 100-456) that the system is operationally suitable and effective.

Sincerely,

A handwritten signature in dark ink, appearing to read "Frank Kendall".

Frank Kendall
Acting Deputy Director
(Tactical Warfare Programs)

Objectives, Scope, and Methodology

As required by the fiscal year 1989 National Defense Authorization Act (P.L. 100-456), we evaluated the performance of the Air Defense Anti-tank System (ADATS), the Army's line-of-sight forward heavy air defense system, during operational testing.¹ Our objective was to determine whether the system had adequately demonstrated its suitability and effectiveness for combat.

Final Army and Office of the Secretary of Defense reports on the results of ADATS' operational testing were not available when we completed our review. As a result, this report is based on our analysis of interim test results and other program-related documents, our observations of the operational tests, and our discussions with Army and Office of the Secretary of Defense officials. Our calculations are based on the programs and the data base of the Army's Operational Test and Evaluation Agency.

Between January and May 1990, we attended all operational tests at White Sands Missile Range, New Mexico, and the majority of tests and post-trial meetings at Fort Hunter-Liggett, California. We discussed the conduct of the tests, their results, and analysis with numerous test participants.

We reviewed test planning documents developed by the ADATS Program Manager, the Operational Test and Evaluation Agency, other Army organizations, and the Director of Operational Test and Evaluation in the Office of the Secretary of Defense. We discussed the ADATS program and test-related issues with Army and defense intelligence officials; the Forward Area Air Defense System Program Executive Officer; the ADATS Program Manager; Test and Experimentation Command test conductors; and officials of the Air Defense Artillery School and Center, the Operational Test and Evaluation Agency, the Logistics Evaluation Agency, the Army Materiel Systems Analysis Activity, Headquarters of the Department of the Army, and the Office of the Secretary of Defense.

We examined the Army's internal controls for ensuring the validity of test data by reviewing the instrumentation and audio, video, and manual systems for trial data collection. The Army recognized that the data collection system would contain errors. However, due to time constraints, we did not test those systems to quantify the magnitude of potential errors.

¹The act also requires that the Director, Operational Test and Evaluation, perform a similar review.

Appendix II
Objectives, Scope, and Methodology

We also reviewed internal controls for ensuring accuracy in data analysis and conducted a limited test of those controls. On the basis of our observations during trials and attendance at post-trial meetings, we identified anomalies in trial conditions and conduct. We traced selected anomalies through the Army's data validation processes to determine how Army evaluators had treated anomalies. Due to the complexity and volume of generated data and the numerous anomalies identified during the trials, we did not quantify the impact of trial anomalies on the Army's conclusions. Further, we did not verify the Operational Test and Evaluation Agency's programs. Therefore, our current analysis accepted the Army-developed data as valid.

We conducted our work from December 1989 to August 1990 in accordance with generally accepted government auditing standards.

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