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Report to the Chairmen, Subcommittees on Defense, Senate and House Committees on Appropriations

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ARMY ACQUISITION

Decision to Buy Test Equipment Not Adequately Justified

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The Honorable Daniel K. Inouye
Chairman, Subcommittee on Defense
Committee on Appropriations
United States Senate

The Honorable John P. Murtha
Chairman, Subcommittee on Defense
Committee on Appropriations
House of Representatives

In response to the conference report on the Department of Defense (DOD) appropriations for fiscal year 1992 (H. Conf. Rept. 102-328, dated November 18, 1991), we reviewed (1) the Army's 1989 and 1992 cost and operational effectiveness analyses for the integrated family of test equipment (IFTE), (2) the 1990 cost-benefit analysis for the electro-optic augmentation for IFTE, and (3) the supporting data for these analyses. Our objective was to determine if the analyses provided valid support for buying IFTE. IFTE is designed to be a general purpose automatic test equipment system capable of providing current and future direct support, general support and depot level maintenance requirements for Army electronic, missile, aircraft, and combat vehicles.

The conference report specified that the IFTE program will be provided about $69 million in fiscal year 1992. However, the report also provided that the Army make no efforts to develop an electronic or electro-optical capability for the IFTE Base Shop Test Facility for use with the M-1 series Abrams Tank, the Bradley Fighting Vehicle, and the Tube-launched Optically-tracked Wire-guided (TOW) missile before we validated the IFTE cost and operational effectiveness analyses.

Background

The Army has developed automatic test equipment that was unique to specific weapon systems. This has resulted in a proliferation of system-unique automatic test equipment, which produced high operation and support costs, and inefficient use due to nonstandardized operation and test program sets.[1] The Army required standardized automatic test equipment to eliminate the problems of system-unique equipment. In 1986, the Army designated IFTE as the standardized test equipment that must now be used to support weapon systems, unless this requirement is waived.

IFTE consists of three systems: a Contact Test Set, a Base Shop Test Facility, and commercial equivalent equipment. A Contact Test Set—a portable, on-system tester—is used at the unit and direct support level to diagnose failures to the unit or part of an end item that is replaceable. A Base Shop Test Facility consists of two shelters, each mounted on separate 5-ton trucks with two towable generators. One shelter houses the Base Shop Test Station, support equipment, and a work area. The second shelter is used to store the test program sets. A Base Shop Test Facility is fielded at the direct support or general support locations and is used to test faulty major components. The commercial equivalent equipment is the testing equivalent to the Base Shop Test Station at the depot level for off-system testing.

The Army initiated the IFTE program in fiscal year 1982 and published a cost and operational effectiveness analysis, dated May 1985, to support the milestone II (engineering and manufacturing development) decision. That analysis concluded that IFTE was the preferred alternative to meet the Army's test, measurement, and diagnostic equipment needs. In 1985, we questioned the Army's analysis and reported that it had several shortcomings, including not considering various alternatives, using questionable assumptions, and excluding some applicable costs.[2] We recommended delaying the award of the full-scale development contract until a reassessment of IFTE costs, benefits, and potential alternatives was completed. Nevertheless, the Army moved IFTE into full-scale development in fiscal year 1986.

In January 1989, the Army published a new cost and operational effectiveness analysis that re-examined the issues left unresolved in its 1985 analysis. The 1989 analysis supported a milestone IIIa (low-rate

[1]A test program set includes the unique software, interconnecting device, and cabling required to interface with automatic test equipment used to test or diagnose a unit or part of an end item that is replaceable in the operational environment.

[2]GAO Concerns About Army Plans to Develop Intermediate Forward Test Equipment (GAO/NSIAD-85-137, Aug. 13, 1985).

initial production) decision to initiate limited production of IFTE. During 1989, while in initial low-rate production, the Army added electro-optical test capabilities to IFTE's Required Operational Capability for the three systems. A cost-benefit analysis on the IFTE electro-optical program was issued in December 1990. The Army's objective is to upgrade 153 Base Shop Test Facilities and 941 Contact Test Sets with electro-optic capabilities.

A December 1991 DOD Inspector General's study questioned, among other things, the Army's premature replacement of existing test equipment with IFTE. The study recommended that the Army delay the replacement of existing test equipment for the Abrams tank, Bradley Fighting Vehicle, and TOW missile. Nevertheless, in January 1992, the Army published a new cost and operational effectiveness analysis to support a milestone IIIb decision to enter full-scale IFTE production. This analysis was to update the cost figures for the Base Shop Test Facility and the Contact Test Set and to explore the Contact Test Set's costs and benefits related to no evidence of failure (NEOF) rates—the rate at which working components are erroneously diagnosed as faulty.

The Army approved full-scale production on March 6, 1992. The program baseline document showed a planned procurement of 241 Base Shop Test Facilities and 37,612 Contact Test Sets. The Army plans to procure between 6 and 13 Base Shop Test Facilities a year through fiscal year 1997 for a total of 56 at a cost of about $204 million. According to the IFTE contract analyst, as of April 21, 1992, the full-scale production contract had yet to be negotiated.

Results in Brief

The cost and operational effectiveness analyses used to support a decision to buy IFTE were incomplete and contained inaccurate information. Thus, they should not be used to justify the Army's decision to procure IFTE to meet all its test, measurement, and diagnostic equipment needs.

The 1989 analysis did not compare the IFTE Base Shop Test Facility to feasible alternatives that may have been more cost-effective. The analysis compared IFTE to (1) an all new system-unique equipment alternative and (2) a base case, which includes a combination of current test equipment and use of a contractor. The analysis did not compare IFTE to alternatives that may combine some quantities of IFTE with (1) existing automatic test equipment, (2) modified existing automatic test equipment, and (3) some types of new system-unique automatic test equipment.

The December 1990 cost-benefit analysis performed on the electro-optical program for IFTE also did not consider other feasible alternatives. The analysis only compared general purpose and system-unique alternatives for providing electro-optical test capability to the IFTE subsystems. It did not consider existing electro-optical test equipment or electro-optical augmentation of existing equipment.

Some of the key supporting data and underlying assumptions used in the 1989 and 1992 analyses were inaccurate. For example, (1) requirements and costs for the IFTE Base Shop Test Facilities and the Contact Test Sets were understated; (2) the useful life estimate for automatic test equipment used in the 1989 analysis was inappropriately reduced in the 1992 analysis, thus increasing the cost of the existing equipment alternatives; and (3) the Contact Test Set's cost-effectiveness was overstated because of inaccurate cost-saving estimates claimed for Contact Test Set NEOF-rate reductions.

The Cost and Operational Effectiveness Analysis Did Not Compare IFTE to a Combination Alternative

The 1989 cost and operational effectiveness analysis only considered pure alternatives of either existing, new system-unique, or new IFTE automatic test equipment. Various combinations of equipment consisting of existing, modified existing, new system-unique, and some new IFTE general purpose equipment may be more cost-effective than IFTE. The Army's 1989 analysis did not include a comparison of IFTE to any such combinations.

An Alternative That Included Existing Test Equipment May Have Been More Cost-Effective

The 1989 analysis indicated that IFTE's Base Shop Test Facility was less costly than the current method of testing and diagnosing faulty components. Some of the systems have automatic test equipment, while others rely on contractor maintenance. According to the analysis, the IFTE alternative was considered more cost-effective primarily because of the high cost of contractor maintenance for the systems that do not have automatic test equipment. The Direct Support Electrical System Test Set, used to test the Abrams Tank and the Bradley Fighting Vehicle, is an example of existing automatic test equipment that is less costly than the purchase of the new IFTE Base Shop Test Facility.

The current estimate of useful life for the Direct Support Electrical System Test Set has been estimated to be at least through the year 2001. According to Army officials, it provides equal performance to the IFTE Base Shop Test Facility in testing Abrams Tank and Bradley Fighting Vehicle components.

The Army's current cost estimate for IFTE's Base Shop Test Facility is $2.2 million a unit in fiscal year 1992 dollars, plus an additional $2.2 million a unit to augment the Base Shop Test Facility with the electro-optical capabilities. Additional costs for the test program sets for each different type of component to be tested is yet another cost that would have to be considered in the total cost of the IFTE equipment. The Direct Support Electrical System Test Set represents equipment on hand or on order, making it a much more cost-effective alternative.

An Alternative That Included Modified Existing Test Equipment May Have Been More Cost-Effective

The Modified Direct Support Electrical System Test Set, which currently supports the M1A2 Abrams Tank, is an example of modified existing equipment that could be included in a less costly alternative to IFTE's Base Shop Test Facility. According to program officials, upgrading the existing automatic test equipment to support the M1A2 costs approximately $206,000 a unit compared to the $2.2 million for each IFTE Base Shop Test Facility. Since the two systems would have comparable capability in testing the M1A2 Abrams Tank, the upgraded Direct Support Electrical System Test Set provides a considerable cost advantage over purchasing the IFTE Base Shop Test Facility.

An Alternative That Included New System-Unique Test Equipment May Have Been More Cost-Effective

The 1989 cost and operational effectiveness analysis concluded that IFTE would have a life-cycle cost advantage over system-unique equipment primarily because of the economies associated with a single development and production program versus separate development and production programs for the various system-unique equipment. There are individual cases, however, where new system-unique equipment is sufficiently less complex than IFTE's Base Shop Test Facility that it can overcome this cost disadvantage. According to the analysis, the Single Channel Ground and Airborne Radio System—commonly known as SINCGARS—is an example of a supported system where new system-unique automatic test equipment is more cost-effective than the purchase of the IFTE Base Shop Test Facility.

The Cost-Benefit Analysis Did Not Compare IFTE Electro-Optical Augmentation to Any Other Alternative

The December 1990 cost-benefit analysis did not demonstrate the cost-benefit advantage of electro-optical augmentation of IFTE over the continued use of existing electro-optical test equipment or electro-optical augmentation of existing equipment. The analysis compared the cost benefits of a general purpose to a system-unique alternative to provide the Base Shop Test Facility and the Contact Test Set with electro-optical augmentation. It concluded the general purpose electro-optical alternative would be less costly. The analysis did not evaluate the alternative of continuing to use existing electro-optical equipment or modifications to existing equipment, such as the TOW Subsystem Support Equipment and the Direct Support Electrical System Test Set.

The TOW Subsystem Support Equipment, which provides on-system testing of electro-optical components for the Bradley Fighting Vehicle's TOW missile, is a cost-effective alternative. This equipment was first deployed in 1983 and is currently still in production. It is expected to be in the field through the year 2007. According to program officials, it has been performing satisfactorily and is expected to continue to do so throughout the lifetime of the weapon system. The development costs and much of the production costs have already been expended for this equipment, making this alternative a less costly option. Continuing to use this equipment would also avoid the uncertainty involved in using new equipment of unknown performance.

The Army contractor modified the Direct Support Electrical Support Test Set to provide cost-effective off-system testing of electro-optical components for the Bradley Fighting Vehicle and the Abrams Tank. It was modified to provide the Bradley TOW electro-optical test capability during Operation Desert Shield/Storm. According to program officials, it performed satisfactorily in this role. It was also modified to allow it to test the Thermal Imaging System on the M-1 Abrams Tank. The fiscal year 1992 contract cost for the Direct Support Electrical Support Test Set Abrams Tank Thermal Imaging System modification was about $163,000 a unit. This cost compares favorably to the estimated $2.2 million a unit to augment the Base Shop Test Facility with electro-optical test capability, which would be used to test the Abrams Tank as well as other weapon systems such as the Bradley Fighting Vehicle.

Some of the Data and Underlying Assumptions Used in the Analyses Were Inaccurate

Our review indicated that the Army (1) understated IFTE requirements and costs, (2) inappropriately reduced the useful life of existing automatic test equipment when making the cost comparisons, and (3) overstated IFTE's Contact Test Set's cost-effectiveness.

IFTE Requirements and Costs Were Understated

The requirements for the number of Base Shop Test Facilities used in the 1989 analysis were less than what the Army needs to support its fielded and anticipated weapon systems. This underestimated IFTE program procurement costs. The Army based requirements on a work load analysis that excluded requirements for the Table of Distribution and Allowance organizations. These organizations have a support mission for which a Table of Organization and Equipment does not exist, and may include civilian positions such as at training schools. The analysis used only the Table of Organization and Equipment requirements, which describes the structure, manpower, and equipment for a particular unit. This omission understated the Army's total needs for automatic test equipment and understated IFTE's costs.

The Army further understated requirements because the work load analysis for the number of Base Shop Test Facilities needed was based on a peacetime operating demand level. For a peacetime level of operation, IFTE was shown to be more cost-effective than a system-unique alternative. However, a second analysis contained in the 1989 cost and operational effectiveness analysis showed that at higher levels of demand (two to four times the peacetime demand rate) the system-unique alternative was less costly. A high demand level, such as might be experienced during war, would greatly increase the spares stockage level for the IFTE Base Shop Test Facility alternative and hence its total cost. The system-unique alternative would not be affected as much by the high demand rate, since it has spare capacity to increase work load.

The Army also understated the cost estimates and requirements for the Contact Test Set in the 1992 analysis. The analysis included only 9,209 of the total planned buy of 37,612 Contact Test Sets in its calculation of total program costs. According to Training and Doctrine Command Analysis Center officials, the analysis also excluded the cost of the Contact Test Set's test program sets from the total procurement costs. Test program sets are required for the Contact Test Set to test failed components. Program officials did not have any cost estimates available for the test program sets; however, they indicated they could be significant.

Existing Test Equipment's Useful Life Reduced, Increasing Cost Estimates

The Army reduced automatic test equipment's useful life in its 1992 analysis from 20 years to 10 years, which would require a more rapid replacement of existing equipment. The 1989 analysis and the 1990 cost-benefit analysis used a 20-year useful life assumption in estimating costs for automatic test equipment. The 50-percent reduction in previously accepted useful life estimates for this equipment significantly increased the cost estimates for alternatives, including existing equipment.

The Army cited Appendix C to Part IV of the Supplement to Office of Management and Budget (OMB) Circular A-76 (revised), as the justification for a less than 20-year useful life of automatic test equipment. OMB assigned a 9-year and 11-year useful life to the federal supply classification for the Direct Support Electrical System Test Set and Simplified Test Equipment, respectively.[3] However, OMB assigned other automatic test equipment federal supply classification categories useful lives up to 25 years.

Abrams Tank and Bradley Fighting Vehicle program officials stated that the Direct Support Electrical System Test Set and the Simplified Test Equipment is expected to have a useful life of at least 20 years and beyond, as long as spare parts are available. An Army official at the U.S. Army Missile Command cited the Land Combat Support System as an example of fielded automatic test equipment that had been in the field over 24 years. This system supports the non-Bradley TOW missile. This official stated that the TOW Subsystem Support Equipment, which had been fielded in 1983, is expected to be in the field through the year 2007, 24 years in service.

IFTE Contact Test Set's Cost-Effectiveness Is Overstated

The Army overstated the Contact Test Set's cost-effectiveness in its 1992 analysis. The analysis justified the cost-effectiveness of the Contact Test Set by comparing the life-cycle costs of the Base Shop Test Facility with and without the use of the Contact Test Set. The analysis assumed the Contact Test Set could reduce the current NEOF rate of 20 percent by 55 percent. This reduction was based on a poll of subject matter experts, not on demonstrated test results. A 1988 test of the Contact Test Set showed that it had not been as accurate in identifying faulty components as the Simplified Test Equipment, which the Army plans to replace with the Contact Test Set. A less accurate fault identification rate would lead to higher NEOF rates. The 1992 analysis concluded that the 55-percent reduction in NEOF rates, using the Contact Test Set, would result in a net cost reduction of $157 million. The analysis attributed the biggest portion of cost savings to a reduced spares inventory based on the claimed reduction in NEOF rate. If a NEOF reduction is not realized, the Contact Test Set would not be cost-effective.

[3]Simplified Test Equipment is used at the unit level to identify faulty components.

According to program officials, the 1992 analysis also overstated the current level of NEOF rate. It assumed an approximate 20-percent rate based on a limited amount of sample data collection. Abrams Tank and Bradley Fighting Vehicle program officials told us they thought this assumed rate was too high. Moreover, the 1989 analysis used depot return NEOF data, which showed a rate of 8 percent. The effect of using a lower rate would be to decrease the cost savings that could be claimed from reducing the NEOF rate achieved with the use of the Contact Test Set.

The 1992 analysis further overstated the effect of NEOF on spares inventory requirements by applying the 33 days of supply rule.[4] According to a Training and Doctrine Command Analysis Center official, the analysis applied this rule in conjunction with the new NEOF rate to arrive at a new spares inventory level. However, applying the rule overstated the effect of NEOF on spares inventory requirements because the Base Shop Test Facility, with or without the Contact Test Set, would diagnose suspected NEOF components within 1 to 2 days and return them to the supply system, not the 33 days suggested by the analysis. This would greatly reduce the spares inventory required to compensate for NEOF removals, thus reducing the cost savings achieved by a reduction in NEOF.

Recommendation

We recommend that the Secretary of the Army delay full-rate production until the cost-effectiveness of IFTE over other alternatives has been appropriately demonstrated.

Scope and Methodology

We examined the 1989 and 1992 cost and operational effectiveness analyses for IFTE, the 1990 cost-benefit analysis for the electro-optic augmentation for IFTE, and the supporting data for these analyses to determine whether they were valid to support the IFTE procurement decision. We also reviewed historic and current program data on IFTE and program data on three of the current pieces of system specific automated test equipment that IFTE is to replace—the Simplified Test Equipment, the Direct Support Electrical System Test Set, and the TOW Subsystem Support Equipment. We also reviewed our prior report on IFTE and the

[4]The 33 days of supply rule is the requirement to stock sufficient spares to allow operations to continue while waiting for an ordered shipment. The time between ordering a shipment of spares and receiving the order is expected to be 28 days plus a slight margin of stock for a safety level of 5 days, thus the 33 days of supply.

recent DOD Inspector General's study on the validity of the IFTE cost and operational effectiveness analysis.

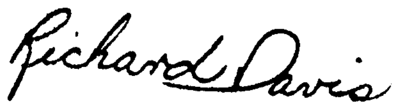
We conducted our review at (1) the U.S. Army Training and Doctrine Command Analysis Center, Fort Lee, Virginia, where the 1992 analysis was prepared; (2) the U.S.A. Army Test, Measurement and Diagnostic Equipment Activity, Redstone Arsenal, Alabama, which has the responsibility for developing policies, managing the implementation of general purpose automated test equipment; (3) the U.S.A. Army Missile Command, Redstone Arsenal, Alabama, the location of the TOW/TOW II missile system program office; (4) the U.S. Army Ordnance Missile and Munitions Center and School, Redstone Arsenal, Alabama, where the requirements for the Army test measurement and diagnostic equipment are developed; and (5) the Tank-Automotive Command, Warren, Michigan, the location of the Abrams Tank and Bradley Fighting Vehicle program offices.

At the various locations we visited, we interviewed personnel responsible for generating the data used in the cost and operational effectiveness analyses and the cost-benefit analysis and program officials for the existing automatic test equipment and its supported weapon systems. We obtained IFTE program documents, which were used by the Army to support the analyses and existing automatic test equipment program documents.

We conducted our review from January 1992 to April 1992 in accordance with generally accepted government auditing standards. We did not obtain fully coordinated DOD comments on this report. However, we did obtain oral comments on a draft of this report from representatives of the Offices of the Under Secretary of Defense for Acquisition, the Director of Operational Test and Evaluation, the Army Program Manager Test, Measurement, and Diagnostic Equipment, and others. We have incorporated their comments where appropriate.

We are sending copies of this report to the Chairmen and Ranking Minority Members of the House and Senate Committees on Armed Services, the Secretaries of Defense and Army, and the Director of the Office of Management and Budget. We will also make copies available to others upon request.

Please contact me on (202) 275-4141 if you or your staff have any questions concerning this report. Other major contributors to this report are listed in appendix I.



Richard Davis
Director, Army Issues

Major Contributors to This Report

National Security and International Affairs Division, Washington, D.C.

Henry L. Hinton, Associate Director
Derek B. Stewart, Assistant Director
Laura L. Durland, Evaluator-in-Charge