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Supplement to a Report to the Chairman, Subcommittee on Defense, Committee on Appropriations, U.S. Senate

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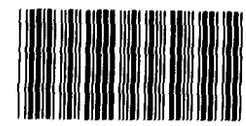
TEST AND EVALUATION

Description of Projects in DOD's Central Test and Evaluation Investment Program



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National Security and
International Affairs Division

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May 7, 1991

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

Dear Mr. Chairman:

This is a supplement to our report entitled Test and Evaluation: Projects Funded by DOD's Central Test and Evaluation Investment Program (GAO/NSIAD-91-111). This supplemental report provides more detailed descriptions of the test and evaluation projects.

Please contact me on (202) 275-8400 if you or your staff have any questions concerning this supplemental report. Major contributors to the supplement are listed in appendix V.

Sincerely yours,

Paul F. Math
Director, Research, Development,
Acquisition, and Procurement Issues

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Abbreviations

ACETEF	Air Combat Environment Test and Evaluation Facility
AFEWES	Air Force Electronic Warfare Evaluation Simulator
ARM	Anti-Radiation Missile
AWTI	Airborne Western Test Instrumentation
BSTS	Boost Surveillance and Tracking System
C3	command, control, and communication
CAIS	Common Airborne Instrumentation System
CERS	Combat Environment Realism System
CTEIP	Central Test and Evaluation Investment Program
DNA	Defense Nuclear Agency
DOD	Department of Defense
ECDES	Electronic Combat Digital Evaluation System
EWVA	Electronic Warfare Vulnerability Analysis
GBR-X	Ground Based Radar-Experimental
GPS	Global Positioning System
HSV	High Speed Video
IDAPS	Image Data Automated Processing System
MASTER	Modeling and Simulation Techniques Evaluation Research
MILCON	Military Construction
MOTR	Multiple Object Tracking Radar
MSTS	Munitions/Submunitions Tracking System
OSD	Office of the Secretary of Defense
PMTC	Pacific Missile Test Center
PTS	Portable Tracking System
RAJPO	Range Application Joint Program Office
REDCAP	Real-Time Electromagnetic Digitally Controlled Analyzer and Processor
RMA	Red Mission Analysis
SAI	Standard Aircraft Instrumentation
SAM	surface-to-air missile
SDIO	Strategic Defense Initiative Organization
TSPI	time-space-position information

Air Force Projects

Stores Certification Capability Upgrade Program

Stores certification is the process used by the services to properly load a munition, such as a missile or a bomb, on an aircraft; carry it to a target; release it; and determine its bombing accuracy. Until an aircraft/stores combination is certified, the weapon system cannot use the munition in combat. The overall objectives of the Stores Certification Capability Upgrade Program are to cut the process time and cost in half, use the process during development testing instead of after hardware is delivered, and standardize applications for all the services.

The project supports 21 subprojects that will focus on simulation and analysis software, test range instrumentation, and technical data base standardization. The software is expected to cut down on the time-consuming and costly flight testing associated with the current process (eight subprojects). To verify the integration of the stores on the aircraft, the Air Force plans to improve the ground and airborne instrumentation capabilities (nine subprojects). To save time and staff-hours, the Air Force also plans to develop and manage standard data bases (four subprojects).

Justification for the Project

According to Office of the Secretary of Defense (OSD) and Air Force officials, the program was initiated by the Air Force to eliminate a 4-year backlog in its stores certification process and to ensure that another backlog does not develop. (The backlog was recently reduced to 3 years.)

Air Force officials told us that the program is their highest priority and that Central Test and Evaluation Investment Program (CTEIP) funding is generally used only for the program's multiservice applications. However, there are some unique service applications for this project that are funded only by the Air Force. Air Force officials explained that the Navy has a small backlog of certifications and the Army contracts out for its certifications.

All existing and future weapon systems that release munitions in flight will benefit from this project. Programs and technologies supported include the A-10, B-2, Direct Airfield Attack Combined Munition, F-14, F-15, F-15E, F-16, F-18, F-111, Advanced Tactical Fighter, Advanced Tactical Aircraft, Advanced Medium-Range Air-to-Air Missile, Advanced Short-Range Air-to-Air Missile, Sensor-Fused Weapon, Durandal, Short-Range Attack Missile II, Maverick, Shrike, High-Speed Anti-Radiation Missile, fuel tanks, and gun pods.

Interrelationships Among CTEIP Projects

Although the project does not duplicate other CTEIP efforts, it does complement the Air Force's Global Positioning System project, the Army's Smart Munitions Test Suite, and the Navy's Common Airborne Instrumentation System project. For example, the Standard Aircraft Instrumentation subproject developed under the stores certification program will support the Common Airborne Instrumentation System project. In addition, the stores certification program will provide funds to the Army's Smart Munitions Test Suite project to acquire equipment valued at $18 million. However, the Army is having difficulty executing this project.

According to Air Force officials, the large backlog occurred in the mid-1980s because Air Force aircraft/stores combinations were allowed to be used without certifications. Because the Air Force programs did not provide funding for the certifications in the past, an official told us, the Air Force had not provided the funding, and the only funding available to correct the problem was CTEIP. To address the backlog, however, the Air Force plans to supplement $105.5 million in CTEIP funding with its own funding of $101.8 million, as shown in table I.1. According to an Air Force official, the CTEIP effort motivated the Air Force to increase its funds from $8 million to $101.8 million.

Table I.1: CTEIP and Air Force Funding for the Stores Certification Capability Upgrade Program

Dollars in millions

Fiscal year	CTEIP	Air Force
1990	$6.3	$1.0
1991	14.2	0.9
1992	25.0	12.9
1993	27.1	21.4
1994	16.4	15.9
1995	16.5	18.3
1996	0	19.7
1997	0	11.7
Total	**$105.5**	**$101.8**

We were told that because the Army only has helicopters that carry munitions, it spends about $10 million for stores certification. The Navy takes a different funding approach for its stores certification process by building the cost into the individual weapon programs. If the Navy programs do not provide the funding, the certification is denied.

Execution of the Project for Fiscal Years 1990 and 1991

During fiscal year 1990, the Air Force was able to execute the stores certification program because it prepared the initial documentation for contract awards prior to receiving CTEIP funds and because it used purchase orders, which are easy to execute. CTEIP funds have been used chiefly to support five test range instrumentation subprojects: Standard Aircraft Instrumentation (SAI), Image Data Automated Processing System (IDAPS), Airborne Weapon Test Instrumentation (AWTI), Mobile Time-Space-Position-Information System (Mobile TSPI), and High Speed Video (HSV). The Air Force contracts awarded in fiscal year 1990 for these five main subprojects are listed in table I.2.

Table I.2: Air Force Contracts Awarded for Five Main Subprojects (Fiscal Year 1990)

Project	Contractor	Date of award	Amount
SAI	ISN Corp., Shalimar, Fla.	February 1990	$126,959
	SRI Corp., Shalimar, Fla.	March 1990	99,497
	SCI Technology, Atlanta, Ga.	June 1990	1,427,440
		September 1990	143,160
IDAPS	Environmental Research Institute of Michigan, Ann Arbor, Mich.	March 1990	1,296,347
AWTI	TEAS Corp., Eglin Air Force Base, Fla.	May 1990	260,000
	Harris Corp., Melbourne, Fla.	April 1990	250,000
Mobile TSPI	Diversified Engineering, Richmond, Va.	September 1990	350,000
	IBM, Fort Walton Beach, Fla.	August 1990	46,590
HSV	TEAS Corp., Eglin Air Force Base, Fla.	May 1990	64,583
	Arizona Board of Regents, University of Arizona, Tucson, Ariz.	June 1990	150,000
	University of Central Florida, Orlando, Fla.	August 1990	20,000
Total			**$4,234,576**

The Air Force did not anticipate problems executing the $13.4 million for use in fiscal year 1991. Generally, the Air Force planned to use the CTEIP funds to support the same subprojects. Funds would be placed on existing contracts or new contracts could be easily awarded. Also, purchase orders could be issued for some items.

Outyear Funding Profiles

By comparing the funding of the program as of April 1989 to the revised outyear funding profile as of August 1990, we found that the stores certification program is scheduled to receive additional funding amounting to $13.3 million over the life of the project. According to Air Force officials, most of this increase ($11 million) will cover costs associated with

meeting the needs of the Navy. As shown in table I.3, the funding will also be stretched out from fiscal years 1994 to 1995.

Table I.3: Funding Profiles for the Stores Certification Capability Upgrade Program

Dollars in millions

Fiscal year	Funding as of April 1989	Funding as of August 1990
1990	$23.5	$6.3
1991	26.1	14.2
1992	25.0	25.0
1993	15.1	27.1
1994	2.5	16.4
1995	0	16.5
Total	**$92.2**	**$105.5**

Global Positioning System Range Applications Joint Program Office Development

The Global Positioning System (GPS) is a satellite system designed to provide users with worldwide, three-dimensional position and velocity information along with coordinated universal time. Currently, no system can accurately monitor or measure in real-time the hundreds of participants, aircraft, vehicles, missiles, and targets that make up a comprehensive test.

The GPS Range Applications Joint Program Office (RAJPO) project will allow for the development and initial acquisition of a new generation of receivers, transmitters, and control centers based on GPS technology. Once the equipment is developed, the services are expected to purchase the equipment for use at their test ranges. At that time, each of the nine ranges will be provided a full complement of GPS equipment. The project also will establish maintenance requirements, such as spare parts supplies and a depot-level repair capability, to support the equipment.

Justification for the Project

OSD initiated this project to develop and acquire GPS equipment that could be used by all the services on their test ranges. From fiscal years 1987 to 1989, OSD's financial support for the program amounted to $74.1 million. Beginning in 1990, CTEIP funding was used to further develop and test GPS equipment.

The GPS equipment will provide time-space-position information of air, land, and sea participants for virtually all testing in fiscal year 1992 and beyond.

Interrelationships Among CTEIP Projects

The Air Force's GPS RAJPO project complements and does not duplicate other CTEIP projects. The Air Force's GPS equipment will be acquired by the Navy and the Army under separate CTEIP projects. Unlike the Air Force, the Navy and Army do not plan to use their own funding to acquire the equipment.

Execution of the Project for Fiscal Years 1990 and 1991

Funding for the Air Force GPS RAJPO project was increased from $23.5 million as of March 1990 to $25 million in June 1990 to accelerate the development of GPS equipment. By consolidating and miniaturizing this equipment, OSD believes that future savings may be realized. The increased funding also allowed for cost growth.

The Air Force was able to execute this project because it prepared documentation for contract awards before receiving CTEIP funds. The Air Force contracts awarded in fiscal year 1990 are listed in table I.4.

Table I.4: Air Force Funds Awarded for the GPS RAJPO Development Project
(Fiscal Year 1990)

Project	Contractor	Date of award	Amount
Development of GPS equipment	Interstate Electronic Corp., Anaheim, Calif.	January 1990	$16,353,365
		September 1990	1,786,229
	Stanford Telecom, Santa Clara, Calif.	January 1990	799,822
Technical support	SRI, Menlo Park, Calif.	December 1989	2,072,959
	VSE, Valparaiso, Fla.	November 1989	194,915
	ARINC, San Diego, Calif.	February 1990	62,579
	Technical Engineering Acquisition Support, Eglin Air Force Base, Fla.	November 1989	600,000
	The Analytical Sciences Corp., Eglin Air Force Base, Fla.	December 1989	392,873
Other costs			
In-house government expenses			2,510,000
Miscellaneous expenses			227,258
Total			**$25,000,000**

Air Force officials did not anticipate problems executing the fiscal year 1991 projects because existing contracts would be used to obligate the funding.

Outyear Funding Profiles

By comparing the funding of the program as of April 1989 to the revised outyear funding profile as of August 1990, we found that the GPS RAJPO

project is scheduled to receive additional funding amounting to $18.2 million over the life of the project (see table I.5). Further, it is expected to be completed as originally planned by fiscal year 1994.

For fiscal year 1990, the funding for the GPS RAJPO project was increased from $16.8 million to $25 million for a number of reasons. First, GPS equipment will be acquired to undergo operational testing. Second, improvements to GPS equipment—including consolidation and miniaturization—will be accelerated. Third, increased funding was provided for a new data link to improve upon the existing data link.

For fiscal year 1991, the proposed funding for the project was increased from $13.4 million to $23.4 million because OSD decided to pay for nonrecurring costs, such as initial tooling, as opposed to allocating the costs to the GPS equipment. OSD originally wanted the services to pay for these costs as a part of the equipment's unit price. However, the nonrecurring costs could have driven up the cost of the GPS equipment, making it more expensive for the services. For this reason, OSD feared that the services would not purchase the higher-priced equipment.

Table I.5: Funding Profiles for the Air Force GPS RAJPO Development Project

Dollars in millions

Fiscal year	Funding as of April 1989	Funding as of August 1990
1990	$16.8	$25.0
1991	13.4	23.4
1992	14.9	14.9
1993	11.5	11.5
1994	8.2	8.2
Total	**$64.8**	**$83.0**

Red Mission Analysis

Red Mission Analysis (RMA) is a project to develop a system to create models and run simulations representing airborne Soviet and other threats. Intelligence analysts using RMA will be able to easily create digital models of threats, such as a MIG-29 aircraft or an Exocet missile, based on the most current, complete, and accurate information available. These models can then be placed into combat scenarios and run against other models representing the electronic combat systems of the United States and other North Atlantic Treaty Organization countries to evaluate how the systems perform.

Justification for the Project

The Air Force initiated the project but consulted with the Army and Navy to ensure the project was applicable to their needs by incorporating the ability to model and simulate land and undersea threats. So far, however, Army and Navy personnel have been involved only informally in the project.

To more effectively test its electronic combat systems, the Air Force has developed a "scientific test process" for testing at each stage of development from computer simulation to flight testing. RMA would be used throughout the process as the baseline threat reference. The Air Force believes the threat models in use now are fragmented, incomplete, sometimes conflicting, and costly because the models usually have to be redeveloped each time a new system is tested.

Weapon systems with either offensive or defensive electronic combat systems could be tested using RMA. These weapon systems include the B-1, F-14, F-15, Light Helicopter Experimental, and Advanced Tactical Fighter.

Interrelationships Among CTEIP Projects

Four Air Force CTEIP projects complement one another as part of the service's "scientific test process." Besides RMA, the projects are the Electronic Combat Digital Evaluation System (ECDES), Air Force Electronic Warfare Evaluation Simulator, and Real-Time Electromagnetic Digitally Controlled Analyzer and Processor Upgrade. Though ECDES and RMA can each exist without the other, it becomes much easier and less expensive for RMA to be used by all levels of the testing community, from digital laboratories to flight ranges, if ECDES is developed as well.[1]

Prototype software for RMA is being developed in conjunction with a larger Air Force effort, Modeling and Simulation Techniques Evaluation Research (MASTER). The Air Force's Foreign Technology Division has been developing the software for more than 5 years. The Air Force is contributing $2 million to the development of the software, and CTEIP is funding $3.6 million for this effort over the life of the project.

[1]ECDES is to provide a system for creating a library of models that will become the baseline for the actual field testing of U.S. and other North Atlantic Treaty Organization electronic warfare systems. However, the CTEIP project was terminated in fiscal year 1990.

Execution of the Project for Fiscal Years 1990 to 1992

Congress cut all funding for RMA in fiscal year 1990. Because all of RMA's funding for that year was supposed to go to the MASTER effort and RMA is a major funding source for that effort, MASTER was delayed somewhat. However, MASTER is still on schedule to deliver prototype software in fiscal year 1992. Eighty-five percent of RMA's funds for fiscal years 1991 and 1992 will be going to the MASTER effort.

Outyear Funding Profiles

By comparing the funding of the program as of April 1989 to the revised outyear funding profile as of August 1990, we found that RMA is scheduled to receive an additional $500,000 over the life of the project (see table I.6). The congressional cut in fiscal year 1990 led CTEIP to rework RMA's budget profile; completion of the project will be delayed by a year, and the budget will be stretched out, with less funding provided each year. The project's action officer said that even though the funding strategy was imposed by CTEIP, the Air Force should be able to adjust the project based on the level of funding provided.

Table I.6: Funding Profiles for the Red Mission Analysis Project

Dollars in millions

Fiscal year	Funding as of April 1989	Funding as of August 1990
1990	$1.5	0
1991	4.2	$1.5
1992	5.7	4.4
1993	4.0	4.6
1994	0.5	3.2
1995	0	2.7
Total	**$15.9**	**$16.4**

Air Force Electronic Warfare Evaluation Simulator Upgrade

The Air Force Electronic Warfare Evaluation Simulator (AFEWES), an indoor ground test facility, is designed to test aircraft electronic countermeasures, such as jammers, against enemy systems, such as fighters and surface-to-air missiles (SAM).

The Air Force and CTEIP are jointly funding this project. While the Air Force is funding five AFEWES upgrades, CTEIP is funding the development of new simulators that can be adapted or reconfigured to meet future threats more quickly and at lower costs. Specifically, the project supports a reconfigurable Soviet airborne interceptor and reconfigurable Soviet SAMs.

Justification for the Project

The simulator project was initiated by the Air Force and has multiservice applications. Because AFEWES will be the only facility able to simulate several Soviet SAMs, the Air Force expects heavy use of it by all three services and by allied foreign governments. Over the past 5 years, the Air Force has used the facility 47 percent of the time, the Navy 19 percent, the Army 5 percent, foreign governments 22 percent, and others 7 percent.

According to an Air Force official, the threats that AFEWES simulates are 10 or more years out of date. Because AFEWES does not currently simulate up-to-date threats, it cannot test weapon systems with advanced avionics. The B-1 program cancelled testing at the facility because of these limitations. Weapon systems that will benefit from the upgrades include the F-15, EF-111A, ALQ-131, and Advanced Tactical Aircraft.

Interrelationships Among CTEIP Projects

AFEWES is one of the electronic warfare projects that are part of the Air Force's "scientific test process" for testing electronic warfare systems. The other projects are ECDES, RMA, and the Real-Time Electromagnetic Digitally Controlled Analyzer and Processor (REDCAP) Upgrade. AFEWES can use the ECDES/RMA models and integrate actual hardware and personnel into the testing process. Field test results are used to validate the models. In turn, the models are used to validate the field test, thus lending more credibility to both results.

AFEWES is related to the Air Force's REDCAP facility in that each represents a part of the electronic environment that an aircraft would face in combat. The primary difference between the two facilities is that REDCAP simulates enemy command, communications, and control systems, whereas AFEWES simulates threat systems.

The Air Force will fund test analysis equipment and upgrade AFEWES's existing simulators to maintain currency with the rapidly changing threat environment. The Air Force is contributing $171 million for these upgrades, which includes $21.4 million for the reconfigurable simulators also being funded by CTEIP. The following table shows the outyear funding profiles for both CTEIP and Air Force funding.

Table I.7: CTEIP and Air Force Funding for the AFEWES Project

Dollars in millions

Fiscal year	CTEIP	Air Force
1990	$9.3	$25.7
1991	11.6	34.9
1992	6.1	18.4
1993	0	25.7
1994	0	23.3
1995	0	21.1
1996	0	21.9
Total	**$27.0**	**$171.0**

Execution of the Project for Fiscal Years 1990 to 1994

During fiscal year 1990, the Air Force used its existing contract with General Dynamics, Fort Worth, Texas, to continue work on the reconfigurable simulators and the upgrades. The contract continues through fiscal year 1994.

Outyear Funding Profiles

By comparing the funding of the program as of April 1989 to the revised outyear funding profile as of August 1990, we found that CTEIP funds for the project had been reduced by $16.9 million (see table I.8). However, because the reconfigurable simulators have the highest priority in the upgrade project, the Air Force has used its own funds to make up for the CTEIP funding cuts. Consequently, the Air Force has stopped work on one of the subprojects it was funding and has put another on hold.

Table I.8: Funding Profiles for the AFEWES Project

Dollars in millions

Fiscal year	Funding as of April 1989	Funding as of August 1990
1990	$20.0	$9.3
1991	12.3	11.6
1992	11.6	6.1
Total	**$43.9**	**$27.0**

Although this schedule shows the CTEIP project completed by fiscal year 1992, only the reconfigurable SAM B simulator will be operational by that year. The other two reconfigurable simulators will not be operational until fiscal year 1994, with the Air Force continuing the funding for those projects in fiscal years 1993 and 1994.

Real-Time Electromagnetic Digitally Controlled Analyzer and Processor Upgrade

REDCAP is a ground test facility that simulates parts of an enemy air defense system, such as early warning radars and command, control, and communication (C3) systems. It is the only facility for testing aircraft penetration tactics, electronic combat concepts, and equipment operating in a hostile C3 environment.

The Air Force and CTEIP are jointly funding upgrades for REDCAP. The upgrades will modify existing simulators and add advanced simulators to keep pace with developments in U.S. and foreign electronic combat systems. The CTEIP project is funding the integration of a Soviet C3 system with an existing Soviet radar simulator. In addition, CTEIP is funding the development of a prototype link between REDCAP and the Navy's Air Combat Environment Test and Evaluation Facility (ACETEF) to demonstrate that two or more electronic combat test facilities can be linked in real-time and that these links will enhance the capabilities of both facilities.

Justification for the Project

The Air Force initiated these upgrades and added ground and sea portions of the Soviet radar system to meet multiservice needs. Currently, REDCAP is used almost exclusively by the Air Force. However, the Air Force expects the Army, Navy, and others to increase their use of the facility because of the upgrades and the data link with ACETEF.

The threat that REDCAP simulates is 10 to 15 years out of date, according to the Air Force. Therefore, weapon systems are not being adequately tested in the current environment. Air Force documents show that the REDCAP upgrades will be used to test numerous systems, including the B-1B, B-2, F-14, F-15, F-15E, F-16, F/A-18, EF-111A, Advanced Tactical Fighter, Advanced Tactical Aircraft, CV-22A, and Combat Talon aircraft.

Interrelationships Among CTEIP Projects

REDCAP is one of the electronic warfare projects that are part of the Air Force's "scientific test process" for testing electronic warfare systems. The other projects are AFEWES, RMA, and ECDES. REDCAP and AFEWES are similar facilities but are not duplicative because they have different objectives.

The Air Force is providing the bulk of the funding of the project, $49.2 million, compared with $10.4 million from CTEIP. The Air Force is funding the upgrade to the Integrated Air Defense System simulator to

represent the current version of the Soviet threat, the design and development of new Early Warning/Ground-Controlled Intercept radar simulators, and the acquisition of a new computer system to support all of the upgrades.

Execution of the Project for Fiscal Years 1990 to 1992

The project got off to a slow start in fiscal year 1990; it was 3 months late in beginning to obligate funds. Calspan Corporation, which operates the current facility, was awarded the contract for the upgrades in two phases, one in September 1988 and the other in March 1990. The $800,000 in CTEIP funding for fiscal year 1990 was spent almost evenly between the Soviet radar simulator upgrade and data link.

For fiscal years 1991 and 1992, all the CTEIP funding will go to the Soviet radar upgrade.

Outyear Funding Profiles

By comparing the funding of the program as of April 1989 to the revised outyear funding profile as of August 1990, we found that the project had been reduced in funding by $2.2 million (see table I.9). Originally, CTEIP was going to fund development of the Early Warning/Ground-Controlled Intercept simulator, which is currently being funded by the Air Force. Instead, CTEIP is now funding the Soviet radar simulator upgrade, which the Air Force considers a higher priority and which has clear tri-service applications.

Table I.9: Funding Profiles for the Real-Time Electromagnetic Digitally Controlled Analyzer and Processor Upgrade Project

Dollars in millions

Fiscal year	Funding as of April 1989	Funding as of August 1990
1990	$4.6	$0.8
1991	2.0	3.6
1992	6.0	6.0
Total	**$12.6**	**$10.4**

Although this schedule shows the CTEIP project completed by fiscal year 1992, the overall project has been stretched out 1-1/2 years until fiscal year 1994 because of the combination of CTEIP and Air Force funding cuts. The stretch-out and these cuts have left a projected shortfall of $16 million in fiscal year 1993 for the project. The program manager is hoping that a combination of cost-cutting measures and some additional funds from the Air Force will allow the project to be completed without any substantive impact.

Electronic Warfare Vulnerability Analysis

The Electronic Warfare Vulnerability Analysis (EWVA) project will assess the potential effects to U.S. electronic systems, including avionics and C3 equipment, when operating in a hostile electronic combat environment. Instead of designing and testing electronic systems based on rigid threat definitions, the EWVA project will allow flexibility by assessing electronic systems for their potential vulnerability during combat regardless of known threats.

EWVA supports three efforts: (1) develop a methodology assessing the potential vulnerability of U.S. electronic systems to evolving threats; (2) identify and acquire data bases, equipment, and facilities to support the methodology; and (3) promote the methodology for use throughout a system's life cycle to address the changing threat.

Justification for the Project

EWVA is the Air Force's implementation of OSD's Data Link Vulnerability Analysis applied to all electromagnetic-dependent systems, not just data links. Originally, this project was designed specifically for Air Force applications, but when it came under CTEIP, the project was changed slightly to meet the needs of all three services. Most of the money spent on the project so far has funded development of a joint service approach to the project.

Currently there is no Department of Defense (DOD) methodology for systematically identifying the potential effects on weapon systems of known, postulated, or technically feasible electronic combat threats. Because this sort of assessment has not been available, several fielded systems, such as the APG-63, APG-68, and ALQ-161, have manifested significant electronic combat vulnerabilities. Developing this methodology and applying it during the development and acquisition process should help field more effective major weapon systems. All avionics, electronic combat systems, and C3 systems will use EWVA.

Interrelationships Among CTEIP Projects

There is no duplication of this project with other CTEIP projects. The Air Force does not provide any additional funding for this program.

Execution of the Project for Fiscal Year 1990

Since this project is in the early planning stages, much of the $279,000 spent during fiscal year 1990 has funded travel and other planning costs. In addition, the project purchased some equipment for future use

totaling $166,000: five digital error injectors (used in simulating jamming scenarios), a pulse digitizer (converts analog signals to digital signals), and a frequency and time interval analyzer (used for assessing analog signals when it is impractical to use digital signals).

Outyear Funding Profiles

By comparing the funding of the program as of April 1989 to the revised outyear funding profile as of August 1990, we found that EWVA is scheduled to receive an additional $300,000 over the life of the project (see table I.10). Budget cuts in fiscal year 1990 have delayed the project by 1 year, from an original completion target of fiscal year 1994 to 1995. The delay has allowed the project managers to establish a tri-service working group and purchase some equipment up-front. On the other hand, the customers of EWVA—those people developing radars, avionics, and other electronic combat systems—will not be able to use this technology to test those systems until fiscal year 1995.

Table I.10: Funding Profiles for the Electronic Warfare Vulnerability Analysis Project

Dollars in millions

Fiscal year	Funding as of April 1989	Funding as of August 1990
1990	$0.5	$0.3
1991	2.5	0.5
1992	6.8	2.5
1993	8.6	6.8
1994	9.4	8.6
1995	0	9.4
Total	**$27.8**	**$28.1**

DOD Space Test Capability

The DOD Space Test Capability project will support the scheduled worldwide testing of strategic and tactical systems over the next 5 years by using space and ground test facilities. Existing assets distributed among many facilities will be linked and augmented with additional capabilities.[2]

The project will support five subprojects. First, an existing support center will be upgraded to manage the space test capability. Second, a safety system will be established to track man-made objects in space and

[2]The DOD Space Test Capability project is planned to be implemented in three phases. Phase I, which is funded by this CTEIP project, combines multiservice test resources and functions into the integrated DOD space test range. CTEIP may also fund phase II, which will address more advanced weapon systems and vehicles, and phase III, which will address requirements of the next century.

guard against possible collisions. Third, existing assets on the ground will be linked to ensure greater coverage during a test. Fourth, a scheduling system will be created to coordinate the actual tests that are to be conducted. Finally, an experiment control center will be developed to improve the coordination among existing assets.

Justification for the Project

This project was initiated by the Air Force; however, OSD has taken the initiative to bring all the services together for this effort. The Air Force, which is the executive agent, is responsible for the space test support center, space safety system, and experiment control center; the Army is responsible for linking the ground facilities (internetting); and the Navy is responsible for the scheduling system.

A Space Test Range Architecture Study, dated September 1988, which was sponsored by the Strategic Defense Initiative Organization and conducted by the Air Force with tri-service participation, initiated the Space Test Capability project. The approach is to build initially on existing Air Force, Army, and Navy assets for test support requirements posed by new space systems over the next decade.

The programs and technology supported by this project include ongoing programs: ballistics, boosters, Combined Release and Radiation Effects Satellite, Geostationary Operational Environmental Satellite, Inertial Upper Stage, National Oceanic and Atmospheric Administration Satellites, Relay Mirror Experiment, and Space Transportation System. In addition, formal support has been requested for Complementary Space Experiment/Zenith Star, Laser Geodynamic Satellite-2, Light Amplification by Simulators Emission of Radiation Test, Launch Observation Satellite-X, Laser Atmospheric Compensation Experiment, Midcourse Space Experiment, Special Program Flight Experiment, Space-Based Surveillance and Tracking System Validation Satellite, Space Technology Experiments Platform, Software Technology for Adaptable Reliable Systems, and Technology for Autonomous Satellites. Finally, preliminary support has been requested for Advanced Photovoltaic Electronics Experiment, Aero-Assist Flight Experiment, Array of Low X-Ray Imaging Sensors, Boost Surveillance and Tracking System, Electric Insertion and Transfer Experiment, International Solar Terrestrial Physics, Kinetic Energy Antisatellite, Meteorological Satellite, National Aerospace Satellite, Neutral Particle Beam, Pegasus, Polar Ozone Aerosol Measurement II, Satellite Relay Proof of Concept, Strategic Defense System, Survivable Solar Power Subsystem Demonstrator, Tether Dynamic Explorer-1, Ultra-High Frequency Follow-On, and Zest.

Interrelationships Among CTEIP Projects

The DOD Space Test Capability project was designed to eliminate duplication among the services. According to an Air Force official, the project consolidates the space testing needs of the services, which were similar in concept but not duplicative. The Air Force is generally responsible for all space testing and has taken the lead role. The Army is interested in linking the existing ground test facilities to assist its command and control functions, and the Navy is interested in tests conducted by multiple test participants at sea.

During fiscal years 1988 and 1989, the Strategic Defense Initiative Organization provided $3 million per year for this project. In fiscal year 1990, the Organization provided $1.5 million. Beginning in fiscal year 1990, CTEIP will generally fund all the costs of the DOD Space Test Capability project, including design and the production items. To support the project, however, the services are expected to fund the operations and maintenance costs for the system. An Air Force official told us the services have not budgeted in the outyears for these costs.

Execution of the Projects for Fiscal Years 1990 and 1991

During fiscal year 1990, the DOD Space Test Capability project received $3 million, which was easily placed on existing contracts by the three services. An Air Force official explained that the contracts were prepared in anticipation of receiving the CTEIP funding. The Air Force, Army, and Navy contracts awarded in fiscal year 1990 are listed in table I.11.

Table I.11: Air Force, Army, and Navy Contracts Awarded for the DOD Space Test Capability Project (Fiscal Year 1990)

Project	Contractor	Date of award	Amount
Initial space safety system	Applied Technology Associates and UNISYS, Calif.	[a]	$538,000
Interrange internet system	Georgia Tech Research Institute, Ga.	[a]	900,000
Interrange schedule system	Stanford Research International, Calif.	[a]	390,000
Space test support center	Holmes and Narver, Orange, Calif.	September 1990	170,000
Technical support	Aerospace Corporation, Calif.	[a]	1,002,000
Total			**$3,000,000**

[a]The award was added on to existing contracts.

The Air Force did not anticipate problems executing $7 million for use in fiscal year 1991. Funds will be placed on existing contracts, or documentation will be prepared so that contracts can be easily awarded.

Outyear Funding Profiles

By comparing the funding of the program as of April 1989 to the revised outyear funding profile as of August 1990, we found that the DOD Space Test Capability project is scheduled to receive $35.2 million less than had been anticipated over the life of the project (see table I.12).[3] However, DOD plans to meet the objectives established for the project by fiscal year 1997. In addition, the internetting project has been accelerated and increased in scope. Finally, the completion of the experiment control center and space test support center subprojects have been stretched out from fiscal year 1993 to fiscal years 1996 and 1997. According to an Air Force official, the stretch-out of the project will not adversely affect future space testing needs because the scheduled tests have also slipped a few years.

Table I.12: Funding Profiles for the DOD Space Test Capability Project

Dollars in millions

Fiscal year	Funding as of April 1989	Funding as of August 1990
1990	$3.0	$3.0
1991	15.0	7.0
1992	32.0	23.2
1993	66.6	20.0
1994	77.0	14.2
1995	0	45.8
1996	0	35.1
1997	0	10.1
Total	**$193.6**	**$158.4[a]**

[a]Due to rounding, this figure differs slightly from the amount shown in appendix II of our report on CTEIP (GAO/NSIAD-91-111).

Scene Generation Test Capability

The Scene Generation Test Capability project will develop a facility to simulate a broad range of combat scenarios for testing infrared sensors and related systems. Generally, these sensors are used to identify missiles and warheads that are launched from the ground or traveling in

[3]Originally, DOD planned to support the proposed DOD Space Test Capability projected by providing funds to support phases I and II. However, the existing CTEIP project is providing funds only for phase I.

space. The sensors will be tested to determine their ability to differentiate missiles from other heat patterns that are placed against an Earth or space background.

There are two phases to the project: Phase I will develop and validate the technological concept for the project by producing a Transportable Direct Write Scene Generator, and phase II will produce a Focal Plane Array Test Chamber with full threat capability to satisfy a broad range of user requirements for current and future programs.

Justification for the Project

The project was initiated by the Air Force and meets multiservice and multiagency needs. Brilliant Pebbles and other Strategic Defense Initiative programs, Air Force surveillance and Navy reconnaissance satellites, and Army anti-ballistic missile programs all plan to use this facility.

According to the Air Force, existing scene generators cannot adequately create realistic threat environments to properly test current and upcoming space-related systems. In addition, current treaties and budget restrictions limit the amount of field or space-based testing that can be done in this area, so a realistic, laboratory-based scene generation capability is critical for properly testing these systems.

Interrelationships Among CTEIP Projects

This project does not duplicate any other CTEIP projects. However, the project is receiving $1.1 million from the Air Force's Boost Surveillance and Tracking System (BSTS) project during fiscal years 1990 and 1991. This system will be the initial user of phase I and will purchase the Transportable Direct Write Scene Generator modified for some unique requirements of that project. In addition, several contractors are building Focal Plane Array Test Chambers (phase II) that are designed for specific program applications rather than, in this project, for a broad range of user requirements.

Execution of the Project for Fiscal Years 1990 and 1991

The project did not get underway until February 1990 because of funding delays. BSTS provided $300,000 for initial investigations on the application of the scene generation technology to BSTS. Once CTEIP funding became available, the project was restructured to reflect the delayed start of the project and the new funding and requirements of BSTS. Because of the late start, the project was able to spend only $2 million in fiscal year 1990, rather than the $2.5 million originally

programmed at the beginning of that year, in addition to the funds provided by BSTS.

The tasks for this project were added to an existing contract that Calspan Corporation has with Arnold Engineering Development Center at Arnold Air Force Base, Tennessee.

Outyear Funding Profiles

By comparing the funding of the program as of April 1989 to the revised outyear funding profile as of August 1990, we found that funding is scheduled to increase by $200,000 over the life of the project, as shown in table I.13.

Table I.13: Funding Profiles for the Scene Generation Test Capability Project

Dollars in millions

Fiscal year	Funding as of April 1989	Funding as of August 1990
1990	$3.0	$2.0
1991	4.0	3.6
1992	4.0	6.6
1993	2.0	1.0
1994	0	0
Total	**$13.0**	**$13.2**

Climatic Test Chamber Upgrade

The Climatic Test Chamber at Eglin Air Force Base is the only large facility in the country that can test combat equipment, such as tactical aircraft, under extreme environmental conditions. One of the key features of the facility is that it can maintain these conditions with aircraft jet engines running at full throttle. The current facility is old, deteriorating, and often closed for repairs.

This project will be used to renovate two of the six existing chambers, as well as provide for two upgrades. Phase I will be the renovation of the main chamber, and phase II will be renovation of the second chamber. In addition, phase II will allow for upgrades that will support both chambers. These upgrades (1) double the air make-up capacity, which allows the chamber to maintain extreme environmental conditions while the jet aircraft engines are running, and (2) improve the facility's monitoring and control system, including the fire safety system.

Justification of the Project

The Air Force initiated the upgrade, and the project meets the needs of all three services and other agencies. All major new weapon systems, particularly aircraft, will use the Climatic Test Chamber. In addition, the Federal Aviation Administration, National Aeronautics and Space Administration, the Coast Guard, and others plan to use the facility. Currently, the Air Force uses the facility about 50 percent of the time, the Navy about 30 percent, the Army 10 to 20 percent, and other agencies the rest of the time. However, some weapons cannot be fully tested now because of limited air handling capacity. For example, the B-1B could have only three of its four engines running at idle during testing and then not for very long.

Interrelationships Among CTEIP Projects

Because this is a one-of-a-kind facility, it does not duplicate other CTEIP projects. The Air Force provided about $11 million in fiscal years 1989 and 1990 as an interim effort to keep the facility operating and safe before the CTEIP project began.

The Air Force considered the project to be too expensive to handle on its own, especially considering the use of the facility by the other services. The Air Force also considered charging users, including private industry, to pay for the renovation and upgrades, but the costs would have made using the facility prohibitively expensive.

Execution of the Project for Fiscal Years 1990 to 1992

This project received $100,000 in fiscal year 1990 for initial design work and travel expenses. The integration of the project's design will get underway in fiscal year 1991 by the Civil Engineering Office at Eglin Air Force Base and be completed in fiscal year 1992. The U.S. Army Corps of Engineers will serve as the procurement agent for the project.

Outyear Funding Profiles

The cost of the project has grown from $49.4 million to $62.6 million, as shown in table I.14, because the design costs were added in and the inflation rate was recalculated. The original funding profile was changed to allow for a more efficient design phase and for testing to continue while the project is being designed. Originally, phase I of the project was to be designed in fiscal year 1991 and then built in fiscal year 1992. Phase II was to be designed in fiscal year 1993 and built in fiscal year 1994. Now, the whole project will be designed in fiscal years 1991 and 1992, and construction will take place in fiscal years 1993 and 1994. Full-scale renovation will not start until early fiscal year 1994 after the last currently scheduled test is completed. The

project manager expects the facility to be operational by November 1995.

Table I.14: Funding Profiles for the Climatic Test Chamber Upgrade Project

Dollars in millions

Fiscal year	Funding as of April 1989	Funding as of August 1990
1990	0	$0.1
1991	$1.8	1.6
1992	15.6	4.8
1993	7.0	23.3
1994	25.0	32.8
Total	**$49.4**	**$62.6**

Army Projects

Smart Munitions Test Suite

The Smart Munitions Test Suite is used to evaluate the launch and separation of munitions that search, detect, identify, and track targets until the munitions make contact. The Army's testing capabilities have not kept pace with the development of these "smart" munitions because of the absence of requirements developed by the smart weapons community, the low priority assigned to this need, and a lack of funding. The test suite is to be an independent, mobile system so that it can be transported from range to range. It will initially be installed at White Sands Missile Range.

The test suite project is a complement of eight systems that will increase the capabilities of test ranges to support the smart munitions testing requirements. These systems are the Munitions/Submunitions Tracking System (MSTS), Submunitions Telemetry System, Target Illumination Measurement System, Target Array Mapping System, Atmospheric Characterization System, Test Facility Control System, Test Monitoring Instrumentation, and High Resolution Millimeter Wave Radar System.

Justification for the Project

Smart munitions present problems for the test community because a large number of high-speed objects are released below the horizon and must be tracked from varying stand-off ranges. As a result, a new generation of tracking, sensing, and mapping systems is needed to evaluate and verify their performance.

According to OSD and Army officials, this project is basically an Army initiative. An Army official told us that the Army fielded the first generation of smart munitions without adequate testing and that the next generation of smart munitions would benefit from the project. Current test programs include the Army Tactical Missile System and the Multiple-Launch Rocket System applications of the Sense and Destroy Armor munitions and the Terminally Guided Weapon. Future programs will include other submunition-dispensing weapons.

Interrelationships Among CTEIP Projects

According to an Army official, this project does not duplicate other CTEIP projects. However, there is a plan under the Air Force stores certification project to purchase a part of the test suite for use at Eglin Air Force Base at a cost of $18 million. The Army is having difficulty executing a contract for the capability at White Sands Missile Range, which may have an impact on the Air Force acquisition. In addition, other CTEIP projects, such as the Multiple Object Tracking Radar and Aerial Cable Facility, will also be used for smart munitions testing. The Army has

been buying parts for this test suite on a piecemeal basis but has not been able to fully fund it.

The Army and Air Force are each providing about $10 million to $12 million for integration of the suite into the range.

Execution of the Project for Fiscal Years 1990 and 1991

Execution of this project has been stretched out because the Army was not ready to enter into contracts when funding was received in fiscal year 1990. The Army issued a solicitation for the MSTS. There was one bidder, and the bid was about 60 percent above the estimated costs. The Army is now reviewing other options, such as scaling down the MSTS, as well as gathering requirements data for the MSTS and the entire test suite.

Fiscal year 1991 execution plans include contracting for the development of the MSTS. If the contracting process does not move forward for this system, according to the program manager, other systems could be moved up in the acquisition schedule. However, the MSTS is the foundation for the entire test suite and will take the longest to develop.

Outyear Funding Profiles

By comparing the funding of the project as of April 1989 to the revised outyear funding profile as of August 1990, we found that funding for the Smart Munitions Test Suite is scheduled to increase by almost $29 million over the life of the project (see table II.1). The overall increase is primarily due to an increase of $24 million in CTEIP funding to cover a gap created when Army funding from the Improvement and Modernization budget for this project was withdrawn in August 1989. The additional $4.8 million represents increased contracting costs associated with the stretch-out of the project.

Table II.1: Funding Profiles for the Smart Munitions Test Suite Project

Dollars in millions

Fiscal year	Funding as of April 1989	Funding as of August 1990
1990	$8.2	$0.7
1991	15.4	9.0
1992	16.5	12.0
1993	11.9	23.3
1994	5.1	19.6
1995	0	21.3
Total	**$57.1**	**$85.9**

Army Range Global Positioning System

The Army Range GPS uses satellites to provide time-space-position information from aircraft, missiles, and ground vehicles involved in tests. These tests are conducted in canyons, over mountainous terrain, and at low altitudes; employ pop-up maneuvers; use growing numbers of players; and are conducted two or more times a day. Tests conducted during 1988 involved as many as 10 aircraft and 3 ground vehicles. The mix, number, staging areas, and flight pattern changed on an almost daily basis.

This project will equip White Sands Missile Range with the initial components of the GPS for early missile testing, including player, ground, data relay, and some computational equipment. It also provides GPS starter kits for other test ranges. One subproject, Trajectory Data Selector, is included as an option subject to additional funding.

Justification for the Project

The GPS project was initiated by OSD to interface with the Air Force and Navy GPS projects. The original project was changed to take advantage of the Air Force and Navy GPS applications. Plans for GPS projects at other Army ranges were also changed from range-unique systems to a standard GPS system.

White Sands Missile Range's current time-space-position information systems cannot handle the three tests per day that are required. If this project is not completed, White Sands Missile Range cannot support range users employing GPS equipment.

Systems and facilities that would benefit from this project include Patriot, Chaparral, Hawk, High Energy Laser Systems Test Facility, Air-Launched Cruise Missile, Copperhead, Multiple-Launch Rocket System, Short-Range Attack Missile, and Forward Area Air Defense System.

Interrelationships Among CTEIP Projects

This project does not duplicate other CTEIP projects, although it does parallel the Air Force and Navy GPS projects being funded by CTEIP. Also, according to an Army official, GPS could be used, along with other projects, such as the Multiple Object Tracking Radar and target control, in place of the CTEIP Air Defense Capability project.

According to an Army official, about $50 million in Army funds will be spent to integrate the GPS package into White Sands Missile Range.

Execution of the Project for Fiscal Years 1990 and 1991

Project activity for fiscal year 1990 included awarding two contracts—one to assist with design and integration into White Sands Missile Range and the other to conduct site surveys and design a solar-powered trailer to move the equipment around the site. Both contracts were awarded to established DOD contractors. Lockheed is one of the in-house contractors for White Sands Missile Range, and the Navy has an ongoing contract with Stanford Research Institute. The Army contracts awarded in fiscal year 1990 are listed in table II.2.

Table II.2: Contracts Awarded for the Army Range Global Positioning System (Fiscal Year 1990)

Project	Contractor	Date of award	Amount
GPS design and integration	Stanford Research Institute, Arlington, Va.	May 1990	$100,000
Site survey and trailer design	Lockheed Engineering Systems, White Sands Missile Range	March 1990	130,000
Total			**$230,000**

In fiscal year 1991, the program manager plans to transfer $3.6 million to the Air Force GPS Range Applications Joint Program Office for the Army's first installment on the procurement of the systems. Also, he plans to spend $1.2 million on vans and other mobile systems to house the personnel and equipment needed for the GPS at White Sands Missile Range.

Outyear Funding Profiles

By comparing the funding of the project as of April 1989 to the revised outyear funding profile as of August 1990, we found that the Army GPS is scheduled to receive significant increases in funding over the life of the project (see table II.3). Additional CTEIP funding was provided to the project from another CTEIP project, the Air Defense Capability, because of a change in scope from the original GPS project and a need to provide GPS "starter kits" for all Army ranges. Starting in fiscal year 1992, money will be spent to begin the procurement of GPS equipment at the other ranges.

Table II.3: Funding Profiles for the Army Range Global Positioning System

Dollars in millions

Fiscal year	Funding as of April 1989	Funding as of August 1990
1990	$0.8	$0.4
1991	6.9	5.1
1992	9.0	9.5
1993	8.2	12.0
1994	4.0	15.0
1995	0	20.3
Total	**$28.9**	**$62.3**

Ground Based Radar-Experimental Upgrade

After the Strategic Defense Initiative Organization (SDIO) completes tests using the SDIO-developed Ground Based Radar-Experimental (GBR-X), the radar will be used as a range asset. The project involves modifying the Army's Kwajalein Atoll range GBR-X hardware during acquisition of the radar to provide new capabilities, such as an imaging X-band modification, needed to satisfy user requirements that are not now being met at the range. The X-band modification will allow the tracking of many targets simultaneously. The GBR-X is expected to become operational as a range asset in fiscal years 1994 or 1995.

Justification for the Project

The GBR-X upgrade project was initiated by the Army and, according to the Army CTEIP program manager, would benefit all the services. For a $46 million investment in the design of the GBR-X, the Kwajalein range would be acquiring a range asset to replace two to three existing radars. The SDIO would bear the cost of GBR-X acquisition—about $500 million. Without the upgrade, the GBR-X would be of little or no use to the range after the SDIO finished its tests.

Studies have been conducted by the Mitre Corporation and Environmental Research Institute of Michigan to verify the need for this type of radar and to compare this radar to the Multiple Object Tracking Radar (MOTR), another CTEIP project. In a study to compare the two radars, it was determined that, if the GBR-X met its specifications, it should satisfy primary user needs as well as many other required capabilities. This study also determined that MOTR does not meet some basic needs of the Kwajalein range users. Another study identified a number of inadequacies in the GBR-X. For example, the GBR-X lacked multiple-target tracking and real-time data gathering; beam agility, or the ability to assess many

objects at once over a wide field of view; simultaneous imaging of multiple targets; an X-band frequency radar, which allows the tracking of many small objects; and research and development test bed for Ballistic Missile Development radar technology. These inadequacies would limit the amount of testing that could be done and increase the costs. The study determined, however, that a properly modified GBR-X could remove many of these shortcomings.

Users of the range have indicated that, with the upgrade, the GBR-X would be used most of the time. The National Aeronautics and Space Administration has projected use of 2,000 hours per year. The Air Force and Navy plan to test launch the Peacekeeper and Trident missiles three to four times per year. The Army, the Strategic Air Command, and the Space Command will also have needs for GBR-X that vary depending on various launch schedules.

Systems or programs that would benefit from this project include offensive weapons development and testing, Strategic Air Command and Navy operational testing, Air Force Ballistic Missile Defense, orbital debris mapping, ballistic missile defense research, and space surveillance.

Interrelationships Among CTEIP Projects

This project does not duplicate other CTEIP projects. Although there is a CTEIP project (MOTR) to procure other radar equipment, the GBR-X upgrade will track 200 objects over 2,000 miles, as compared to MOTR's ability to track 10 objects over 400 kilometers.

No service funding will be involved in this project because the Kwajalein range does not have the funding to support the project's design and development. The Army, however, will provide funding to support and maintain the GBR-X after it is installed at the range.

Execution of the Project for Fiscal Years 1990 and 1991

Execution during fiscal year 1990 was critical because the project had to be executed concurrently with the GBR-X acquisition, which was ongoing. If the design was not modified, the window of opportunity would be lost, and, according to the GBR-X Upgrade program manager, it would cost $150 million to upgrade the radar later. One contract, shown in table II.4, was awarded in fiscal year 1990 to design the hardware modifications for the GBR-X.

Table II.4: Contract Awarded for the GBR-X Upgrade Project

Project	Contractor	Date of award	Amount
GBR-X upgrade	Raytheon, Wayland, Mass.	April 1990	$1,902,000

Execution plans for fiscal year 1991 include developing the software for the GBR-X and incorporating the hardware design into the GBR-X.

Outyear Funding Profiles

By comparing the funding of the project as of April 1989 to the revised outyear funding profile as of August 1990, we found that the GBR-X Upgrade is scheduled to receive an increase in funding over the life of the project (see table II.5). According to Army officials, this is due to a low cost estimate ($23 million) during the initial planning for CTEIP. After the project received CTEIP funding and underwent further study, a more realistic cost was established. Funding was moved from the Air Defense Capability project to the GBR-X project to help with the additional funding needs.

Table II.5: Funding Profiles for the GBR-X Upgrade Project

Dollars in millions

Fiscal year	Funding as of April 1989	Funding as of August 1990
1990	0	$2.0
1991	$3.0	11.0
1992	10.0	15.0
1993	8.0	12.0
1994	2.0	5.0
1995	0	1.0
Total	**$23.0**	**$46.0**

Multiple Object Tracking Radar Procurement

MOTR is a general-purpose tracking radar, intended to (1) track up to 10 objects simultaneously at a range of up to 400 kilometers, (2) produce a higher volume of more accurate data than the single-object tracking radars currently in use, and (3) reduce staff needs.

The CTEIP project will fund the procurement of four MOTRs. They will be placed at White Sands Missile Range, Yuma Proving Ground, and the Navy Pacific Missile Test Center. The project will pay for varying amounts of installation costs at each of the Army locations. Finally, the project provides an option to purchase an additional 14 MOTRs. However,

as of August 31, 1990, none of the services had made any commitments to purchase any of the additional 14.

Justification for the Project

The MOTR project, initiated by OSD, will provide the capability to test increasingly complex multiple-player weapon systems, which cannot be supported by most existing radars that track only one object. According to an Army official, the multiple-tracking capability was needed 15 years ago, and any system that required a multiple-tracking ability, such as the first generation of smart munitions, was not adequately tested. The MOTR can be used in 90 percent of the range missions. Two single-tracking radars will be replaced by each MOTR.

Procurement of the MOTRs will benefit the following systems: Patriot, Aries, Multiple-Launch Rocket System, Aerobee, Advance Medium Air-to-Air-Missile, MQM-107, Advanced Air-to-Air Missile, Aegis, Harpoon, Advanced Tactical Fighter, and Close-in Weapon Systems.

Interrelationship Among CTEIP Projects

According to an Army official, the MOTR Procurement does not duplicate any CTEIP efforts. The Navy has a CTEIP project to integrate its two MOTRs into the Pacific Missile Test Center. This project will fund the infrastructure, including a concrete pad for the Army MOTRs. Because the radar can be rotated to point in different directions, these MOTRs will also be used by the Air Force at Vandenberg Air Force Base.

In the past, the Army and Air Force provided funds to purchase four MOTRs. The Army purchased two MOTRs for White Sands Missile Range, and the Air Force purchased one MOTR for the Eastern Space and Missile Center at Patrick Air Force Base and another for the Western Space and Missile Center at Vandenberg Air Force Base. The CTEIP project will provide $230,000 for test and maintenance equipment for the second MOTR to be delivered at White Sands.

Execution of the Project for Fiscal Years 1990 and 1991

The Army had difficulty executing the project in 1990. Because of questions regarding incremental funding of the MOTRs, the acquisition plan for the procurement was not approved until May 1990. As a result, the MOTR Procurement was pushed back 1 year. A solicitation has now been issued for the procurement, and the contract is expected to be awarded in May 1991.

Current plans call for the purchase of one MOTR each year. This may change, however, if it proves to be less expensive to order two in 1991 and two in 1993 based on order quantity savings information generated by the request for proposal. The MOTRs would then be funded incrementally over 2 or more years.

Outyear Funding Profiles

By comparing the funding of the project as of April 1989 to the revised outyear funding profile as of August 1990, as shown in table II.6, we found that MOTR is scheduled to receive additional funds over the life of the project because of inflation and the purchase of spare parts. Also, in fiscal year 1993, money has been included for a depot contract to repair and maintain the MOTRs, although this contract may not be awarded if funding is not available.

Table II.6: Funding Profiles for the MOTR Procurement Project

Dollars in millions

Fiscal year	Funding as of April 1989	Funding as of August 1990
1990	$27.3	$0.4
1991	23.0	25.4
1992	22.0	25.4
1993	7.0	26.1
1994	2.0	25.8
Total	**$81.3**	**$103.1[a]**

[a]Due to rounding, this figure differs slightly from the amount shown in appendix II of our report on CTEIP (GAO/NSIAD-91-111).

Although not shown in the table II.6, the MOTR Procurement will begin in fiscal year 1991 and end in 1998. The first MOTR will be ordered for Pacific Missile Test Center in fiscal year 1991, with delivery expected in 1994. The second MOTR will be ordered for Yuma Proving Ground in fiscal year 1992 for delivery in 1995. The third MOTR will be ordered for White Sands Missile Range in fiscal year 1993 for delivery in 1996. Finally, the fourth MOTR will be ordered for Pacific Missile Test Center in fiscal year 1994, with delivery expected in 1997.[1]

If CTEIP funding is removed from this project, the Army will not support the acquisition of the MOTRs.

[1]For each of the two MOTRs placed at Pacific Missile Test Center, the CTEIP project will provide $230,000 for test and maintenance equipment. In addition, the project will provide $380,000 and $630,000 for the installation of the MOTRs at White Sands and Yuma, respectively.

Target Control-White Sands Missile Range

The Target Control project is aimed at modernizing and upgrading the Drone Formation Control System at White Sands Missile Range. This system is used for automatic tracking and control of multiple drones and ground targets.

The Target Control project will develop a tri-service system for controlling drone aircraft and a mobile capability to move to remote locations for performing more realistic tests. It is also intended to provide additional capabilities to control multiple advanced threat targets, helicopter targets, and all other service aerial targets to be tested at White Sands Missile Range.

Justification for the Project

This project was initiated by OSD and is managed by the Army. However, according to an Army official, the project is not considered as important as other Army CTEIP projects. It also has little support from the Air Force and none from the Navy. In addition, OSD is planning to replace the current target control system beginning in fiscal year 1995.

The current facility cannot control more than 6 aerial or 12 ground targets simultaneously. Realistic testing requires that the system control more. In addition, a mobile control system is needed for use in remote areas where on-site control systems are not available. Also, the technology of the current system is out of date, and parts are not available. The systems that would benefit from this project are Patriot, Advanced Medium Range Air-to-Air Missile, Forward Area Air Defense System, Multiple-Launch Rocket System, and Hawk.

Interrelationships Among CTEIP Projects

This project does not duplicate any other CTEIP projects. It performs some of the functions needed for the Air Defense Capability project and, according to the Army CTEIP program manager, can be used in place of that part of the Air Defense Capability. It also supports the Smart Munitions Test Suite, which will attempt to track and control smart munitions.

According to an Army official, the services are performing tests with the old equipment, and each range is working on some target control improvements. This official estimated that the Army is spending between $0.5 million and $4 million per year on target control. The Air Force and Navy are spending similar amounts.

Execution of the Project for Fiscal Years 1990 and 1991

The Army had trouble starting the project in fiscal year 1990 because the Army could not reach agreement with the other services on the technical approach for the project. The Navy still is not in agreement. OSD shifted $3.1 million from this project to other CTEIP needs, primarily the GBR-X and Aerial Cable Facility projects, because of the delay in execution. No contracts were awarded in fiscal year 1990. However, CTEIP money was used to develop a flight control console by adding on to an existing contract.

Because contracts were not awarded in fiscal year 1990, funding for the project was also reduced in fiscal year 1991. Despite the lack of agreement among the services on the technical approach, the Army plans to award contracts for development of hardware and software for the tri-service control system and to begin development of the mobile capability.

Outyear Funding Profiles

By comparing the funding of the project as of April 1989 to the revised outyear funding profile as of August 1990, we found that the funding for Target Control is scheduled to decrease by $2.2 million over the life of the project (see table II.7). As stated above, money was shifted from the Target Control project in fiscal years 1990 and 1991 because the project was slow getting started. The project has been stretched out beyond 1995 to accommodate the early delays, but it is expected to proceed as currently planned starting in fiscal year 1992.

Table II.7: Funding Profiles for the Target Control-White Sands Missile Range Project

Dollars in millions

Fiscal year	Funding as of April 1989	Funding as of August 1990
1990	$3.3	$0.2
1991	4.3	0.8
1992	3.5	4.7
1993	3.3	3.4
1994	4.5	3.1
1995	0	3.2
1996	0	1.2
Total	**$18.9**	**$16.6[a]**

[a]Due to rounding, this figure differs slightly from the amount shown in appendix II of our report on CTEIP (GAO/NSIAD-91-111).

Air Defense Capability

The Air Defense Capability project will be a joint Army and Air Force effort to develop, acquire, and integrate the test and evaluation equipment needed to simulate realistic combat environments for the testing of air defense and air-to-air weapon systems. Test and evaluation equipment is needed to generate a realistic combat environment in the European theater to subject the equipment and personnel operating the equipment to the stress levels expected during an actual battle.

The Air Defense Capability will be mobile so that the equipment can be taken to various geographic areas. The project will provide funding for hardware and software that are not tied to a particular weapon system and therefore will allow for testing at multiple sites. The equipment is to be capable of testing joint mobility operations and provide real-time data analysis and casualty assessments, threat simulation interaction, and other capabilities.

Justification for the Project

According to an Army official, this project was initiated by the Army and would benefit the Army and the Air Force. Both services have requirements to simulate a realistic combat environment. However, this project is not considered as important as other Army CTEIP projects. Also, according to Army project documents, there is a lack of tri-service commitment for this project.

The systems that will benefit from this project are the following: Forward Area Air Defense System; Joint Surveillance/Target Attack Radar System; Phoenix; Advanced Tactical Fighter; High-Speed Anti-Radiation Missile; and other air defense, air-to-air, and air-to-ground missiles.

Interrelationships Among CTEIP Projects

According to an Army official, other projects being funded by CTEIP or the Army complement certain aspects of the Air Defense Capability project. The Army is receiving CTEIP funds for the Target Control, MOTR, and GPS projects, which can be used for air defense testing. The Air Defense Capability project also interfaces with the Air Force's GPS project and the Navy's Combat Environment Realism System and Common Airborne Instrumentation System.

The Army is funding other complementary projects that can be used to test an air defense capability. Included in that funding are the Mobile Automated Instrumentation System, which produces real-time casualty assessments, for $70 million; threat simulators for $30 million; and targets for $10 million.

Execution of the Project for Fiscal Years 1990 and 1991

An Army official told us that during fiscal year 1990 the Air Defense Capability project office was not ready to obligate money when the funding became available. Therefore, some money was shifted from the project to the GPS project, which has a higher priority and a need for additional funding to provide GPS equipment at all Army ranges. Funding for the GBR-X project was also increased.

In fiscal year 1990, a contract was awarded to identify tri-service requirements for the Air Defense Capability project. The contract is scheduled for completion the second quarter of fiscal year 1991. Also, a contract for the data link instrumentation design set has been awarded. The Army contracts awarded in fiscal year 1990 are listed in table II.8.

Table II.8: Contracts Awarded for the Air Defense Capability Project (Fiscal Year 1990)

Project	Contract	Date of award	Amount
Tri-service requirements	Stanford Research Institute, Arlington, Va.	March 1990	$500,000
Data link	United International Engineering-White Sands Missile Range	August 1990	150,000
Total			**$650,000**

Plans for fiscal year 1991 include awarding a contract for system engineering technical assistance. The lack of tri-service commitment, however, might delay design of the project or result in tri-service requirements not being incorporated into the system.

Outyear Funding Profiles

By comparing the funding of the project as of April 1989 to the revised outyear funding profile as of August 1990, we found that funding for the Air Defense Capability is scheduled to decrease by almost $45 million over the life of the project (see table II.9). This change is due to the transfer of funds from the Air Defense Capability project to the GPS and GBR-X projects. The Army CTEIP program manager said that this project was not ready to obligate funds in 1990 and is not as important as other projects. Other existing CTEIP and Army projects cover many of the air defense testing capabilities. According to the Army CTEIP program manager, the project could not take any more cuts and still be viable.

Table II.9: Funding Profiles for the Air Defense Capability Project

Dollars in millions

Fiscal year	Funding as of April 1989	Funding as of August 1990
1990	$1.0	$0.6
1991	4.0	1.0
1992	12.0	3.3
1993	30.0	6.6
1994	50.0	10.9
1995	0	15.0
1996	0	15.0
1997	0	15.0
Total	**$97.0**	**$67.4**

Aerial Cable Facility

The Aerial Cable Facility project will fund a permanent facility combining the use of a cable stretched between two mountaintops and a trolley that carries targets and moves along the cable. This facility will have the capability to suspend test items at precise heights above ground, drop items at exact locations, and provide moving targets for air defense weapons. The facility will be located at White Sands Missile Range and will share some of the range's instrumentation and resources.

The project consists of a 3-mile-long cable, trolleys, trolley and test control systems, target-servicing areas and equipment, a target command and telemetry system, and accommodations for the handling of explosives and other materials used in the cable operation.

Justification for the Project

This project was initiated by the Army, supported by OSD, and, according to the Army CTEIP program manager, is needed by all the services. This official said that the project has been identified as a critical need for DOD and has received increased CTEIP funding where possible to expedite the project. The only cable facility in operation in the United States is a contractor-run facility that is old and cannot handle all of DOD's testing needs. This cable is too short for high-speed testing and is used mainly for drop tests. Also, the contractor has announced that this cable facility will be shut down in 1992.

The new facility will provide short test turnaround times, test repeatability, and the ability to reuse targets. According to the Aerial Cable Facility program manager, conducting system tests in an aerial

cable facility rather than with live aircraft and remotely piloted vehicles results in a 47 percent return on investment per year.

The Aerial Cable Facility will benefit the following systems: smart munitions, bombs, precision-guided munitions, scoring systems, terminally guided weapons and components, missile warning systems, and others.

Interrelationships Among CTEIP Projects

The Aerial Cable Facility project does not duplicate other CTEIP projects. However, the facility will support the Army's Smart Munitions Test Suite project, which provides the capability to test and track submunitions released from missiles. The Aerial Cable Facility aids in positioning the missiles for the testing.

According to an Army official, the Army needs to provide an additional $10 million to $15 million above the CTEIP funding for instrumentation to record and analyze data generated by the testing at the facility.

Execution of the Project for Fiscal Years 1990 and 1991

During fiscal year 1990, the Army funded the original design for the facility. Execution of CTEIP funding for fiscal year 1990 included contracting for studies on high-speed target and cable design through the Army Research Office and for an environmental impact statement to be prepared by the Department of Energy. Contracts for studies to build a 1/4-scale target and design of the trolley and trolley control system were awarded in September 1990. The Army contracts awarded in fiscal year 1990 are listed in table II.10.

Table II.10: Contracts Awarded for the Aerial Cable Facility Project (Fiscal Year 1990)

Project	Contractor	Date of award	Amount
Environmental impact statement	Department of Energy/ Sandia Lab, Albuquerque, N.M.	January 1990	$850,000
Cable design and high-speed target	Army Research Office, Cornell University, N.Y., and Composites, Calif.	July 1990	83,000
1/4-scale target	Department of Energy/ Sandia Lab, Albuquerque, N.M.	September 1990	400,000
Trolley and trolley control	Stanford Research Institute, Arlington, Va.	September 1990	150,000
Total			**$1,483,000**

Fiscal year 1991 execution plans include completion of the impact statement, due in December 1991. Final range design details cannot be completed until then. Because there probably will be a gap between the completion of the Aerial Cable Facility and the closing of the contractor-run cable, the program manager is trying to accelerate the program, but he has stated that there are extra costs associated with moving the schedule up.

Outyear Funding Profiles

The Aerial Cable Facility project is a new initiative that was not included in the original CTEIP. The outyear funding, as shown in table II.11, is based on a facility that uses instrumentation already available at White Sands Missile Range. According to the project manager, sharing resources with the range rather than building a stand-alone cable facility will result in some delays in test completion and some tests not being conducted. This is due to the time it takes to schedule and move equipment from one place to another and due to the range priorities. However, it would take an additional $15 million to build a stand-alone facility.

Table II.11: Funding Profiles for the Aerial Cable Facility Project

Dollars in millions

Fiscal year	Funding as of April 1989	Funding as of August 1990
1990	[a]	$1.8
1991	[a]	1.0
1992	[a]	3.2
1993	[a]	7.6
1994	[a]	2.1
1995	[a]	0.2
Total	[a]	**$15.9**

[a]Not applicable.

Navy Projects

Multiple Object Tracking Radar Installation

The MOTR Installation project will provide support for five MOTR sites at the Pacific Missile Test Center (PMTC).[1] Three will be located on San Nicolas Island, one at Point Mugu, and the other at Laguna Peak. With these MOTR sites, PMTC will be able to simultaneously support tracking operations seaward and inland.

According to a Navy official, CTEIP will fund (1) the site selection and survey; (2) the costs associated with radar installation, such as concrete pads, power, water, site access, and data and voice communication links; (3) operational training; and (4) limited, on-site spare parts.

Justification for the Project

According to the CTEIP program manager, MOTR Installation was an OSD initiative, in conjunction with the Army's MOTR Procurement project. At the time of our review, the project covered installation of only Navy MOTRs; however, range interoperability and projected multiservice use offer a wider dimension to the MOTR concept. There is tri-service coordination of MOTR operations with PMTC, White Sands Missile Range, and Vandenberg Air Force Base.

PMTC is limited in outer sea range operations to four precision (single-object) tracking radars at San Nicolas Island. Current PMTC tracking radars cannot incorporate sea clutter (small, erratic moving objects at low altitudes) rejections; however, new MOTRs are to be capable of such realism. In addition, according to a Navy official, due to the current radars' permanent positions at PMTC, there are two blind spots in tracking. Flexibility in positioning of the new, transportable MOTRs should eliminate this problem.

PMTC programs that require concurrent support from more than the current precision tracking radars include the following: Aegis, Phoenix, Harpoon, Standard Missile variants, Close-In Weapon System, and Advanced Air-to-Air Missile.

Interrelationships Among CTEIP Projects

This project does not duplicate other CTEIP projects because it will provide for the installation, not the acquisition, of MOTRs. Another CTEIP project, the Army's MOTR Procurement project, deals with acquisition. According to a Navy official, the project receives no Navy funding.

[1]The Army's MOTR procurement project is purchasing two MOTRs (radars capable of simultaneous tracking of up to 10 objects) for PMTC. According to a Navy official, the Navy plans to move its MOTRs among the five installation sites to allow for a variety of test configurations.

CTEIP will provide funding for the installation of Army MOTRs through the MOTR Procurement project, and, according to the Navy, the Air Force has funded support sites for MOTRs at Vandenberg Air Force Base.

Execution of the Project for Fiscal Years 1990 and 1991

This project received no funding in fiscal year 1990. According to a Navy official, because of a slip in the MOTR Procurement project schedule, the Navy does not expect to receive its MOTRs as originally planned. Therefore, site survey will not begin until fiscal year 1991.

The MOTR Installation program office informed us that the Navy has requested $200,000 for fiscal year 1991, which will be spent on planning, site survey, evaluation of current PMTC ground communication and power facilities for MOTR compatibility, and management. This amount is less than the $1.3 million scheduled allotment for fiscal year 1991 and, according to the project manager, is due to the delay in the MOTR Procurement project.

Outyear Funding Profiles

By comparing the funding of the program as of April 1989 to the OSD-revised outyear funding profile as of August 1990, we found that the MOTR Installation is scheduled to receive an additional $2 million over the life of the project (see table III.1). According to a Navy official, the MOTR Installation program office believed that most of the cost for installing the MOTRs was included in the MOTR procurement package; therefore, the Navy's original budget included only site survey, partial installation, provision of a limited number of spare parts, and training. He added that the new, increased budget will include complete installation.

Table III.1: Funding Profiles for the Multiple Object Tracking Radar Installation Project

Dollars in millions

Fiscal year	Funding as of April 1989	Funding as of August 1990
1990	0	0
1991	$0.6	$1.3
1992	1.2	1.9
1993	0.9	0.7
1994	0.4	0.4
1995	0	0.7
1996	0	0.1
Total	**$3.1**	**$5.1**

According to the MOTR Installation program office, the current, unofficial budget total for MOTR Installation is slightly higher and is extended by 1 year (estimated completion in 1997) due to slippage in procurement. The office also stressed a shortfall of $300,000 for operational training and $3.5 million for a central, tri-service spare parts depot for major items.

Navy Range Global Positioning System

The GPS is a satellite system designed to provide users with worldwide, three-dimensional position and velocity information along with coordinated universal time. Currently, no system can accurately monitor or measure in real-time the hundreds of participants, aircraft, vehicles, missiles, and targets that make up a comprehensive test.

This Navy Range GPS project will purchase equipment developed under the Air Force's GPS Range Applications Joint Program Office project. This GPS equipment will support testing activities at the following Navy test and evaluation ranges: Pacific Missile Test Center, Point Mugu, California; Naval Air Test Center, Patuxent River, Maryland; Naval Air Weapons Center, China Lake, California; and Atlantic Undersea Test and Evaluation Center, Andros Island, Bahamas. The Pacific Missile Test Center is the lead range.

Justification for the Project

The GPS concept was initiated by OSD to develop and acquire GPS equipment that can be used by all the services. It is intended to improve standardization and interoperability of test ranges, expand range coverage area, and enhance test range operations. Although this project will provide assets only for Navy ranges, the GPS concept is intended to have a multiservice application.

Some programs that will benefit from the availability of GPS equipment include the following: Advanced Air-to-Air Missile, S-3A, Tomahawk, F-14, Advanced Tactical Fighter, Advanced Medium-Range Air-to-Air Missile, Short Range Attack Missile II, V-22, High-Speed Anti-Radiation Missile, MK XV, A-6, EA-6B, SH-600B, MK-50, and AN/SQQ-89. The Navy's Operational Test and Evaluation Force lists requirements for time-space-position information; GPS equipment is also required by Navy antisubmarine warfare ranges.

Interrelationships Among CTEIP Projects

This project does not duplicate other CTEIP efforts. According to the Air Force GPS project manager, that project is developing GPS equipment that will be purchased through the Navy and Army GPS projects. Two other CTEIP projects, the Deep Water Range and Portable Tracking System, also will use GPS equipment for their in-air tracking subsystems.

The Navy Range GPS project manager heads a tri-service group that includes all the CTEIP projects involving command, control, communication, and instrumentation: Common Airborne Instrumentation System, Smart Munitions Test Suite, Stores Certification Capability Upgrade, and the Air Force GPS project. We were told that the group meets periodically to discuss technical issues, lessons learned, and cost savings.

Execution of the Project for Fiscal Years 1990 and 1991

According to the project manager, the Navy GPS program office executed all the funds allocated to it in fiscal year 1990. He added that the project received an additional $600,000 to purchase encryption and decryption equipment and investigate long-range surface and airborne capabilities of the GPS. The Navy contracts awarded and in-house costs incurred in fiscal year 1990 are listed in table III.2.

Table III.2: Contracts Awarded and In-House Costs Incurred for the Navy Range Global Positioning System Project (Fiscal Year 1990)

Range	Contractor	Date of award	Amount
Pacific Missile Test Center	Electronic Warfare Associates, Ridgecrest, Calif.	July 1990	$236,797
	Interstate Electronics Corporation, Anaheim, Calf.	July 1990	277,648
	SRS Technologies, Camarillo, Calif.	June 1990	81,616
	Ball Corporation, San Diego, Calif.	August 1990	50,000
	Falcon Microsystems, Landover, Md.	June 1990	14,207
	In-house and other activities		822,732
Naval Weapons Center	Classified contract	March 1990	263,000
	Executive Resources Associates, Ridgecrest, Calif.	August 1990	263,250
	Comarco, Inc., Ridgecrest, Calif.	July 1990	13,000
	In-house		147,750
Naval Air Test Center	In-house		170,000
Atlantic Undersea Test and Evaluation Center	In-house		170,000
Total			**$2,510,000**

According to the project manager, fiscal year 1991 funds will be used for continuing procurement of GPS equipment. The funds will be allocated among the four ranges as follows: Pacific Missile Test Center, $6.6 million; Naval Weapons Center, $3.9 million; Naval Air Test Center, $4.1 million; and Atlantic Undersea Test and Evaluation Center, $200,000.

Outyear Funding Profiles

By comparing the funding of the program as of April 1989 to the OSD-revised outyear funding profile as of August 1990, we found that the Navy Range GPS project is scheduled to receive an additional $3.9 million over the life of the project (see table III.3). The project manager attributed this increase to a rise in the cost of GPS equipment since the time of the original budget proposal. Because GPS equipment was not developed under the Air Force GPS project as early as intended, some of the Navy GPS equipment could not be purchased in fiscal year 1990.

Table III.3: Funding Profiles for the Navy Range Global Positioning System Project

Dollars in millions

Fiscal year	Funding as of April 1989	Funding as of August 1990
1990	$7.3	$2.5
1991	14.6	14.9
1992	8.7	10.0
1993	7.5	10.8
1994	10.9	14.7
Total	**$49.0**	**$52.9**[a]

[a]Due to rounding, this figure differs slightly from the amount shown in appendix II of our report on CTEIP (GAO/NSIAD-91-111).

As of April 1990, the Navy Range GPS project showed $49.1 million in unfunded requirements for fiscal years 1995 to 1997.

Deep Water Range

The Deep Water Range project will create a large, underwater range for testing antisubmarine warfare weaponry. Ninety miles off the coast of Eleuthera Island in the Bahamas, the Deep Water Range will measure 35 by 70 nautical miles and will be able to track underwater, surface, and airborne test participants. The critical test capabilities that most

distinguish this range from other underwater ranges are those of the convergence zone and bottom bounce, to accuracies of 50 meters.[2]

The Deep Water Range will have five subsystems: (1) in-water tracking, (2) in-air tracking, (3) communications, (4) automated data processing equipment, and (5) a satellite data link. It therefore provides large open ocean areas for free-play exercises with multiple players.

Justification for the Project

The Deep Water Range was initiated by the Navy and is a single-service project. According to the Navy, current facilities cannot accommodate newer, longer range undersea warfare weapons. The requirements for a deep range offering convergence zone and bottom bounce test capabilities are established in the Navy's Long Term Underwater Support Resource Plan.

The Navy states that this project will support new generation antisubmarine warfare weapons and combat systems that are now being planned. Some additional systems supported include the Vertical Launch ASROC, MK50 Advanced Lightweight Torpedo, MK48 Advanced Capability Torpedo, sonobuoy development, Light Airborne Multi-Purpose System MK1, Arleigh Burke (DDG-51) Guided Missile Destroyer, AN/SQQ-89 Sonar System, SSN-21 Seawolf-class Submarine, and AN/BSY 1 and 2 combat systems.

Interrelationships Among CTEIP Projects

The Deep Water Range does not duplicate other CTEIP projects, but there is resource sharing and interaction among them. The Navy GPS, Portable Tracking System, and Deep Water Range all depend on GPS instrumentation for in-air tracking. While both the Deep Water Range and Portable Tracking System test antisubmarine warfare weaponry, they have different capabilities. The Portable Tracking System emphasizes test realism; it will be transported for testing in a variety of ocean environments and depths but will not be capable of precise convergence zone and bottom bounce testing.

[2]"Convergence zone" is the path followed by sound energy transmitted downward in the ocean to a depth where it is refracted toward the surface, so that the signal again reaches the surface at a distance from the source. The signals are then successively reflected and refracted to reappear at the surface in similar patterns at intervals out to several hundred miles. "Bottom bounce" is the form of sound transmission in which sound waves strike the bottom in deep water at relatively steep angles and are reflected toward the surface.

The Navy does not directly fund the Deep Water Range. However, the project will benefit from Atlantic Undersea Test and Evaluation Center facilities (boats, wiring systems, and cables already in place and the range operations center), which are valued at $69 million. Existing fixed underwater ranges are able to provide some of the same capabilities, but they are not as large and do not provide the convergence zone and bottom bounce test capabilities.

Execution of the Project for Fiscal Years 1990 and 1991

The Deep Water Range program office spent the funds allotted for fiscal year 1990. In addition, several survey tasks were accelerated. The Navy contracts awarded and in-house costs incurred in fiscal year 1990 are listed in table III.4.

Table III.4: Contracts Awarded and In-House Costs Incurred for the Deep Water Range Project (Fiscal Year 1990)

Activity	Contractor	Date of award	Amount
In-water	SYSCON, Washington, D.C.	February 1990	$150,000
Program management	Aquidneck Management Associates, Middletown, R.I.	February 1990	30,000
In-house	Naval Undersea Systems Center contracts and expenditures	February 1990	330,000
Total			**$510,000**

The projected allocation for fiscal year 1991 is $900,000; funds will be spent on continued planning and study. Fiscal year 1991 funds will be added on to the 1990 contracts, with a projected $300,000 to be placed on to the SYSCON contract, $60,000 to Aquidneck Management Associates, and $540,000 for in-house Naval Undersea Systems Center contracts and expenditures.

Outyear Funding Profiles

By comparing the funding of the program as of April 1989 to the revised outyear funding profile as of August 1990, we found that the Deep Water Range is scheduled to receive a $9.1 million increase over the life of the project (see table III.5). There are two reasons for this change. First, the April 1989 estimate, according to the Navy, was too low; it did not allow for adequate testing. The revised budget reflects a slower, more realistic plan, with a reduction in technical and scheduling risks. Second, the new budget includes four underwater hardware systems (in addition to the original three) for the communications subsystem, which will allow for a wider area of coverage on the ocean floor.

Table III.5: Funding Profiles for the Deep Water Range Project

Dollars in millions

Fiscal year	Funding as of April 1989	Funding as of August 1990
1990	$0.5	$0.5
1991	2.0	1.0
1992	15.0	2.0
1993	20.0	11.0
1994	17.5	17.4
1995	0	22.1
1996	0	10.2
Total	**$55.0**	**$64.2[a]**

[a]Due to rounding, this figure differs slightly from the amount shown in appendix II of our report on CTEIP (GAO/NSIAD-91-111).

The year-to-year changes in the project budget are driven by the CTEIP management office. According to the project manager, the gradual build-up represents more realistic spending and is more consistent with the push to reduce project risk.

Portable Tracking System

The Portable Tracking System (PTS) will test undersea weaponry in diverse water environments. The system will track weapons deployed in varying water depths, acoustic conditions, and climates. According to the PTS program office, test and tracking hardware and a mobile range operations system will be transported to different ocean test sites.

Five subsystems will comprise the PTS: (1) in-water tracking, which will track submarines and torpedoes in deep, shallow, and arctic water conditions; (2) in-air tracking, which will use GPS instrumentation to track surface ships and fixed- and rotary-wing antisubmarine warfare aircraft; (3) portable range operations; (4) communications; and (5) submarine self-track, which will allow submarines to track their own position in relation to other range elements. Some of these subsystems will use existing equipment, whereas others will require new developments.

Justification for the Project

According to a Navy official, PTS was initiated by the Navy. It is a single-service project that will supplement existing and planned fixed-range capabilities. While fixed ranges can track underwater weaponry, they cannot do so in a wide variety of environments. The need for a system to test antisubmarine warfare weaponry in realistic and varied combat conditions is stated in the Navy's Long Term Underwater Support

Resource Plan. According to a Navy official, the project is also supported by the Navy's Operational Test and Evaluation Force.

PTS will support Vertical Launch ASROC, MK48 Advanced Capability Torpedo, MK50, stealth weapons, Light Airborne Multi-Purpose System MK1, and Aircraft Carrier Inner-Zone Antisubmarine Warfare Helicopter upgrades, sonobuoy developments, AN/BSY-1 and AN/BSY-2, SSN-21, DDG-51, and AN/SQQ-89. According to the project manager, the Test and Evaluation Master Plan for AN/SQQ-89 has been re-written to include the PTS requirement.

Interrelationships Among CTEIP Projects

This project does not duplicate other CTEIP projects. According to a Navy official, CTEIP's PTS, Deep Water Range, and Navy Range GPS projects are interrelated in that they will use the same equipment for in-air tracking. In addition, although both PTS and Deep Water Range will permit in-water testing of antisubmarine warfare systems, they have different capabilities. The in-water subsystem of PTS is much more complex than that of the Deep Water Range, allowing for in-water testing in a variety of ocean environments. Joint review of these two CTEIP Navy ranges is being conducted to facilitate the sharing of resources and knowledge.

The Navy does not directly fund the PTS project, according to a Navy official. However, $55 million of Atlantic Undersea Test and Evaluation Center facilities will be used to support PTS. In addition, the Naval Underwater Systems Center contributed to the construction of models for transponders and signal processors that will be used with PTS. This official also said that the study for these models was conducted in 1986 and was valued at $64,000.

Execution of the Project for Fiscal Years 1990 and 1991

The PTS program office executed the funds allotted for fiscal year 1990. Between outside contracts and in-house efforts, the project received $970,000 that year, as shown in table III.6.

Table III.6: Contracts Awarded and In-House Costs Incurred for the Portable Tracking System (Fiscal Year 1990)

Activity	Contractor	Date of award	Amount
Systems engineering	SYSCON, Middletown, R.I.	February 1990 May 1990	$150,000 40,000
Special studies	Atlantic Applied Research Corporation, Burlington, Mass.	March 1990	50,000
Program management	Aquidneck Management Association, Middletown, R.I.	February 1990	60,000
In-house expenditures			670,000
Total			**$970,000**

The project manager expects that funds will be added to the SYSCON and Aquidneck Management Association contracts for continued general program and systems development in fiscal year 1991. With these and additional contracts, the project manager expects that PTS will easily spend its fiscal year 1991 allocation, amounting to $2.1 million.

Outyear Funding Profiles

By comparing the funding of the program as of April 1990 to the OSD-revised outyear funding profile as of August 1990, we found that the PTS budget is scheduled to be increased by $9.5 million over the life of the project (see table III.7). The project manager provided two reasons for this increase. First, the cost as of April 1989 did not allow for testing of the integrated PTS after development. The Navy developed a new budget that provided for this testing and presented it to CTEIP management. Second, CTEIP management recommended even further testing of the system in a variety of ocean configurations. The current budget, therefore, reflects increased time (2 years) and money ($9.5 million) for additional testing.

Table III.7: Funding Profiles for the Portable Tracking System

Dollars in millions

Fiscal year	Funding as of April 1989	Funding as of August 1990
1990	$0.8	$1.0
1991	1.9	2.1
1992	3.7	3.2
1993	8.0	5.9
1994	7.8	6.0
1995	0	6.6
1996	0	6.9
Total	**$22.2**	**$31.7**

According to the PTS project manager, a potential rise in the price of GPS equipment is not accounted for in this project. Such an increase could affect the total PTS budget.

Common Airborne Instrumentation System

The Common Airborne Instrumentation System (CAIS) project is developing an airborne flight test capability to provide a common instrumentation package for various types of aircraft that can be used at a number of test ranges. The CAIS project manager told us that once the capability is developed and tested, it will be acquired by the services with their own funds for use in their existing and future aircraft.

The CAIS adjustable instrumentation package can be expanded to meet future requirements. A key characteristic of the system will be modular, expandable architecture to meet test and evaluation program requirements. The system is to adhere to existing standards for the transmission of data to the ground stations, ensuring compatibility with ground stations at the various ranges. In addition, a management organization will be created for all users of CAIS to include procurement, maintenance, upgrades, and system support.

Justification for the Project

According to an OSD official, this project was initiated by OSD and has multiservice applications. The requirement for this project was developed by all the services. Historically, the three services have developed new instrumentation systems for each new major weapon system they have procured. These instrumentation systems were specific to the weapon system and the particular test range. This practice has led to a proliferation of instrumentation systems, a minimal application to other programs, and higher costs.

Weapon systems to benefit from CAIS include fixed-wing and rotary-wing test and evaluation aircraft. Specific weapon systems cited include the F-14, F-15, F-16, F-18, Advanced Tactical Fighter, Light Helicopter, and B-2.

Interrelationships Among CTEIP Projects

CAIS does not duplicate other CTEIP efforts, although it will interface with the MOTR project.

According to the CAIS program office, the Air Force has attempted to develop a standard airborne instrumentation system but has generally failed to do so. For example, its Air Force Flight Test Instrumentation

System was developed with the assistance of the Navy, but cooperation was limited and the system was dropped. Currently, the Air Force has the Advanced Airborne Test Instrumentation System, which has a limited capability and will be insufficient for future needs, according to the Navy. CAIS is expected to eventually replace this system because of CAIS' increased capabilities. According to the CAIS program office, the services will acquire CAIS rather than other equipment that may be available. The services do not plan on re-instrumenting older aircraft because it would be too expensive.

Execution of the Project for Fiscal Years 1990 and 1991

During fiscal year 1990, the CAIS project was scheduled to receive $2.7 million. However, according to the CTEIP program manager, the funding for the project was reduced because the Navy could not execute it. The reduced funding was spent on office staff, contractor support, travel, and utilities.

During fiscal year 1991, the Navy expects to award the primary CAIS development contact. According to the project manager, the majority of the fiscal year 1991 funds will be spent on the primary contract for development of the instrumentation, with the remainder of the funds going for management and administration.

Outyear Funding Profiles

By comparing the funding of the program as of April 1989 to the OSD-revised outyear funding profile as of August 1990, we found that the overall funding level generally will not change over the life of the project (see table III.8). We were informed that the scope of the project has not been curtailed because of the budget cuts.

Table III.8: Funding Profiles for the Common Airborne Instrumentation System

Dollars in millions

Fiscal year	Funding as of April 1989	Funding as of August 1990
1990	$5.0	$0.7
1991	9.0	12.0
1992	10.0	11.0
1993	12.5	12.5
1994	15.0	10.0
1995	0	5.0
Total	**$51.5**	**$51.2**

According to a Navy official, the CAIS project's budget will be spent on the core contract, valued at $25 million, and low-rate initial production of the common airborne instrumentation packages, valued at $15 million. The remaining funds will support management, utilities, and flight testing.

Air Combat Environment Test and Evaluation Facility

The Air Combat Environment Test and Evaluation Facility (ACETEF) is an integrated ground test facility for testing fully integrated aircraft (tactical-sized aircraft) and aircraft systems in an anechoic chamber that offers a secure and controlled environment.[3] The facility, which is supported by several laboratories, allows for simulation of the combat environments and the direct stimulation of the aircraft hardware and flight crew in the anechoic chamber.[4]

The CTEIP project upgrades ACETEF by providing funding for four existing laboratories (Electronic Warfare Integrated Systems Test Laboratory, Closed Loop Threat Facility, Advanced Flight Simulator, and Aircrew Systems Evaluation Facility), the development of two new laboratories (Communications, Navigation, and Identification Laboratory and Offensive Sensors Laboratory), and the integration of all laboratories into an interoperable test and evaluation complex. The Operations and Control Center provides the cornerstone for total integration of this software-intensive project.

Justification for the Project

According to OSD and Navy officials, this project, which was initiated by the Navy, has multiservice applications. For example, the facility is planned to support a wide variety of users over the next several fiscal years. However, we found that the Navy used the anechoic chamber more than 80 percent of the time during fiscal year 1989. According to a Navy official, other systems are scheduled as backups, but Navy systems are given priority. In addition, we were told that ACETEF serves as a model for future DOD integrated ground test facilities.

Some programs supported by ACETEF include the F-14, F-18, A-6, EA-6B, E-2C, P-3, S-3, CH-53, SH-60, and AV-8.

[3]An anechoic chamber is an enclosure that reduces reflected sound waves to the lowest possible level.

[4]Simulations deceive both the aircraft and flight crews into believing that they are in actual combat. On the other hand, stimulations by computer-controlled environment generators provide radio frequency, electro-optical, and laser stimuli that duplicate, as closely as possible, real signals.

Interrelationships Among CTEIP Projects

Although the project does not duplicate other CTEIP efforts, we were told it interrelates most directly with two Air Force upgrading projects, the Air Force Electronic Warfare Evaluation Simulator and the Real-Time Electromagnetic Digitally Controlled Analyzer and Processor. However, at the time of our work, there was no real-time link among them.

According to Navy officials, ACETEF is currently valued at $250 million. Navy officials told us that ACETEF would be funded without CTEIP, but at a lower level of funding extended over a longer period of time. The Navy will provide about $3 million to $4 million annually for improvement and modernization and $10 million to $15 million from user fees to pay for operations and maintenance on a yearly basis. Currently, CTEIP is projected to provide $180.2 million to upgrade, develop, and integrate the laboratories.

Although the ACETEF project is currently a one-of-a-kind facility that claims multiservice usage, we found that the Air Force is building a large anechoic chamber for bomber-size aircraft at Edwards Air Force Base and a small anechoic chamber for fighter aircraft and an Electronic Warfare Integrated Systems Test Laboratory at Eglin Air Force Base. These facilities are not yet fully developed or integrated, but, according to Navy officials, plans are underway to build laboratory support at Edwards.

Execution of the Projects for Fiscal Years 1990 and 1991

During fiscal year 1990, ACETEF received $9.2 million to support the Electronic Warfare Integrated Systems Test Laboratory; the Closed Loop Threat Facility; the Communications, Navigation, and Identification Laboratory; and the Operations and Control Center. The first project was reduced by $450,000 during fiscal year 1990. Because the Navy prepared early for the project by preparing the appropriate documentation, it was able to quickly award contracts. The Navy contracts awarded and in-house costs incurred in fiscal year 1990 are listed in table III.9.

Table III.9: Contracts Awarded and In-House Costs Incurred for the Air Combat Environment Test and Evaluation Facility (Fiscal Year 1990)

Project	Contractor	Date of award	Amount
Electronic Warfare Integrated Systems Test Laboratory	ASDI, Baltimore, Md.	December 1989	$2,337,000
	American Systems International, Chantilly, Va.	January 1990	620,000
Closed Loop Threat Facility	Digital Equipment Corporation, Merrimack, N.H.	March 1990	409,000
Communication, Navigation, and Identification Laboratory	Digital Equipment Corporation, Merrimack, N.H.	May 1990	458,000
	J.F. Taylor, Lexington Park, Md.	January 1990	711,000
Operations and Control Center	Amherst Corporation, Landisville, Pa.	January 1990	175,000
	BDM, Albuquerque, N.M.	May 1990	450,000
In-house[a]			3,990,000
Total			**$9,150,000**

[a]Additional procurement, including Los Alamos, Naval Air Test Center, and other efforts.

According to Navy officials, ACETEF's multifaceted structure allows for flexibility in response to changing funding levels. Priority is given to less expensive, short-term subprojects in reduced funding scenarios. Contracts have been developed for fiscal year 1991; proposals have been submitted for a $15 million contract for the Communication, Navigation, and Identification Laboratory (total value over 5 years) and a $5 million contract with General Electric, Daytona Beach, Florida, for the Advanced Flight Simulator visual system.

Outyear Funding Profiles

By comparing the funding of the program as of April 1989 to the revised outyear funding profile as of August 1990, the ACETEF project has been reduced in funding by $16.5 million over the life of the project (see table III.10). We were informed that (1) $16 million for part of a large, anechoic facility originally proposed for CTEIP was cut because the Air Force built a similar facility at Edwards Air Force Base; (2) the development of two subprojects was extended by 1 year; and (3) the project was stretched out.

Table III.10: Funding Profiles for the Air Combat Environment Test and Evaluation Facility

Dollars in millions

Fiscal year	Funding as of April 1989	Funding as of August 1990
1990	$15.7	$9.2
1991	22.6	12.6
1992	71.3	31.5
1993	49.0	39.1
1994	38.1	10.6
1995	0	29.8
1996	0	28.7
1997	0	18.7
Total	**$196.7**	**$180.2**

Combat Environment Realism System

The Combat Environment Realism System (CERS) project will simulate air and surface combat environments for testing primarily missile systems in a dense electromagnetic environment. According to the CERS program office, threat radars, jammers, and simulators will be mounted on air-, land-, and sea-based systems to generate an electromagnetic environment. A monitor will interpret the response from the missile and transmit the data back to the range operations center.

The CERS program office informed us that the project will be implemented in two phases. Phase I, which is funded by CTEIP, will develop relatively simple threat scenarios involving Navy weapon systems. CTEIP funds will provide for (1) the procurement of electronic assets for threat scenarios and (2) the modification of range facilities to accommodate various threat simulations. Phase II will develop more complex threat scenarios and will incorporate multiservice requirements. According to the CERS program office, phase II, at an estimated cost of $55 million, is currently unfunded.

Justification for the Project

According to a Navy official, this project was initiated by the Navy. A study by Stanford Research Institute, outlining the Navy requirements for the project, stated that no current test ranges can create a fully realistic electromagnetic environment. The CERS project is expected to fill this void. In addition, the Navy's Operational Test and Evaluation Force has identified a need for a wider mix of threat simulators.

A study was tasked in April 1990 to identify and incorporate tri-service requirements into the project. Once the CERS has completed phases I and

II, some programs supported will include the Advanced Air-to-Air Missile, Advanced Medium-Range Air-to-Air Missile, Aegis, Tomahawk, F-14D, High-Speed Anti-Radiation Missile, Standard Missile 2, and Phoenix Missile.

Interrelationships Among CTEIP Projects

This project does not duplicate other CTEIP projects. It is similar to ACETEF in that it creates a varied threat environment, but ACETEF tests only single aircraft and aircraft systems, whereas CERS will also test Navy surface ships.

According to a Navy official, the Navy originally provided $500,000 for engineering studies, but the Navy no longer funds the CERS project. The project office informed us that it had asked for improvement and modernization funding from the Navy but was denied because of the high cost.

Execution of the Project for Fiscal Years 1990 and 1991

During fiscal year 1990, the CERS project received $220,000 more than its original allocation of $100,000. According to the project manager and as shown in table III.11, this money was divided among existing contracts.

Table III.11: Contracts Awarded and In-House Costs Incurred for the Combat Environment Realism System (Fiscal Year 1990)

Activity	Contractor	Date of award	Amount
Engineering support	Stanford Research Institute, Arlington, Va.	April 1990	$135,000
Systems integration	Comptek Research, Inc., Camarillo, Calif.	March 1990	100,000
CERS project office			85,000
Total			**$320,000**

For fiscal year 1991, CERS is projected to receive $5.1 million. According to a Navy official, threat simulators costing $2.9 million will be purchased by using existing Pacific Missile Test Center contracts. He added that the remaining fiscal year 1991 CERS funds will be placed on existing CERS contracts and will fund the CERS project office.

Outyear Funding Profiles

By comparing the funding of the program of April 1989 to the OSD-revised outyear funding profile as of August 1990, we found that the CERS project budget was increased by $7.2 million (see table III.12). Originally, the Navy's "best estimate" for the project was $40.6 million.

After further study, the Navy concluded that a new, more realistic budget would be $47.8 million. This increased funding is to ensure that final equipment is adequately tested. (The original budget did not provide for all the required testing.)

Table III.12: Funding Profiles for the Combat Environmental Realism System

Dollars in millions

Fiscal year	Funding as of April 1989	Funding as of August 1990
1990	0	$0.3
1991	$9.1	5.1
1992	12.1	8.6
1993	14.1	7.5
1994	5.3	4.0
1995	0	5.5
1996	0	6.8
1997	0	10.0
Total	**$40.6**	**$47.8**

According to a Navy official, the stretch-out of the CERS project budget was mandated by OSD. The estimated $55 million cost for phase II is not included in the outyear funding profile.

Underwater Weapon Simulator

The Underwater Weapon Simulator will test underwater weapons and countermeasures in a secure environment. Ocean, tactical, and acoustic environments are to be modeled to test weapons over a full range of operational conditions. Weapon hardware is planned to be placed in the simulator to test its interaction with various computer-driven stimuli, known as hybrid simulation.

This project involves three hybrid simulators with varying capabilities. Hardware for all three is identical; variations among them are a reflection of different software. CTEIP will fund software development for all three and hardware purchases for two. Those totally funded will be at the Naval Ocean Systems Center in San Diego, California, which will be dedicated primarily to lightweight torpedoes, and at the Naval Coastal Systems Center in Panama City, Florida, which will be dedicated to mines and acoustic countermeasures. The third facility, currently unfunded, will be at the Naval Underwater Systems Center in Newport, Rhode Island, and will test primarily heavyweight torpedoes and new submarine developments.

Justification for the Project

The simulator project was initiated by the Navy and benefits only the Navy. Two simulators currently are in operation, and each sponsored more than 18,000 test runs in 1989. According to the Navy's Long Term Underwater Support Resource Plan, these simulators are no longer useful and are not capable of responding to increasingly complex simulation requirements.

Navy weapons tested by the new simulators will include such systems as torpedoes (MK46, MK48 ADCAP, and MK50), surface ship torpedo defense systems, and undersea mines and countermeasures. The Navy's Operational Test and Evaluation Force supports the need for the project and said it will benefit from the simulator's test data.

Interrelationships Among CTEIP Projects

This project does not duplicate other CTEIP efforts. Although the Navy does have two underwater weapon simulators already in operation, as well as a test tank for performance under pressure, it claims that these facilities are no longer adequate. The Navy does not currently fund the project, although the Navy has proposed funding the third simulator at the Naval Underwater Systems Center.

Execution of the Project for Fiscal Years 1990 and 1991

All fiscal year 1990 funds have been distributed for this project; money has been placed on either existing or new contracts, as shown in table III.13.

Table III.13: Contracts Awarded and In-House Costs Incurred for the Underwater Weapon Simulator (Fiscal Year 1990)

Project	Contractor	Date of award	Amount
Lightweight torpedoes	Honeywell, San Diego, Calif.	March 1990	$321,000
	In-house		1,023,000
Mines and countermeasures	TRACOR, Panama City/Austin, Tex.	September 1989	450,000
	In-house		623,000
Heavyweight torpedoes	BBN, Inc., Newport, R.I.	[a]	263,000
	In-house	[a]	137,000
General research	Applied Research Laboratory, Pennsylvania State University, State College, Pa.	[a]	56,000
	Applied Physics Laboratory, University of Washington, Seattle, Wash.	[a]	177,000
Cost estimate	Dynamic Systems, Inc., Alexandria, Va.	[a]	75,000
Other		[a]	165,000
Total			**$3,290,000**[b]

[a]This award was added to an existing contract.

[b]This figure is $90,000 higher than the fiscal year 1990 allocation. The project manager said that no extra money was spent, but he did not know which figures were reduced.

It is planned that the majority (78 percent) of fiscal year 1991 funds will be spent on continuing systems and hardware engineering and software development.

Outyear Funding Profiles

By comparing the funding of the program as of April 1989 to the revised outyear funding profile as of August 1990, we found that the Underwater Weapon Simulator budget was increased by $12.8 million (see table III.14) and stretched out. We discovered, however, that the original budget did not show $24.7 million in outyear funding requirements (through fiscal year 1996); this would have put the total project costs at $75.2 million. This larger budget was then actually reduced to $63.3 million (the current amount) when the hardware for the third simulator was removed from the project.

Table III.14: Funding Profiles for the Underwater Weapons Simulator

Dollars in millions

Fiscal year	Funding as of April 1989	Funding as of August 1990
1990	$6.3	$3.2
1991	9.5	7.9
1992	10.2	9.8
1993	11.2	10.7
1994	13.3	11.6
1995	0	9.7
1996	0	7.4
1997	0	3.0
Total	**$50.5**	**$63.3**

Anti-Radiation Missile Targets

The Anti-Radiation Missile (ARM) Targets project is planned to employ targets that replicate enemy radars, creating an advanced threat scenario. The targets are to be developed so that, whenever possible, the valuable transmitter equipment will not be hit in the test exercise; only a replaceable, remote antenna will be destroyed. According to Navy officials, the user agrees to pay for the antenna's replacement.

ARMs are designed to destroy enemy radars. The ARM Targets project will fund (1) the procurement of five advanced ARM target systems, (2) the upgrade of existing target emitters, and (3) the purchase of a mobile target certification and monitoring van to employ sensitive receiving, analysis, and recording equipment. The new targets will be mobile and standardized to permit transport to and use at several ranges.

Justification for the Project

According to a Navy official, the Navy initiated the project. There has been an increase in ARM testing requirements in conjunction with new developments and changing threats, and the Navy's Operational Test and Evaluation Force has stressed a need for ARM targets. According to the project manager, the ARM Targets project is categorized as a joint service project. The Navy and Air Force will benefit primarily, given the joint nature of new ARM programs, but there is also projected Army involvement.

The project manager told us that the project will test new generation ARMs, Sidearm, Tacit Rainbow, High-Speed Anti-Radiation Missile, as well as some foreign military programs. Current targets are based on

30-year-old transmitters and cannot respond to advanced threat scenarios.

Interrelationships Among CTEIP Projects

This project does not duplicate other CTEIP efforts. According to the project manager, no Navy improvement and modernization funding was made available for the ARM Targets project because transportable, reusable targets are not considered range assets. However, a Radio Frequency Targets Program Office has been in operation at China Lake, California, since 1985. The project manager added that previous target operations were funded by individual ARM programs. Until now, developments have focused on specific systems and ranges, with no concept of general usage or reuse. New, advanced targets are intended to be more generic in nature than previous systems.

The ARM Targets project manager expects the funding to the Radio Frequency Target Program Office (approximately $2.8 million in fiscal years 1990 and 1991) to decrease as the ARM Targets program assets are developed and used. Instead of developing new targets, the program office will be used to modify and maintain the targets for weapon-specific programs.

Execution of the Project for Fiscal Years 1990 and 1991

According to a Navy official, this project was completely executed in fiscal year 1990; all of the $3.3 million allotted to it was spent. Contract documentation had been prepared prior to receiving funds. The Navy contracts awarded and in-house costs incurred in fiscal year 1990 are listed in table III.15.

Table III.15: Contracts Awarded and In-House Costs Incurred for the Anti-Radiation Missile Targets Project (Fiscal Year 1990)

Activity	Contractor	Date of award	Amount
Certification and monitoring van	EMI-T, Las Cruces, N.M.	September 1990	$1,469,000
New target development	ASE, Fort Worth, Tex.	May 1990	546,000
		August 1990	256,000
	Hughes, El Segundo, Calif.	September 1990	270,000
Target upgrades	Redstone Arsenal, Ala.	March 1990	278,000
In-house			480,000
Total			**$3,299,000**

Contract documentation has been prepared for fiscal year 1991, and the program office does not expect problems in executing 1991 monies. Two-

thirds of the funding is expected to fund the development of advanced targets and one-third to upgrade old targets.

Outyear Funding Profiles

By comparing the funding of the program as of April 1989 to the OSD-revised outyear funding profile as of August 1990, we found that the ARM Targets budget has changed only minimally (see table III.16). Initial operating capability was delayed by 6 months as a result of the fiscal year 1990 congressional cut. According to a Navy official, the overall budget increase is attributed to inflation associated with this redistribution.

Table III.16: Funding Profiles for the Anti-Radiation Missile Targets Project

Dollars in millions

Fiscal year	Funding as of April 1989	Funding as of August 1990
1990	$5.1	$3.3
1991	4.3	4.4
1992	4.0	6.1
1993	4.7	6.0
1994	4.8	3.8
Total	**$22.9**	**$23.6[a]**

[a]Due to rounding, this figure differs slightly from the amount shown in appendix II of our report on CTEIP (GAO/NSIAD-91-111).

OSD and Defense Nuclear Agency Projects

Test Technology Development and Demonstration

The Test Technology Development and Demonstration project supports the evaluation of emerging technologies that can be used by the test and evaluation community. The technology being developed by the services through their research and development programs is often directly applicable to improvements in DOD's ability to test and evaluate its weapon systems. OSD believes that these advanced technologies should be evaluated for DOD-wide application.

According to its program manager, the test technology project supports the services' basic research efforts with 11 subprojects: optical adjunct, chemical agent sensor, standard test targets, trajectory measurements, electromagnetic gun, radio frequency, signature modeling, complex display, electro-optical signature modeling, dim targets, subminiature telemetry, and time-space-position information engine. The program manager said that in the future the new subprojects would focus on the services' development efforts.

Justification for the Project

The program manager told us that this project was initiated by OSD. According to OSD, the sophistication of major weapon systems greatly exceeds the ability of current testing technologies to reliably gather and evaluate test data. No coordinated DOD-wide program exists to adapt new technology from the research and development community to meet test and evaluation needs, and a coordinated tri-service effort is needed to bridge the gap between research and technology and test and evaluation support systems. According to this project's program manager, all the basic research efforts proposed by the services for fiscal year 1990 were funded under this project.

The program manager told us that the programs and technology supported by the project included advanced weapon systems that exceeded the capability of current test and evaluation systems to adequately test functions such as low observables, high-power microwave, and data fusion.

Interrelationships Among CTEIP Projects

The test technology project does not duplicate other CTEIP projects. However, the program manager told us that the project complements others. For example, the trajectory measurements subproject will support the Army's Smart Munitions Test Suite, which will develop a capability to test smart munitions.

Although the services have performed limited work in the past addressing the objectives of this project, OSD believes that more studies are needed. According to this project's program manager, the services should have been conducting these studies all along. He told us that over the past few years OSD provided about $1 million to support similar studies that are now conducted under this CTEIP project.

Execution of the Project for Fiscal Years 1990 and 1991

OSD officials informed us that during fiscal year 1990 several contracts were awarded for studies on various issues. We were told that these studies focused on research and development issues, as opposed to the development of prototypes that would demonstrate emerging technologies. In some cases, the subprojects will later receive additional funding for developing prototypes. The contracts awarded and in-house costs incurred in fiscal year 1990 are listed in table IV.1.

Table IV.1: Contracts Awarded and In-House Costs Incurred for the Test Technology Development and Demonstration Project (Fiscal Year 1990)

Project	Contractor	Date of award	Amount
Optical adjunct	Kaman Sciences, Colorado Springs, Colo.	May 1990	$250,000
Chemical agent sensor	Battelle Pacific Northwest Labs, Richland, Wash.	April 1990	250,000
Standard test targets	Dyncorp, Sierra Vista, Ariz.	April 1990	170,000
Trajectory measurements	EG&G, Las Vegas, Nev.	May 1990	45,000
Radio frequency signature modeling	University of Illinois, Champaign, Ill.	March 1990	84,000
Complex display	BBN, Inc., Cambridge, Mass.	August 1990	120,000
	University of California, Los Angeles, Calif.	August 1990	80,000
Electro-optical signature modeling	Horizons Technology, Inc., San Diego, Calif.	April 1990	56,000
	I-MATH Associates, Inc., Orlando, Fla.	April 1990	70,000
Subminiature telemetry	Harris Corporation, Melbourne, Fla.	February 1990	95,000
TSPI engine	Ball Systems Engineering Division, San Diego, Calif.	February 1990	364,000
In-house efforts			
Electromagnetic gun	Yuma Proving Ground, Ariz.	February 1990	200,000
Dim targets	Pacific Missile Test Center, Point Mugu, Calif.	February 1990	165,000
Other projects	Various ranges		631,000
Total			**$2,580,000**

The project's program manager told us that during fiscal year 1991 OSD would award contracts with the objective of developing hardware that could be evaluated for possible use by the test and evaluation community. A tri-service committee has recently met to discuss possible studies; however, at the time of our work, decisions had not been made on which studies would be funded.

Outyear Funding Profiles

By comparing the funding as of April 1989 to the revised outyear funding profile as of August 1990, we found that funding for this project is scheduled to increase by $22.1 million over its life (see table IV.2). An OSD official told us that OSD would like to fund four studies on a yearly basis, with each study costing about $3 million.

Table IV.2: Funding Profiles for the Test Technology Development and Demonstration Project

Dollars in millions

Fiscal year	Funding as of August 1989	Funding as of August 1990
1990	$5.0	$2.6
1991	6.0	3.5
1992	10.0	6.0
1993	12.5	9.0
1994	15.0	12.0
1995	0	12.0
1996	0	12.5
1997	0	13.0
Total	**$48.5**	**$70.6**

Large Blast/Thermal Simulator

The Large Blast/Thermal Simulator project will provide a facility to simulate the combined blast and thermal effects of nuclear weapons. This facility will primarily test tactical systems and components to verify their ability to survive a nuclear explosion and identify their vulnerabilities. The facility will be located at White Sands Missile Range, New Mexico.

The Defense Nuclear Agency (DNA) is the executive agent for the project, and construction of the facility is being funded through the Military Construction (MILCON) account. CTEIP is funding heat tubes, the design of new plugs, and the instrumentation for the facility.

Justification for the Project

This project was initiated by DNA; however, the simulator will fulfill primarily Army testing requirements because the Army has the largest set of systems that must meet the survivability criteria for the blast and thermal effects of nuclear weapons. A backlog of approximately 300 systems, more than 200 of which belong to the Army, has not been tested against blast and thermal effects.

This simulator will be used to test most Army mobile tactical systems, Navy shipboard equipment, the Peacekeeper Rail Garrison, and other systems that may face blast and thermal effects.

Interrelationships Among CTEIP Projects

According to Army officials, a simulator of this size is not available anywhere. There are also no other CTEIP projects that provide the capabilities that the facility offers.

Execution of the Project for Fiscal Years 1990 to 1992

Funding for the project, $74.4 million in fiscal years 1990 and 1991, was transferred from the CTEIP budget to the MILCON account because the simulator is essentially a construction project. Design and construction are on schedule, with construction scheduled to start in the third quarter of fiscal year 1991 and continuing through fiscal year 1992. CTEIP funding does not begin until fiscal year 1992.

Outyear Funding Profiles

By comparing the funding of the project as of April 1989 with the revised outyear funding profile as of August 1990, we found that funding for the project has decreased by almost $67.6 million (see table IV.3). (As explained above, funding for the project was shifted to MILCON.) An additional $6.8 million was added to the CTEIP budget in fiscal year 1992 to fund upgrades to the simulator beyond what MILCON is providing.

Table IV.3: Funding Profiles for the Large Blast/Thermal Simulator

Dollars in millions

Fiscal year	Funding as of August 1989	Funding as of August 1990
1990	$9.6	0
1991	64.8	0
1992	0	$6.8
Total	**$74.4**	**$6.8**

Radiation Effects Test Facility

The Radiation Effects Test Facility is intended to provide DOD with the ability to test the effects of powerful doses of radiation on space-based subsystems. Satellites and other space systems will be tested for their ability to survive and function in a nuclear conflict. The facility will augment (and perhaps replace) underground nuclear testing and enhance the theoretical analysis of radiation effects.

This project consists of three parts: an X-ray nuclear weapons effects simulator, the housing of the simulator, and the data acquisition monitoring and control system. Essentially, CTEIP is funding a large, powerful X-ray simulator that is designed for the testing community rather than the research community.

Justification for the Project

DNA initiated the project to meet multiagency and multiservice test requirements. DOD's policy dictates that nuclear survivability be an inherent part of all major and nonmajor systems that must perform critical missions in nuclear conflicts.

Existing, above-ground simulators are believed to be too small to test whole subsystems and have inadequate instrumentation and diagnostics because they were built for research rather than testing. In addition, some lack the security required for classified weapon systems, and the radiation generators are of outdated technology. Further, underground testing is done only once or twice a year and may be stopped entirely if a comprehensive test ban treaty is successfully negotiated. Most space-based weapon systems, such as Strategic Defense Initiative programs and military satellites (especially communications and navigation satellites), will use the facility.

Interrelationships Among CTEIP Projects

The Radiation Effects Test Facility project does not duplicate other CTEIP projects.

DNA will provide $20.9 million from fiscal years 1990 to 1994 for research and development of inductive energy storage technology, which is to provide a more powerful and maintainable X-ray generator than the conventional water line technology.

Execution of the Project for Fiscal Years 1990 and 1991

The project obligated funds under five contracts in fiscal year 1990 totaling $770,000, as shown in table IV.4. Tasks included architectural and engineering support and other aspects of project initiation. Most of the tasks were added on to existing contracts. Before CTEIP funding was approved, DNA used its own money to get the tasks started and then was reimbursed when the CTEIP money became available.

Table IV.4: Contracts Awarded and In-House Costs Incurred for the Radiation Effects Test Facility (Fiscal Year 1990)

Tasks	Contractor	Date of award	Amount
Architectural and engineering support	Physics International, San Leandro, Calif.	[a]	$150,000
	Maxwell Laboratories, San Diego, Calif.	[a]	150,000
Pre-integration	W.J. Schafer, Arlington, Va.	[a]	400,000
Architectural and engineering design	Corps of Engineers	November 1989	20,000
Environmental assessment	Corps of Engineers	September 1990	50,000
Total			**$770,000**

[a]This effort was added on to an existing contract.

In addition, DNA spent $700,000 on pre-design work. DNA expects to be reimbursed for that money when the CTEIP funding for construction becomes available in fiscal year 1993.

Only one additional contract, for integration of the various parts of the project, is expected to be awarded during fiscal year 1991.

Outyear Funding Profiles

By comparing the funding of the program as of April 1989 with the revised outyear funding profile as of August 1990, we found that funding for the project is scheduled to increase by $6.9 million over the life of the project (see table IV.5). In addition, most of the funding will be moved from the fiscal year 1992-93 period to the fiscal year 1993-94 period, and the project will be extended for an additional year (now expected to be completed in fiscal year 1995). The project manager told us that the budget and funding profile was modified to meet budget constraints. According to the project manager, the extended schedule has not had an adverse impact on the project; DNA is using the additional time to do more research. The program manager said, however, that a comprehensive test ban treaty would create pressure to speed up the project.

Table IV.5: Funding Profiles for the Radiation Effects Test Facility

Dollars in millions

Fiscal year	Funding as of August 1989	Funding as of August 1990
1990	$0.9	$0.9
1991	2.6	0.9
1992	25.3	8.6
1993	21.7	25.3
1994	3.1	20.6
1995	0	4.2
Total	**$53.6**	**$60.5**

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