United States General Accounting Office 132717

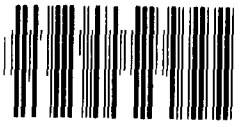
GAO

Report to the Chairman, Committee on Armed Services, House of Representatives

March 1987

MISSILE PROCUREMENT

AMRAAM Cost Growth and Schedule Delays



GAO/NSIAD-87-78

GAO

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

National Security and
International Affairs Division

B-221734

March 10, 1987

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

Dear Mr. Chairman:

This report discusses the Advanced Medium Range Air-to-Air Missile (AMRAAM) research, development, and production program from a historical viewpoint and focuses on the missile's requirements determination, contracting strategy, testing, and program management.

Unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days after its issue date. At that time, we will send copies to the Chairman, Senate Committee on Armed Services and House and Senate Committees on Appropriations; the Director, Office of Management and Budget; the Secretary of Defense; the Secretary of the Air Force; and other interested parties.

Sincerely yours,

Frank C. Conahan
Assistant Comptroller General

Executive Summary

Purpose

The Advanced Medium Range Air-to-Air Missile (AMRAAM) development and production program has experienced significant cost growth and schedule delays. The missile's estimated acquisition cost, which includes research, development, and production costs for both the Air Force and the Navy, has more than doubled in 1984 constant dollars, from about $3.4 billion for approximately 20,000 missiles to $8.2 billion for 24,335 missiles. The current full-scale development phase schedule has been extended from 54 months to 79 months. The scheduled initial operational capability date has advanced from 1986 to 1989.

The Chairman, House Committee on Armed Services, requested GAO to develop a historical case study of the AMRAAM program that would focus on why the cost overruns and schedule delays occurred Specifically, GAO was asked to look at the AMRAAM program's

- requirements determination,
- contracting strategy,
- testing, and
- program management.

Background

The AMRAAM is being developed jointly by the Air Force and the Navy to meet their air-to-air missile requirements for the 1985-2005 time frame. The missile is to provide launch and leave capability and be compatible with the armed services' latest fighter aircraft, as well as with a number of aircraft produced by allied nations.

The AMRAAM program includes the missile, rail launchers, aircraft interfaces, support equipment, and aircraft modifications for AMRAAM testing. The program is in full-scale development under contract to Hughes Aircraft Company. The Raytheon Corporation is being qualified as a second source producer for future competition.

Results in Brief

The AMRAAM program's missed milestones and cost increases can be related to understated estimates of risks, schedule, and costs by both the Air Force and the contractors. There are a number of factors that may have contributed to the understated cost estimates or added to the time and cost of developing the missile, including (1) competition for program funding and pressure to "sell" or justify the program over other new or existing programs, (2) contractor competition for the missile design and development contracts, and (3) frequent program manager turnover.

These factors typify major system acquisition problems identified by the President's Blue Ribbon Commission on Defense Management.

Principal Findings

Time and Cost Estimates Over y Optimistic

Optimistic time and cost estimates were the primary causes for the AMRAAM's increase in cost from $3.4 billion to $8.2 billion in 1984 constant dollars.

AMRAAM's original development and production time frame was reduced by 20 months to meet a desired 1986 initial operational capability date. Because of this shortened schedule, which was very success oriented and involved a high degree of risk, the missile was not sufficiently developed by the date required to exercise contract options for the first two production lots. The later renegotiated price for these missiles was substantially higher than the option price. Also, attempts to adhere to the shortened schedule resulted in the use of more costly technology, which contributed significantly to the increase in AMRAAM's original cost estimate.

In addition to the optimistic schedule contributing to cost increases, AMRAAM cost estimates were optimistic. For example, in 1982 the cost estimate was increased by $1.6 billion following a review by the Department of Defense Cost Analysis Improvement Group. The review found that estimated cost savings from production efficiencies were too optimistic.

Contracting Strategy and Testing

The requirement for the AMRAAM was based on identified shortcomings of existing missiles, a current and future threat assessment, and the desire for enhanced capability. Not all design and performance requirements have been met. This is due primarily to technological, time, and cost limitations. GAO did not review or validate the performance and design requirements or assess their affordability.

The AMRAAM's contracting strategy was by competitive fixed price rather than cost-reimbursement contract This has resulted in the development contractor having to absorb $255 million in cost overruns. The contractor stated that future fixed price proposals will likely be more conservative and reflect the cost risks of systems development.

Testing scheduled for the validation phase was not completed on time and was subsequently included in the full-scale development phase, for which a total of 90 development and initial operational flight tests are scheduled through 1988. As of January 1, 1987, 24 flight tests have been conducted, of which 21 were considered successful. A low-rate production decision is scheduled for early 1987. GAO is currently reviewing the adequacy and realism of the testing prior to low-rate and full-rate production decisions.

Conclusions

GAO has identified, in previous reports, similar major acquisition problems to those discussed in this report. The Department of Defense has had a number of initiatives to address these problems and is currently implementing recommendations made by the President's Blue Ribbon Commission on Defense Management. These recommendations address systemic weaknesses in the weapon system acquisition process. In addition, the Air Force, under the Federal Managers' Financial Integrity Act, identified cost controls for weapon systems acquisitions as a material weakness and is implementing a number of corrective actions. Since the AMRAAM program's cost and schedule problems, for the most part, reflect these weaknesses, GAO is not making any recommendations.

Agency Comments

In commenting on a draft of GAO's report (see app I), the Department of Defense concurred with GAO's findings, but identified several areas where it felt some clarification or additional explanation was needed. GAO made revisions or additions to its report, as appropriate.

Contents

Abbreviations

AMRAAM	Advanced Medium Range Air-to-Air Missile
APEP	AMRAAM Producibility Enhancement Program
FSD	full-scale development
GAO	General Accounting Office
IOC	initial operational capability
JSOR	Joint Service Operational Requirement
JSPO	Joint Systems Project Office

Introduction

The Advanced Medium Range Air-to-Air Missile (AMRAAM) is being developed jointly by the Air Force and the Navy to meet their air-to-air missile requirements for the 1985-2005 time frame. The missile is to be compatible with the armed services' latest fighter aircraft. As an eventual replacement for the Sparrow medium range air-to-air missile, AMRAAM is intended to improve interceptor combat effectiveness.

The AMRAAM is designed to operate both within and beyond visual range. Performance features designed to provide improvement over the Sparrow missile include higher speed, greater range, increased maneuverability, better resistance to electronic countermeasures, an active terminal seeker in the missile, and an ability to guide to lower altitude targets. The aircraft employing the AMRAAM will have the capability to simultaneously track multiple targets, launch multiple missiles, and leave. The missile is also intended to be more reliable and maintainable.

AMRAAM History

In July 1976, the Congress, in the Department of Defense Appropriation Authorization Act of 1977, approved the development of a new adverse weather medium range air-to-air missile. Following this, the Under Secretary of Defense for Research and Engineering directed that a joint Air Force/Navy program office be established to develop an advanced beyond visual range air-to-air missile. The Air Force was designated the executive service for the AMRAAM development. The Navy had developed and managed the current inventory of air-to-air missiles, e.g., the Sparrow, Sidewinder, and Phoenix.

In October 1976, the Air Force issued a Program Management Directive for the initiation of a joint Air Force/Navy development program for an AMRAAM. In November 1976, a Joint Systems Project Office (JSPO) was established at the Armament Division, Eglin AFB, Florida, to implement the Program Management Directive. Prior to this time, the Armament Division had been primarily a weapons research and testing facility and had not developed or managed a major weapon system program.

The development strategy for the AMRAAM is in accordance with Office of Management and Budget Circular A-109 and the prototyping philosophy directed by the Under Secretary of Defense for Research and Engineering. This strategy consists of three competitive phases, with the number of competing contractors being reduced for each successive phase. Phase I, the concept definition phase, consisted of preliminary development efforts by five competing contractors and was designed to

allow each of the contractors to develop technologies peculiar to his concept. Two of the five contractors were selected to conduct phase II, the validation phase. During the validation phase, the two contractors—Hughes Aircraft Company and Raytheon Corporation—accomplished preliminary system design and the design, fabrication, and some testing of the prototype missiles and launchers. For phase III, the full-scale development (FSD) phase, one contractor, Hughes Aircraft, was chosen to design, develop, fabricate, qualify, and support government tests for the missiles and related equipment. The program approach also called for the award of a second production contract to another contractor, who would be taught by the developer to produce the AMRAAM. Raytheon Corporation was selected as the second source contractor

On December 11, 1981, Hughes Aircraft Company received a fixed price incentive contract for FSD with initial production options. The contract was for $386 million (the target price), with a ceiling price (maximum cost to the government) of $512 million. The ceiling price, according to a JSPO official, provided the contractor with some security against the unknowns involved in the development of the AMRAAM.

The contract was modified the same day as the award (December 11, 1981) to include hardware for the F-14 and F-15 aircraft, which increased the ceiling price to $526.5 million. The current ceiling price is $559.7 million, which includes approximately 73 modifications to the original contract.

The AMRAAM development program experienced cost overruns and schedule delays throughout its early FSD phase. In January 1985, the Secretary of Defense, expressing concern over the program's schedule delays and escalating costs, ordered a complete review of the program to determine if and how program costs could be reduced. This resulted in the establishment of a $330 million AMRAAM Producibility Enhancement Program (APEP) to identify and integrate design and other changes to reduce AMRAAM's production costs. The JSPO estimates the APEP will save about $2 billion in AMRAAM production costs. The review also resulted in the program's FSD phase being extended from 54 to 79 months and initial operational date being advanced from 1986 to 1989.

On November 8, 1985, the Congress enacted the Defense Authorization Act for fiscal year 1986, requiring the Secretary of Defense to certify by March 1, 1986, that the AMRAAM program would meet certain cost and performance requirements. Specifically, the Secretary was to certify that (1) the AMRAAM design is complete, (2) system performance has not

been degraded from the original development specification, (3) the maximum practical number of cost reduction design changes would be incorporated into the flight test program and qualified before production, (4) a fixed price contract not to exceed $556,580,480 was entered into for research, development, test, and evaluation, (5) total production cost for a minimum of 17,000 missiles (the Air Force share) would not exceed $5.2 billion in fiscal year 1984 dollars, and (6) the missiles procured would perform in accordance with the development specification. The act stated the AMRAAM program would be terminated if the Secretary did not make the certification. On February 28, 1986, the Secretary of Defense certified to these items.

The Congress, in the National Defense Authorization Act for fiscal year 1987, established an AMRAAM $7 billion total production cost ceiling (in fiscal year 1984 dollars) for 24,000 missiles. This reflects both the Air Force and the Navy procurements. The current $8.2 billion AMRAAM cost estimate includes $1.2 billion for research and development and $7 billion for procurement.

Objectives, Scope, and Methodology

The Chairman, House Committee on Armed Services requested us to develop a historical case study of the AMRAAM program that would focus on why the cost overruns and schedule delays occurred. Specifically, we were asked to look at the AMRAAM program's requirements determination, contracting strategy, testing, and program management.

In performing this review, we met with and obtained data from Air Force officials in Washington, D.C., and the AMRAAM JSPO at Eglin Air Force Base, Florida. We also visited and interviewed former senior key officials (Air Force, Navy, and civilian) associated with the program from its inception, including former JSPO Program Managers and Commanders of the Air Force Systems Command. We also visited and obtained data from the AMRAAM development contractor—Hughes Aircraft Company at Canoga Park, California, and visited the major competing contractor—Raytheon Corporation at Bedford, Massachusetts. We conducted our work from September 1985 through January 1987

Our review was conducted in accordance with generally accepted government auditing standards.

Why Schedule Delays and Cost Overruns Occurred

The AMRAAM program has been affected by schedule slippage and cost increases since approval by the Congress in July 1976. The AMRAAM's initial operating capability (IOC) date has been advanced from 1986 to 1989. Its original research, development, and production cost estimate for both the Air Force and the Navy of $3.4 billion, in 1984 dollars, has more than doubled to about $8.2 billion.

The missed milestones and increase in program costs can be attributed to understated estimates of risks, schedule, and costs by both the Air Force and the contractors. We also identified a number of factors that may have contributed to the understated cost estimates or added to the time and cost of developing the missile, including (1) competition for program funding and pressure to "sell" or justify the program over other new or existing programs, (2) contractor competition for the missile design and development contracts, and (3) frequent program manager turnover. These factors typify major system acquisition problems identified by the President's Blue Ribbon Commission on Defense Management.

Unrealistic Schedule Added to Cost

In 1978, even though AMRAAM's development progress had already been slowed by a 1-year delay in funding, the Air Force reduced AMRAAM's planned development and first production time from 90 to 70 months in order to meet a 1986 IOC date. This shortened schedule was very success oriented and involved a high degree of risk. The IOC date proved unrealistic and after a number of missed milestones, it was eventually extended by 3 years. Attempts to adhere to the shortened schedule resulted in the use of more costly technology which, along with other factors, nearly doubled the originally planned AMRAAM unit cost.

Development Schedule Reduced

In early 1978, the Commander, Air Force Systems Command, expressed a desire to reduce the AMRAAM development schedule to the minimum possible time. The Commander wanted the schedule reduced from approximately 90 to 70 months because of (1) the desire of the Tactical Air Command to tie the AMRAAM IOC date to the deployment of F-16 aircraft to Europe and (2) concerns expressed by congressional members and senior Department of Defense officials over the length of research and development efforts. The former Commander stated that he believed the shortened time frame was realistic based on his experience in developing ballistic missiles.

The House Committee on Armed Services was briefed in late February 1978 on a reduced development schedule. The Commander, Air Force Systems Command, directed an in-house study to investigate possible ways to obtain a shortened system acquisition schedule. This study was completed in March 1978. The study compared the AMRAAM's originally planned 90-month program for validation/FSD to a 70-month program, a 54-month program, and a 42-month program.

The study concluded that the planned 90-month AMRAAM development could be accelerated if additional cost, schedule, and performance risk were accepted and if the system acquisition process could be streamlined. The study noted that many shortcuts would have to be taken and that considerable concurrency would be required. The report noted that a 70-month program, compared to a 90-month program, presented a higher risk that production problems normally discovered in the limited production phase would not be uncovered until full production had been initiated. The study concluded that this risk might be acceptable if the operational need was strong. The shortened schedule was estimated to have a 60 to 70 percent chance of being met on time and within cost. The study also warned that the program approaches presented were very preliminary.

The 70-month schedule was considered highly concurrent[1] and totally success oriented. The JSPO felt strongly that this alternative was the shortest schedule possible. Former officials associated with the AMRAAM program informed us that the JSPO and other senior Air Force officials felt the schedule was optimistic but could be met. We were informed that all five contractors participating in the concept definition phase had agreed that the AMRAAM program could meet this schedule.

In March 1978, the Air Force issued a Program Management Directive for the initiation of the AMRAAM validation phase in February 1979 and the expansion of contractor efforts in the validation phase to make possible a shortened FSD phase, with a tentative first production goal of 1985.

In August 1978, the Commander, Air Force Systems Command, approved an AMRAAM program schedule that had a 33-month validation phase, followed by a 40-month FSD phase. The missile's 6-month initial

[1]For example, development test and evaluation and initial operational test and evaluation would be combined during the FSD phase. Full system follow-on test and evaluation would be accomplished with production missiles, which would also be available for inventory.

operational test and evaluation was scheduled during the 40-month FSD phase. Development test and evaluation and the initial operational test and evaluation would be accomplished with the missiles produced during FSD. This program would provide AMRAAM operational capability sooner, and it was believed that development costs would be reduced by shortening low-rate and going into full-rate production.

Validation Phase Slippage

The Air Force planned to design the missile during the validation phase and make it producible during FSD. This plan was not realized because the contractors fell behind the validation phase schedule. As early as July 1979, slightly more than 20 weeks after the validation phase began, one contractor was already 5 weeks behind schedule In February 1980, the JSPO reported that the AMRAAM schedule reflected a marginally satisfactory status. Although the technical challenge proved much greater than originally thought, the Air Force decided to end the validation phase on schedule and begin FSD. Accordingly, some design efforts planned for the validation phase had to be rescheduled for FSD, which further strained the FSD schedule.

IOC Date and FSD Phase Slippages

In August 1980 both validation phase contractors began to express concern about the reasonableness of the proposed FSD 40-month schedule, with a September 1985 IOC date. There were written warnings by two JSPO officials that design efforts during the validation phase were not maturing for either contractor as planned and that additional design and development time might be required during FSD. As it turned out, the JSPO was unable to obtain reasonable bids for a 40-month FSD schedule and, after deliberations with the contractors, settled on a 50-month FSD schedule, with an IOC date of August 1986.

Hughes Aircraft's Contractor Cost and Schedule System showed that it was behind schedule almost from the start of FSD, which began in December 1981. The reports for the first 13 months of FSD showed significant deviations from the amount of work scheduled to have been accomplished during this period. For example, an independent schedule assessment by General Research Corporation completed in June 1982, about 6 months after contract award, predicted a 2- to 4 1/2-month delay in the start of guided test flights and a possible 7-month delay in the availability of software tapes needed to complete tests with the F-16.

In November 1983 the House Committee on Armed Services contracted with H. J. Ford Associates, Inc., to conduct a study to assess the system's readiness for production. In March 1984, the study reported that the development program had experienced significant delays caused by the redesign of the terminal seeker and guidance system. The study concluded that the schedule was already 6 months behind due to Hughes Aircraft's underestimation of both the complexity and magnitude of the design and manufacturing effort and of the special test equipment requirements. The study further concluded that solutions to these design and manufacturing problems required the use of considerable advances in technology, and therefore a timely resolution was difficult to predict and schedule.

Reduced Development Schedule Resulted in Too Little Time for Testing

In an August 1981 report on AMRAAM,[2] we noted that the AMRAAM JSPO had developed a tight testing schedule. About September 1980 the JSPO had determined that the validation phase test schedule could be shortened without impacting the government's ability to validate the AMRAAM concept. In line with this decision, the number of tests, as well as the quantity of test missiles to be delivered by each contractor, was reduced. However, even this schedule could not be achieved. In a May 1984 report on AMRAAM,[3] we concluded that the validation phase testing had fallen behind schedule because of technical immaturity, hardware delivery delays, poor weather, and other problems. In addition, in that May report, we also noted that the FSD test plan called for an average of 5 firings a month with some months having as many as 10 or 11. This plan was not achieved. The FSD test schedule has since been extended and the number of firings per month reduced. As of January 1, 1987, under the current FSD schedule of 79 months, 24 scheduled flight tests have been conducted. Twenty one of the flight tests were considered fully successful. In attaining these successes, at least seven additional flight tests were cancelled or aborted. With the recent addition of a third test site, the Department of Defense is projecting the current schedule should improve by allowing some acceleration in flight testing.

[2]Report to the Secretary of Defense, AMRAAM Effectiveness of the Advanced Medium Range Air-to-Air Missile Is Uncertain, GAO/C-MASAD-81-17, August 4, 1981

[3]Report to the Secretary of Defense, The Advanced Medium Range Air-to-Air Missile Resolve Uncertainties Before Production, GAO/C-NSIAD-84-18, May 7, 1984

Schedule Compression Resulted in the Use of More Costly Technology

The compression of the combined validation and FSD schedule from 90 months to 70 months prevented the contractors from having more time to mature the large scale integrated technology and thus maximize the use of less costly large scale integrated circuits in AMRAAM's design. As a result, larger and more costly state-of-the-art hybrid circuits were used to a greater extent. The FSD contract stated that "custom designed integrated and hybrid circuits shall be avoided unless no reasonable alternative exists." Both Air Force and Hughes engineers stated that more large scale integrated circuits could have been incorporated into the AMRAAM's design had the program's schedule not been compressed. According to JSPO officials, the decision to go with hybrid technology was made because the compressed schedule led to an unacceptable degree of risk if large scale integrated circuitry were used. The use of hybrid circuits contributed to a slight increase in the missile's size and weight, and a reduction in speed and range. This reduction resulted in the missile's F-Pole performance requirement—a measure of the relative engagement range between the launch aircraft and the target—being reduced. According to Air Force officials, this performance requirement change occurred prior to the Secretary of Defense's certification to the Congress on February 28, 1986, and therefore did not violate the certification that the missile's performance would not be degraded.

The Hughes missile design had intended to use a solid state transmitter. However, because of certain technological problems and time constraints, the solid state transmitter was replaced by a traveling wave tube. Developing a solid state transmitter was described as a workable packaging challenge that could not be met because of the compressed schedule. Even with the use of the traveling wave tube, the compressed schedule left little time to convert from the solid state transmitter to the tube.

Contract Options Not Exercised

The Air Force, in contracting for the FSD phase in December 1981, included provisions for prepriced options for two initial production lots. During the bidding for the FSD contract, both contractors insisted on establishing firm dates by which the Air Force had to exercise the production options.

Because AMRAAM's development was behind schedule during the FSD phase, the contractor's development efforts had not matured sufficiently for the Air Force to exercise the FSD contract options for initial production. The contract called for exercising the first option for 204 missiles by November 1, 1984, at a price of $273 million and the second

for 720 missiles on November 1, 1985, at $486 million, a total of 924 missiles for $759 million. The options were not exercised because the Air Force did not have confidence that the missile was sufficiently developed for production. The price for the first two production lots, with quantities of 260 and 833 missiles, respectively, is now estimated to be approximately $1.5 billion.

Understated Air Force Cost Estimate

AMRAAM's research, development, and production estimate has more than doubled, rising from $3.4 billion to $8.2 billion (in constant 1984 dollars) since its original planning estimate. The $8.2 billion anticipates a planned net savings of $2 billion in APEP changes The increase was due primarily to overly optimistic estimates of the complexity and cost of the missile. For example, in 1982 an independent cost analysis by Department of Defense's Cost Analysis Improvement Group estimated that savings from production learning rates and competition would be about $1.6 billion (in constant 1984 dollars) less than the Air Force had estimated. Based on the independent estimate, the Office of the Secretary of Defense directed the Air Force to increase its estimate and budget for AMRAAM by $1.6 billion.

Another cause for the increase in the cost estimate was the difference between planning and development estimates of the number of missiles to be procured. The planning estimate was based on the production of 20,000 missiles, while the development estimate was based on the production of 24,335 missiles.

In January 1985, following concerns over AMRAAM's schedule problems and cost increases, the program was restructured. The IOC date was advanced from February 1986 to June 1989, and the APEP was started in February 1985 to find ways to reduce AMRAAM's production costs. Under APEP, Hughes and Raytheon have submitted proposals to the JSPO to modify certain missile components and subcomponents to make the missile less costly to produce. The Air Force plans to spend about $330 million developing and incorporating these changes, which the Air Force estimates will save about $2 billion in AMRAAM production costs. A major portion of the cost savings that will be realized in the APEP will come from the replacement of hybrids with large scale integrated circuits

Competition for AMRAAM Funding and Contracts May Have Impacted Cost, Schedule, and Performance Estimates

The President's Blue Ribbon Commission on Defense Management, in April 1986, reported that the need to "sell" a new program does not encourage realistic estimates of cost and schedule. The need to justify the development of an AMRAAM to replace the Sparrow may have contributed to optimistic cost and schedule estimates. For example, in September 1976 the Air Force and Navy developed a joint service requirement for an advanced medium range air-to-air missile to replace the Sparrow. The missile was to provide improved and added capabilities, including an active seeker to provide launch and leave capability similar to that of the larger Phoenix long range air-to-air missile. While a missile designed to meet all the joint requirements was clearly desirable, the affordability of developing and producing such a missile was questioned. A congressional staff member testified during hearings on the defense budget that an improved Sparrow missile could be provided at a lower cost than the AMRAAM. However, Air Force officials stated that competing the AMRAAM, together with lower costs for electronic components, would make the AMRAAM less costly than the Sparrow. This estimate, as discussed earlier, was based on very optimistic and success oriented assumptions and was later increased significantly based on an independent cost analysis.

The Blue Ribbon Commission also reported that award of initial development contracts often goes to the contractor whose proposal is the most optimistic. The Commission report further stated that, in underbidding, the contractor assumes there will be an opportunity later to recover understated costs. Hughes has had to absorb about $255 million in AMRAAM development cost above the ceiling price. Hughes officials stated that the competitive environment had resulted in the company's basing its bid on optimistic cost and schedule assumptions.

Program Management Turnover May Have Impacted Cost and Schedule

The AMRAAM program manager turnover was not conducive to the most effective AMRAAM development and acquisition effort, although it is not possible to specifically identify the contribution this condition may have made to underestimating AMRAAM's cost and schedule.

The AMRAAM program has had six managers. From 1980 to 1984, five program managers were in charge of the program for various lengths of time. (One of these was the AMRAAM Deputy Program Manager, a Navy officer, who was appointed program manager for about 6 weeks while the Air Force selected an Air Force officer for the position.)

The high manager turnover resulted in, at least, a lack of continuity in the management of the JSPO, i.e., a loss of corporate knowledge and historical perspective. Former JSPO officials informed us that because of this loss, cost and schedule problems may have gone unsolved longer than was necessary. For example, one former AMRAAM program manager stated that, in his initial briefings, he was given a positive picture of the AMRAAM's development status—an impression which he conveyed further up the chain of command. It was not until after a number of months in the JSPO that he learned of conditions that led to a major schedule slippage. A former JSPO official informed us that this was due to the difficulty of obtaining current and accurate information from the contractor.

Due to similar experiences with program manager turnover in other weapons systems programs, the Congress provided, in Public Law 98-525, dated October 19, 1984, the Department of Defense Authorization Act for fiscal year 1985, that "The tour of duty of an officer of the Armed Forces [as a program manager]...shall be (1) not less than four years, or (2) until completion of a major program milestone...."

Table 2.1 shows tours of duty for AMRAAM's program managers.

Table 2.1: AMRAAM JSPO Program Managers' Tours of Duty

Program Manager	Time frame
1st	Inception - 4/30/80
2nd	5/1/80 - 6/14/80
3rd	6/15/80 - 5/5/82
4th	5/6/82 - 4/21/83
5th	4/22/83 - 7/1/84
6th	7/2/84 - Present

There were a number of explanations for the large number of managers. Two retired when they became eligible, one was reassigned, another held that position until a new candidate was selected by the Air Force, and one was promoted to another position.

Conclusions

The cost and schedule problems associated with the AMRAAM program are typical of major systems acquisition problems identified by the President's Blue Ribbon Commission on Defense Management. These include

- unrealistic cost and schedule estimates resulting, in part, from the need to "sell" the program and
- initial contractor underestimation of cost.

These and other factors, such as the pressure to justify and support the development of a new air-to-air missile to replace the Navy-developed Sparrow and competition between contractors to win the AMRAAM development contract, contributed to the overly optimistic estimates of cost and time to develop and produce the AMRAAM. In addition, the high turnover of AMRAAM program managers was not conducive to effectively managing the program.

AMRAAM Requirements Determination, Contract Strategy, and Testing

The requirement for the AMRAAM was based on identified shortcomings of existing missiles, a current and future threat assessment, and the desire for enhanced capability. We did not review or attempt to validate the detailed performance and design requirements or address the affordability of each of the requirements. However, not all design requirements have been met, and in one case a performance requirement was reduced prior to the Secretary's certification. This is due to a combination of technological, time, and cost limitations. The AMRAAM's contracting strategy was by competitive fixed price rather than cost-reimbursement contract, in order to help control the program's costs. Numerous tests have been performed or are planned for the AMRAAM development program. We are currently reviewing the adequacy and realism of the testing prior to low-rate and full-rate production decisions.

AMRAAM Performance Requirements Determination

The need for an AMRAAM was identified in a 1976 joint Air Force and Navy tactical study of air-to-air weapons requirements for 1985 and beyond. The study group, composed primarily of combat-experienced Air Force, Navy, and Marine Corps air crew members, determined that existing air-to-air missile systems had a number of deficiencies, incompatibilities, and dependencies, which limited aircraft mission capability. Some of the shortcomings identified for existing missile systems were

- incompatibility with certain aircraft,
- speed limitations,
- lack of launch and leave capability and heavy dependence on launch aircraft's radar,
- reduction of aircraft missile carrying capability by high missile weights,
- high life-cycle costs, and
- lack of multiple target engagement capability.

The shortcomings identified by the study group formed the basis for the Joint Service Operational Requirement (JSOR). The JSOR, which was approved on September 15, 1976, called for a missile with state-of-the-art capabilities to be used as a Sparrow follow-on. The JSOR defined the operational need in terms of the threat, problem, need, concept, and capability. The JSOR, within these categories, defined a total of 33 requirements that the missile had to satisfy. These requirements included higher speed, greater range, increased maneuverability, all-aspect look-down shoot-down capability, better resistance to electronic countermeasures, and an active seeker Air Force, AMRAAM JSPO, and contractor officials all concurred that the JSOR provided a sound basis for

designing and developing the missile. According to the JSPO, the requirements were detailed, realistic, and technologically feasible. The JSOR formed the basis for developing and making trade-offs in the missile design and performance specifications.

The JSOR was reaffirmed by the Air Force in 1985. At that time the Secretary of Defense directed the Assistant Secretary of the Air Force for Research, Development and Logistics to conduct a comprehensive review of the AMRAAM program and alternatives to meeting the requirements. The review reaffirmed the AMRAAM requirement. The review also found, after looking at approximately 20 program alternatives, including variants of an improved performance version of the Air Force's current radar missile, the AIM-7 Sparrow, that the "alternatives, by themselves, were judged to be unacceptable either because they did not meet the threat-driven requirements or because they were projected to take longer to develop and to cost more than AMRAAM."

The JSOR was used as the basis for the original development specifications. The original development specifications did not contain specific, measurable performance requirements for the system. The 1981 AMRAAM FSD contract and the June 1985 AMRAAM Decision Coordinating Paper provided more detailed and specific performance requirements.

One engineering change proposal revised the dimensional limits of the AMRAAM missile by increasing the weight, length, and diameter. These changes caused an increase in missile drag, and according to the contractor, resulted in minor reductions in speed and range performance requirements. According to the contractor and the JSPO, the time and high cost of meeting the dimensional specifications would have been excessive, thereby necessitating a change in performance requirements. DOD stated that these changes were acceptable to the Tactical Air Command. The Department of Defense, in commenting on a draft of this report, noted that the AMRAAM is proving itself capable of meeting all of the JSOR except for F-Pole and launch to eject time. This performance requirement change was made prior to the Secretary's certification.

Contracting Strategy

Contracting for the AMRAAM, for both the validation and FSD phases, unlike contracting for earlier missile development, has used competitive fixed price rather than cost-reimbursement type contracts. A fixed price contract establishes a firm price to complete the required work, while a cost-reimbursement contract is based on payment by the government to a contractor of allowable costs plus an identified profit, as prescribed by

the contract. AMRAAM officials stated that the purpose of using a fixed price contract was to hold down the government's costs and reduce the risk to the Air Force of large cost overruns. Air Force officials believe the AMRAAM fixed price contracts have been successful in limiting cost growth to the government. In the validation phase, both contractors experienced cost overruns, and Hughes experienced large FSD cost overruns that have resulted in use of their own funds to develop the AMRAAM. As of March 1986, Hughes estimates that it has absorbed $255 million above the ceiling price in developing the AMRAAM Hughes officials believe that a cost-reimbursable contract is more appropriate for system development because it provides a cost margin for unknowns that may be due to the complexity of the system being developed, provides for better communication between the developer and the government, and provides the Department of Defense with more control over the contractor's FSD efforts. They also indicated that, based on their fixed price experience under the AMRAAM contract, the cost of accepting such risks would increase the amount of offers on future systems development contracts.

Testing

To validate AMRAAM's performance, numerous tests, such as captive carry, simulation, integration, reliability, environmental, and live air launched flights, have been performed or are planned during the validation and FSD phases. Air Force officials stated that the planned AMRAAM testing program is much more thorough and extensive than testing programs for other Air Force air launched missile systems.

The FSD contractor is required to produce 122 missiles for use in development testing and evaluation and initial operational testing and evaluation purposes during this phase. As of November 1, 1986, 54 FSD missiles had been delivered to various test facilities. Nine of these have been returned to the contractor because of some malfunction.

To demonstrate missile performance, 90 development test flights and 8 missile separation control vehicle tests are planned through 1988. As of January 1, 1987, 24 flight tests had been conducted. Twenty one of the flight tests were considered fully successful. In attaining these successes, at least seven additional flight tests early in the FSD test phase were cancelled or aborted due to missile malfunction According to AMRAAM JSPO officials, even the aborted flights were considered a form of success because they demonstrated AMRAAM's abort feature, which prevents a launch when there is an internal malfunction. In prior years the

cause of the malfunction would have been unknown because the missile would have been launched and destroyed upon impact with the ground.

The development and initial operational test flights are scheduled to be completed in late 1988. However, the Air Force believes that by early 1987 it will have sufficient data concerning AMRAAM capabilities to make the scheduled low-rate production decision.

Conclusions

The requirement for AMRAAM was based on Air Force and Navy identified shortcomings of existing missiles, a current and future threat assessment, and the desire for enhanced capability. According to JSPO, AMRAAM's requirements were detailed, realistic, and technologically feasible. However, not all design and performance requirements have been met. This is due primarily to technological, time, and cost limitations.

The AMRAAM's contracting strategy was by competitive fixed price rather than cost-reimbursement contract in order to help control the program's costs. As a result, the contractor had to absorb large cost overruns. In the future, the contractor stated that it will likely provide more conservative fixed price cost proposals that will cover the cost risks associated with a system development.

Numerous tests were planned for the AMRAAM in all phases of the development program. Concern has been voiced that testing was too extensive and contributed to cost overruns and schedule delays. As of January 1, 1987, 24 of a scheduled 90 test flights have been conducted. We are currently reviewing the adequacy and realism of the testing prior to low-rate and full-rate production decisions.

Comments From the Under Secretary of Defense (Acquisition)

ACQUISITION

OFFICE OF THE UNDER SECRETARY OF DEFENSE

WASHINGTON, DC 20301

22 JAN 1987

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

Dear Mr. Conahan:

This is the Department of Defense (DoD) response to General Accounting Office (GAO) draft report, "MISSILE PROCUREMENT: AMRAAM Cost Growth and Schedule Delays," dated December 2, 1986 (GAO Code 392171/OSD Case 7174).

The DoD generally agrees with the findings in the GAO draft report. Enclosed, however, are detailed comments that clarify the interpretation of some of the facts contained in the report. The comments also address several matters highlighted in the report.

With regard to the AMRAAM development and testing schedule, the DoD is concerned that the impression might be given that the program may slip further. The recent addition of a third test site will, in fact, improve the schedule by allowing some acceleration in flight testing.

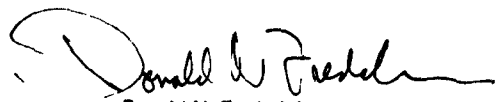
The GAO reported that the development schedule, which was reduced in 1978 from 90 to 70 months, prevented the contractors from maximizing the use of less costly large scale integrated circuits in the AMRAAM design. While these facts are accurate, the use of hybrid circuits had only a slight effect on missile weight and speed. It should be recognized that the missile still meets or exceeds the criteria certified to the Congress by the Secretary of Defense.

The DoD generally agrees that the AMRAAM production cost has increased, but not in the amount reported by the GAO. The GAO estimated the total production cost to be $7.4 billion in FY 1986 dollars. The Secretary of Defense certified to Congress that 24,000 missiles would be purchased for less than $7.0 billion in FY 1984 dollars. The OSD inflation indices place this value at $8.043 billion in FY 1986 dollars.

The GAO concluded that not all AMRAAM design and performance requirements have been met, which is due primarily to technological, time and cost limitations. While the DoD agrees, care must be taken not to confuse development specifications with Joint Service Operational Requirements (JSOR). The AMRAAM is proving itself capable of meeting all of the JSOR requirements except for F-pole and launch-to-eject time.

The GAO indicated concern that at least seven flight tests were cancelled or aborted due to missile malfunction. This is true; however, it should be recognized that most of these aborts occurred early in the flight test phase. Flight tests over the past year have not encountered any aborts due to the missile. In addition, AMRAAM has the best flight test results to date of any comparable missile development program.

Sincerely,



Donald N. Fredericksen
Deputy Under Secretary
of Defense
(Tactical Warfare Programs)

Enclosure

DEPARTMENT OF DEFENSE COMMENTS ON
GAO DRAFT REPORT - DATED DECEMBER 2, 1986
(GAO CODE 392171), OSD CASE 7174

MISSILE PROCUREMENT: AMRAAM COST GROWTH AND SCHEDULE DELAYS"

* * * * *

FINDINGS

FINDING A: Unrealistic Schedule For The Advanced Medium Range Air-to-Air Missile (AMRAAM). The GAO reported that in 1978 the Air Force reduced the AMRAAM plannned development and first production time from 90 to 70 months to achieve a 1986 initial operating capability (IOC). The GAO identified two reasons why the schedule was changed: (1) the desire of the Tactical Air Command to tie the AMRAAM IOC to the deployment of the F-16 to Europe, and (2) concerns expressed by Congressional and DoD officials over the length of the AMRAAM research and development. According to the GAO, a 1978 Air Force study observed that the reduced 70-month schedule was very success oriented and involved a high degree of risk and concurrent development. The GAO found that despite the degree of risk and concurrence, in August 1978 a shortened development schedule was approved. The GAO reported that the expected advantages were (1) an advanced AMRAAM operational capability and (2) reduced development costs resulting from shortening low rate production and going into full rate production. The GAO observed, however, that slippages occurred early in both the validation and full scale development phases of the revised schedule, due largely to an under-estimation of the design and technical challenges involved. In addition, the GAO found that the reduced development schedule resulted in a tight testing schedule for AMRAAM, which has not been achieved. The GAO reported that the full scale development schedule has since been extended to 79 months and the number of firings per month reduced, which the project office is projecting may slip further. The GAO concluded that the reduced development schedule approved by the Air Force in 1978 was unrealistic, and reflects an under-estimation of AMRAAM risks and technical challenges by both the Air Force and the contractors. (pp. 2-3, pp. 11-16/GAO Draft Report)

Now on pp. 12-15.

DOD POSITION: Concur. The DOD generally agrees with the GAO finding, but is concerned that it may give the impression that the AMRAAM program may slip further. With the recent addition of the third test site, the schedule will, in fact, slightly improve since this will allow some acceleration in flight testing.

The GAO conclusion that the early reduced development schedule was unrealistic and risky is true; however, at the time this decision was made it was believed by all parties, Government and contractor, that the accelerated program was achievable. The high technical risk of the AMRAAM surfaced after this decision was made. Concurrence in a program has proven itself in other programs as a viable means of ensuring an optimum schedule and smoothing the transition to production.

Enclosure

FINDING B: Cost and Performance Impacts Of The Compressed AMRAAM Schedule. The GAO reported that the reduced AMRAAM development schedule prevented the contractors from maximizing the use of less costly large scale integrated circuits in the AMRAAM design. The GAO found that, instead, larger and more costly hybrid circuits were used to a greater extent than planned According to the GAO, this contributed to an increase in the missile's size and weight, and a reduction in speed and range. In addition, the GAO found that because development was behind schedule, the contractor's development efforts had not matured sufficiently for the Air Force to exercise the full scale development contract options when planned. As a result, the GAO reported the price for the first two production lots is now estimated to be $818 million, or $59 million more than originally estimated. The GAO concluded that the unrealistic compressed AMRAAM schedule increased program costs. (pp. 2-3,p 11, pp 16-17/GAO Draft Report)

Now on pp 16-17

DOD POSITION: Concur The DOD agrees with this finding in that the facts are accurate; however, certain clarifications are necessary. The reduced schedule did not allow the contractor time to mature the large scale integrated circuit technology. Because of this, the more costly yet "state of the art" hybrid circuits had to be used. The use of these hybrids did cause slight changes in the missile weight and resulting speed (0.6 percent increase in weight and approximately a 2 percent decrease in speed), but the missile still meets or exceeds the criteria certified to Congress by the Secretary of Defense.

The estimated production cost of $818 million for the first two lots is not a recognizable cost to the DOD. The estimate for the first two lots, reflecting missile quantities of 260 and 833 respectively, totals $1,467 4 million in FY 1984 dollars.

FINDING C: The AMRAAM Production Cost Estimate Has Increased. The GAO found that since the original planning estimate, the AMRAAM production estimate has more than doubled, rising from $3 1 billion to $7.4 billion. The GAO concluded that the primary reason for the increase was because the original Air Force estimates were overly optimistic with regard to missile cost and complexity. The GAO cited, as an example, a 1982 DoD analysis, which estimated that savings from production learning rates and competition would be about $1.6 billion less than estimated by the Air Force The GAO noted that the Air Force was subsequently directed to increase its AMRAAM budget estimate by $1.6 billion According to the GAO, another reason for increased AMRAAM cost estimates was an increase in the number of missiles to be produced, from 20,000 to 24,335. The GAO reported that in January 1985, the AMRAAM program was restructured as a result of the increasing cost estimates. Under the restructured program, the GAO reported the AMRAAM IOC has been delayed from February 1986 to June 1989, and an AMRAAM Producibility Enhancement Program (APEP) established at a cost of $330 million. (The GAO noted that the Air Force estimates the APEP will save about $2 billion in AMRAAM production costs.) (p. 3, p. 9, p. 11, pp. 17-18/GAO Draft Report)

Now on p 17

DOD POSITION: Concur. The DOD generally agrees with the finding; however, certain facts are in error. The GAO estimate of the total production cost is $7.4 billion in FY 1986 dollars. At the time the Secretary of Defense certified the AMRAAM to the Congress a cap of $7.0 billion for 24,000

FY 1984 dollars was placed on the program. If the OSD inflation indices are used to escalate this value to FY 1986 dollars, the result is $8.043 billion.

The APREP program is on contract and on or ahead of schedule at this time. The cost to exercise all options for every project to carry them through to completion is $330 million. The monetary savings are conservatively estimated to be approximately $1.6 billion.

The increasing costs for AMRAAM was not the sole purpose for restructuring the program. Schedule problems resulting from the unanticipated technical complexity of the program required that the program be restructured to allow the time necessary to reduce risks in meeting the development and testing milestones.

FINDING D: Underlying Factors That Affected AMRAAM Understated Cost Estimates. The GAO identified several factors that it concluded may have contributed to understated AMRAAM cost estimates or added to development time and costs. First, the GAO reported that the need to justify the development of AMRAAM to replace the Sparrow may have contributed to the overly optimistic AMRAAM estimates. In this regard, the GAO pointed out that in April 1986, the President's Blue Ribbon Panel on Defense Management reported that the need to "sell" a new program does not encourage realistic estimates. The GAO reported that a second underlying factor may have been contractor competition for the AMRAAM design and development contracts. The GAO again cited the Blue Ribbon Panel, which reported that award of initial development contracts often goes to the contractor whose proposal is the most optimistic. In the case of AMRAAM, the GAO reported that one of the AMRAAM contractors--Hughes Aircraft Company--had to absorb about $225 million in costs above the ceiling price, which contractor officials attributed to optimistic estimates resulting from the competitive environment. A third underlying factor, according to the GAO, may have been the rapid turnover in AMRAAM Program Managers. According to the GAO, this high turnover resulted in a lack of continuity in program management, and a loss of corporate knowledge and historical perspective. The GAO concluded that many of the AMRAAM cost and schedule problems are typical of the major acquisition problems identified by the President's Blue Ribbon Panel. (p. 2, p. 11, pp. 19-21/GAO Draft Report)

Now on pp. 18-19

DOD POSITION: Concur. The DOD agrees that some, if not all of the potential contributing factors--i e. optimistic estimates, contractor competition, and turnover in program managers--could have played a role to different degrees to AMRAAM's added development time and cost. This situation, however, applies to nearly any program, and is not unique to the AMRAAM.

FINDING E: AMRAAM Performance Requirements Determination. The GAO reported that the 1976 requirement for AMRAAM was based on identified shortcomings of existing missiles, a current and future threat assessment, and the desire for enhanced capability. The GAO found that the Air Force, the project office and contractor officials all agreed that the September 1976 AMRAAM Joint Service Operational Requirement (JSOR) provided a sound basis for designing and developing the missile. The GAO reported that the JSOR was reaffirmed by the Air Force in 1985, based on a review of the AMRAAM program and alternatives directed by the Secretary of Defense The GAO found, however, that not all AMRAAM design and performance requirements have been met, which

Now on pp 22-23

the GAO concluded is due primarily to technological, time and cost limitations The GAO noted that it did not review or validate the AMRAAM requirements, or address the issue of affordability. (p. 3, pp 23-25, p. 27/GAO Draft Report)

DOD POSITION: Concur. The DOD agrees with the GAO findings Care must be taken, however, not to confuse development specifications with JSOR requirements. The AMRAAM is proving itself capable of meeting all of the JSOR requirements except for F-Pole and Launch-to-Eject Time (LTE).

It is also important to understand that the Joint Service Operational Requirement for AMRAAM assessed the projected threat that would face our tactical forces and came up with sound requirements and capabilities that our air-to-air missiles would have to have to meet that threat. The Sparrow (AIM-7), in any of its versions, is not able to meet all of those requirements.

FINDING F AMRAAM Contracting Strategy. The GAO found that, unlike contracting for earlier missile development, the DoD has used competitive fixed price, rather than cost reimbursement type contracts for AMRAAM development The GAO reported that, according to AMRAAM officials, the purpose of using this approach was to hold down the Government's costs and reduce the risk of large cost overruns The GAO also reported that Air Force officials claim the fixed price contracts have been successful in limiting cost growth. The GAO found, however, that Hughes estimates it has absorbed $225 million above the ceiling price in developing AMRAAM The GAO reported that Hughes officials, therefore, consider a cost reimbursable contract (rather than a fixed price contract) more appropriate for system development because it provides (1) a cost margin for unknowns, (2) better communication between the developer and the Government, and (3) more control to the Government The GAO concluded that future contractor fixed price proposals will likely be more realistic and reflect the cost risks of systems development. (p 3, pp. 25-26/GAO Draft Report)

Now on pp 23-24

DOD POSITION. Concur. The DOD agrees with the GAO finding and adds the following clarifications It is Federal Acquisition Rrgulation (FAR) policy that fixed priced type contracts are normally preferred because they put the risk of cost control on the contractor. The FAR also recognizes that sometime in the early stages of research and development the profit motive may be secondary in view of the high degree of technical and cost risk associated with performance or consistent with achieving desired technical objectives Since the AMRAAM program had been through concept definition and the validation phase, cost and performance/schedule risks were considered to have been substantially decreased due to available data in these risk areas In recognition of the remaining risk in these areas, however, a Fixed Price Incentive (FIP) contract with a ceiling of 140 percent of target cost was negotiated This approach was considered an appropriate balance between the contactor assuming a reasonable risk for cost control and the Government's desire to reduce the risk for contract overrun The 140 percent ceiling was higher than normal and was considered adequate protection for the contractor. The Government's liability is capped at the $556.2 million ceiling Under a cost type contract the Government would currently be funding a large overrun or the contractor would have stopped work The FPI contract was successful in limiting cost growth for the Government Based

upon the latest estimate at completion, Hughes will absorb approximately $251 million above the ceiling price of the contract.

Both FPI and cost reimbursement contracts may be appropriate for system development depending upon stage of development and other case by case circumstances. An FPI puts more cost risk on the contractor while the Government assumes the risk under a cost reimbursement type contract It is doubtful that the type of contract affects communication between the contractor and Government to any significant degree except in the area of cost reporting. Under cost reimbursement contracts cost reporting is normally more extensive because the Government is at risk to fund overruns if the contract is not completed for the amount negotiated. The Government has more flexibility/control under a cost type contract because the contractor knows, it will be reimbursed for allowable cost and is willing, therefore, to perform any task within the general scope of the contract. The contractor is at no risk because when he expends all allotted funds the Government will have to add more funds to the contract or the contractor will stop work Under a fixed price arrangement the contractor will carefully scrutinize every task to ensure it is within the scope of the contract before performing it because the contract must be completed for the fixed price of the contract.

FINDING G. AMRAAM Testing. The GAO found that numerous tests have been or are planned during AMRAAM development, which (according to Air Force officials) represents a much more thorough and extensive testing program than that done for other Air Force missile systems. The GAO reported that during full scale development, the contractor is required to produce 122 missiles for development testing and evaluation and initial operational testing According to the GAO, 90 development test flights and 8 missile separation control vehicle tests are planned through 1988. The GAO found that as of November 1, 1986, 20 flight tests had been conducted. The GAO observed, however, that at least seven flight tests were cancelled or aborted due to missile malfunction. (The GAO noted that project office officials consider even the aborted flights were a form of success since they demonstrated the AMRAAM's abort feature) Although the test flights are not scheduled to be completed until late 1988, the GAO reported that Air Force officials expect to have sufficient data by early 1987 to make a low rate production decision. Although noting concern has been voiced that AMRAAM testing was too extensive and contributed to cost overruns and schedule delays, the GAO did not reach any conclusions of its own. The GAO noted, however, that it is presently reviewing the adequacy and realism of the testing prior to low and full rate production decisions under a separate assignment (GAO Code 392265). (pp. 3-4, p. 23, pp. 26-28/GAO Draft Report)

Now on pp 24-25

DOD POSITION: Concur. The DOD agrees with the finding with one clarification. The GAO observed that at least seven flight tests were cancelled or aborted due to missile malfunction. This is true; however, it should be noted that most of these aborts occurred early in the full scale development flight test phase and that recent flight tests over the past year have not encountered any aborts due to the missile The facts also show that AMRAAM has the best flight test results to date of any comparable missile development program

Requests for copies of GAO reports should be sent to:

U.S. General Accounting Office
Post Office Box 6015
Gaithersburg, Maryland 20877

Telephone 202-275-6241

The first five copies of each report are free. Additional copies are $2.00 each.

There is a 25% discount on orders for 100 or more copies mailed to a single address.

Orders must be prepaid by cash or by check or money order made out to the Superintendent of Documents.

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

Official Business
Penalty for Private Use $300

Address Correction Requested

First-Class Mail
Postage & Fees Paid
GAO
Permit No G100