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Report to the Chairman, Committee on Armed Services, U.S. Senate

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DOD ACQUISITION PROGRAMS

Status of Selected Systems

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GAO/NSIAD-87-128

Table 1: Summary of Cost, Schedule, and Performance Problems for the 19 Programs

Programs	Cost	Schedule	Performance
ARMY			
Light Helicopter Family	X	X	a
Aquila Remotely Piloted Vehicle		X	
Forward Area Air Defense System			
Line-of-Sight Forward Heavy Weapon			a
Non-Line-of-Sight Weapon		X	a
Command, Control and Intelligence System	X	X	a
All-Source Analysis System	X	X	
Joint Surveillance and Target Attack Radar System	X	X	X
NAVY			
TOMAHAWK Cruise Missile			
Carrier Inner Zone Anti-Submarine Warfare Helicopter	X		a
Trident II (D-5) System			
FY 1989 Submarine Combat System		X	a
AIR FORCE			
Titan IV Rocket (CELV)	X		
Common Strateg c Rotary Launcher			
Short Range Attack Missile II		X	a
Advanced Medium Range Air-to-Air Missile	X	X	X
Mark XV Identification Friend or Foe System		X	a
Microwave Landing System		X	a
NAVSTAR Global Positioning System (User Equipment)	X		a
World Wide Military Command and Control System's Information System	X	X	a

[a] It is too early in the acquisition cycle to determine overall performance characteristics

For the 19 programs discussed in this report, 18 are at or are scheduled to reach milestone II in fiscal year 1988 or 1989 Four of the programs scheduled to reach milestone II will do so without completing the demonstration and validation phase.

Eleven programs are at or are scheduled to reach milestone IIIB in fiscal year 1988 or 1989 For 9 of these programs, operational testing has not begun

Cost

For the 19 programs, 9 had current cost estimates which increased their baseline cost estimates (1 had an incomplete total program cost estimate and 3 had increases of over $4 billion each), 6 had current estimates which were the same as their baseline (1 had an incomplete total program cost estimate), and 4 had current estimates which decreased their baseline cost estimates by $400 million to $1 2 billion

Schedule

Of the 19 programs, 7 are on schedule and 12 have experienced schedule slippages ranging from 4 months to 51 months The average delay was 17 months, and in most cases the delay resulted in increased costs.

Performance

An overall performance characterization for 11 programs would be premature because they are early in the acquisition cycle. For the remaining 8 programs, 6 have achieved or are expected to achieve system performance expectations while 2 may not unless changes are made

Appendix I provides background information on DOD milestone management, the new provisions for milestone authorization of defense acquisition programs, and a description of our objectives, scope, and methodology. Detailed information on each of the 19 programs is included in appendixes II through IV

To develop information included in this report, we interviewed DOD and service program officials and examined program and budget documents and selected acquisition reports for each program. We obtained official oral comments from DOD and have incorporated their comments where appropriate. We performed our work from December 1986 to March 1987 in accordance with generally accepted government auditing standards.

We are sending copies of this report to the Chairmen, House Committee on Armed Services, House and Senate Committees on Appropriations, Senate Committee on Governmental Affairs, and House Committee on Government Operations; the Secretary of Defense; the Secretaries of the Army, Navy, and Air Force; and the Director, Office of Management and Budget. Copies will be made available to other interested parties upon request.

Sincerely yours,

Frank C Conahan
Assistant Comptroller General

Contents

Abbreviations

ACCS	Army Command and Control System
AMRAAM	Advanced Medium Range Air-to-Air Missile
ASAS	All Sources Analysis System
CELV	Complementary Expendable Launch Vehicle
CSRL	Common Strategic Rotary Launcher
C2I	Command and Control and Intelligence
DOD	Department of Defense
ENSCE	Enemy Situation Correlation Element
FAA	Federal Aviation Administration
FAADS	Forward Area Air Defense System
FY89CS	Fiscal Year 1989 Submarine Combat System
GAO	General Accounting Office
GPS	Global Positioning System
GSM	ground station module
JRMB	Joint Resource Management Board
JSTARS	Joint Surveillance Target Attack Radar System
JTFP	Joint Tactical Fusion Program
LHX	Light Helicopter Family
LOS-F-H	Line-of-Sight Forward Heavy
MLS	Microwave Landing System
FOG-M	Fiber Optics Guided Missile
RPV	Remotely Piloted Vehicle
SHORAD	Short Range Air Defense Command and Control
SRAM	Short Range Attack Missile
SUBACS	Submarine Advanced Combat System
UE	User Equipment
WIS	WWMCCS Information System
WWMCCS	World Wide Military Command and Control System

Background and Objectives, Scope, and Methodology

Background

According to Department of Defense Directive 5000 1, "Major Systems Acquisitions," DOD will ensure that its acquisitions of major defense programs are carried out efficiently and effectively Management responsibilities for systems acquisition programs are decentralized, except for decisions specifically retained by the Secretary of Defense

Major defense acquisition programs, as defined in 10 U.S.C. 2432 (a) (1), are DOD acquisition programs that are (1) not classified as highly sensitive, (2) designated by the Secretary of Defense as major acquisition programs, or (3) estimated to require an eventual total expenditure for research, development, test, and evaluation of more than $200 million (based on fiscal year 1980 constant dollars) or eventual total expenditure for procurement of more than $1 billion (based on fiscal year 1980 constant dollars)

Under the new provisions in 10 U.S.C. 2436 and 2437, defense acquisition programs can be nominated as Defense Enterprise Programs by the service Secretaries and selected by the Secretary of Defense for milestone authorization

Under the new provisions, programs that are in or ready to go into milestone II or IIIB can be designated as Defense Enterprise Programs.

Milestone II is the Secretary of Defense's second major decision for program go-ahead and approval to proceed with full-scale development, following the approval of concept selection.

Milestone IIIB is either the service Secretary or Secretary of Defense decision for program go-ahead and approval to proceed with full-rate production. According to DOD Directive 5000 1, authority is delegated to the lowest level of the DOD component at which a comprehensive view of the program rests The military service program manager is given authority and resources commensurate with the authority to execute the program efficiently. Reviews, such as those conducted by the Joint Requirements Management Board (previously called the Defense Systems Acquisition Review Council), are a means to evaluate the information required for a decision which higher authority has specifically reserved and not delegated to the program manager.

Objectives, Scope, and Methodology

We were requested by the Chairman, Senate Committee on Armed Services, to review certain major defense acquisition programs that are scheduled to reach either milestone II or milestone IIIB in fiscal years

1988 and 1989 to assist the Committee in its examination of these programs for milestone authorization

Our review focused on cost, schedule, and performance. We also examined certain other areas, such as system alternatives, funding adequacy, and compliance with DOD and service review procedures.

We reviewed the latest System Acquisition Report for each selected program as well as relevant budget and program documents and interviewed responsible agency program officials We obtained official oral comments from DOD on each program and have incorporated them in this report where appropriate

Our work was conducted at DOD and the Departments of the Army, Navy, and Air Force at the Pentagon, Arlington, Virginia, Army Missile Command, Huntsville, Alabama; Aviation Systems Command, St Louis, Missouri; Communications and Electronics Command, Fort Monmouth, New Jersey; Naval Underwater Systems Center, New London, Connecticut; Navy Surface Weapons Center and Navy Operational Test and Evaluation Force, Norfolk, Virginia, the Air Force Logistic Command, Warner-Robbins Air Force Base, Georgia, Aeronautics Division, Air Force Systems Command, Wright-Patterson Air Force Base, Ohio, Electronics Systems Division, Air Force Systems Command, Hanscom Field, Massachusetts, and Space Division, Air Force Systems Command, Los Angeles, California

Army Programs

Army Light Helicopter Family

The Army's Light Helicopter Family (LHX) is to be a fleet of new helicopters with the advanced capabilities to perform several new missions, such as air-to-air combat and fighting across battle lines, as well as existing anti-armor and utility missions The LHX will be the Army's most technically advanced helicopter if it is to perform these missions and survive against the expected threat weaponry of the 1990s, while meeting its requirement of light weight and the goal of being a single seat helicopter. It was conceived to replace the Army's current fleet of light helicopters—the AH-1, UH-1, OH-6, and OH-58—which the Army considers too obsolete to meet the demands of the future battlefield The heart of the LHX is its avionics, which are as sophisticated as the Air Force's Advanced Tactical Fighter now in development In addition, the LHX airframe will be made from lightweight composite materials, rather than from metal. The program is managed by the Army's Aviation Systems Command in St. Louis, Missouri

The LHX's original goals have proven to be too optimistic projected weight and costs are higher, performance expectations are lower, and the feasibility of a single seat version of the LHX remains undemonstrated. The Army is currently assessing its cost effectiveness, and reassessments will be necessary if the program moves further away from its goals. Another concern is the program's affordability. At projected total quantities and rate of production, the LHX will dominate the Army's aircraft procurement budget in the mid-1990s and beyond The Army already faces potential funding shortfalls during those years, and whether enough funds can be set aside for LHX remains to be seen.

Description

Current plans call for two versions of the LHX—the Scout/Attack and the utility Both versions will have many common components. The Scout/Attack helicopter will perform attack and armed reconnaissance missions and will replace the AH-1, OH-58, and OH-6 helicopters It is the more sophisticated of the two helicopters and will be a single seat helicopter, if technically and operationally feasible, whose armament will include Hellfire antitank missiles, air-to-air missiles, and a gun system.

The utility version will replace the UH-1 and will have two seats. It will carry air-to-air missiles for self-defense, but it will not have the target acquisition equipment of the Scout/Attack

The Army plans to buy 2,000 Scout/Attack and 2,500 utility helicopters The program is in advanced development, and the full-scale development decision (milestone II) is scheduled for April 1987. Current plans call for contractor teams to compete throughout full-scale development.

Cost

LHX's estimated costs have changed many times since the program's inception in 1983. The Army's current plan is to procure approximately 4,500 LHX helicopters at a total acquisition cost of $44.9 billion in 1986 dollars ($66 billion in escalated dollars), according to the LHX program office's baseline cost estimate As of February 1987, no Army or DOD estimates, independent of the program office's, had been completed. They are scheduled to be completed before the full-scale development decision

The changes in estimated LHX costs are due primarily to changes in mission equipment and acquisition strategies. Table II.1 shows the original 1983 estimates, the 1986 estimates at the time we completed our first review, and the February 1987 estimates

Table II.1: Cost Estimates for the LHX

Dollars in billions

Program	May 1983	1986	February 1987
Research and development			
1986 dollars	$2 7	$2 7	$3 8
Escalated dollars	3 1	3 2	4 4
Procurement			
1986 dollars	39 2	38 0	41 1
Escalated dollars	79 9	57 4	61 6

The increase in research and development costs is due mainly to changes in the acquisition strategy suggested by DOD's Defense Science Board, which extended the LHX team competition through full-scale development to include a competitive flight test. The previous strategy had called for selecting one contractor before the prototype stage began. Also contributing to cost increases were Army decisions to build a two-seat Scout/Attack prototype in addition to a single-seat prototype

The Army set cost goals (in 1984 dollars) early in the program for the LHX in terms of unit flyaway costs. Flyaway costs are a subset of procurement costs and exclude items such as initial spares and repair parts. In May 1986, the goals were $6 million for the Scout/Attack, $4 million for the utility, or an average of $5 3 million for the entire fleet. As of February 1987, unit flyaway costs have increased 15 percent for the Scout/Attack and 35 percent for the utility version. The effects of these increases on total estimated procurement costs were reduced somewhat by a decrease in the total buy and a change in the mix of Scout/Attack and utility versions As of May 1986, 5,023 helicopters were to be procured, made up of 3,072 Scout/Attack and 1,951 utility versions; as of February 1987, 4,500 helicopters were to be procured, made up of 2,000 Scout/Attack and 2,500 utility versions Table II.2 shows the estimated increases in the unit flyaway costs and unit procurement costs since May 1986.

Table II.2: Unit Cost Changes

Dollars in millions

	May 1986	February1987
Procurement unit costs (fleet avg)		
1984 dollars	$7 1	$8 6
escalated dollars	11 4	13 7
Flyaway unit cost (1984 dollars)		
Scout/Attack	6 0	6 9
Utility	4 0	5 4
Fleet average	5 3	6 1

The Scout/Attack unit cost estimates increased primarily because of the need to increase aircraft weight to satisfy mission requirements The Army's revised plan to procure fewer Scout/ Attack helicopters has also increased the unit cost estimate.

The utility helicopter's unit cost estimate increase is due mainly to the Army's decision to outfit that aircraft with the same mission equipment as the more expensive Scout/Attack, with some exceptions, such as equipment directly related to target acquisition and weapon fire control Greater aircraft weight for the utility helicopter has also increased the unit cost estimate

In order to buy 4,500 helicopters and to replace the current fleet as quickly as possible, the Army plans to procure as many as 480 LHX helicopters per year. In those peak production years, the Army estimates the LHX program could require up to $6 billion a year (in escalated dollars) During this same period, many other Army systems will be competing for the limited amount of funds that will be available for programs funded from the Army procurement appropriation.

A preliminary Army analysis shows that, assuming no real growth annually in available funds, the procurement account may be short over $100 billion cumulatively from fiscal years 1987 through 2000. Peak LHX production, as planned, will occur in the late 1990s With such large fund shortages being projected, it seems likely the Army may face either canceling or stretching out some weapon system programs if it is to buy the LHX at the planned rate

In the area of operation and support costs, estimated savings are less than expected Originally, the LHX fleet's operation and support costs were expected to be 40 to 50 percent less than those of the fleet of helicopters it was to replace Currently, such savings are estimated at 20 to 25 percent. Basically, the lower expectations are due to the availability of better operation and support cost data on the existing fleet, more realistic estimates of LHX reliability, and increased spare parts costs, which reflect the greater costs now estimated for LHX production helicopters

Schedule

The LHX is scheduled for a full-scale development decision (milestone II) in April 1987, followed by contract awards in January 1988 The Army plans a competitive development, awarding contracts to two teams, each consisting of two contractors Development contracts will be awarded in three phases, each consisting of 18 to 24 months of effort The winning team is to be selected before low-rate initial production (milestone III), and the two members of the winning team will be split to compete for shares of the remainder of production (milestone IIIA) The Army will assess results at the end of each phase and determine whether program changes should be made, including the possibility of an early selection of a single team.

Since the LHX program began in 1983, its development and procurement schedules have changed substantially and frequently. Table II 3 shows six of these revisions to the LHX's key milestones since 1983.

Table II.3: LHX Schedule Changes

Schedule date	Milestone II	Milestone III	Milestone IIIA[a]	Fielding Date
Oct 1983	Oct 1986	Not Avail	Not Avail	Sept 1994
May 1984	Nov 1985	Apr 1990	Dec 1991	Sept 1992
Sept 1984	June 1986	Jun 1991	Not Avail	Sept 1993
Sept 1985	Apr 1987	May 1993	Jun 1995	Oct 1995
Feb 1986	Oct 1987	Jan 1994	Jan 1996	May 1996
Oct 1986	Jan 1989	Sept 1995	Sept 1997	Jun 1998
Nov 1986	Jan 1988	Jun 1993	Nov 1995	Nov 1995

[a]Only the last two schedules show a discrete milestone IIIA decision, which would precede splitting the winning team for the rest of production The dates shown for the earlier schedules represent when the team was to be split

The major factor causing the delays was the Army's persistent difficulty in obtaining funds for the program. Other factors include difficulties in (1) finalizing the Required Operational Capability document and its request for proposal to industry, (2) deciding what mission equipment would be needed, and (3) reacting to comments from industry on the feasibility of the requirements

The schedule was also restructured to reflect DOD's Defense Science Board recommendations to extend competition through prototype flight tests

While schedule changes have substantially delayed starting full-scale development and plans for fielding the aircraft, the additional time is allowing for many of the state-of-the-art technologies planned for LHX to reach greater maturity

Performance

The LHX's requirements to perform a variety of missions against an advanced threat with a single-seat aircraft are demanding from a technology standpoint alone. Meeting these requirements is even more difficult given the unit flyaway cost, operation and support cost, and aircraft weight goals the Army is also striving to meet Trade-offs are still being made between performance requirements and cost and weight goals Therefore, it is too early to evaluate how well, or if, the LHX will meet its performance requirements However, progress to date has indicated that original performance expectations and cost estimates were too optimistic and will not be met

On the basis of LHX advanced development efforts to date, the Army concluded that the feasibility of having a single pilot fly, maneuver, and control a helicopter had been demonstrated, but the feasibility of a single pilot performing the mission-related tasks, such as targeting, had not been demonstrated. The Army also learned that the performance necessary from the optical sensors to fully automate the targeting function for the single pilot may not be available for application to the initial LHX helicopters The Army considered developing a radar sensor to complement the optical sensors available for the LHX to achieve full automation, but decided that the additional equipment was too costly and too heavy for inclusion in the initial LHX helicopters. These factors, combined with an assessment by the Defense Science Board, have raised some doubts about achieving the single-seat objective and have led to the addition of a two-seat version to the development program

In addition to automated targeting technologies, other areas where performance expectations have been lowered include the quality of the visual displays to the pilot's helmet, digital map, automatic hover-hold, and aircraft survivability equipment Performance reductions reflect trade-offs due to cost, weight, technical risk, or a combination of these. Regarding aircraft weight, the original program goal for the Scout/Attack was 8,500 pounds The current goal is 9,500 pounds A two-seat version would weigh more

Other Issues

System Alternatives

The Army is currently examining alternatives to developing a new LHX helicopter in its Cost and Operational Effectiveness Analysis. This analysis is scheduled for completion by the full-scale development decision in April 1987 The alternatives under consideration are (1) modifying the existing AH-1, UH-1, and OH-58A/C helicopters with reliability, availability, maintainability, and safety improvements, (2) modifying the existing AH-64, UH-60, and OH-58D helicopters with reliability, availability, maintainability, safety, and performance improvements, working together with the S-76 commercial helicopter as a utility aircraft, and (3) developing a new tilt rotor aircraft. While modifying existing helicopters will cost less, none will meet all of LHX's requirements

According to DOD, there are currently no helicopters being produced by our allies that have comparable capabilities to the LHX. The LHX represents an attempt to make significant advances in technology, and it is difficult to foresee technological breakthroughs which would render it obsolete for some time The LHX's avionics are already considered among the most advanced of DOD programs and are to be designed to accept future technological advances.

Funding Adequacy

The Senate report accompanying the fiscal year 1987 Appropriations bill required the DOD Cost Analysis Improvement Group to certify the LHX's unit cost estimate before any fiscal year 1987 funds for technology risk reduction would be released. As of January 31, 1987, this certification had not been made, and the fiscal year 1987 funds had not been released for obligation Risk reduction efforts must be substantially completed before the Army contracts for full-scale development in January 1988. The Army has requested the Congress to release $25 million of the $44 million appropriated for fiscal year 1987 to continue the program through May 1987, the date the Army's cost estimate is scheduled to be completed and certified While the House of Representatives has concurred with the Army's request, the Senate had taken no action as of January 31, 1987 The Army considers the fiscal year 1987 funding of $44 million to be adequate and the dollars programmed for fiscal years 1988 and 1989 to be sufficient for the first years of full-scale development

Compliance With Review Procedures

As currently planned, the LHX will not proceed through the normal weapon system development phases of concept exploration, demonstration and validation, and full-scale development. Rather, it will proceed directly from concept exploration to full-scale development DOD Directive 5000.1 encourages tailoring acquisition strategies to the needs of the particular program, with prior approval for combining or omitting phases. Although such prior approval was not obtained for the LHX, the Office of the Secretary of Defense has approved budget requests, which reflect its accelerated strategy, and plans a review of the program's entry into full-scale development in April 1987

Relevant Products

Weapon Systems. Issues Concerning the Army's Light Helicopter Family Program, GAO/NSIAD-86-121, May 22, 1986, and DOD Acquisition: Case Study of the Army Light Helicopter Program, GAO/NSIAD-86-45-S-1, August 25, 1986

Aquila Remotely Piloted Vehicle

The Army's Aquila is a miniaturized, remotely piloted air vehicle, which, together with its ground equipment, is designed to conduct unmanned battlefield surveillance and target acquisition over enemy territory This information is communicated back to the battlefield commander as it is being collected to extend the commander's sight beyond the front lines

The Army has been developing the Aquila since 1974 At that time, an advanced development program was begun that demonstrated the technical and tactical feasibility of flying a pilotless air vehicle equipped with a small television camera to gather target information This very basic concept was proven, and the program entered full-scale development when the Army awarded a contract to the Lockheed Missiles and Space Company in August 1979 The program, managed by the Army Missile Command in Huntsville, Alabama, is scheduled for a production decision (milestone III) in July 1987

Throughout full-scale development, the Aquila has experienced technical problems, which, together with funding shortages, has more than tripled cost and delayed fielding by nearly 7 years Some progress has been made in resolving the problems, but the Army and DOD may have difficulty in assessing production readiness because measurable performance thresholds have not been established. Also, an infrared sensor needed to enhance system performance has encountered technical problems, and its funding is not sufficient to complete development.

Description

The Aquila system consists of an air vehicle, a ground station, a remote ground terminal antenna, launch equipment, recovery equipment, and support and maintenance equipment The Aquila is a mobile system with all its equipment mounted on or contained in a fleet of trucks or trailers The air vehicle has a wing span of 13 feet and carries flight control electronics, a communications terminal, and a mission payload consisting of a television sensor and a laser rangefinder/designator The laser rangefinder/ designator is a device that focuses a laser beam on a target to measure how far away it is, as well as to guide laser-seeking munitions to the target This payload allows for only daytime operations. The Army is developing a forward-looking infrared sensor to provide a day/night and limited adverse weather capability There is only enough space and weight to accommodate one payload at a time

A typical mission begins when the launch system catapults the Aquila air vehicle into the air The Aquila is then controlled from a ground control station through a jam-resistant data communication link Aquila's tasks, which it performs with the television sensor and laser device, include detecting and identifying targets, providing target locations for adjusting artillery fire, designating targets for precision-guided munitions, and performing reconnaissance After the tasks are completed, an automated recovery system guides the air vehicle back into a net near the ground station

Cost

The Aquila program has experienced considerable cost growth due to technical problems, funding limitations, and an expansion of its original performance requirements In February 1987, the Aquila's development and procurement costs were estimated at $850 million and $969 million, respectively, in 1986 dollars While the costs of the individual Aquila system components have increased in recent years, total procurement costs have not increased because quantities have been reduced. Table II 4 shows Aquila's estimated costs (in escalated dollars) and procurement quantities at various times during development

Table II.4: Acquisition Costs and Quantities as Estimated During Development

Dollars in millions

	1978	1982[a]	1984[a]	1987[a]
Acquisition costs (escalated dollars)				
Development	$123	$590	$686	$868
Procurement	440	1,425	1,386	1,157
Total	**$563**	**$2,015**	**$2,072**	**$2,025**
Procurement quantities				
Air vehicles	780	995	543	376
Ground control stations	72	74	77	53

[a]Includes costs for the forward-looking infrared sensor

Schedule

The Aquila program has experienced numerous schedule slippages, primarily due to technical problems, and to a lesser extent, funding limitations. When the Aquila program entered full-scale development in 1979, the Army envisioned a 43-month engineering development program. The program was later extended to 52 months because of technical problems with the communication system and again to 70 months because the Army eliminated fiscal year 1982 funding In 1984, 1985, and 1986, the

Army extended the program to 79 months, 92 months, and 95 months, respectively, because of continued performance difficulties. Table II 5 shows the changes in the Aquila's schedule resulting from stretching full-scale development from 43 months to 95 months

Table II.5: Aquila Program Schedule Changes Since Full-Scale Development Decision

Event	1979 program	Current program
Full-scale development decision	August 1979	August 1979
Operational testing	December 1982	March 1987
Production decision (milestone III)	April 1983	July 1987
Production contract award	April 1983	August 1987
Initial operational capability	August 1984	March 1991

Performance

Although the Aquila has experienced significant technical problems during full-scale development, progress has been made It is difficult to assess whether the Aquila meets performance expectations because the Army did not establish a comprehensive set of measurable performance thresholds that the system is to achieve by the production decision (milestone III). Such thresholds are usually set for weapon systems at the time they enter full-scale development to provide quantitative measures against which system performance can be evaluated during testing and to provide a basis for making the production decision Criteria for assessing some aspects of the Aquila's performance can be found in its Required Operational Capability document and the test plan for its ongoing operational test. However, these two documents do not constitute a comprehensive or consistent set of measurable performance expectations for the Aquila as it enters production.

Performance Problems

The Aquila has encountered flight and mission performance problems throughout full-scale development. Because of the numerous flight failures and other critical performance problems experienced during testing in 1984 and 1985, the Army convened a special task force in May 1985, referred to as the Red Team, to evaluate Aquila's readiness for operational testing The team reported its findings in July 1985. The report pointed out serious performance limitations, and that losses of test air vehicles to crashes had created shortages in test air vehicles This caused the program's test schedule to be extended because more time was needed to resolve technical fixes and conduct additional testing Also, program management was moved from the Aviation Systems Command to the Missile Command, where it was thought that their expertise could help resolve the Aquila's problems. Even after these changes were made, the program continued to experience flight failures and technical difficulties during training exercises in 1986.

In November 1986, the Army reported improvements in the system's performance and capabilities after completing a series of tests to verify that hardware and software fixes were effective. Subsequently, the Army began operational testing at Fort Hood, Texas, to demonstrate the system's operational effectiveness and suitability. These tests are to be completed by late March 1987. Information collected during these tests will assist DOD and Army managers in deciding whether to award a production contract in August 1987

Performance Thresholds

We found the Required Operational Capability document does not provide measurable requirements for all essential performance characteristics such as survivability, availability, and target tracking Also, while the Required Operational Capability document specified the criteria requirement for reliability, project officials believe it related to performance at the time of deployment rather than at the beginning of production According to project officials, the reliability level required for the system to be approved for production is lower.

Similarly, the criteria for evaluating Aquila's performance during operational testing were not specific regarding certain critical operational capabilities, such as survivability, reliability, availability, and maintainability According to test plans, these factors will be assessed generally for their contribution to accomplishing the operational mission but will not be measured against specific performance criteria In some cases the criteria established to measure success in the operational tests differed from the Required Operational Capability document

Other Issues

System Alternatives

The Army chose the Aquila over other remotely piloted vehicles to perform the basic targeting and surveillance mission. However, the forward-looking infrared sensor may be critical to the Aquila's effectiveness during both day and night operations, and the sensor's development is in trouble If the sensor cannot be successfully developed for the

Aquila, the Army may have to reexamine alternative remotely piloted vehicles to meet its needs

The Army examined several alternatives to the Aquila in 1984, and concluded it was the only vehicle capable of satisfying its primary needs for target acquisition, designation, artillery adjustment, reconnaissance and surveillance. The study also concluded that alternative remotely piloted vehicles could be modified and equipped to perform the basic mission that the Aquila performs, but they could not match Aquila's earlier availability and costs projected at the time.

At the time of the study, the Army assumed it could successfully develop a forward-looking infrared sensor to complement the Aquila's daytime television sensor The television sensor was to be fielded first The forward-looking infrared sensor would allow the Aquila to be used at night, and would also enhance daytime performance by providing the capability to see through clouds and smoke Clouds and smoke obstruct the television sensor's view of the target area and, unless the Aquila can maneuver around them, limit the system's effectiveness. This could be a significant problem, particularly in view of the often cloudy conditions in central Europe, where the Aquila will be deployed

The forward-looking infrared sensor has encountered technical problems in development, and funding has been cut to the point that it is not sufficient to complete development Design changes resulting from contractor tests completed in 1985 increased the sensor's development costs and resulted in congressional action that reduced Aquila's fiscal year 1987 development budget by $30 million The Army established an investigation team to review ways to reduce the sensor's costs and is to report to the Congress by April 1987 on alternative approaches to developing a forward- looking infrared sensor

Funding Adequacy

The current project office budget for the Aquila program is $72 million less than its most recent baseline cost estimate, dated August 1986 Aquila project officials explained that the difference was due to a $62 million budget reduction for fiscal years 1987-89 and a $10 million reduction to reflect lower inflation rates. According to project officials, with the exception of the forward-looking infrared sensor, the Aquila program can be implemented if the Army is given an additional $3.9 million in fiscal year 1988 The additional development funding needed to complete the forward-looking infrared sensor depends on which development approach the Army selects.

Compliance With Review Procedures

The Aquila program was designated as a major weapon system after it began full-scale development. The Army plans to follow established procedures for major weapon systems in reviewing the program and in recommending whether it should proceed into the production phase. An Army System Acquisition Review Council meeting is scheduled for June 1987, and the DOD Joint Requirements and Management Board meeting is planned for July 1987, at which time a production decision will be made.

Relevant Products

Aquila Remotely Piloted Vehicle: Recent Development and Alternatives (GAO/NSIAD-86-41BR, January 4, 1986) and Results of Forthcoming Critical Tests Are Needed to Confirm Army Remotely Piloted Vehicles's Readiness For Production (GAO/NSIAD-84-72, April 4, 1984)

Line-Of-Sight Forward Heavy Weapon

The line-of-sight forward heavy (LOS-F-H) weapon system is to be one of five elements that will comprise the Army's Forward Area Air Defense System (FAADS). FAADS is being acquired to provide Army divisions with more effective defense against attacking helicopters and fixed wing aircraft than is offered by current systems, such as the Chaparral missile and Vulcan gun

The LOS-F-H is to replace the recently terminated Sergeant York air defense gun It is to protect division units in the forward battle area from attacks by enemy aircraft that are visible and within shooting range The other elements of the FAADS are (1) a line-of-sight rear missile and gun to protect the division's rear units, (2) a non-line-of-sight missile to attack targets hidden from the gunner's view by the terrain, (3) combined arms initiative weapon systems utilizing tanks, infantry fighting vehicles, and helicopters as platforms for missiles and guns to attack targets in the forward area, and (4) a command, control and intelligence network through which the other FAADS elements are connected to receive information such as target locations

The Army plans to acquire the LOS-F-H in two stages because it believes a system capable of meeting all its requirements is presently unavailable. The first stage is to buy an existing system, starting in November 1987 so that it can be fielded by fiscal year 1990 A request for proposal, soon to be released to industry, will call for live fire testing from July through October 1987 System selection is scheduled for November 26, 1987.

The second stage calls for a follow-on system that can meet all the requirements and can be fielded by fiscal year 1994. This system will be acquired by either upgrading the near-term system or procuring a new system The approach will be decided in November 1987 at the same time the Army selects its near-term system.

Our concerns about the LOS-F-H are.

- whether the near term system will prove cost-effective if it does not meet all requirements, particularly, the Army's survivability requirement,
- whether the Army will be relying too extensively on contractor tests and simulations, and conducting too few of its own testing before selecting the winning prototype for the near term, and
- since some important tests are to be deferred until 1988, whether there will be sufficient information available about the competing systems to make an appropriate selection by November 1987

Description

The Army plans to select an LOS-F-H system from several candidates that have either been produced or developed by companies in the United States or in Europe An LOS-F-H system satisfying all of the Army's requirements is expected to include a missile subsystem, a gun subsystem, a fire control subsystem, and a ranging device It should be capable of operating in day/night/adverse weather, and of distinguishing between friendly and enemy aircraft The gun subsystem will be used against close-in aircraft while the missile subsystem will be used against more distant aircraft. LOS-F-H fire units will be required to operate both autonomously and in conjunction with the forward air defense command and control network

Cost

The Army's baseline cost estimate for the LOS-F-H weapon system is to be completed by March 30, 1987. In the meantime, the Army's Missile Command has established an acquisition cost goal of $3 6 billion for the system, stated in escalated dollars. It includes $124 million for research, development, test and evaluation and about $3 5 billion for procurement of 525 fire units (an acquisition unit cost of about $6 9 million per fire unit).

The Army is also conducting a cost and operational effectiveness analysis, scheduled to be completed in March 1987 The results of the analysis will be considered by Army management in choosing the system to be acquired from among the competing candidates.

Through fiscal year 1987, a total of $51.8 million has been allocated for LOS-F-H testing and evaluation. The budget request for fiscal years 1988 and 1989 includes $30 6 million for development and $323 4 million for production.

As yet there are no indications of cost growth. The Army considers the cost risk for acquiring the interim system to be low It believes it can hold costs down by maintaining competition before it selects the winning system, negotiating a firm, fixed price contract for production with annual production options, and including warranty provisions in the contract making the contractor responsible for correcting defects attributable to the system's design without increasing the contract cost The Sergeant York production contract had similar provisions and resulted in costs being contained. However, to take advantage of the favorable option prices, the Army tended to exercise those options even though the Sergeant York was still experiencing serious performance problems The options, therefore, acted as a two-way-sword on the one hand, contributing to cost control but, on the other hand, inducing the Army to continue production when the system had not performed satisfactorily in tests.

Schedule

The fiscal year 1987 Defense Appropriations Conference Committee expressed concern over what it considered to be the slow pace of the LOS-F-H program The Committee directed the DOD to use fiscal years 1986 and 1987 funds to acquire and evaluate systems that are either in production or ready for production The Committee further directed DOD to complete all test and evaluation and to select a system by November 26, 1987. A production contract is to be awarded immediately after the selection

The request for proposal requires interested contractors to submit proposals by April 6, 1987 Up to four contractors will be selected to participate in the competition Each contractor will be required to deliver two units for test and evaluation during July and October 1987 The winning contractor's prototypes will be further tested from March to September 1988

The Army's goal is to select a system that meets all of its requirements. However, the Army acknowledges this may not be possible given the information it has available on the performance characteristics of the systems it anticipates will be proposed by the competing contractors, and its desire to have the system it will select deployed by fiscal year 1990 Accordingly, the Army has reduced its requirements for the near-term system It does, however, plan to have a system in place by 1994, which will meet all of its requirements Each contractor competing for the near-term system has been asked to submit with its proposal a plan showing how its system can be upgraded to one that would meet the total Army requirements by the desired deployment date Should the Army's evaluation determine that the system it selects will be incapable of the growth that would be necessary to meet its total requirements, the Army plans to initiate a separate procurement of a system for the far term (1994 and beyond).

Performance

It is uncertain that any of the systems proposed will meet all performance requirements Yet, the Army perceives a need to replace the Sergeant York as quickly as possible to help fill the gap in its air defense capability It appears willing to consider a system lacking certain performance capabilities which, nevertheless, meets its most urgent requirements. Therefore, the interim system will not be required to (1) have a gun subsystem or ranging device, (2) fully meet the survivability requirement, or (3) be interoperable with the forward area air defense command and control network

Performance capabilities of each system will be determined by actual testing and by analyzing prior test results and simulations provided by the potential contractors During the evaluation, each contractor will be required to fire eight missiles. The evaluation will also include target acquisition and tracking tests

After the candidate system is selected in November 1987, the Army plans to continue testing in order to verify additional performance parameters. The amount of testing required prior to actual hardware delivery will depend on the maturity of the system selected The hardware will undergo force development tests from April through July 1988, production qualification tests from July 1989 through February 1990, and an initial operational test from June through August 1990

The Army plans to include a performance warranty clause in the production contract to reduce risks. Each potential contractor will be required to identify in its proposal the performance characteristics it would be willing to cover under a warranty clause

Other Issues

System Alternatives

The Army will consider both foreign and U S systems to meet the LOS-F-H requirement According to the Army, however, preliminary analysis indicates that no currently available system will fully meet all performance requirements

Funding Adequacy

According to the project manager, funds programmed in the current Army Program Objective Memorandum and Five Year Defense Plan will probably be adequate to evaluate and acquire the interim system but are probably insufficient to upgrade the system to meet all performance requirements should the Army decide in November to do so.

Compliance With Review Procedures

The interim LOS-F-H weapon will be acquired as a nondevelopmental item. The Under Secretary of Defense for Acquisition approved this approach in December 1986. He also directed the Army to formulate options for acquiring a system to meet all performance requirements and to present the costs, benefits, and risks of each option to the Joint Requirements and Management Board principals by March 1, 1987 The final decision on selecting an interim system and the option for obtaining a system to meet all performance requirements is scheduled for a November 1987 Board meeting Possible options that will be considered are upgrading the interim system or initiating procurement of a new system that would be ready for deployment in fiscal year 1994

Non-Line of Sight Weapon

FAADS is a combination of various weapon systems designed to protect ground troops and vehicles from an air threat operating in an area nearest the enemy (forward area). The FAADS consists of five elements. (1) a non-line-of-sight weapon using missiles to attack targets hidden from view, (2) a line-of-sight forward heavy weapon using missiles and guns to attack targets in the forward area, (3) a line-of-sight rear weapon using missiles and guns to attack targets in the rear area, (4) combined arms initiatives using tanks, infantry fighting vehicles, and helicopters as platforms for missiles and guns to attack targets in the forward area, and (5) a command, control, and intelligence system to tie the elements together

To meet the requirement for a non-line-of-sight weapon, the Army selected the fiber optics guided missile (FOG-M) The missile is controlled through a fiber optics link (wire) and is capable of locating targets by passing the image through the fiber link to the weapon's gunner FOG-M is intended to provide the Army with the capability to sight and attack hovering and slow moving helicopters hidden from view by terrain features such as hills

Although the Congress has requested and the Army has taken action to slow down the program, we are still concerned about the high degree of concurrency in the program Low-rate production is scheduled to begin before flight tests are started and engineering development is completed In addition, deployment of the weapon is to begin before initial operational tests are to start

Description

The FOG-M system, which is to be mounted on vehicles, such as the High Mobility Multipurpose Wheeled Vehicle, consists of a missile, a launcher, a gunner's station, and communication and navigation equipment The FOG-M is in the validation phase (milestone I) and when first deployed, the missile will have a television seeker offering only a daylight operations capability A product improvement is planned to equip the missile with an imaging infrared seeker to provide all weather, day and night capability, and with increased range.

Cost

The Army has not finalized a baseline cost estimate for the FOG-M program, but the project manager's preliminary estimate places the system's current total acquisition cost at about $2.6 billion, of which $566 million is for research, development, test, and evaluation and $2 billion is for procurement of 403 firing units and 16,550 missiles The baseline cost estimate is to be completed and validated in time to support a May 1987 milestone II decision on full-scale development The Congress provided $9.7 million in fiscal year 1986 and $63.3 million in fiscal year 1987 for FOG-M research, development, test, and evaluation The budget request for fiscal years 1988 and 1989 includes $266 million for research, development, test, and evaluation and $67.5 million for procurement.

The Army considers the risk of cost growth in the FOG-M program to be medium because historical cost data is available on most components, and there will be two sources for most major subsystems. The primary cost risks are in modifying the hardware to meet all military requirements, such as operation in environmental extremes, adapting the missile to the carrier vehicles, and improving the missile to extend its range and provide a night and all weather capability The Army plans to control cost growth by using fixed price contracts for both research, development, test, and evaluation and production and by maintaining competition into the production phase.

Schedule

FOG-M development is being conducted in-house by the Army Missile Command. The Command plans to begin transferring the FOG-M technology to at least two contractor teams in November 1987, each team consisting of two contractors. After a 14-month technology transfer period, one of the teams will be selected to complete the system's development and begin limited production in November 1989. The first Army unit is to be equipped in July 1991. Full-rate production (milestone IIIB) will begin in November 1992

The Senate Committee on Appropriations report on the fiscal year 1987 budget expressed concern over the FOG-M schedule At that time, the Army was proposing to skip engineering development and begin production in fiscal year 1988 The Committee recommended that the Army slow down the program

In response to the Committee's recommendation, the Army restructured the program in November 1986 to add an engineering development phase and delay initial production. Low-rate production was delayed by 1 year and the date for equipping the first unit by 18 months.

Nevertheless, there is still a relatively high degree of concurrency in the FOG-M schedule Low-rate production will start about 20 months before engineering development is completed and about 3 months before any flight tests are conducted to confirm system performance capability Deployment of the system will begin about 6 months before initial operational tests are scheduled to start

The system will be deployed initially with only a daylight capability Improvements to increase the missile's range and provide night and adverse weather capability will be developed concurrently and incorporated during limited production According to the Army, schedule risks are high due to the long lead time needed to buy certain components, the need to incorporate improvements during limited production, and the short, concurrent development and limited production phase. If problems are encountered during production or testing, schedule delays could result

Performance

The Army is finalizing the performance requirements for the FOG-M system. The Required Operational Capability document is to be completed in time to support a full-scale development decision in May 1987.

The system initially fielded will be required to provide daytime engagement capability out to about 6 miles As product improvements are incorporated, it will be required to engage targets at extended ranges during day, night, and adverse weather conditions As currently planned, the system will be operated by a two-person crew and is to allow for the gunner to control at least two missiles in flight at the same time

Between February 1984 and June 1986, the Army conducted 12 test flights, of which 7 were successful and 5 failed. According to FOG-M project officials, failures occurred for various reasons such as the propellant burning through a motor case and a power supply failure Program officials maintain that the problems have been resolved The maximum range tested to date has been about 6 miles Additional tests are planned to demonstrate the ability of the gunner to control two missiles in flight simultaneously and to provide data on the performance of the imaging infrared seeker These tests are to be completed by June 30, 1987

An operational evaluation scheduled for April through September 1988 is to provide information for the low-rate production decision The evaluation's primary objective will be to assess the system's performance and the soldier's ability to operate it

The evaluation will be conducted with prototype systems produced by the Army Missile Command using commercially available equipment Future tests will be designed to ensure that the system developed by the contractor will achieve the required performance The test program will include missile firings with emphasis on operating with the FAADS command, control, and intelligence network. Planned future testing includes technical tests, force development test and experimentation, an initial operational test and evaluation, and production qualification tests decision can be made. For example, a production satellite needs to be successfully launched and tested. The earliest date planned for such a launch is October 1988 This should be followed by UE operational field testing which requires the integration or installation of LRIP UE on test vehicles. Any problems identified during satellite or UE testing should be resolved Therefore, it may be fiscal year 1990 or later before a full-rate production contract award can be made

Performance

A June 1986 Test and Evaluation Master Plan includes current performance requirements for GPS UE effectiveness and suitability. User requirements and milestone IIIB criteria have also been established.

GPS program officials told us that the results of UE technical performance test were excellent, but there were some problems with reliability and maintainability Excellent technical results were achieved with a five-channel receiver installed on a B-52 bomber, but both the two- and five-channel receivers tested on surface ships failed maintenance tests

According to a June 1986 GPS UE Decision Coordinating Paper, the UE did not meet field test reliability goals during Phase II of full-scale development initial operational testing UE for all three services were tested and all failed to meet user requirements for reliability and maintainability. The Paper also indicated that the one- and two-channel receivers passed laboratory tests, but did not pass the full-scale development Combined Environmental Reliability Testing.

UE problems were not resolved prior to LRIP approval Phase IIIA testing of LRIP UE by the contractor is currently underway. This in-plant demonstration test and evaluation is at the contractor's expense and it will concentrate on correcting deficiencies identified during Phase II testing. At the conclusion of this testing, each service's UE developmental test and evaluation should be reviewed and the results used to support a decision for full-rate production

Evaluation of UE capabilities to meet critical mission requirements is still unresolved because of the unavailability of an operational production satellite for testing. The primary concern is that these capabilities have not yet been proven under realistic operational conditions

Other Issues

System Alternatives

There are no alternatives to GPS and there are no comparable allied UE programs Program officials said that UE will be available for use by our allies

In 1985 the Air Force selected the UE design of the LRIP contractor as the baseline configuration Technological changes are to be incorporated through a pre-planned product improvement program over several years, beginning in 1989. A competitive procurement is planned for a second source in fiscal year 1990; however, the design for this follow-on production will be the same as that selected in 1985.

Other equipment touted as being equivalent to GPS UE is currently on the market. This market is worldwide with many companies advertising receiver sets with newer technology and are smaller, lighter, and less costly. However, program officials, said that the commercial sets on the market are not compatible with GPS's P-code (a code used in military sets for precision position and navigation and anti-jam operations) and they are not hardened or tested for reliability Program officials have decided to stay with the current design because they believe that (1) additional development funding would be needed and (2) substituting new technology would delay the program. However, if significant delays occur in launching a production satellite for testing, there may be an opportunity for early integration of new technology in the current UE design

Funding Adequacy

Program officials said that current funding is adequate.

Compliance With Review Procedures

The acquisition of GPS UE is in compliance with DOD review procedures.

Relevant Products

Issues Concerning The Department of Defense's Global Positioning System As It Enters Production (MASAD-83-9, January 26, 1983).

World Wide Military Command and Control System's Information System

The U.S. World Wide Military Command and Control System (WWMCCS) information system is a worldwide arrangement of computers, software, and telecommunication networks that support the National Command Authorities (the President and the Secretary of Defense or their successors), the Joint Chiefs of Staff, unified and specified commands, services, and other DOD components in planning and managing the use of military resources. The WWMCCS Information System (WIS) modernization

Unit cost information in the WIS selected acquisition report could be misleading because the system components that comprise a unit vary between sites and can be changed to meet affordability constraints. Changes in the joint requirement costs may never be reflected in the calculated unit cost For example, the WIS system program office is currently evaluating a contractor proposal for block A that would require sites to purchase more costly workstations than planned for the automated message handling system Because of these increased costs, sites may opt to buy fewer workstations in order to live within established budget constraints If fewer workstations are acquired, the actual cost increase for WIS components may not be reflected in the WIS selected acquisition report because the unit cost is simply the total cost divided by a fixed number of WIS sites

Finally, it is not clear what service-unique system costs are included in WIS because DOD has not consistently defined what constitutes the WIS program across DOD departments and agencies For example, program officials told us that the Army has included all of its joint and unique WIS-related command and control activities as part of the reported WIS modernization program On the other hand, the Navy excludes the Navy Command and Control System—its unique WWMCCS system—from its definition of WIS program costs.

Schedule

A combined milestone I/II review was held July 2, 1985. In September 1985, the Secretary of Defense approved milestone I for the entire WIS program and milestone II for block A. The next milestone II decision, currently planned for March 1988, will be to approve full-scale development for WIS block B

Since approval for WIS block A, the scheduled start of block A developmental testing and evaluation has slipped 5 months—from May to October 1987 Operational testing and evaluation has slipped 1 year—from October 1987 to October 1988. These slippages in the testing program, in turn, have caused a 14-month slippage in achieving the block A initial operational capability—from November 1987 to January 1989. Program records indicate that the primary reasons for these testing schedule slippages were (1) delays in awarding a follow-on contract to continue system integration, (2) implementation of network authenticated security, and (3) imposition of additional testing requirements.

Since September 1985, the block B full-scale development program decision (milestone II) has slipped 14 months—from January 1987 to March

1988—causing a 15-month slippage in award of the joint mission computing system contract from March 1987 to June 1988. According to WIS selected acquisition reports, slippages in the block B program resulted primarily from funding reductions. Program officials explained that overall funding reductions were absorbed in the WIS program by not fully funding block B efforts. Available funds were applied to block A in order to prevent further slippages The selected acquisition report reflects no specific milestones yet for block C

Performance

Although some products are being developed without apparent problems, other key WIS subsystems may not meet user requirements. Our review focused on the block A products and developments because it is too early in the block B development process to directly address block B performance

The contractor responsible for integrating segments being developed for WIS into one system (General Telephone and Electronics Corp , Strategic Systems Division (GTE)) has delivered an initial set of tools for developing software using the Ada programming language. Site-level testing of these tools is scheduled to begin in March 1987 The WIS joint program manager reported that the local area network successfully completed critical design review. There were no indications that the design would result in performance problems

However, our examination of the workstations and the automated message handling system raised concerns about the adequacy of the requirements determination process We are concerned that requirements problems that occurred in block A may reoccur in block B. For example, the joint WIS system program office established the block A workstation equipment specifications before the performance requirements for that equipment were adequately determined WIS users have obligated $29 million for early product workstations and associated soft ware through December 1986 A key objective was that these workstations could be used with the automated message handling system being developed in WIS block A. In December 1986, while refining the system design, the automated message handling system contractor advised the WIS system program office that more powerful workstations were needed Currently, the joint program manager is evaluating whether more powerful workstations are needed and, if so, whether the workstations already acquired could be upgraded

The block A automated message handling system will not meet the performance requirements of the primary WIS site, the National Military Command Center, which supports the Joint Chiefs of Staff However, it may meet the needs of unified or specified commanders The number of messages processed per day at the command center greatly exceeds the peak performance requirement specified for the WIS block A system and is expected to grow significantly. While the command center's current system is adequate today, the computing equipment is obsolete and a command center official believes it should be replaced. The performance shortfall of the automated message handling system for the primary user raises questions as to the conduct of the WIS requirements determination process. An official in the WIS system program office stated that the requirements documents were well coordinated among the user community However, Joint Chiefs of Staff officials told us they did not realize the performance shortfall until they saw the draft milestone II decision coordinating paper, which was after the automated message handling system contract award

Finally, we found that although joint requirements determination is critical to the progress of block B, progress against milestones for key requirements documents has not been formally tracked by the WIS system program office There have been delays in providing requirements For example, we were told by joint program management officials that the functional description for the joint applications software was delayed for at least 1 year In our view, because these delays are not formally tracked on milestone schedules for the WIS program, there is a risk that specifications will be put under contract before block B requirements are defined

Other Issues

System Alternatives

A program official told us that the WIS approach is to make maximum use of commercially available information system products We were also told that any new and relevant technologies could be incorporated without affecting the basic requirement for WIS. Program officials also indicate that our allies have no systems that provide an alternative to WIS As part of its preparation for the block B milestone II review, the WIS joint program management office plans to analyze alternative development approaches

Ambiguities in Contractor and Management Roles

The effectiveness of WIS development efforts may have been jeopardized by ambiguities in contractor and program management roles In a March 1986 letter to the Air Force contracting officer, GTE advised program officials that its "marginal" attempts to perform its original integration role resulted from (1) a lack of contractual authority, and (2) poorly defined contractor and WIS program management roles. The contractor expressed concern over being held accountable for complete system integration efforts since it had no control over (1) development of WIS components by associate contractors, (2) acquisition of new operating system software for the existing WWMCCS computers, and (3) development of block A specifications GTE further stated that serious duplications of effort and authority exist between the joint and system program managers, and between other government and contractor participants in the WIS modernization program. GTE suggested corrective actions needed on these matters to assure future success of the integrator's role. In regard to the GTE concern about overlapping authority, Air Force officials commented that there is no question that in contractual matters the WIS system program office is the single point of government direction to the WIS contractors.

In January 1987, the WIS joint program manager advised us that GTE's role requires additional clarification and adjustment to ensure that complete system engineering efforts are accomplished. Prior to resolving these contractual problems, Air Force chose to award to GTE a sole-source $125 million follow-on contract to continue system integration activities. During February 1987, the WIS system program office was in the process of defining tasks, contractual language, and costs associated with strengthening the integration contractor's role Assuming no delays, this office expects to complete its changes to the follow-on contract in June 1987—about 15 months after the problems were surfaced The joint program manager is also evaluating the WIS management approach to identify actions needed to ensure, among other things, appropriate organizational responsibilities for the program

Funding Adequacy

WIS program officials state that funding has been inadequate to keep the program on schedule. However, only blocks B and C have been affected The most recent projected schedule slippage is a 1 year delay in block B that WIS program officials attribute to DOD reducing joint WIS RDT&E funding for fiscal year 1988 Following a $126 million DOD reduction to the services' original request of $157 9 million, the Chairman of the Joint Chiefs of Staff requested full restoration of funds Despite the chairman's strong support, DOD only restored about $50 million This resulted in a net funding decrease of $75.8 million Our analysis showed that this decrease was greater than the combined congressional RDT&E reductions for fiscal years 1986 and 1987 ($51.4 million).

Compliance With Review Procedures

Our review disclosed no WIS variances from the normal major defense system review procedures The DOD Inspector General reviewed program documentation for the first WIS Defense Systems Acquisition Review Council review and all identified problems were resolved

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The Navy originally scheduled a Joint Requirements and Management Board milestone II (full-scale development) review for September 1987 DOD requested that the Navy reschedule the Board review to November 1987 to allow more time to evaluate the contractors' July 1987 system proposals.

Potential Schedule Risk

The Navy believes that implementing the FY89CS is a medium schedule risk. We believe, however, that implementing FY89CS as scheduled is a high risk because of the large quantity of software that will be required for system development. Implementing the program as scheduled may be difficult if any unforseen problems were to develop, because they could adversely affect the SSN-21 delivery schedule.

Historically, the time required for software development and integration has been underestimated. For example, the initial AN/BSY 1 combat system was originally scheduled to have total system software delivered to the shipbuilder in May 1987, approximately 4 years after full-scale development began However, because of the complexity of the AN/BSY-1 system and cost, schedule, and performance problems during its development, total software will not be delivered until September 1988, more than 1 year later than planned Under the FY89CS program, the Navy has an additional year, or 6 years to develop, test, integrate, and deliver nearly twice the amount of software

In recognition of the large quantity of software needed to implement the program, the Navy plans to·

- develop and test software as separate modules, called software partitioning;
- develop a software program that will validate the input and output, memory usage, and communications loads between processors before tactical software code is written.
- procure and provide the selected full-scale development contractor with software development equipment early enough to allow an additional year of development and testing within the overall schedule

Performance

Program officials are concerned that the contractors' proposals will not contain all performance capabilities required in the combat system's Prime Item Development Specifications Because the Navy transferred responsibility for developing the FY89CS to contractors, the extent of total system capabilities will not be known until the contractors submit their proposals in July 1987

Before preparing the above development specifications, the Navy reviewed the availability of domestic and foreign technology. For example, two FY89CS program officials visited France to examine distributive data bus technology and displays currently included in a French submarine combat system They found that the data bus did not meet FY89CS program requirements, and the displays were no better than those planned

Testing

According to a Naval Underwater System Center program official, the Navy elected not to include a demonstration and validation development phase for the FY89CS because it would have taken about 2 years to complete. The program official stated that this would have prevented the combat system from being available to meet the first SSN-21 submarine delivery date.

In the absence of a demonstration and validation phase, and because concern had been expressed over the Navy's ability to provide an independent operational assessment prior to milestone II, the Chief of Naval Operations requested that the Navy's Operational/Test and Evaluation Force conduct an operational assessment of the FY89CS before the milestone II decision The Operational/Test and Evaluation Force performed at-sea tests on an advanced development model of the new wide aperture array and approved it for full-scale development. Currently, IBM and RCA are developing wide aperture array engineering development models that will be evaluated by the Navy for production Because new technology is not required, a Naval Underwater System Center official believes the wide aperture array program is a low risk

Other Issues

System Alternatives

Before selecting the FY89CS, the Navy evaluated the feasibility of modifying the AN/BSY-1 combat system and installing it in SSN-21 submarines This alternative was not selected for several reasons. (1) it showed a low potential for system expansion, (2) it did not meet the system's top level performance requirements, and (3) Navy documentation showed that AN/BSY-1 combat system could not have been implemented without affecting the SSN-21 submarine and modifying combat system hardware and software

Funding Adequacy

As previously discussed, the Navy has developed cost estimates for RDT&E and procurement. Currently, IBM and RCA are developing system designs and cost proposals for submission to the Navy in July 1987 Therefore, the adequacy of program funding will not be known until the contractors' system design and cost proposals are evaluated, probably by September 1987.

Compliance With Review Procedures

The FY89CS milestone I Joint Management Review Board review was conducted in June 1986. After the review, an official from the DOD Product Engineering Services Office, the defense agency that performs program reviews of major systems acquisition for the Board, stated that the milestone I review was not consistent with DOD's instruction 5000.2 (Major System Acquisition Procedures) because it awarded the system design definition contract prior to the milestone I review

Relevant Products

SUBACS Problems May Adversely Affect Navy Attack Submarine Programs, (GAO/NSIAD-86-12) November 1985.

Air Force Programs

Titan IV Rocket Complementary Expendable Launch Vehicle

The Air Force's Complementary Expendable Launch Vehicle (CELV) program, which was initiated to provide assured access to space for the nation's highest priority space systems, consists of 23 vehicles (rockets) now called Titan IVs. The Air Force estimates that the 23 vehicles will cost about $4 33 billion in then-year dollars The most significant cost difficulty anticipated, according to Air Force officials, is the Centaur upper stage, which will be used in the Titan IV to lift space payloads to higher orbits According to Air Force officials, some slippage could occur because of problems with the Centaur upper stage and underfunding by $75 million in fiscal year 1987 The Air Force program office currently estimates that the primary performance requirements will be met

Description

The Air Force was originally authorized to acquire 10 CELVs, all of which were to be launched from Cape Canaveral Air Force Station, Florida. After a source selection award for the CELV to Martin Marietta Corporation, a contract was signed in February 1985 for what is now called the Titan IV. The Titan IV evolved from the family of Titan launch systems used by DOD and NASA for over 25 years The Titan IV consists of a 119-foot two-stage liquid propellant core, plus a pair of seven-segment solid rocket motors

After the loss of the space shuttle Challenger and two Titan 34D (earlier Titan model) failures, DOD developed a recovery plan which included the acquisition of 13 additional Titan IV vehicles and operation of the Titan IV at Vandenberg Air Force Base, California The original 10 vehicles were all to use the Centaur liquid-fueled upper stage, a modified version of the Centaur envisioned for use on the space shuttle The 23 vehicle program consists of three different configurations: Titan IV/Centaur; Titan IV/Inertial Upper Stage (IUS), which is a solid fueled upper stage, and Titan IV/No Upper Stage (NUS)

According to an Air Force program official, the Titan IV is in its second year of production, and the only remaining milestone is initial launch capability

Cost

Martin Marietta Corporation is under contract to the Air Force for 10 Titan IV/Centaurs. This is a fixed price incentive contract for $2 53 billion in then-year dollars Martin Marietta has been asked to submit a proposal for a new contract covering all 23 vehicles by March 1987 The Air Force program office's current estimate for the 23 vehicles is $4 33 billion in then-year dollars The 23 vehicle program estimate includes modifications to the launch facilities at Cape Canaveral, estimated to cost $131 million. The 23 vehicle program estimate also includes the modification of one pad at Vandenberg Air Force Base, California, estimated to cost $81 million, and the construction of a new Titan IV launch complex at Vandenberg The Air Force has budgeted $260 million for the new pad. Air Force program officials said the pad will cost more than is budgeted. However, an estimate of the amount was not yet available.

Air Force officials stated that the procurement costs are underfunded by $75 million in the fiscal year 1987 appropriation due to a congressional cut in the President's Budget. If the $75 million is not restored in fiscal year 1987, officials said the delivery and launch of the first Titan IV/IUS would slip at least 3 months beyond October 1988, and the scheduled dates for the second Titan IV/IUS and the first Titan IV/NUS vehicles would also be delayed However, program officials expect reprogramming actions to provide the $75 million by June 1987

The most significant anticipated cost difficulty, according to an Air Force program official, is the Centaur upper stage. The Centaur was being developed for use with both the Titan IV and the space shuttle Because the first three planned Titan IV launches do not need the full capability of the Centaur, Air Force officials said the Air Force switched these launches to the IUS to save the Centaur upper stages for launches that must use them Consequently, the Air Force issued a stop work order on the Centaur in February 1985, which remained in force for 18 months In June 1986, National Aeronautics and Space Administration (NASA) announced the decision not to allow the use of the Centaur on the shuttle because of safety concerns over carrying a liquid-fueled upper stage in the shuttle. A firm estimate of the costs associated with the stop work order and the cancellation of the shuttle/Centaur will not be known until the contractor's 23 vehicle proposal is received, an Air Force official stated

Under the current 10 vehicle contract, the Centaur is being procured by the prime contractor (Martin Marietta) from a subcontractor (General Dynamics Space Systems) and provided as part of the Titan IV/Centaur program After the program office receives the contractor's proposal, an official said a new contract price for the program will be negotiated, including the impact of the anticipated Centaur cost increase. The Air Force anticipated a cost increase due to the Air Force stop work order, but did not identify it in the September 30, 1986, Selected Acquisition Report Program officials said this was an oversight

As of November 1986, the contractor was about $5 million over projected costs and had not completed about $30 million worth of work that was planned to be completed by then Both the $5 million and $30 million variances are measured against a 100-day margin the contractor built into the schedule to ensure that the contract requirements are met.

During 1985 and 1986 two Titan 34D launches failed. Studies were undertaken to identify changes needed for the Titan IV, which uses many of the elements of the Titan 34D Air Force program officials said some of the changes have already been incorporated into the Titan IV program and other changes will be made in the future. A cost estimate for these changes will be included in Martin Marietta's proposal for the 23 vehicle program, which is due by March 1987 According to an Air Force official, the Air Force program office and the contractor will then negotiate the cost for the changes.

Schedule

According to an Air Force program official, the program is undergoing concurrent development and production. He said authority to proceed into production was obtained for the Titan IV/IUS in October 1985 and for the Titan IV/Centaur and Titan IV/NUS in August 1986

An Air Force official said that after the Challenger accident and the decision to add 13 more Titan IVs to the program, production was increased from 2 vehicles per year to 5 per year by fiscal year 1989. Production is planned to continue until January 1993 Thus, 23 vehicles will be procured over about the same period that the original 10 vehicles were scheduled to be procured. The current plan is for initial launch capability at Cape Canaveral for the Titan IV/IUS in October 1988 and for the Titan IV/Centaur in February 1990. At Vandenberg, initial launch capability for the Titan IV/NUS is to be no later than April 1989

The biggest challenge of the program, according to an official, is the Centaur He said that the Centaur contractor, General Dynamics Space Systems, has alerted the program office to expect a 3-month slip in schedule due to the 18-month Air Force stop work order for the Centaur and the NASA shuttle/Centaur cancellation. However, the official said the Air Force program office has not yet agreed to accept the slip.

An Air Force program official said there are some problems with the solid rocket motors, payload fairing (cover), and the core vehicle. For example, he said that in November 1986 the nose cone failed during a test of the payload fairing, requiring redesign and retest which was completed on March 16, 1987. He said that, as of February 1987, the contractor has 70 of the 100 days left in the schedule margin for the core vehicle The official stated that the solid rocket motors and payload fairing have all 100 days of the margin remaining

An Air Force official said that the Titan IV schedule could be impacted by launch pad availability. The Titan IV/NUS will use the same launch pad that the Titan 34D uses at Vandenberg. The Titan 34D pad will have to be modified to accommodate the Titan IV, according to the official, and if these pad modifications are not completed in time, the Titan IV launch schedule at Vandenberg could be delayed. The official said modification of the Vandenberg pad is due to begin after the last Titan 34D launch, and the pad is expected to be ready no later than April 1989. At Cape Canaveral, modification of an available pad began in June 1985, and the pad is planned to be ready in July 1988, according to the official

Performance

The performance requirements are different for each of the three vehicle configurations

- The Titan IV/Centaur primary requirement is to lift a 40-foot long, 10,000-pound payload to a geostationary orbit As of February 1987 the program office estimates that it will meet that requirement, with excess lift capability of about 330 pounds. The estimate was derived using contractor model simulations, which are done on a continual basis
- The Titan IV/IUS primary requirement is to deliver a 38,784-pound IUS and satellite to a low earth orbit. The IUS primary requirement is to then lift 5,250 pounds, plus or minus 90 pounds, to a geosynchronous orbit As of January 1987 the program office estimates that the Titan IV will be able to meet the 38,784-pound requirement, with a 66-pound excess lift capability The Titan IV/IUS estimated lift capability for the IUS is 5,302 pounds to the required orbit This provides a 52-pound excess lift capability over the 5,250 pounds, however, it falls 38 pounds short of the 5,340-pound maximum end of the requirement range.
- According to an Air Force official, Martin Marietta and the program office are developing Titan IV/NUS requirements, which should be defined by March 1987 A program official stated that the requirements for this configuration are not defined yet because of the diversity of payloads planned for the Titan IV/NUS

An Air Force program official said the Titan IV is not following the traditional Department of Defense research and development process because the program primarily involves modifying proven hardware He stated that test and evaluation is being done by the contractor. The Air Force Operational Test and Evaluation Center is not evaluating the program and there is no Test and Evaluation Master Plan, according to the official

An Air Force program official said that preliminary and critical design reviews for all Titan IV major components and some critical subcomponents were held to ensure the contractor's work is acceptable. A number of items needing further action were identified during the reviews, such as verifying that the appropriate thermal environment has been provided and incorporated in the solid rocket motor nose cone design A program official said about 60 percent of the items have been resolved

According to an Air Force official, the Titan IV program includes qualification and acceptance tests, which will be conducted using test equipment. However, there will be no launch of a prototype, according to the official. He said testing of the first Titan IV/IUS, the first of the 23 vehicles planned for launch, will be completed in December 1987. Testing of the Titan IV/NUS will be completed in January 1989 and in mid-1989 for the Titan IV/Centaur, the official stated

Other Issues

System Alternatives

According to an Air Force program official, the only U S alternative to the Titan IV is the space shuttle, although it is not an alternative for all three Titan IV configurations For example, the official said the shuttle/Centaur cancellation left the Titan IV/Centaur as the only U.S. vehicle capable of launching heavy payloads to a geostationary orbit The shuttle/IUS may be an alternative to the Titan IV/IUS for 5,000-pound class payloads to geosynchronous orbit, an official stated The shuttle may or may not be an alternative to the Titan IV/NUS at Vandenberg, depending on the eventual post-accident shuttle capability, according to a program official

An Air Force program official stated that none of the U S. allies has comparable capability to the Titan IV The European Space Agency's

Ariane 5 may be an alternative to the Titan IV/IUS, but it is not expected to be available until 1994. Also, no significant technological breakthroughs have occurred which could supercede the Titan IV, according to the official.

Compliance With Review Procedures

Air Force program officials stated that the Titan IV is not a Defense Acquisition Board program and the program did not go through the concept exploration, demonstration and validation, and full scale development phases Instead, officials said the program office had selected the vehicle after competition and went directly into full production Officials stated that development and production had occurred concurrently because the Titan IV is not a new technology Furthermore, they said that since the Titan IV is an upgraded version of the Titan 34D and other prior Titan III vehicles, technical, cost, and schedule risks were decreased

Air Force Studied Need for Additional Titan Ivs

An official said the Air Force has done a study on the need for more than 23 Titan IVs if the shuttle is down more than 2 years. However, the results of this study were not available to us at the time that we completed our review

Common Strategic Rotary Launcher

The Air Force's Common Strategic Rotary Launcher (CSRL) program provides for development and integration of an internal weapons launcher on three bomber aircraft—the B-52H, B-1B, and advanced technology bombers The CSRL is designed to accommodate existing and planned nuclear gravity bombs, Short Range Attack Missiles, and cruise missiles While launcher configurations vary somewhat among the three types of bombers, the CSRL program has stressed commonality among launchers, support, and test equipment to the maximum extent practical. Due to the security classification of information concerning the advanced technology bombers, the CSRL program for only the B-52H and B-1B bombers is being addressed Testing of the CSRL on B-52H bombers is complete Testing on B-1B bombers is expected to be completed in 1988 The Air Force plans to buy 104 CSRLs and 96 B-52H integration kits. In November 1986, the Air Force approved full-rate production of the CSRL and B-52H integration kits. As of January 1987, the Air Force has contracted with Boeing Aerospace for 31 CSRLs and 26 B-52H integration kits. According to program officials, the CSRL program is on schedule to meet its initial operational capability date of March 1990. The program is below projected cost, and the CSRL has met its performance requirements.

Description

The CSRL is 22 feet long and weighs approximately 5,000 pounds It consists of a central shaft, power drive unit and controller, eight weapons ejectors, and associated electronics The CSRL can accommodate several types of nuclear weapons in either uniform or mixed loads, including

- Air-Launched Cruise Missiles,
- Advanced Cruise Missiles, and
- nuclear gravity bombs.

Initially, the CSRL will be limited to carrying uniform loads of these weapons on B-52H and B-1B bombers. Growth provisions are included in the CSRL program to accommodate projected future weapons.

Integration of the CSRL into the B-52H and B-1B bombers involves changes to the aircraft's internal bomb bay structure and the weapons management electronics B-52H integration kits are being developed and acquired under the CSRL program The 104 CSRLs being acquired will initially be installed in B-52H bombers. At a later date, these launchers are to be reconfigured and installed on B-1B bombers Conversion kits enabling this change are developed and can be acquired when the Air Force decides to make this transfer.

The CSRLs and associated B-52H integration kits are being developed and manufactured by the Boeing Military Airplane Company. Full-scale development began in 1983 The Air Force approved low-rate initial production in 1985 and full-rate production in November 1986. The Air Force and Boeing have negotiated fixed price contracts with options for five annual procurements in fiscal years 1986-1990 for both the CSRLs and B-52H integration kits

Cost

The Air Force estimates the total CSRL program cost to be $629 3 million in then-year dollars. This cost includes $270.7 million for development, $332 1 million for procurement of 104 CSRLs and 96 integration kits, and $26 5 million for operation and maintenance The total yields a unit procurement cost of $3.19 million and a unit acquisition cost of $6.05 million. The current cost estimate in then-year dollars is $167 million lower than that reported in the Air Force's Selected Acquisition Report of December 1985, as shown in table IV 1.

Table IV.1: CSRL Cost Estimates (In Then-Year Dollars)

Dollars in millions

	Selected Acquisition Report (12/85)	Current program cost estimate (12/86)	Difference
Development	$300 2	$270 7	$29 5
Procurement	481 9	332 1	149 8
Operations & maintenance	31 7	26 5	5 2
Total	**$813.8**	**$629.3**	**$184.5**

The CSRL's current program estimate is lower due to lower escalation rates, negotiation of a fixed price contract for B-52H integration kits in December 1986, and refinement of previous estimates for engineering change orders

Schedule

The CSRL full-scale development program began in June 1983 and is on schedule to achieve the planned initial operational capability milestone in early 1990 CSRL development and integration on the B-52H bomber were completed in 1986, except for nuclear certification, which is scheduled for early 1989 Flight testing of the CSRL on B-1B aircraft is to be completed in 1988 The Air Force approved low rate initial production of five CSRLs and three B-52 integration kits in November 1985 The first B-52H with a CSRL installed is to be delivered to the Air Force in April 1988 Beginning in early 1989, about two B-52Hs with CSRLS installed are to be delivered each month until the program is completed, in mid-1993

The Air Force approved full-rate production for the CSRL and B-52H integration kits in November 1986 Subsequently, the Air Force awarded contracts for fiscal year 1987 procurements of 26 CSRLs and 23 integration kits The program manager told us that the CSRL program is on schedule and that no schedule problems are anticipated

Performance

The CSRL must be able to safely carry, launch, release, and jettison a variety of nuclear weapons on three different bombers During 1985 and 1986, the Air Force successfully concluded a series of ground and flight tests of the CSRL and its integration on a B-52H bomber The CSRL qualification test program included proof load, ground vibration, durability, damage tolerance, and ultimate load tests The Air Force also demonstrated and verified uploading, downloading, and reconfiguration requirements The flight test program included numerous cruise missiles and gravity bomb captive carry flights, as well as live launches. During these flights, launcher rotation, weapon ejection, and aircraft/launcher interoperability were successfully demonstrated The Air Force Operational Test and Evaluation Center conducted initial operational test and evaluation of the CSRL in 1986 to determine its operational effectiveness and suitability. The Center's final report states that the CSRL met all requirements for operational effectiveness and suitability

Ground and flight testing of the CSRL and B-1B bomber will continue through 1987 and is scheduled to be completed in 1988 The CSRL program manager told us no problems have been identified thus far in these tests.

Other Issues

System Alternatives

There are no alternative launches that provide the commonality of the CSRL.

Funding Adequacy

The Air Force has requested $70 6 million for the CSRL program in the President's fiscal year 1988 budget The CSRL program budget for fiscal years 1989-1993 totals $161.4 million. The program manager told us funding identified in the program budget is adequate to complete the CSRL program as currently planned.

Compliance With Review Procedures

Normal DOD acquisition procedures have been followed on this program

Short Range Attack Missile II

The Air Force's Short Range Attack Missile (SRAM) II is to be an improved nuclear air-to-surface missile capable of penetrating advanced defensive threats from stand-off ranges to strike targets The Air Force Strategic Air Command will incorporate the SRAM II into the strategic aerospace offensive forces with the B-1B and advance bombers as the primary carrier aircraft Originally called the Advanced Air-to-Surface Missile, the SRAM II is to replace the SRAM A missile currently in the inventory

The SRAM II program has generated substantial congressional concern over the requirements for this weapon system and whether the Air

Force has adequately considered potential alternatives, such as modifying the existing SRAM A missile. The Secretary of Defense has been directed to submit a report to the Congress addressing the cost effectiveness of the SRAM II compared to modifying the SRAM A This report was expected in late March 1987

Description

The SRAM II is to use existing propulsion, guidance, and airframe technology to improve performance without introducing unacceptable technical risk. Compared to SRAM A, the SRAM II is to have increased range, greater speed, and better accuracy and is to use a new warhead with modern safety features It is to be about 14 feet in length and 14.75 inches in diameter and weigh about 1,800 pounds. The missile is comprised of three major sections: the forebody, which contains the warhead; the centerbody, which contains the avionics and the dual-pulse solid propellant rocket motor; and the boattail, which contains the control surfaces and control actuators

Cost

The SRAM II current cost estimate in then-year dollars, as reflected in the fiscal year 1988/1989 President's budget, is $2,465 0 million, including $1,050 2 million for research, development, test, and evaluation and $1,414.8 million for procurement of 1,633 missiles This is a reduction of $599.5 million from the planning estimate of $3,064.5 million The lower estimate is due to revised economic escalation rates and the actual contractor proposals from the recent competitive source selection Warhead costs are not included in either the planning or the current estimate.

Schedule

In September 1982 the Air Force initiated the SRAM II program, following an unsuccessful attempt to establish a new production source to replace the existing SRAM A rocket motor The original contractor had gone out of business, and the Air Force was concerned over the potential age-out of the motor and the declining SRAM A inventory The SRAM II program was approved as a new start for fiscal year 1985 by the Office of the Secretary of Defense's Resource Board in 1983

An accelerated acquisition approach was chosen for SRAM II because an operational system needed to be fielded in the early 1990s and because it was considered a low risk development program The normal concept exploration and the demonstration/validation phases were combined into a system definition phase A competition was conducted, and contracts were awarded in February 1985 to three contractors (Boeing

Aerospace, Martin Marietta Orlando Aerospace, and McDonnell Douglas Astronautics) for system definition studies and component risk reduction testing Integration study contracts were also awarded to Rockwell International and Boeing Military Airplane Company for B-1 integration.

The Air Force used the studies' results to select SRAM II missile characteristics, such as size and propulsion type. In April 1986 the Air Force issued a request for proposal for pre-full-scale development, full-scale development, low rate initial production (100 units), and the first lot (300 units) of full-rate production. Two of the original contractors submitted proposals, and Boeing Aerospace was announced as the winner in December 1986 The Department of Energy, following a Warhead Decision Cost Study, announced in November 1986 the warhead design candidate that had been selected. The Milestone II (full-scale development) briefing to the Joint Requirements Management Board was in January 1987 with final documentation and action items to be completed in June 1987 Contract award (fixed-price incentive fee) to initiate the pre-full-scale development was delayed until about March 1987 to allow completion of the congressionally directed report comparing the cost effectiveness of a remotored SRAM A versus SRAM II and of a modified existing warhead versus development of a new warhead Initial Operational Capability, 50 deployed missiles, is now scheduled for April 1993, a 13-month slip due to deletion of fiscal year 1989 production funding by the Office of the Secretary of Defense (OSD) because of concern regarding the degree of program concurrency. Production funding for 1,633 missiles is scheduled to begin in fiscal year 1990 and extend through fiscal year 1996. Missile deliveries are scheduled to begin in fiscal year 1991 and conclude in fiscal year 1997

SRAM II program milestones are shown in table IV 2.

Table IV.2: SRAM II Milestones

Milestone	Planning estimate and approved program	Current estimate
Systems Concept Paper	February 1985	February 1985
Milestone II	June 1987	June 1987
Preliminary Design Review	July 1987	August 1987[a]
Critical Design Review	June 1988	August 1988[a]
First Live Launch	October 1989	August 1989[a]
Milestone IIIA[b] Low Rate Production	April 1990	May 1990[c]
Milestone IIIB	September 1991	July 1992[c]
Initial Operational Capability (50 missiles)	March 1992	April 1993[c]

[a]These changes resulted from schedules developed during the source selection process

[b]Approved by the Joint Requirements Management Board/Air Force Systems Acquisition Review Council

[c]These changes resulted from OSD's deletion of fiscal year 1989 production funding

Performance

The SRAM II is intended to have significantly improved performance compared to the SRAM A, as well as improved reliability, availability, and maintainability. Improved range, speed, accuracy and lethality are design goals Because the first SRAM II live launch is not scheduled until August 1989, no performance assessment using test results is possible at this time

Other Issues

System Alternatives

The Congress has directed DOD to provide a report addressing the cost effectiveness of modifying the existing SRAM A fleet with new motors and/or existing warheads as an alternative to procuring the SRAM II and new warhead The Air Force has contracted this study with the ANSER Corporation and, according to Air Force officials, the draft report is being reviewed by the Air Force and the Office of the Secretary of Defense The report was scheduled to be available in late March 1987

Funding Adequacy

Current funding projections based on the President's Budget for fiscal 1988-1989, indicate the total SRAM II program funding requirements can be met with some potential excess in reserve. Some early program years, however, have projected funding shortfalls for both development and procurement. According to the SRAM II Program Director, these initial funding shortfalls relative to requirements preclude executing the directed program. These shortfalls are the primary basis for the 13-month slip in Initial Operational Capability.

Compliance With Review Procedures

The normal DOD acquisition process is being followed, as shown in table IV.2.

Advanced Medium Range Air-To-Air Missile

The Advanced Medium Range Air-to-Air Missile (AMRAAM) is being developed jointly by the Air Force and Navy to meet their medium-range air-to-air missile requirements for the 1985-2005 time frame The missile is to replace the Sparrow (AIM-7) and is to be compatible with the services' latest fighter aircraft—F-14, F-15, F-16, and F/A-18 The system is in full-scale development with initial production scheduled to begin in fiscal year 1987 The Air Force is the lead service responsible for managing the program Hughes Aircraft Company is the prime contractor, and Raytheon Company is being qualified as a second production source

The AMRAAM program experienced substantial cost growth and schedule delays between 1978 and 1985, when the program was restructured In 1985 the Congress required the Secretary of Defense to certify that the missile met certain cost, design, testing, and performance requirements This certification was provided in 1986 The fiscal year 1987 National Defense Authorization Act establishes a procurement cost cap If AMRAAM cost assumptions prove inaccurate the cost cap may be exceeded.

To meet the current initial deployment date of 1989, the Air Force plans to begin low-rate production of an interim design missile that does not fully meet performance requirements Full-rate production is scheduled before the final design has begun follow-on testing and evaluation This increases the risk that missiles will be produced that do not fully meet requirements and require costly modifications

Description

The AMRAAM, unlike the Sparrow, has a built-in radar tracking capability that allows the launching aircraft to turn away from the target once the missile is within range Other improvements over the Sparrow are higher missile speed, greater range, increased maneuverability, better resistance to electronic countermeasures, and the ability to simultaneously engage several targets The AMRAAM, which is smaller and lighter in weight than the Sparrow, is about 12 feet long with a 7-inch diameter and weighs about 340 pounds.

Cost

AMRAAM's acquisition cost is currently estimated at $8.2 billion (1984 dollars), $1 2 billion for research and development and $7 billion for procurement of 24,320 missiles (an acquisition unit cost of about $336,963). The Air Force is updating this estimate for the initial production decision (milestone IIIA) scheduled for May 21, 1987.

Through fiscal year 1987, a total of about $1.9 billion has been appropriated for the system, $1 052 billion for research and development and $874 million for procurement. The fiscal year 1988 budget requests $832.9 million for 630 missiles in fiscal year 1988 and $875 million for 1,750 missiles in 1989

AMRAAM's estimated acquisition cost increased from about $3 4 billion to $9 billion between January 1979 and December 1984 (1984 dollars) The increase resulted primarily from overly optimistic cost and schedule estimates and design changes. Concern over the increase resulted in a program review to identify ways to reduce AMRAAM's procurement costs In 1985 the Secretary of Defense approved a restructured program that included design and other changes to reduce the procurement portion of the estimate to $7 billion A total of $1 6 billion (taking future inflation into account) in cost reduction design changes have been identified Some of these savings were reflected in the 1984 estimate of $9 billion The remaining changes are part of the reductions reflected in the 1985 estimate of $7 billion

The current full-scale development effort is under a fixed-price contract with a ceiling price of $560 3 million This figure reflects an increase of $33 7 million over the original ceiling price of $526.6 million The increase is the result of about 75 contract modifications, directed by the Air Force, adding to the scope of work required. The $1.2 billion research and development estimate, which includes costs incurred prior to the full-scale development phase, will not be exceeded unless the Air Force significantly increases the contract's scope of work or awards additional contracts The AMRAAM Program Manager does not expect this to occur

The National Defense Authorization Act for fiscal year 1987 provides that AMRAAM procurement cost may not exceed $7 billion (1984 dollars) for 24,000 missiles The act provides that the $7 billion cap may be adjusted for the effects of congressional funding actions, such as funding reductions or limitations, however, the Secretary of Defense must notify the Congress if any such adjustments will increase estimated costs beyond the $7 billion ceiling

The current procurement cost estimate, like all out-year projections, includes a number of uncertainties and assumptions such as the following, which could cause the estimate to change.

- The estimate assumes that the program will remain on schedule and that the Congress will provide from $750 million to $1 billion annually over the next 9 years for AMRAAM production. Future program reviews, however, could reduce program funding even though the Air Force considers AMRAAM a high priority For example, because of budget constraints and concerns about AMRAAM's development status, the Congress reduced the procurement quantity for the first production lot from 260 to 180 and the second production lot from 833 to 630 The Air Force estimates that this action will increase procurement costs by about $172 million.
- The estimate reflects $1 6 billion (taking future inflation into account) in savings projected from a number of design changes to reduce production costs. Most of these are to be incorporated in production lots three and four, scheduled for 1989 and 1990 and all subsequent production lots The accuracy of the estimated savings will remain tentative until contracts for these lots are negotiated.
- The current estimate includes about $99 million for warranty costs These costs, however, are still uncertain because efforts to define the performance warranty provisions have not been completed Refined estimates are to be presented at milestone IIIA.
- The current estimate deleted $66 1 million included in earlier estimates by deferring the cost of depot maintenance equipment until after the procurement period. While final decisions have not been made, it now appears that the equipment will be required during the production period

According to the Air Force the $7 billion cap will be exceeded as a result of the fiscal year 1987 funding reduction. Additional cost estimate increases are likely if the cost assumptions prove inaccurate

Schedule

The AMRAAM initial production decision (milestone IIIA) is scheduled before full-scale development design and testing are completed A number of tests and other tasks that were to be completed prior to the initial production decision are behind schedule. The full-rate production decision (milestone IIIB) is scheduled before follow-on testing and evaluation begins.

The AMRAAM is scheduled to complete full-scale development in July 1988. The initial production decision is scheduled for May 1987 followed by a full-rate decision in June 1989 Some of the missiles from the first production lot will be used for testing and others will be used to achieve an initial operational capability in 1989

The 1985 restructured program increased AMRAAM's full-scale development phase from 54 to 79 months and advanced the initial operational date from 1986 to 1989 Causes for the slippage included redesign of the terminal radar seeker and guidance system and the complexity of the special test equipment To avoid additional slippage of AMRAAM's operational availability, the restructured program calls for initial production of an interim design missile, which does not have full performance capabilities. There has been some slippage of tasks required under the restructured schedule For example, the functional configuration audit intended to ensure design completion has slipped from November 1986 to December 1987 The software critical design review for the initial production missile has slipped from September 1986 to an undetermined future date. The flight test program is also behind schedule by about 3 months, however, the recent addition of a third test site should help accelerate the test program. The Program Manager said these slippages will not prevent the scheduled completion of the development program in July 1988

Performance

An accurate assessment of AMRAAM's ability to meet its performance requirements cannot be made until the design is complete and tested in a production representative missile. This testing is scheduled to begin March 1989. As of January 31, 1987, the Air Force had completed 2 of 8 unguided and 23 of 90 planned guided flight tests. Both of the unguided tests and 19 of the guided flights were judged fully successful, and 2 guided flights were judged partially successful One of the guided flights was unsuccessful and one was scored a "no test" Tests aborted due to missile malfunctions were not counted Missiles that are to be initially produced for operational use (lot 1) will not meet all performance requirements because they will not include all of the software and hardware required. Full-scale development tests of a missile with all planned hardware and software are scheduled to begin in August 1987, 3 months after the initial production decision. Missiles in the second production lot, planned for about May 1988, are to have all components and software. Follow-on testing and evaluation of these complete production missiles are to begin in January 1990 after the decision on full-rate production (milestone IIIB).

When the program was restructured in 1985, the Secretary of Defense directed the Air Force to establish performance criteria for the initial production and full-rate production milestones The proposed criteria for initial production missiles are less demanding than the criteria proposed for the full-rate decision, which are closer to the full system requirements For example, initial production missiles will not have to demonstrate full electronic countermeasure performance or the minimum requirement for multiple simultaneous engagements.

The Defense Authorization Act of 1987 requires the Secretary of the Air Force to evaluate AMRAAM flight tests against the less demanding criteria and report the test results and evaluation to the House and Senate Committees on Armed Services before obligating funds for initial production.

Other Issues

System Alternatives

A 1985 program review directed by the Secretary of Defense evaluated about 20 alternatives to AMRAAM, including the existing Sparrow and several variants. The review concluded that none of the alternatives were acceptable because either they could not achieve the performance requirements or they were projected to take longer to develop and/or cost more than AMRAAM. The Air Force has recently decided to equip 270 F-16As, designated to defend the United States against bomber attacks, with Sparrow missiles

The Program Manager informed us that he was not aware of any technological breakthroughs that would indicate a need to consider alternative systems. Also there is a memorandum of understanding between the United States and the governments of Germany, and the United Kingdom in which they agreed not to develop a medium range missile separate from the United States. Accordingly, there is little or no potential that those countries will develop a competing missile.

Funding Adequacy

The Air Force Program Manager told us that the AMRAAM is adequately funded in the President's budget and the Five Year Defense Plan. We also noted that contractor proposals and not-to-exceed commitments for the first two production lots have been consistent with estimated and budgeted amounts To this extent the funding appears to be adequate However, this assumes that there will be no significant schedule delays or performance problems and that scheduled production will proceed as planned

Delays or reductions in the planned production rates would likely reduce the required near term funding levels and increase out-year requirements as well as the total program estimate.

Compliance With Review Procedures

DOD complied with regulations requiring program reviews at major milestones or decision points The decisions for AMRAAM to proceed from one development phase to another are documented by signed decision memoranda. The dates of past and future Office of the Secretary of Defense reviews are shown below

Table IV.3: AMRAAM Milestones

Milestone	Date
I	November 1978—began concept validation
II	September 1982—continued full-scale development
IIIA	May 1987—begin initial production
IIIB	June 1989—begin full-rate production

Relevant Products

AMRAAM Cost Growth and Schedule Delays, GAO/NSIAD-87-78, March 1987

Advanced Medium Range Air-to-Air Missile (AMRAAM) Certification Issues, GAO/NSIAD-86-124BR, July 1986

Advanced Medium Range Air-to-Air Missile Legal Views and Program Status, GAO/NSIAD-86-88BR, March 1986

Status of Certification, GAO/NSIAD-86-66BR, February 1986

The Advanced Medium Range Air-to-Air Missile: Resolve Uncertainties Before Production, GAO/C-NSIAD-84-18, May 7, 1984

Effectiveness of Advanced Medium Range Air-to-Air Missile is Uncertain, GAO/C-MASAD-81-17, August 4, 1981

Progress and Problems of the Advanced Medium Range Air-to-Air Missile Program, GAO/C-MASAD-81-6, February 23, 1981

Mark XV Identification Friend or Foe System

The Mark XV is a joint service aircraft Identification Friend or Foe (IFF) system It is designed to provide both positive friend identification and air traffic control capabilities for the military. The system will also operate with existing and future civil air traffic control systems A goal of the Mark XV program is the development of a North Atlantic Treaty Organization (NATO) and tri-service, interoperable replacement for the existing less capable Mark XII IFF system

Program cost estimates have decreased by more than 25 percent principally due to a change from two to one contractor for full-scale development. Advance development models are being delivered late, but program officials believe that other activities can be adjusted to enable the full-scale development decision to remain on schedule.

Description

The Mark XV system is designed to be capable of identifying friendly aircraft and have an extremely low probability of the enemy exploiting either the interrogation or the reply emitted from a friendly aircraft. The system will be able to transmit and receive signals in a secure, jam resistant, and precise time mode. The Mark XV system is expected to contribute to achieving maximum capability of beyond visual range (medium-and long-range) air defense weapons

The Mark XV program is in the competitive demonstration and validation phase with Bendix Communications Division and Texas Instruments, the competing contractors for the full-scale development contract Full-scale development of the system is expected to begin after the milestone II full-scale development review of the program by the Joint Requirements and Management Board (JRMB) in May 1988

During the full-scale development phase, the Mark XV Joint Program Office will be responsible for the development of Mark XV equipment and integration of the Mark XV equipment into six selected weapons—F-15 and F-18 aircraft, EH-60 helicopter, I-Hawk missile, and AEGIS and SPRUANCE missile ships The program office will also have overall responsibility for all-environment, tri-service Development Test and

Evaluation and Initial Operational Test and Evaluation Test program Integration of the equipment into additional aircraft will be service-unique activities managed and funded by individual service organizations.

Cost

The Mark XV program baseline planning estimate, established for the milestone I review by the Defense System Acquisition Review Council in July 1984, was $1,672.1 million (in then-year dollars) for the research, development test, and evaluation program, based on the December 31, 1986, Selected Acquisition Report. The planning estimate was based on a May 1984 Independent Cost Analysis. The current program office cost estimate for development from 1980 through 1995 is $1,241.2 million, or $430.9 million less than the planning estimate Based on a program office review, current full-scale development funding requirements for the Mark XV total $1,068.0 million for fiscal years 1988 through 1993, as shown in table IV 4.

Table IV.4: Mark XV Program Funding Status as of January 8, 1987

Dollars in millions

	Requirement	Planned funding
Air Force (core)	$432 5	$432 5
Air Force (unique)	213 6	213 6
Army (unique)	71 6	71 6[a]
Navy (unique)	350 3	145 0a
Total	**$1,068.0**	**a**

[a]Data were Army and Navy planned funding for fiscal year 1993 were not available to the program office Available data show that Army requirements are fully funded while the Navy requirements are under-funded by $197 4 million for fiscal years 1988 through 1992

The next Mark XV annual cost estimate is expected to be completed in March 1987

While there have been several changes to the baseline planning estimate, according to Air Force officials, the major reason for the overall decrease is a change in plans from two independent full-scale development contractors to one. Originally, two competing contractors were to each design, develop, fabricate, and test a Mark XV system to determine which system should go into production. Current program acquisition strategy assumes a leader-follower arrangement, which will permit two production sources The team leader will be given overall full-scale development responsibility and dual production source qualification As yet, there are no procurement estimates for the Mark XV

Schedule

Both contractors in the demonstration/validation phase are delivering Mark XV advanced development models 4 months late The program manager has compensated for this by delaying the start of flight testing and shortening the advanced development model/test bed integration period Program officials state that full flight testing will be conducted as planned, but the delays will compress the time available for preparing specifications for the process The program office does not expect the delays to impact its ability to be ready for the JRMB milestone II review in May 1988 JRMB's IIIA review is scheduled for the third quarter of fiscal year 1992, and its IIIB review for the third quarter of fiscal year 1993

Performance

The purpose of the current demonstration/validation phase is to demonstrate through advanced development model testing, studies and analyses, and modeling that solutions to the primary areas of technical risk are available. The Mark XV advanced development models will be representative of full-scale development equipment in terms of functional and performance capability, however, there will be the normal size and electronic component differences. The equipment is intended to demonstrate the performance of the tri-service electronic signal and the compatibility of the system with selected current Mark XII system interfaces The advanced development models are not required to meet the form, fit, or environmental requirements of full-scale development hardware. Electromagnetic interference and compatibility requirements will be met only to the extent required to provide safety of flight and to ensure proper system performance. Test data results will be used to establish the achievable operational performance requirements that will be compared to the required system performance prior to a milestone II decision.

Although much testing remains to be accomplished, a Mark XV program engineering official stated that he had no reason to believe that the operational requirements in the July 1984 Multi-command Required Operational Capability document would not be achieved Testing during the demonstration/validation phase includes parametric laboratory testing, which began in December 1986 and is scheduled to be completed in April 1987 Flight testing is scheduled to start in March 1987 and to be completed in June 1987. Other testing includes an Army HAWK missile system compatibility demonstration in June 1987, Navy unique testing in July and August 1987, and North Atlantic Treaty Organization interoperability testing in October and November 1987.

Other Issues

System Alternatives

Mark XV Program Office officials stated that there have not been any significant technological breakthroughs that might supercede the Mark XV program or suggest that an alternative to the program is justified. Relative to cooperative question-and-answer identification approaches, the Mark XV is applying state-of-the-art technology, according to these officials They stated that, although other forms of identification are available, the question-and-answer link is required to identify friendly aircraft with high confidence They were not aware of any other system that would meet the defined requirement and stated that, while the existing Mark XII system could be improved in terms of reliability and security, it can not adequately support beyond visual range weapons in a combat environment

We were advised by program office officials that North Atlantic Treaty Organization allies are developing systems with comparable capabilities They stated that the Federal Republic of Germany and the United Kingdom are building advanced development models in parallel with the U S program Also, France has a smaller scale program in progress and Italy has shown interest in participating with another nation during full-scale development and production Program officials advised us that although these systems are, in varying degrees, comparable in function and are to be interoperable where those functions are comparable, they will not meet U S size requirements for existing U S. aircraft which are needed to minimize aircraft integration costs and provide an affordable system. Program officials state that, after 17 years of trying, agreement was reached recently with our NATO allies on a mutually acceptable technical full-scale development description They said this cleared a major program obstacle to reaching a U S. full-scale development decision

Funding Adequacy

Available data show that Army and Air Force requirements are fully funded, but the Navy requirements are under funded by $197.4 million for fiscal years 1988-92.

Compliance With Review Procedures

This program is managed and reviewed in accordance with DOD's major systems acquisition review procedures, DOD Instruction 5000.2. The next major milestone decision for the Joint Requirements Management Board is for Phase 2 of full-scale development, currently scheduled for May 1988

Relevant Products

Aircraft Identification Improved Aircraft Identification Capabilities—A Critical Need (GAO/C-NSIAD-86-18, August 1986)

Microwave Landing System

The Microwave Landing System (MLS) program is a joint civil/military effort to provide capabilities that will enable specially equipped aircraft to use ground generated signals to continuously display the aircraft's position relative to its preselected line and slope approach during landing.

The MLS program was initiated in the 1970s in response to demands for a precision landing system which would overcome the limitations of existing systems. In 1978 the International Civil Aviation Organization selected a MLS for worldwide implementation. In the United States, the Federal Aviation Administration (FAA), which is responsible for our National Airspace System plan, manages the civil portion of the MLS acquisition and the Air Force manages the military portion.

The initial FAA contract for 178 fixed ground-based systems has experienced software development delays and, as yet, no systems have been delivered by the contractor Delivery is expected to begin in March 1988 In the House of Representatives Report 99-976, it was recommended that no fiscal year 1987 appropriations for the MLS program be approved. It also directed that no further procurement activity be initiated until the House and Senate Committees on Appropriations hold hearings to determine the status of the MLS program.

Description

The MLS program includes fixed and mobile ground-based systems and two types of avionics systems, commercial and military

The fixed ground-based systems are intended to provide capabilities to generate microwave signals for in-flight reception by MLS equipped aircraft These systems will be placed at commercial airports and/or military air bases in the United States and at U.S. military bases overseas.

The military's mobile ground-based systems are intended to provide off-airfield and adverse weather operations to support (1) initial deployments of ground forces, (2) forward area supply, medical, and evacuation activities, and (3) special operating forces

Commercial avionics systems installed in commercial aircraft are to permit in-flight reception of microwave signals from the fixed ground-based systems. The Air Force plans use a modified version of the commercial systems for some of its cargo and transport aircraft

The acquisition of military avionics systems is intended to provide MLS capabilities for fighter aircraft having environmental and space limitations. This acquisition program, which is in the concept definition phase, is the only part of the MLS program subjected to DOD's major systems acquisition review procedures

Cost

The total cost for the DOD part of the MLS program is estimated to be $2 174 billion Estimated costs for research, development, test, and evaluation, procurement, and installation for each type of system, by appropriations, are as shown in table IV 5

Table IV.5. MLS Cost Estimates - DOD Only

	Ground-Based Systems		Avionics Systems		
Appropriations	**Fixed**	**Mobile**	**Commercial**	**Military**	**Total**
Research, development, test & evaluatation	$ •	$40	$10	$82	**$132**
Procurement	269	97	237	885	**1,488**
Installation	88	•	74	392	**554**
Total	**$357**	**$137**	**$321**	**$1,359**	**$2,174**

A total of at least 1,650 fixed ground-based MLSs will be acquired with three FAA contracts DOD will pay the FAA an estimated $357 million for 405 of these systems, the Air Force will receive 256 and the remaining 149 will be allocated between the Army and Navy.

The Air Force plans to develop and produce 82 mobile ground-based systems through a development contract with production options The contract will also include options for up to 50 systems for the Army estimated to cost $137 million.

The DOD plans to modify the new commercial avionics system for military cargo, transport and operational support aircraft. The Navy and the Marine Corps have unique avionics requirements which are planned to be met with a multi-mode receiver system.

The first avionics acquisition is for the 376 C-130 aircraft, and is estimated to cost $36 3 million. The development contract to modify the avionics will have production options, and is scheduled for award in May 1987

The Air Force intends to develop and acquire a military avionics system for about 7,700 combat aircraft. In fiscal year 1987 $2 million will be used for developmental designs The total DOD cost to develop, acquire and install MLS avionics on approximately 18,000 military aircraft is about $1.36 billion

Schedule

Procurement activities associated with the MLS program await both congressional and, in the case of the military avionics segment, the Office of the Secretary of Defense's approval To date, schedule delays are largely attributable to both contractor delays on the first fixed ground-based MLS contract, and, in part, to the reduction of fiscal year 1987 funding

Fixed Ground-Based Systems

The first production contract was awarded in January, 1984. Four systems under this contract will be allocated to DOD (two at Andrews Air Force Base for Presidential support and two for the Army).

The initial production contract for 178 fixed ground-based MLSs is currently 27 months behind schedule The FAA estimates that deliveries for the first contract will begin in March 1988 and that the units from the second contract will be installed beginning at least 33 months after contract award

Mobile Ground-Based Systems

The denial of fiscal year 1987 appropriations for FAA ground-based system funding has also affected the Air Force's funding request for the mobile MLS. The release of the Air Force's request for proposal for developing the mobile MLS is linked to the release of the FAA's request for proposal for the second fixed-base production contract Both are to be released at the same time and those contractors submitting proposals for the mobile system must actually submit two proposals· one assuming that the contractor will win the FAA production contract and one assuming that the contractor will not.

Commercial Avionics

Existing precision landing systems, such as the instrument landing system, and the MLS may have to co-exist for a period of time extending into the late 1990s and beyond. The military services plan to equip certain aircraft with dual or multiple landing capabilities during the transition period

The commercial avionics contract for the C-130 aircraft is scheduled for award in May, 1987 It will be a development contract with production options. Planned use of fiscal years 1988-90 procurement funds is to exercise the production options This contract award will probably be made before the FAA and Air Force release their RFPs for the ground-based fixed and mobile segments This is because the modification, acquisition, and installation of commercial avionics systems on several different types of the 2,600 aircraft will be a lengthy process and military aircraft need to be MLS-capable so that both fixed and mobile ground-based systems can be tested

Military Avionics

A full-scale development decision (milestone II) is scheduled for July 1988 for the military avionics system

Performance

Limited test data on the fixed ground-based system and commercial avionics indicate that they may effectively operate together For example, commercial avionics system tested with a fixed-base system on a military base in Alaska is operational. However, no data exist on equipment meeting government specifications. Also, no performance data yet exist on mobile MLS or military avionics.

Other Issues

System Alternatives

The FAA and Air Force have examined the Global Positioning System program and determined that, while the latitude and longitude accuracies of the GPS are excellent, the vertical accuracy provided is not sufficient to meet the minimum MLS requirements for 200 feet altitude one-half mile from the runway. A differential GPS receiver used with a radar altimeter may be able to provide the required accuracies.

Also, the Navy's multi-mode receiver system, should be reexamined when the military avionics definition is completed. The cost of this receiver may be greater than the projected cost of the MLS avionics package.

The MLS is an international program of which the United States is a part Currently, it is not clear how changes to scope or pace of the United States civil or military portions of the MLS program would have on the international use of MLS

Funding Adequacy

Congressional approval is required before continuing the FAA's acquisition of fixed ground-based systems This approval, or disapproval, may also impact DOD's request for funding the acquisition of the mobile ground-based systems and the military avionics systems.

For the fixed ground-based MLS segment, the Air Force is requesting multi-year funding beginning in fiscal year 1988 and ending in fiscal year 1992—a 5-year request The Navy and Air Force want their procurement funding to begin in fiscal year 1988 and the Army in fiscal year 1991

Compliance With Review Procedures

Only the military avionics system is subjected to major systems acquisition procedures

NAVSTAR Global Positioning System - User Equipment

The NAVSTAR Global Positioning System (GPS) is a space-based radio system being developed by the Air Force. The user equipment (UE) segment of the GPS is intended to provide users with capabilities to receive precise, continuous, all-weather, common-grid, world positioning and navigation, and time reference information on land, at sea, and in the air.

Program cost estimates have more than doubled with almost all of the growth within GPS's UE segment. Also, the UE part could be delayed beyond the current estimate by at least a year

Description

GPS consists of (1) a space segment, which includes the satellites; (2) a ground control segment, which includes facilities and equipment to monitor and control the satellite operations; and (3) a user equipment segment, which includes radio receivers to convert satellite transmitted signals into useful position, navigation, time, and weapon delivery information.

The space and ground control segments are already in the full-rate production phase.

The UE segment of GPS program is to develop one-, two-, and five-channel radio receiver sets that will be integrated into over 200 different types of aircraft, land vehicles, surface ships, and submarines A full-rate production decision on the UE segment is currently scheduled for March 1989.

GPS was previously scheduled to be fully operational in 1988, but the Challenger disaster in January 1986 left it without launch capability and delayed the full operational capability date to a current estimate of 1991.

Cost

Selected Acquisition Reports show that the total GPS program cost estimate has increased from a 1980 estimate of $2,306 7 million to the current December 1986 estimate of $6,538 1 million Most of the increase is in the UE segment of the program as shown in table IV.6

Table IV.6: Cost Estimates of GPS

Dollars in millions

	1980	1986
Space and Control segments	$1,510 8	$2,378 1
UE segment	795 9[a]	4,160 0
Total	**$2,306.7**	**$6,538.1**

[a]A UE estimate of $795 9 million for RDT&E was identified separately until the September 1985 SAR when procurement costs were added

Of the $4,160 million for UE, $1,311 million is allocated to complete research, development, test and evaluation (RDT&E), of which $667.0 has already been spent. The remaining, $2,849 million is allocated to complete the UE procurement, of which $7.6 million has been spent for limited rate initial production

Growth in the UE segment has substantially affected the total cost of the GPS program Short-term funding needs are mainly for RDT&E for the UE segment and, according to program officials, current funding is adequate Program officials told us that, although they are better able to identify cost now than ever before, long-term funding cannot yet be clearly predicted.

Schedule

GPS passed milestone I (concept validation) in 1973, milestone II (full-scale development) in 1979, and milestone IIIA (limited-rate initial production—LRIP)in June 1986. A 5-year contract was awarded Rockwell-Collins in April 1985 A full-rate production decision (milestone IIIB) is scheduled for March 1989

The UE LRIP contract was awarded before some design and development concerns and reliability problems were resolved Program officials told us that it is not uncommon to move into LRIP with some continuing problems However, in this case, they will cause some delay in reaching milestone IIIB For example, during initial operational testing, the UE's effectiveness was evaluated as marginal, and its suitability unsatisfactory In addition, the UE failed to meet most user requirements for reliability and maintainability. These problems, which are being addressed in a DOD directed reliability program, should be resolved before the program moves into milestone IIIB.

GPS officials estimate that the March 1989 milestone IIIB decision will slip by about 4 to 6 months. This estimate may be optimistic, however, because some significant events must occur before a full-rate production

The Army considers the FOG-M technical risk to be low because of performance already demonstrated in early testing The primary technical issues to be resolved are (1) operation of the fiber optic link in extremely hot and cold temperatures, (2) the effects on the fiber optics of long-term storage, (3) achieving the low weight needed to permit mounting the system on the High Mobility Multipurpose Wheeled Vehicle, (4) target acquisition using the television seeker, (5) the ability of the missile to automatically track moving helicopters in a cluttered background, and (6) achieving the required accuracy with the extended range missile at an acceptable cost.

Other Issues

System Alternatives

A Forward Area Air Defense Working Group, formed in September 1985, considered six systems to meet the non-line of sight requirement These were (1) Sense and Destroy Armor, (2) a ground-launched Hellfire, (3) Copperhead, (4) the Multiple Launch Rocket System with a terminally guided warhead, (5) a ground-launched version of the Air Force's Advanced Medium Range Air-to-Air Missile (AMRAAM), and (6) FOG-M The Working Group concluded that FOG-M offered the most potential for meeting the non-line of sight requirement, but also recommended that the ground-launched AMRAAM be further evaluated

The Army developed plans to test AMRAAM as an alternative, but in a December 15, 1986, letter, the Under Secretary of Defense for Acquisition directed the Army to terminate the plan According to the Under Secretary, AMRAAM showed limited utility for meeting the non-line of sight requirement and testing it for that role could adversely affect the Air Force's compressed AMRAAM test schedule

According to the FOG-M project manager, fiber optics is the latest technology in missile guidance. He said no technological breakthroughs have occurred since the FOG-M program was initiated that warrants reconsideration of it as the non-line of sight weapon.

Although some countries are developing non-line of sight air defense weapons, according to Army officials, there are no foreign systems currently in production which can meet the non-line of sight requirements.

Funding Adequacy

According to the project manager, FOG-M is adequately funded through the procurement phase, although minor adjustments in the year-to-year funding may be necessary For example, the research and development funding in the Army's program objective memorandum and the Five Year Defense Plan exceeds estimated requirements for fiscal years 1988 and 1989, but is less than the estimated requirements for fiscal years 1990 and 1991.

Compliance With Review Procedures

A Joint Requirements and Management Board is scheduled to consider continued development and limited production of FOG-M in May 1987 The Army will conduct a review in November 1989, prior to exercising the limited production contract option A Board meeting to consider full-rate production is scheduled for September 1992

Command, Control and Intelligence System

FAADS's Command, Control and Intelligence (C2I) system is intended to provide an automated command and control capability for commanders to control the use of short-range air defense weapons Specifically, it is designed to automatically acquire, identify, process, and disseminate incoming aircraft information to commanders of forward area air defense battalions FAADS C2I will be integrated with the Army Command and Control System (ACCS), a larger program to automate the battlefield functions of air defense, maneuver control, fire support, combat service support, and tactical intelligence.

Previously known as the Short Range Air Defense Command and Control (SHORAD C2) system, FAADS C2I is one of the five components of the overall FAADS program The other four components are short-range air defense weapon systems FAADS C2I evolved from a series of DOD/Army reviews following the August 1985 cancellation of the Division Air Defense gun program known as Sergeant York

We identified several issues in the FAADS C2I program which are discussed in the cost, schedule, performance, and other issues sections which follow. These issues include Army cost estimates which may be significantly understated for a variety of reasons, program schedules that have been developed without the benefit of a total program risk assessment and rely upon the assumption of concurrent development, testing, and production, and a nondevelopmental procurement strategy which may have some benefits, but will not fully meet the stated performance requirements of all intended users. These and other issues are discussed below

Description

The current FAADS C2I program, approved in August 1986, consists of four distinct parts: the automated command and control architecture (basic C2), ground sensor, aerial sensor, and aircraft identification The Army estimates that the program will cost $2.6 billion to develop and produce, will achieve initial operational capability in 1991, and will provide substantial improvements in the command and control of short-range air defense. The basic C2 is in full-scale development, the ground sensor has been approved for low-rate initial production, the aerial sensor is in concept definition, and the aircraft identification elements are in demonstration and advanced development.

To exploit the capabilities of its forward air defense weapons, the Army needs an automated command, control, and intelligence system. The system should be capable of automatically acquiring and identifying (friend or foe) incoming aircraft and processing and disseminating such information to appropriate air defense units.

Cost

The Army's $2 6 billion cost estimate (in then-year dollars) includes $942 million for development and $1 7 billion for procurement Shown in table II 6 are the estimated acquisition costs and quantities for each program element.

Table II.6:Acquisition Cost Estimate and Hardware Quantities

Dollars in millions

Program element	Development	Procurement	Total	Production quantities
Basic C2	$465 2	$304 3	$769 5	29
Ground sensor	35 0	533 6	568 6	123
Aerial sensor	136 2	665 0	801 2	Undetermined
Aircraft identification	305 6	195 2	500 8	Undetermined
Total	**$942.0**	**$1,698.1**	**$2,640.1**	

The current program cost estimate has not changed. However, when compared to the SHORAD C2 program cost that was presented in DOD's December 1985 Selected Acquisition Report, the program cost has increased by about $1 5 billion. The SHORAD C2 program did not include an aerial sensor or aircraft identification features, whereas the current FAADS C2I program does This is the primary reason for the difference in these two cost estimates

While total program risks, including the aerial sensor and aircraft identification, have not been assessed, the Army considers the program risk for the basic C2 and ground sensor to be moderate However, delays in getting government-furnished equipment, particularly the ACCS hardware and software and the Position Location and Reporting System/ Joint Tactical Information Distribution System Hybrid, could delay the program and increase cost But, our primary concerns with the Army cost estimate are the following.

- The estimate does not include the cost of equipping Army Reserve units The project office estimates the cost to equip the Reserves with the basic C2 and ground sensor will be about $900 million
- The estimate may not include all costs to upgrade the ground sensor The Army cannot accurately estimate the cost to make these improvements because project officials will not know what capabilities the sensors will have until source selection and candidate testing is completed
- The aerial sensor and the aircraft identification programs have not yet been approved for full-scale development These costs are difficult to project and may change as these segments are better defined For example, a November 1986 estimate indicates that Positive Hostile Identification could cost $836 6 million, whereas, the July 1986 $2 6 billion estimate includes $462 3 million for this element of the aircraft identification program

Schedule

As shown in table II 7, the various program elements are expected to proceed through the acquisition cycle at different times

Table II.7: Scheduled FAADS C2I Acquisition Milestones as of January 1987

	Full-scale development (II)	Low-rate production (IIIA)	Full-rate production (IIIB)
1 Basic C2			
Start	9/86		9/88
Complete	7/91		9/95
2 Ground sensor			
Start		4/88	10/89
Complete		9/91	2/94
3 Aerial sensor			
Start	4/89	1/91	4/93
Complete	4/93	4/94	[c]
4 Aircraft identification			
IFF[a]			
Start	9/88	7/91	10/92
Complete	9/92	7/92	[c]
PHID/NCTR[b]			
Start	1/89	3/90	7/90
Complete	9/89	7/92	[c]

[a]Identification, friend or foe

[b]Positive Hostile Identification/Non-Cooperative Target Recognition

[c]The Army has not established these dates

Acquisition milestones for the basic C2, ground sensor, and aircraft identification have not changed since initial program approval in August 1986 However, the start of full-scale development of the aerial sensor slipped about 1 year to April 1989 because of funding cuts

Project officials believe the schedule risks can be minimized and the planned milestones will be met However, we are concerned about the proposed schedule for the following reasons

- The Army has not assessed total program risks An Army risk assessment of the basic C2 and ground sensor identified a potential schedule slippage of 12 months, however, the risks of the less defined aerial sensor and aircraft identification segments have not been assessed Since these program elements have not entered full-scale development, the acquisition milestones for this part of the program could change as these elements are better defined
- Many acquisition milestones are predicated on concurrent development, testing, and production For example, the basic C2 schedule is dependent on the availability of ACCS common hardware and software The ACCS

hardware will not be delivered in time for use in the basic C2 test and development systems. In fact, the ACCS program manager has not yet selected a hardware and software contractor While the project office directed the software and system integration contractor to obtain substitute hardware, the substitute hardware may contain different operating systems which could result in problems with interface between the unique system software and the ACCS common hardware This could delay system integration and other acquisition milestones Additionally, if the ACCS equipment does not meet the FAADS C2I specifications, as now expected, system design changes will be required This could also delay scheduled milestones Similarly, many of the basic C2 and ground sensor units will be produced before developmental and operational testing These units may have to be modified to reflect changes resulting from this testing Such modifications could delay some scheduled milestones and increase program cost.

Performance

Specific performance requirements are to.

- operate in an electronic countermeasure environment and be survivable against antiradiation missiles;
- attain an 84-percent system operational availability rate;
- provide continuous, all weather, low-altitude surveillance over the division area and 20 kilometers beyond the forward line of troops;
- be transportable by air, rail, surface, and water without disassembly from the carrier, and
- withstand the effects of nuclear, biological, and chemical contamination and decontamination.

As of January 1987, no testing had been done Thus, at this time, there is no basis to determine if specific performance expectations will be met. However, without significant modification the system will not meet all user requirements For example, the nondevelopmental ground sensors will not be survivable against antiradiation missiles Additionally, the early systems will not have aerial sensors and noncooperative aircraft identification capabilities.

Army officials maintain that the system they initially field will be more effective than the manual system now employed But the system will neither meet requirements nor be fully effective without a survivable ground sensor, an aerial sensor, and noncooperative aircraft identification. The Army has not established a specific time frame for improving or replacing the ground sensor. The aircraft identification programs will not be added until 1993, and the aerial sensor will not be available until at least 1995

The acquisition approach for the FAADS C2I system calls for procurement of nondevelopmental items to the extent practical. The acquisition approach assumes that readily available off-the-shelf equipment will be used with little or no modification The Army adopted this approach to enable system fielding in minimum time to meet its urgent need for an automated short-range air defense command and control system

Using the acquisition approach may allow earlier fielding of the system, but it will not provide a system that meets all user requirements Additionally, the Army plans concurrent production and testing of the ground sensor which increases the risk that it will acquire items that will not meet performance requirements without major modifications. For example, the Army plans to buy as many as 94 of the 123 ground sensors before system development/operational tests will be completed Based on current plans, full-rate production of ground sensors will begin in October 1989, about 18 months before the system tests are completed in April 1991.

Other Issues

System Alternatives

According to the Army, existing U S and allied systems will not meet FAADS C2I user requirements The Army concluded a cooperative development program was impractical

The July 1986 FAADS C2I Decision Coordinating Paper indicates the Army considered the following alternatives (1) continue with the existing manual system, (2) develop and deploy the automated FAADS C2I system, which includes a nondevelopmental ground sensor, and (3) develop and deploy an automated system without sensors From these alternatives, the Army selected the FAADS C2I system with the ground sensor.

The Army plans to field a FAADS C2I system with a nondevelopmental sensor even though it is understood that currently available sensors will not survive the antiradiation missile threat However, the Army maintains that the urgent need for the system justifies fielding the nondevelopmental sensors, recognizing they will have to be improved or replaced.

We recognize that the Army needs to acquire ground sensors for test and evaluation and initial fielding. However, we are concerned with the Army's plan to contract for 123 nonsurvivable sensors before 1992, particularly since new technology to enhance survivability is expected to be available by 1994. Additionally, the system will not be fully effective without the aircraft identification and aerial sensors, which are scheduled to be available in 1993 and 1995, respectively

Funding Adequacy

The funding for the development of SHORAD C2 system from 1981 through 1987 is shown in table II 8

Table II.8: SHORAD C2 System

Dollars in thousands

Fiscal year	Appropriated	Released	Obligated	Unobligated
1981	a	$9,947	$9,947	$ •
1982	a	13,090	13,090	•
1983	a	998	998	•
1984	$40,836	31,212	31,199	13
1985	50,356	15,580	15,580	•
1986	31,041	20,111	19,890	221
1987	43,000	23,449	20,911	2,538

[a]Information not available

According to project officials, all appropriated funds were not released to the Army project office because of delays in obtaining DOD program approval and a full-scale engineering development decision These decisions were made in late 1986 Project officials believe the program is adequately funded

Compliance With Review Procedures

The acquisition of the FAADS C2I system is in compliance with the major defense systems acquisition procedures

All-Source Analysis System

The All-Source Analysis System (ASAS) is the Army's element of DOD's Joint Tactical Fusion Program (JTFP). The Enemy Situation Correlation Element (ENSCE) is the Air Force's equivalent. The JTFP was established as a joint Army and Air Force program to develop a single automated system that would correlate, analyze, and disseminate high volumes of time-sensitive, multi-sensor intelligence data. ASAS/ENSCE is to provide tactical commanders with precise location and structure of the opposing forces and near real-time battle situation displays Thus, the ASAS/ENSCE is the analytical hub for intelligence fusion and dissemination in the Army corps and division and the numbered air forces

Efforts to deal with steady development cost growth and numerous program and funding changes have lead to plans for a less capable baseline system, a slower acquisition schedule, and potentially higher costs. Because testing is in the future, performance data is limited

Description

The two main efforts in this program are software development and systems integration The software is the heart of the ASAS/ENSCE and will be developed in blocks with increasing capability for each succeeding block The baseline software effort involves over 1 5 million lines of code and a yet-to-be-determined amount of code for later releases. This is the riskiest element of the program.

The integration effort requires the procurement of current and advanced technology computers, workstations, data communications equipment, and related software These will be integrated into configured systems that will provide data analysis and also disseminate usable, near real-time intelligence information to tactical Army and Air Force commanders

Full-scale engineering development (milestone II) of the ASAS/ENSCE began in March 1983, under an evolutionary approach that was designed to develop and deliver hardware and incrementally developed software By using this evolutionary approach, the program officials expect to achieve increasing levels of performance over time as the technology and software are proven and as user hands-on experience is factored into the designs

The JTFP was waived from the normal DOD acquisition oversight process. This DOD level management task is being performed by the Joint Oversight Group, whose membership and functions are similar to the Joint Resources Management Board

The services are conducting operational concept studies that will confirm the number of ASAS and ENSCE systems to be procured The size and schedule of deliveries have changed several times For example, production was to begin in 1990 under a previous plan Now, the production decision (milestone III) is expected in early fiscal year 1992, at the completion of prototype system testing.

Cost

The Army contributes about 90 percent of the program funding and the Air Force about 10 percent. Cost estimates for the ASAS/ENSCE have grown significantly The cost figures are classified and can be provided by GAO upon request

The cost growth is due largely to poor cost estimates, increasing capability and changing requirements for software and hardware, reconfiguring the system into smaller S-250 shelters, and schedule stretch-outs caused by funding instability DOD told us that the large increase in cost estimates reflected in the Selected Acquisition Report for the baseline system was due, in large measure, to differences in the years included. The 1984 estimate does not include procurement costs for fiscal years 1990-92 while the current estimate does include these years. Neither estimate includes cost to complete the system JTFP is developing that estimate now Also, costs to procure the Air Force ENSCE are included in the current estimate but not in the 1984 estimate

In our July 1986 report on the JTFP, we noted that design changes and budget cuts have come from both DOD and the Congress causing schedule delays The latest program management plan, Plan G, is being developed to accommodate the latest budget cuts and poor contractor cost estimates. In this plan, program officials are reducing the amount of equipment and software to be delivered in the development phase and putting the deferred capabilities in a pre-planned product improvement program The cost of this program has not been estimated. The result is that the services will be receiving much of the expected equipment and software later and at a higher cost than planned

A major element of the cost growth is in software development. Program officials estimate that software costs could be up to $330 million higher than previously thought for the first five software blocks. It is possible that costs will grow more As a result of a concerted independent effort to stabilize the estimating process by the program office, the design and requirements of the first three blocks of software were studied in detail The program office learned that the number of lines of code and time to write them increased significantly. For the second and third software blocks, the lines of code increased from about 350,000 to about 800,000. A similarly detailed study of the design and requirements for planned additional software blocks are likely to result in further cost growth as the program progresses and estimates are better defined and new requirements are identified.

Another element of the cost growth is associated with the production of the ASAS development systems called Limited Capability Configuration systems, which became urgent requirements added in 1986. Cost estimates to deliver these systems beginning in late fiscal year 1988 have doubled There are three reasons for this: (1) poor cost estimates, (2) unanticipated requirements, and (3) a nonstandard production contract.

For the previous ASAS plan, called Plan F, approved in March 1986, the prime contractor estimated that the cost for three Limited Capability Configuration systems would be about $100 million. This was based on the incomplete cost data of off-the-shelf equipment and relatively inexpensive "rack and stack" assembly. This included none of the development costs that were required, such as costs for data package development, nonrecurring engineering, integration, or testing Also, requirements for these systems to operate with the Mobile Subscriber Equipment Communications System and additional sensor systems earlier than planned added to the development effort. As a result of refined contractor estimates, the program office under Plan G will be able to buy only one and one-half systems instead of three and fewer communication modules than previously planned. Program officials believe that they will be able to continue testing, and development and user training with this reduced equipment suite

Schedule

Earlier deliverables and future near-term deliverables were and are expected to be close to schedule These include a partial system for field testing in December 1986, special software and upgrades for existing Air Force systems, and the portable ASAS/ENSCE workstation. The rest of the development and acquisition schedule, however, continues to slip largely due to funding instability, specification changes, and difficulties in estimating software development efforts. Major changes are.

- The delivery of the first development systems, two ASASs and one ENSCE, in 1989 will be about 18 months later than planned. Also, the Army will receive only one of the two ASASs it expected. This could delay ASAS participation in the Joint Surveillance Target Attack Radar System demonstration
- The first block of software is still scheduled for fiscal year 1988. But the second and third blocks, scheduled for delivery in fiscal year 1989 under

Plan F, will be delayed about 18 months. This will align with the hardware deliveries

- Software blocks four and five will not be delivered within the original development budget as expected under Plan F. These capabilities are being integrated into the pre-planned product improvement program
- The production decision scheduled for fiscal year 1990 is rescheduled for 1992, following development system testing

Performance

Limited hardware and software (the ASAS Interface Module and the Air Force's limited ENSCE) have been developed to date Both are operating within expectations A partial ASAS was delivered for service testing in December 1986 This system consisted of two communications and two data handling modules with limited software to test the message handling characteristics of the equipment and to acquaint the user with the system The Army considered the test of this partial system successful at performing these limited functions

Other Issues

System Alternatives

There are more cost and operationally effective ways to configure production system components to require fewer vehicles, personnel, and transport aircraft GAO analysis of one alternative configuration shows a potential for significant savings over the life of the program—$112 million in constant fiscal year 1985 dollars In its response to this report, DOD told the Congress that the program office would conduct a cost and operational effectiveness analysis to determine the best production configuration prior to a production decision in the early 1990s Also, program officials intend to consider and report on design alternatives to the current system during the 1987 and 1988 design review process

Program Instability

Repeated revisions to the program acquisition strategy have contributed to program instability and increased research and development costs. Since June 1984, there have been six major revisions to the strategy These revisions are attributable to a combination of factors, including (1) DOD, service, and congressionally directed changes, (2) changes in DOD and congressional program funding levels leading to reprogramming and rescheduling actions, and (3) efforts to repackage system components into smaller or "downsized" equipment shelters

Data Communications

DOD managers need to implement appropriate and timely solutions to existing data communications problems If not corrected, these problems could disrupt the information flow from sensor to user. Specifically, if ASAS is able to use certain communications equipment being developed as the standard Army battlefield data communications system, the JTFP may be able to realize greater cost savings by reducing the planned procurement of over 100 ASAS unique data communications modules costing about $2 2 million each Some program officials believe this less costly alternative is feasible Currently, the data system is not funded for an ASAS interface. Until the Army resolves this data distribution problem, JTFP must build these modules.

Funding Adequacy

The program office is preparing the baseline cost estimate for the new acquisition plan and will prepare the estimates for the pre-planned product improvement program later. We do not know what the total system will cost Concerning annual funding, frequent budget cuts have been one cause for program instability.

Relevant Products

Tactical Intelligence· DOD's Joint Tactical Fusion Program, (GAO/C-NSIAD-86-27, July 1986)

Joint Surveillance and Target Attack Radar System

The Joint Surveillance Target Attack Radar System (JSTARS) is a joint Air Force/Army project to develop an airborne radar system for finding moving and fixed targets on the tactical battlefield JSTARS is intended to help satisfy the services' need for detecting, locating, disrupting, and destroying second echelon enemy forces While the Air Force is responsible for the airborne radar system and the communications link, the Army is developing and producing the ground station module (GSM) for processing and distributing the JSTARS data for ground commanders

Although the Army has demonstrated the viability of its GSM during field exercises, the program has experienced schedule delays and cost increases One of the current problems is a software flaw which prevents full use of the GSM's designed capabilities. This introduces some risk to the Army's plan for buying a limited number of production units before development is completed Still, if development is successful, the GSM could be suitable as a common ground station for other Army sensor systems

Description

The GSM is a sheltered facility containing computers, displays, communications devices, and other components This equipment stores and displays radar data, allows operators to analyze data, generates target information, and sends the information to appropriate commanders. It has been developed using components of the Army's defunct, helicopter-based Standoff Target Acquisition System Motorola is the prime contractor for GSM development GSM entered the full-scale development phase in August 1984 and is scheduled to enter full-rate production in June 1989

Some GSM development models have already been produced and GSMs may be potentially usable with systems other than JSTARS. Also, a smaller version of GSM is being developed to improve battlefield mobility. However, there is concern about achieving the necessary size and weight reductions for the downsized GSM. The GSM development schedule is currently threatened by the software's inability to handle simultaneous tasks. The first GSM model was fielded in 1984 and used in Europe during two major training exercises. This facility was later used at another overseas site, and is now at the contractor's plant being refurbished. Two additional development models have been fielded to Korea and Fort Hood, Texas, where they are being demonstrated and evaluated to provide feedback for the development process. Six other GSM models are undergoing qualification and logistics support validation tests at contractor facilities.

Although the GSM was initially intended for use with JSTARS, the Army has also found other uses for it. One of these is as a ground-processing facility for the OV-1D Mohawk airborne radar system, which detects moving targets. The original Mohawk radar ground-processing stations are at the end of their useful lives, and the GSMs will replace them In fact, the Army recently approved a plan to buy nine GSMs beginning in fiscal year 1987 as "limited production, urgent" units for use with the Mohawk radar system These units will initially have less capability than the GSM for JSTARS, but will be retrofitted later to provide full capability.

In addition to continuing GSM development and producing the "limited production, urgent" GSMs for the Mohawk, the Army has started developing a downsized GSM. A contract to develop five downsized GSMs outfitted on high mobility vehicles was awarded in fiscal year 1986.

The Army plans to have 70 full-size GSMs and 25 downsized GSMs in operation by 1994

Cost

The Army's estimated GSM acquisition cost, in then-year dollars, is shown in table II.9

Table II.9: Estimated GSM Acquisition Cost

Dollars in millions

Appropriations	Amount
Research, development, test and evaluation	$264 27
Procurement	569 63
Total	**$833.90**

The Army's budget request for fiscal years 1988 and 1989 is shown in table II 10

Table II.10: Army's Budget Request for Fiscal Years 1988 and 1989

Dollars in millions

Appropriations	FY 1988	FY 1989
Research, development, test and evaluation	$23 396	$15 430
Procurement	36 892	81 160

In fiscal year 1987, the Army originally requested $63 4 million in GSM production funds The Congress appropriated $21.7 million but only authorized $10 million The Army and DOD reprogrammed $4.4 million of the appropriated amount to support a joint aircraft identification project. The remaining funds, along with the requested amount for fiscal year 1988, will be used for the limited production, urgent effort to buy nine GSMs for the OV-1D Mohawk UPD-7 radar system

Research and development funds for fiscal years 1988 and 1989 are for continued development of the full-size GSMS, but development of small GSMS may be dropped due to inadequate funds

According to the Army program manager, since the contract was awarded in 1984, the cost of GSM development has increased about $72 million because of the following changes to the program

- $7 million for incorporating the capability to process radar data from the OV-1D Mohawk UPD-7 radar system currently in use.
- $25 million for adding an improved display that will allow the GSM to receive the high resolution imagery that the JSTARS radar system can provide
- about $40 million for developing a downsized GSM to provide greater mobility on the tactical battlefield.

Schedule

The GSM's acquisition schedule has changed over the past several years in response to development delays and modified requirements Because of the longer lead time for building the JSTARS aircraft and radar systems, the GSM schedule has generally been ahead of the Air Force's segment. The Army plans to provide several GSMs for the JSTARS' initial operational test and evaluation in fiscal year 1990.

The current GSM acquisition schedule shows that there are several development and procurement efforts proceeding simultaneously Development of eight full-size GSMs is proceeding according to a lengthened schedule due to changes and improvements being made to the equipment Previously, the developmental/operational test was scheduled for the second quarter of fiscal year 1987; currently, the tests are planned for the fourth quarter of fiscal year 1988 Full-rate production of these units is planned to begin in fiscal year 1989

A contract to develop five downsized GSMs was awarded in mid-fiscal year 1986 Developmental/operational testing of this model is scheduled for the middle of fiscal year 1990, but the schedule could slip

A contract to produce nine GSMs will be awarded in fiscal year 1987 under the limited procurement, urgent program. These GSMs will be used as ground stations for the OV-1D Mohawk UPD-7 radar system. The first of these GSMs is scheduled for delivery near the end of fiscal year 1988, about the same time that testing will be conducted on the development models.

GSM program officials indicated that development delays are the result of modifications and improvements approved after development began. Changes which have affected both the schedule and cost include. (1) incorporation of the capability to process radar data from the OV-1D Mohawk UPD-7 system, (2) addition of the JSTARS data link, (3) addition of protection from nuclear, biological, and chemical warfare effects, (4) an improved display system that exploits the JSTARS sensor capabilities, and (5) development of the downsized GSM for use in Army high mobility vehicles.

Performance

Although formal developmental/operational testing of the GSM will not take place until 1988, field exercises with the prototype and development models have been useful in determining both the strengths and weaknesses of the equipment. Program officials said these field evaluations have demonstrated the viability of the GSM, and have also shown that it can be used with sensors other than the JSTARS radar. The exercises have also identified a software flaw that prevents more than one operator display from being used simultaneously A GSM program official stated the contractor is working on the problem, and is hopeful that the next software revision will correct the flaw by June 1987. He further said that GSM development will be curtailed if the problem persists during formal developmental testing in 1988

The software deficiency adds a degree of uncertainty to GSM acquisition, particularly in view of the plan to procure a limited number of production GSMs before development is completed. However, Army officials are confident that development will be successful They also say that limited production is necessary to satisfy an urgent Army need, and to keep production facilities active until full-scale production is approved

Program officials are also concerned about placing GSM equipment in high mobility vehicles. Although development started just recently, it is proving more difficult than expected to reduce the size and weight of equipment to fit into the smaller vehicles.

Other Issues

System Alternatives

As a way of saving money and reducing logistics burdens, the GSM may be able to serve as a common ground station for other intelligence and electronic warfare systems in the Army

According to a study done for the JSTARS Program Office, the Army will have about 20 different kinds of processing stations at more than 100 locations over a corps area. The study concludes that the number of different types of ground stations could be reduced to as few as seven, and the overall number of stations could also be reduced by acquiring more common ground stations The effect would be substantial savings in procurement and maintenance costs and improved sensor management The study concluded, and GSM program officials agree, the GSM can be used as one of approximately seven types of common ground stations

The Army has requirements for new processing facilities for a variety of its sensors in the next several years. If the GSM development proves successful, it may be a suitable candidate for a common ground station for intelligence and electronic warfare systems

Funding Adequacy

According to Army officials, funds for the GSM over the next several years are adequate to complete development of the full-size GSM and initiate the limited-rate production program The officials cautioned, however, any reductions in research, development, test, and evaluation funds would delay acquisition of the full-size GSM Additional funds would be required to complete the downsized GSM full-scale development

Compliance With Review Procedures

With one exception, the full range of DOD and Army acquisition review procedures appears to have been complied with. The exception was a waiver of the first phase of developmental tests for the GSM. Army program officials indicated that the waiver was given because the GSM had already been tested as part of another system—the Standoff Target Acquisition System.

Relevant Products

Capability, Survivability, and Other Concerns About the Joint Surveillance Target Attack Radar System (GAO/C-NSIAD-86-29).

Navy Programs

TOMAHAWK Cruise Missile

The TOMAHAWK weapon system family consists of four cruise missiles designed to perform a variety of anti-ship and land attack missions Cruise missiles are pilotless, turbofan-powered aircraft armed with either a conventional or nuclear warhead The missiles can be launched from surface ships, submarines, and mobile ground units

The U.S Navy TOMAHAWK family includes three ship and submarine launched variants. nuclear armed land attack (TLAM-N), conventional armed anti-ship (TASM), and conventional armed land attack (TLAM-C) The U.S Air Force nuclear armed ground-launched cruise missile is also a variant of the TOMAHAWK family.

The ship- and submarine-launched TASM and the submarine-launched TLAM-N missile programs do not appear to have incurred unusual difficulties since the TOMAHAWK program was restructured in November 1982 All major milestones of TASM and TLAM-N, according to Navy representatives, have been achieved on schedule, at performance expectations, as well as at or below cost

Description

The TOMAHAWK cruise missile is a long-range, low altitude, subsonic, jet-powered weapon system. The missile is 18 2 feet long, with a wing span of 8.6 feet and a maximum diameter of 21 inches

In addition to the missile, the TOMAHAWK weapon system includes a launch platform, a launcher and weapons control system, and a mission planning system U.S Navy TOMAHAWKs can be launched from armored box launchers on the decks of ships, submarine torpedo tubes, and vertical launchers below the decks of ships and submarines.

Cost

The Navy estimated its total TOMAHAWK program cost in the fiscal year 1988/1989 congressional budget submission at about $12.75 billion in then-year dollars The total Navy cost includes $1 81 billion in research and development, $9 19 billion in weapons procurement, $0 81 billion in other procurement, and $0.94 billion in operations and maintenance

The Navy's TOMAHAWK cruise missile program in the fiscal year 1988/ 1989 congressional budget submission, according to the Navy, shows a reduction of over $1 2 billion in total estimated weapons procurement cost Navy representatives attribute this reduction to anticipated savings from competitive procurement and lower than expected inflation

Schedule

Since the restructure of the TOMAHAWK cruise missile program in November 1982 when the Secretary of Defense directed that the Air Force's ground-launched cruise missile be given priority, Navy representatives said test and development of TASM and TLAM-N have been conducted on schedule

Performance

Submarine-launched TASM achieved initial operational capability in November 1983 Initial operational capability for ship-launched TASM and submarine-launched TLAM-N followed in June 1984. (Further details on schedule and performance are classified)

Other Issues

System Alternatives

The Navy does not know of any alternatives to the TOMAHAWK program, including programs being developed by our allies. According to the Navy, many of our allies are extremely interested in TOMAHAWK technology

Funding Adequacy

The TOMAHAWK program, according to the Navy, was adequately funded until fiscal year 1987, when the Congress cut $67 6 million from fiscal year 1987 weapons procurement and imposed a rescission of $30.8 million in fiscal year 1986 funding levels

Compliance With Review Procedures

TASM and TLAM-N are at milestone IIIA, limited production According to the Navy, it has followed established procedures in reviewing the TOMAHAWK program and in recommending that TASM and TLAM-N proceed to this milestone

Relevant Products

<u>The TOMAHAWK Cruise Missile Program Status As It Begins Deployment</u> (GAO/C-NSIAD-86-2, November 1985).

Carrier Inner Zone Anti-Submarine Warfare Helicopter

The Navy's Carrier Inner Zone Anti-Submarine Warfare (ASW) Helicopter is to provide aircraft carrier battle groups with protection from attacking enemy submarines that are in close proximity to the aircraft carrier. It is also to provide fleet support in the form of search, rescue, and logistics. The SH-60F, approved by DOD as the inner zone helicopter in 1985, is planned to replace the aging SH-3H ASW helicopters, which are becoming insufficient in number and capability to counter the increasingly quiet Soviet submarine threat The program is managed by the Naval Air Systems Command. According to the Navy, the SH-60F is currently within its program cost, schedule, and performance thresholds; however, the estimated program acquisition cost has increased $77 2 million, or 2 5 percent over the development estimate. Also, there is a potential risk in completing the ambitious test schedule prior to the milestone III review and decision for full-rate production.

Description

The SH-60F is a derivative of the SH-60B helicopter, currently being deployed on surface ships in carrier battle groups and other task force formations It uses the SH-60B airframe and drive train, but replaces the SH-60B's mission avionics designed for conducting anti-submarine warfare in the middle and outer areas of the carrier battle group, with one designed for the high noise environment of the inner zone (an area contained within an approximate 50-mile radius of the aircraft carrier). The SH-60F will be equipped with a dipping sonar extended from the bottom of the helicopter, a data processing system, and homing torpedoes for detecting, localizing, and attacking enemy submarines. The AQS-13F dipping sonar will operate deeper and have a greater range and a faster reeling machine than its AQS-13E predecessor on the SH-3H helicopter Automatic Flight Control System modifications are being incorporated to tailor the automatic approach, departure, and hover capabilities to inner zone anti-submarine warfare mission requirements. An external store station added on the port side stub wing will allow an external fuel tank to be carried along with two MK 50 torpedoes The SH-60F is in the full-scale development phase and has been approved for limited production

Cost

As shown in table III 1, the estimated program acquisition cost of 175 helicopters increased by $77 2 million, from $3,076 2 million in February 1985 to $3,153 4 million in December 1986

Table III.1: Estimated Program Acquisition Costs for the Sh-60f (Then-Year Dollars)

Dollars in millions

Appropriations	February 1985 estimated	December 1986 estimated	Difference
Research, development, test and evaluation	$58 0	$53 7	$−4 3
Procurement	2,992 8	3,075 0	82 2
Military construction	25 4	24 7	− 7
Total	**$3,076.2**	**$3,153.4**	**$77.2**

The increase in Navy program acquisition costs resulted from an $82 2 million increase in aircraft procurement that was partially offset by a $5 million reduction in estimates for research, development, test, and evaluation and military construction. The increased estimate for aircraft procurement results from increases in the estimated costs of initial helicopter spares, support equipment, publications, and technical data. Through December 1986, $183.8 million in procurement funds have been appropriated for seven helicopters.

The Navy considers the probability of a cost increase for development and production of the SH-60F to be low. Cost risk has been contained through the use of a competitively awarded fixed-price type development and production contract with not-to-exceed options for five lots of production helicopters. Life-cycle costs will be estimated and refined throughout the program

Schedule

In May 1981, the Navy proposed the carrier inner zone helicopter program as a fiscal year 1983 major new start The Secretary of Defense approved this proposal, and the program was included in the DOD 1983 budget request. The program was delayed in May 1982 when the Office of the Secretary of Defense and the Senate Committee on Armed Services agreed to slip the program to a fiscal year 1984 new start. At that time, the Navy's acquisition strategy emphasized sole sourcing because of commonality with the SH-60B helicopter. A second delay occurred in December 1983 when the Office of the Secretary of Defense did not approve the SH-60F as the inner zone helicopter but directed the Navy to open the program to competition. The Navy revised its operational requirement and acquisition strategy and issued a request for proposal to industry in June 1984. The competition resulted in the selection of Sikorsky as the prime contractor. The Navy awarded a contract to Sikorsky in February 1985 for the development and production of the SH-60F helicopter.

As a result of milestone II briefings, held in January 1985, the Secretary of Defense issued a Decision Memorandum dated February 22, 1985, which authorized the Navy to proceed with concurrent development and limited production of the SH-60F According to the new draft acquisition plan and the program manager, joint development and production is justified given that the helicopter's airframe, engine, and drive train components have already been qualified in the SH-60B program.

According to its program manager, since the initial delays occurred, the program procurement, delivery, and testing schedules approved in 1985 have proceeded as planned During the limited production phase, Sikorsky will deliver seven production aircraft, the first two of which are required for contractor and Navy testing The full-production phase will begin in fiscal year 1988 after the March 1988 milestone III review and decision.

Despite the program manager's optimism, Navy documents indicate that there are potential schedule risks associated with the prime contractor's ability to complete all integration tasks and contractor flight testing before June 1987 Furthermore, extensive development and operational testing is compressed into a tight schedule prior to milestone III Should delivery problems occur, there is potential for schedule slippage Additionally, delivery of the second aircraft will not occur until October 1987, which also compresses the time frame to complete test and evaluation before a milestone III decision.

Performance

The Navy considers the program technical risk to be low since many of the SH-60F components were previously qualified during the SH-60B development and because many of the added subsystems for the inner zone mission are derivatives of other Navy systems Both development and operational testing of new components are progressing according to the approved test plan By design, the test schedule prior to milestone III is ambitious, without slack time for resolving any significant problems or system delivery delays which might occur

Development Testing

Development tests began in April 1985 and are still underway Contractor and Navy ground and flight tests of SH-60F components in the modified SH-60B have been conducted to assess system performance and to identify any deficiencies in the systems being developed. The Navy has monitored the contractor's progress in correcting identified deficiencies and has conducted its own tests for the SH-60F. The Navy has issued interim reports on the results of completed development testing

Contractor testing during January through June 1987 will be conducted to demonstrate the entire avionics system and AQS-13F integration using the production SH-60F aircraft, however, the first production aircraft will not come off the Sikorsky production line until March 15, 1987 The Navy will begin its technical evaluation phase in July 1987 and will continue through mid-October 1987 This testing will evaluate the ability of the SH-60F to meet technical thresholds and to perform the carrier vehicle/anti-submarine warfare inner zone weapon system mission. Joint development and operational testing is scheduled during mid-October to mid-November 1987 using the first two production aircraft A final phase of the technical evaluation is scheduled from mid-December through January 1988 to verify correction of identified deficiencies The Navy will conduct the final development testing phase from February through May 1988 to establish the technical maturity of the SH-60F weapon system and to verify correction of deficiencies discovered in previous development and operational test phases The program office officials believe that most of the deficiencies identified by earlier testing would be corrected before the full production decision.

Operational Testing

The Navy's independent Operational Test and Evaluation Force plans three operational test periods prior to milestone III. The initial test was conducted from August 18 through September 18, 1986 The details of program test plans and test results are classified. A preliminary report was issued in October 1986 and the final report in February 1987

During October and November 1987, the Operational Test and Evaluation Force plans to assess the potential operational effectiveness and suitability of two fully integrated SH-60F production helicopters During November and December 1987, the Force plans to conduct the final operational test before commitment to full-rate production. According to the program schedule, a preliminary report will be available prior to the milestone III decision, but the final report will not be available until later.

Other Issues

System Alternatives

Between 1982 and 1985, and before awarding a contract to Sikorsky, the Navy considered a number of alternatives, such as extending the life of the SH-3H helicopter, procuring foreign weapons systems, and converting the LAMPS I helicopters. Currently, the Navy is considering a modified V-22 Osprey for anti-submarine warfare missions The impact of the V-22 Osprey on performing the inner zone anti-submarine warfare mission is not known at this time. The Navy has included the Advanced Light Weight Sonar System as a Pre-planned Product Improvement to the carrier vehicle inner zone helicopter. The new lower frequency sonar will have a range two to four times that of the AQS-13F sonar, thereby increasing the capability of the helicopter to protect the carrier. Research and development funding for the Advanced Light Weight Sonar System has been postponed until fiscal year 1990. The System will have potential application to SH-60B (LAMPS MK III) helicopters and to the V-22 variant According to Navy documentation, the Advanced Light Weight Sonar must be compatible with these platforms.

Funding Adequacy

The current program funding is adequate.

Compliance With Review Procedures

The program has followed DOD's major system acquisition review procedures.

Relevant Products

In August 1986, GAO issued a report entitled, DOD Acquisition: Case Study of the Navy CV Inner Zone Anti-Submarine Helicopter Program (GAO/NSIAD-86-45S-5)

Trident II (D-5) System

The Navy's Trident II strategic weapon system consists of nuclear submarines, missiles and associated weapon equipment, and shore support facilities. An increased number of missiles per submarine and an increased payload allows the deterrent mission to be achieved with fewer submarines

The Trident II strategic weapon (D-5) system program is to develop an improved sea-launched ballistic missile with greater accuracy and payload capability at equivalent ranges as compared to the current Trident I (C-4) system The D-5 system would greatly increase the sea-based leg of the U.S strategic nuclear triad by (1) providing a survivable system capable of engaging the full spectrum of potential targets and (2) replacing existing missiles with more powerful and accurate missiles

Because DOD has not established the number of submarines and missiles to be acquired and has no collective system cost estimate, the eventual cost of the Trident II system is uncertain Navy officials stated that congressional funding has been adequate and that the Navy has complied with prescribed milestone review procedures.

Description

The D-5 system will be installed on the Ohio class (Trident) nuclear submarine beginning with the ninth ship. The first eight ships of this class will have the D-5 system installed when they are overhauled after about 10 years of service The present program shows plans to acquire 845 missiles (30 test units included) to support deployment of 19 Ohio class submarines.

The D-5 system is completing full-scale engineering development while undergoing initial test and evaluation on a concurrent basis According to the Navy, the time constraint necessitates substantial planned concurrency among development, testing, and production phases through the development program. Planned concurrency is a management decision to combine certain sequential events to reduce the acquisition period for a weapon system The Navy has made efforts to minimize the impact of concurrency and believes any risks resulting from concurrency are acceptable and program objectives and milestones are achievable.

Cost

The cost information for the Trident II system is contained in two Selected Acquisition Reports. However, they do not contain all relevant costs, such as the costs for Department of Energy supplied warheads, research, development, test, and evaluation, and at least $2 billion to install the D-5 system in the first eight submarines.

The eventual cost of the Trident II system is uncertain because DOD has not established the number of submarines and missiles (force level objective) to be acquired

Based on a force level of 19 submarines and 845 missiles (including 30 test units), the Trident II (D-5) missile Selected Acquisition Report of December 31, 1986, shows the projected cost, in then-year dollars of $35,518.5 million This estimate includes funds from the Navy appropriations as shown in table III 2.

Table III.2: Trident II (D-5) Estimated Costs for 845 Missiles

Dollars in millions

Appropriations	FY 1983 base-year	Then-year
Research, development, test, and evaluation	$8,434 9	$9,453 2
Weapons procurement	17,588 5	25,396 9
Military construction	532 9	668 4
Total	**$26,556.3**	**$35,518.5**
Missile quantities		
Research, development, test, and evaluation		30
Weapons procurement		815
Total		**845**

The December 31, 1986, Selected Acquisition Report for the submarine (D-5 capable) shows projected costs of 11 submarines. Procurement funds are drawn from the shipbuilding and conversion, Navy account, as shown in table III 3

Table III.3: Trident II (D-5) Estimated Cost for 11 Submarines

Dollars in millions

Appropriations	FY 1983 base-year	Then-year
Research, development, test, and evaluation	$72 3	$79 5
Shipbuilding and conversion	13,770 1	16,308 3
Military construction	416 5	490 2
Total	**$14,258.9**	**$16,878.0**

The submarine Selected Acquisition Report includes $1,619 3 million for nuclear propulsion costs. However, each Report states that research and development costs incurred by the Department of Energy cannot be quantified. Further, the costs of Department of Energy supplied warheads are not included Additionally, each report excludes costs that are not unique to the respective programs or are not considered acquisition related

Schedule

Milestone II (full-scale engineering development) was approved by DOD in October 1983 and included approval for initial production to meet a December 1989 initial operational capability

The milestone IIIA (initial production) review was held on March 18, 1987 The first development flight test was successfully launched as scheduled from a flat pad at Cape Canaveral on January 15, 1987, the second was successfully launched on March 17 Incremental funding for production was provided in fiscal years 1986 and 1987 appropriations Milestone IIIB review is scheduled for October 1987

The Strategic System Program Office is confident that the December 1989 initial operational capability date will be accomplished However, there may be less than a full load of missiles due to fiscal year 1985 deferral of 24 missiles from initial production to the end of the program The deferral resulted from DOD and Navy fund adjustments to comply with Gramm Rudmann Hollings and other department and budget adjustments.

Performance

Operational testing of the D-5 system is planned near the initial operational capability date. Testing will be conducted by the fleet and unified commanders under the management of the Strategic System Program Office The Navy's Operational Test and Evaluation Force (independent tester) will participate by (1) providing comment to the Chief of Naval Operations on the draft integrated test plan, (2) reviewing reports of tests conducted and providing the Chief of Naval Operations an independent assessment, (3) observing demonstration and shakedown operations and test firings, and (4) providing assessments of development test results and progress

The test and evaluation master plan was revised to state that realization of accuracy objectives is a key area of technological and engineering risk. However, system accuracy cannot be fully measured until completion of the performance evaluation program in 1989. The missile development flight test program of 30 tests began on January 15, 1987, with a successful launch from a flat pad at Cape Canaveral into calibrated impact areas.[1] Specific performance data of interactive subsystems is being analyzed for conformance with desired results for both tests Eighteen additional pad-launched development missiles will be tested

[1] A second development flight was made on March 17

prior to the start of testing 10 submarine-launched performance evaluation missiles.

The performance evaluation missiles will also be flown to test production-type equipment. The missiles will be flown from SSBN 734 (the first with Trident II capability) beginning in March 1989 to demonstrate underwater launch capability and to evaluate weapon system performance. The development testing program will not be completed until August 1989. The first demonstration and shakedown operational missile test flight is also scheduled for August 1989 The Strategic System Program Office continues to estimate the initial operational capability in December 1989.

Other Issues

System Alternatives

The Congressional Budget Office reported[2] in July 1986 alternatives to the D-5 system: (1) cancel plan to backfit Trident submarines with D-5 system, (2) reduce and delay procurement of D-5s, and (3) cancel the D-5 program The Congressional Budget Office did not support any course of action with a recommendation

Funding Adequacy

The Strategic System Program Office stated that congressional funding has been adequate However, departmental cuts in fiscal year 1985 caused a deferral of 24 D-5 missiles to the end of production.

Compliance With Review Procedures

The Strategic System Program Office has complied with prescribed milestone review procedures

Relevant Products

Trident II System: Status and Reporting (GAO/NSIAD-84-86, May 15, 1984). In this report, GAO recommended that the DOD establish the number of missiles and submarines to be acquired so that the eventual cost could be more clearly forecasted

[2] Trident II Missiles Capability, Costs, and Alternatives, A Special Study, July 1986

Fiscal Year 1989 Submarine Combat System

The Navy's Fiscal Year 1989 Submarine Combat System (FY89CS) is to provide advanced sonar and combat control capabilities for the new SSN-21 Seawolf class attack submarines. The system evolved from the Submarine Advanced Combat System[3] (SUBACS), initiated in 1980 as a single phase program for installation into the SSN-688 class submarines authorized in fiscal year 1989. In October 1983 the program schedule was accelerated by 6 years and subdivided into three phases—SUBACS Basic, SUBACS A, and SUBACS B. Because of technical problems, the SUBACS Basic program was restructured twice, in 1984 and again in 1985, and is currently known as the AN/BSY-1 Combat System. The SUBACS A and SUBACS B programs were combined and renamed the FY89CS.

We believe that the Navy's ability to deliver full-up[4] systems to the shipyard and on schedule is a high risk because of the large quantity and cost for new software required and the potential for program slippage The adequacy of program funding will not be known until the contractors submit their system design and cost proposals for full-scale development in July 1987

Description

The FY89CS is a computer-aided detection, classification, and tracking system with two major subsystems—acoustics (sensors) and combat control (fire control and weapons launch) Using a wide aperture array[5] and enhanced information management, the FY89CS is expected to provide improved response times, operability, and firepower capabilities needed for the new SSN-21 Seawolf class attack submarine to counter the increased Soviet anti-submarine warfare threat.

The Navy is planning to provide SSN-21 and SSN-688 class submarines (authorized in fiscal year 1989 and beyond) with wide aperture array capability Although the combat system design is not yet finalized, the system is expected to consist of some existing AN/BSY-1 hardware and software, and new FY89CS components Currently, the FY89CS is in the design definition phase of development. The International Business Machine (IBM) Corporation and the Radio Corporation of America

[3] SUBACS detects, classifies, tracks and destroys enemy targets

[4] A system that provides a full range of functions and processors, and meets performance requirements

[5] Wide aperture array is a passive sensor that will be mounted on the hull of SSN-21 and SSN-688 submarines It will provide enhanced capabilities over previous systems by determining the locations of targets faster and by providing more accurate target range and target motion analysis

(RCA) are the contractors for this phase and are also competing for the FY89CS full-scale development contract.

Cost

As of June 1986, the Navy estimated total acquisition costs to be about $7.3 billion—$1.6 billion for research, development, testing, and evaluation and $5.7 billion for procurement At the June 1986 milestone I design definition, the Navy estimated total research, development, test, and evaluation costs to be about $1.6 billion. We believe that this estimate may be understated. The FY89CS program office, in preparation for the milestone I decision, estimated software development costs to be $313 million, based on a total of 4 2 million lines of software In March 1987, the FY89CS deputy program manager informed us that of the 4 2 million lines needed to implement the program, 2 5 million lines would have to be newly developed. The remaining 1.7 million lines will be retained and/or modified from previous combat systems (By comparison, the initial software requirement estimates for the original SUBACS Basic program totaled 3.3 million lines—1 4 million to be newly developed and 1.9 million retained from previous combat systems) The Naval Underwater System Center, the technical direction agent for the FY89CS program, estimated that it would cost about $300 to develop, fully document, and test one line of software

Based on the estimate of 2.5 million new lines, the cost for the new software could be about $750 million. The Center's cost estimates are based on its experiences with previous combat system programs. The Navy and DOD estimate that it costs between $100 and $150 to write only one new line of software Because of the differences in cost estimates between the Center and DOD, we contacted an IBM official on March 26, 1987, to determine if the corporation could estimate the cost to develop, fully document, and test one new line of software The official could not provide an estimate because such costs vary according to system requirements and other factors such as the number of computers and processors. However, the exact amount of new or modified software required to implement the FY89CS program will not be known until the contractors submit system proposals for full-scale development in July 1987.

In fiscal year 1987, the Navy requested $113 5 million for the FY89CS program, and $5 1 million for the wide aperture array advanced development model Appropriations amounted to $81.8 million for the combat system, or $31 7 million less than requested The Navy received $3 8 million for the wide aperture array program, or $1 3 million less than requested. The $1.3 million was not restored to the program, resulting in a reduction in the program testing The program manager said that in December 1986, the Chief of Naval Operations directed the Navy to restore $31 7 million for the FY89CS to the maximum extent possible We were recently advised that the program office reduced the $31 7 million by $3.2 million by borrowing hardware from other combat system programs Currently, the program office has received $16 5 million with another $3 3 million expected within weeks. The program office expects the remaining $8.7 million in June 1987 We have not yet verified this new information or determined from which other programs the funds will be obtained.

The fiscal year 1987 budget request estimated total procurement costs at about $5.7 billion. This estimate includes the costs of 28 combat systems, all spares, trainers, and shore sites (It also includes eight wide aperture arrays to be installed on SSN-688 class submarines authorized in fiscal year 1989 and beyond.)

Although DOD has reviewed and validated these estimates, we will not know how accurate they are until the Navy evaluates the contractors' system proposals

Schedule

RCA and IBM were awarded contracts in January and March 1986, respectively, for the system design definition phase. The Navy originally planned to issue a request for system proposals by the end of January 1987; however, it was not issued until February 18, 1987 The proposal is for development hardware, one weapons launch trainer, and one basic operator trainer. Options are also included for three combat systems, one maintenance trainer, one land-based engineering system, and six wide aperture arrays for SSN-688 class submarines authorized in fiscal years 1989 through 1991 Proposals are due to the Navy in July 1987 The Navy, in January 1988, plans to award a fixed price, full-scale development and limited production contract to either IBM or RCA The contractor selected (leader) will perform most of the full-scale development and limited production effort The contractor not selected (follower) will perform at least 15 percent of the work. System integration testing of FY89CS acoustics and combat control hardware and software is scheduled to begin in October 1991 and end in November 1993. The first combat system is scheduled for delivery to a shipyard in November 1993. The first SSN-21 is scheduled for delivery in November 1994 The Navy plans to have two companies again compete for the fiscal year 1992 procurement of the FY89CS program