United States General Accounting Office

GAO

Report to the Secretary of Defense

December 1990

T-45 TRAINING SYSTEM

Navy Should Reduce Risks Before Procuring More Aircraft

GAO/NSIAD-91-46

GAO

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

National Security and
International Affairs Division

B-240155

December 14, 1990

The Honorable Richard B. Cheney
The Secretary of Defense

Dear Mr. Secretary:

This report summarizes our review of the Navy's acquisition of the T-45 Training System. We found that the program faces significant cost, schedule, and performance risks. Although the system has been in production for over 2 years, a stable aircraft design has not yet been demonstrated in operational testing. Important cost and schedule issues also remain unresolved.

The Congress recently declined to appropriate requested fiscal year 1991 funding for procurement of another lot of production aircraft. This report recommends that you not authorize the Navy to procure additional aircraft until sufficient testing is completed. We also recommend that you direct the Navy to adjust the rate at which it plans to procure simulators. As you know, 31 U.S.C. 720 requires the head of a federal agency to submit a written statement on actions taken on these recommendations to the Senate Committee on Governmental Affairs and the House Committee on Government Operations not later than 60 days after the date of the report and to the House and Senate Committees on Appropriations with the agency's first request for appropriations made more than 60 days after the date of this report.

We are also sending copies of this report to the Secretary of the Navy.

Please contact me at (202) 275-6504 if you or your staff have any questions concerning this report. Other major contributors are listed in appendix II.

Sincerely yours,

Martin M Ferber
Director, Navy Issues

Executive Summary

Purpose

The T-45A Goshawk aircraft is the major component of a $5.9-billion flight training system McDonnell Douglas Corporation is developing for the Navy. After contracting for the first production lot of 12 aircraft before development was complete, the Navy discovered during initial flight tests in 1988 that the aircraft's design was seriously flawed. The Navy subsequently reported that resolving the aircraft's deficiencies would delay completion of the T-45 acquisition program by 2 years and, with foreign currency fluctuations, would cost over $1 billion.

GAO initiated a review of the T-45 Training System to evaluate cost, schedule, and performance risks and to assess whether an additional production commitment in fiscal year 1991 is warranted.

Background

In addition to 300 production aircraft plus 2 flight-test models, the T-45 system is to include 32 flight simulators, instructional materials and equipment, training integration systems, and logistics support. The system's aircraft, a derivative of the British Aerospace Hawk, will replace the T-2 and TA-4 aircraft currently used for intermediate and advanced jet flight training.

After initial testing revealed the aircraft's design problems, the Office of the Secretary of Defense (OSD) withheld fiscal year 1989 funds that had been appropriated for aircraft. The Navy also canceled its funding request for procurement of 24 additional aircraft in fiscal year 1990. Operational test authorities in OSD and the Navy concluded that correction of the design flaws should be verified through testing before further production was authorized. Before the corrections were made, however, OSD released the fiscal year 1989 funds for the second production lot. The Navy requested $306 million to procure a third lot of 12 aircraft, 5 simulators, and associated equipment in fiscal year 1991.

Results in Brief

Cost, schedule, and performance risks are significant for the T-45 program. The Navy and OSD have instituted risk-reduction measures such as slowing production but have continued concurrent development and production. Those measures will do little to resolve many of the uncertainties the program now faces. Some actions taken by the Navy and OSD in restructuring the program have actually increased program risks. Under the revised program, critical tests have been postponed and the number of aircraft to be procured during the development phase has increased.

GAO believes that it would be prudent to resolve the program's cost, schedule, and performance problems before making any additional procurement commitments.

GAO's Analysis

Concurrent Schedule

Foremost among the risk elements in the acquisition strategy was concurrency, a large overlap in aircraft development and production. The Navy did not schedule flight testing before the first production commitment, or schedule initial operational test and evaluation to be completed until after commitments had been made for 20 percent (60 aircraft) of the planned procurement.

After the extent of the aircraft's design deficiencies became apparent in 1988, additional tests were postponed, development time and costs escalated, and the program had to be restructured. Although the procurement rate was slowed, the number of aircraft to be bought before development and initial operational testing are completed was increased to 24 percent (72 aircraft) of the planned procurement quantity.

Scheduled simulator deliveries are ahead of aircraft deliveries, and at planned procurement rates, the imbalance will increase, at least into fiscal year 1993. According to Navy officials, two simulators a year is the minimum rate required to sustain production.

Performance Problems

The aircraft's design has not yet been proven effective or suitable for its mission. Correction of the deficiencies found in the 1988 tests entails redesigning the aircraft's wing, modifying the rudder, replacing the engine, and making other changes.

Deficiency corrections are scheduled for testing before a decision is made on the fiscal year 1991 procurement commitment. Tests involving other critical issues (e.g., high angle-of-attack/spin testing), however, have been postponed until after the decision points they originally were scheduled to support.

Undetermined Costs

The actual price the Navy ultimately will pay for T-45A aircraft already under contract is not likely to be agreed upon before April 1991. Moreover, according to Navy officials, the contractor has filed an unsettled $293-million claim for price and schedule adjustments under the fixed-price development and initial production contract.

Effects of Deferring Procurement in Fiscal Year 1991

The 12 aircraft in the 1991 budget request are not needed for the Navy to attain an initial operational capability and begin training pilots with the T-45 system. According to the Navy, only 12 aircraft are needed to achieve that milestone, and the service already has 36 aircraft under contract.

Navy officials estimate that deferring the 1991 production commitment will increase procurement costs by about $30 million. According to their estimate, this increase will result if prices have to be renegotiated to compensate the contractor for stretching the delivery schedule for aircraft already under contract. However, the $30-million cost increase estimated by the Navy is not a certainty, especially in light of the evolving nature of the T-45 program.

Recent Congressional Actions

Based largely on GAO's view that additional commitment to production of this aircraft should be deferred until redesigned models successfully complete certain critical tests that the Navy postponed until fiscal year 1992, the Committees on Armed Services and Appropriations cut $147.8 million from the Department of Defense's T-45 request for fiscal year 1991.

Recommendations

GAO recommends that the Secretary of Defense withhold authorization for the Navy to proceed with procurement of any additional T-45A aircraft until (1) operational testing demonstrates that the system can be effective and suitable for its mission and (2) the Navy negotiates a definitized contract price for the aircraft.

GAO also recommends that the Secretary of Defense direct the Secretary of the Navy to procure only two simulators in fiscal year 1991.

Agency Comments

The Department of Defense partially concurred with GAO's findings and recommendations. However, the Department expressed confidence that corrections to aircraft deficiencies could be satisfactorily demonstrated

in operational testing by the spring of 1991. The Department's detailed comments are reprinted in appendix I.

GAO does not believe that testing scheduled for completion in fiscal year 1991 can reduce technical risk sufficiently to warrant an additional commitment to production. Important tests have been postponed until 1992 after the first aircraft incorporating all major aircraft corrections is scheduled for delivery.

Contents

Abbreviations

DAB	Defense Acquisition Board
DOD	Department of Defense
GAO	General Accounting Office
IOC	Initial Operational Capability
LRIP	Low-Rate Initial Production
OSD	Office of the Secretary of Defense

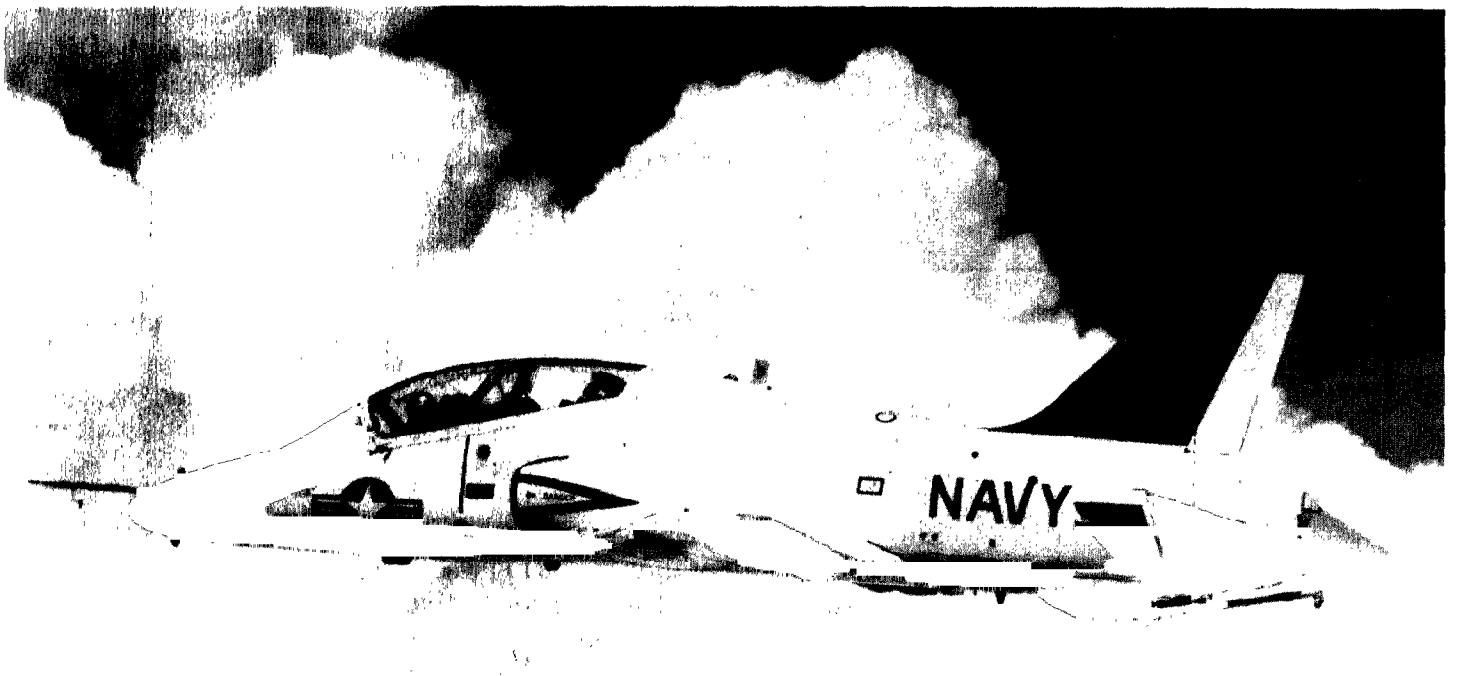
Introduction

The T-45 Training System is designed to provide undergraduate jet pilot training for prospective Navy and Marine Corps aviators, plus a selected number of international students, in the 1990s and beyond. The Navy is procuring the $5.9-billion system from McDonnell Douglas Corporation. The system includes 300 aircraft, plus 2 research and development models for flight tests, 32 flight simulators, instructional materials and equipment, training integration systems, and logistics support. Major subcontractors are British Aerospace (airframe), Rolls-Royce (engine), and Hughes Simulation Systems (simulators).

The system's key component is the T-45A Goshawk aircraft, a derivative of the British Aerospace Hawk, which is being adapted for carrier operations. The T-45A Goshawk will replace the T-2 and TA-4 aircraft the Navy presently uses for intermediate and advanced flight training.

The Navy has already contracted for 36 T-45A aircraft (plus the 2 flight-test aircraft) and 8 simulators. It requested $306 million in fiscal year 1991 for procurement of 12 more aircraft, 5 more simulators, and related equipment.

Figure 1.1: The Navy's T-45A Advanced Jet Trainer



Source: McDonnell Douglas Corporation

Program History

In October 1984, the Navy awarded a firm fixed-price contract to Douglas Aircraft Company, a component of McDonnell Douglas Corporation, for full-scale development of the T-45 system. The contract was definitized in May 1986 at a price of $511.9 million. It included (1) delivery of two research and development aircraft for flight tests and (2) three sequential options for low-rate initial production (LRIP) for a total of 60 aircraft and associated equipment, at not-to-exceed prices. These options included expiration dates that were originally expected to correspond to scheduled events, but expiration would occur even if the contractor was not achieving the scheduled degree of progress.

The three LRIP options included (1) 12 aircraft in fiscal year 1988, (2) 24 aircraft in 1989, and (3) 24 aircraft in 1990. Full-rate production of 48 aircraft a year was scheduled to begin in 1991. The Navy exercised the first of the LRIP options in fiscal year 1988, contracting for the 12 aircraft, plus 2 simulators, a training integration system, and total logistics support at a firm fixed-price of $429.4 million.

In November 1988, nearly a year after that initial production commitment, the program suffered a major setback when the Navy conducted its first flight tests. Until that time, according to an official in the Office of the Secretary of Defense (OSD), the T-45 program had been proceeding smoothly and was considered one of the best defense acquisition programs. That situation changed abruptly, however, after the November 1988 tests.

Initial Navy Flight Tests

The Naval Air Test Center conducted its first development testing and reported 24 deficiencies which adversely affected either the aircraft's safety of flight or mission capability, as well as numerous lesser deficiencies. The Center concluded that although the aircraft had demonstrated limited potential for its mission, it would be satisfactory after the Navy corrected the 24 deficiencies.

The Navy's Operational Test and Evaluation Force found that the aircraft in the configuration tested (1) was potentially effective in a noncarrier environment, (2) was not effective in a carrier environment, and (3) was not operationally suitable because of safety deficiencies. It concluded that these findings did not support a recommendation for limited production until correction of the aircraft's deficiencies had been verified by additional operational testing. No additional operational testing of the aircraft is scheduled until late 1990. The Navy has categorized what it calls the "Big Five" problem areas revealed during the tests as:

- longitudinal control system,
- aircraft performance (engine),
- directional/lateral stability,
- stall performance, and
- abrupt pitch change with speedbrake operation.

Funding Withheld

After the tests, OSD prohibited the Navy from obligating fiscal year 1989 procurement funds for the second production lot of 24 aircraft. The Navy also canceled the fiscal year 1990 budget request to fund 24 additional aircraft in the third production lot.

The Director of Operational Test and Evaluation in the Department of Defense (DOD) concluded that operational testing of corrections to the major deficiencies should be completed before the Defense Acquisition Board (DAB) considered releasing the withheld 1989 funds. The second

and third production options in the development contract expired before the corrections were made.

Baseline Breach

In 1987, OSD designated the T-45 as one of 10 Defense Enterprise Programs under an initiative enacted by the Congress to increase management efficiency for model acquisition programs. Defense Enterprise Programs must adhere to baselines which OSD is statutorily required to submit to the Congress. The T-45 program breached its baseline after the problems revealed in the November 1988 tests caused the schedule to slip and costs to increase. An adverse change in the foreign exchange rate also contributed to the cost increase.

The Navy initially estimated that the aircraft's problems would cause only a 5- to 8-month schedule slip. However, in December 1989, the Navy reported to the DAB that resolving the aircraft's deficiencies would delay program completion by 2 years and, with foreign currency fluctuations, would add more than $1.04 billion in costs.

In May 1989, less than 2 months after notifying OSD of the baseline breach, the Navy requested approval of a restructured program to include (1) canceling the 1990 production lot and placing the fiscal year 1989 production lot of 24 aircraft on contract, effectively keeping the annual production rate at 12 aircraft through fiscal year 1990, and (2) escalating to a rate of 24 aircraft in 1991 and to the full production rate of 48 in 1992. OSD denied the Navy's request, refusing to restructure the program until it had been reviewed by the Conventional Systems Committee and the DAB.

The Navy changed its position in July 1989, reporting to OSD that it was "premature to baseline the T-45A at this time due to technical uncertainties." The Navy recommended that the Conventional Systems Committee's review, tentatively scheduled for August 1989, be postponed until November 1989.

Only 4 days later, however, the Navy informed OSD that the contractor was considering stopping work on the fiscal year 1989 production lot. The Navy explained that Douglas Aircraft had already expended about $28 million in advance procurement funds and, therefore, had been proceeding at its own financial risk since early in fiscal year 1989. The Navy reported that in view of the Douglas Aircraft liabilities to contractors that would accrue by the time the DAB met late in calendar year 1989 to consider release of additional funding, the company had

directed its subcontractors to estimate the cost of stopping work until January 1990.

The Navy concluded that the production break would be a "major disruption," increasing costs by about $30 million and causing a 6-month slip in the program. To avoid this disruption, the Navy requested that $72 million of the deferred fiscal year 1989 procurement funds be released, even before the Conventional Systems Committee and DAB reviews. OSD released the $72 million.

Contract Modification

In an August 1989 contract modification that obligated the $72 million, the Navy and the contractor agreed on a not-to-exceed price of $557 million for the second production lot, which included 24 aircraft and 6 simulators. Although all of the aircraft were to be financed with fiscal year 1989 funds, other system costs were designated as fiscal year 1990 procurement. This action effectively continued production at the rate of 12 aircraft a year through 1990.

The contract modification did not resolve the issue of liability for replacing the aircraft engine. It merely acknowledged that the Navy and the contractor disagreed about (1) whether the original engine met performance specifications and (2) the extent to which the government participated in selection of the engine. The modification also stipulated that the not-to-exceed price for the second production lot of 24 aircraft excluded recurring costs associated with three other deficiency corrections then under consideration: a new wing, relocated speed brakes, and a powered rudder.

In commenting on a draft of this report, DOD said a revised aircraft design was approved after our field work ended which incorporates only one of the three modifications excluded from the not-to-exceed price: the new wing. The revised design includes modification of the speed brakes and rudder but does not include relocation of the speed brakes and a powered rudder—both of which an independent assessment team employed by the Navy said were needed for "robust" solutions to the aircraft's problems.

The target date for definitizing the contract modification covering the 1989/1990 production lot was July 30, 1990. However, that date was predicated on the contractor submitting cost and pricing data to the Navy in December 1989. Navy officials said they did not receive the cost

and pricing data until September 1990 and, therefore, will not be able to definitize the contract until April 1991.

DAB Review and Subsequent Program Changes

The DAB convened to consider release of the fiscal year 1989 procurement funds before the aircraft's deficiencies were corrected—contrary to the previously reported positions of operational test and evaluation authorities. In December 1989, following the Conventional Systems Committee's review, the DAB approved (1) proposed corrections to the aircraft's deficiencies, (2) proposed restructuring of the program baseline, and (3) release of the remaining fiscal year 1989 procurement funds, including advance procurement funds for the fiscal year 1991 production lot.

Less than a month after the DAB's decision, however, the revised schedule became obsolete when the contractor formally notified the Navy that responsibility for the T-45 contract would be transferred from Douglas Aircraft Company to McDonnell Aircraft Company. According to program officials, this change (1) required that scheduled aircraft deliveries be delayed to accommodate the relocation of assembly operations from the Douglas facilities in California to the McDonnell Aircraft facilities in St. Louis, but also (2) reduced the costs of retrofitting new wings on delivered aircraft. The schedule that has been adopted since the McDonnell Douglas announcement calls for the first two aircraft to be delivered in October and December 1990, respectively, with no additional deliveries until January 1992. The first aircraft fitted with wings of the new design is scheduled for delivery in January 1992.

Under the restructured program, the DAB established June 1991 as the target date for the system's initial operational capability (IOC)—that is, the point at which the first training unit was to be equipped and capable of effectively employing the system. Under the schedule adopted since the DAB met, IOC will slip to November 1992, according to Navy officials.

Objectives, Scope, and Methodology

Our objectives were to evaluate cost, schedule, and performance risks and to assess whether additional production is warranted in fiscal year 1991. Our review included all system components, but our emphasis was on the T-45A Goshawk aircraft.

We did not assess the validity of the Navy's requirement for the T-45 system, because the Naval Audit Service is conducting a review. We did

discuss the Navy's training requirements and the general condition of existing trainer aircraft with officials in the Navy's Air Training Command and Air Systems Command.

We reviewed program documents and related materials, and interviewed OSD, Navy, and contractor officials in Washington, D.C., including the T-45 program office; the Navy training and testing commands in Corpus Christi, Texas; Patuxent River, Maryland; and Norfolk, Virginia; and the Douglas Aircraft Company in Long Beach and Palmdale, California, and Hughes Simulation Systems, Inc., in Herndon, Virginia.

Our purpose was to determine both the background and the current status of the program. We compared the program's acquisition strategy with DOD policy, compared earlier schedules and test plans with revised schedules and a March 1990 draft of the program's revised test plan, and identified and assessed program risks.

We performed our review between August 1989 and September 1990 in accordance with generally accepted government auditing standards.

DOD provided us with comments on a draft of this report which are reprinted in appendix I. As a result of the comments, we have made changes in the text of the report to improve accuracy, clarity, and timeliness. A residual point of contention is addressed in chapter 4.

Acquisition Risks

At the outset of development, the Navy adopted a T-45 acquisition strategy which reflected what proved to be an overly optimistic assessment of risk. As prescribed by DOD policy, the Navy tailored the strategy to the program's unique circumstances. These circumstances included (1) technical risks that were assessed as only low to moderate and (2) a stated requirement to have the system operational no later than fiscal year 1991. Reflecting those views, the T-45 strategy offered opportunities to reduce development time and costs but deemphasized safeguards against technical uncertainties. If development of the derivative aircraft went smoothly, production and deployment of the system would be expedited. If major technical problems surfaced, development time and costs were almost certain to escalate.

Adapting the Hawk design to the T-45 mission proved more challenging than either the Navy or the contractor envisioned. Major design flaws became apparent when the Navy conducted its initial tests, about a year after production was first authorized. The aircraft deficiencies the Navy found during those tests led to disrupted schedules, increased costs, and the 1989 breach of the program's baseline.

The Navy and OSD responded to the program's problems by instituting a number of measures intended to reduce risks. By themselves, however, those measures will not reduce all of the risks that have evolved since the aircraft's deficiencies became apparent. Moreover, recent restructuring of the program has heightened risks by postponing key tests and increasing the number of aircraft to be bought before development is completed and before operational testing has demonstrated that a production representative model of the aircraft is effective and suitable for its mission.

Early Risk Assessment Based on Derivative Nature of Aircraft

The key to the T-45 program is successfully adapting the Hawk design to provide the carrier-capable aircraft needed for the Navy's training mission. Success with such adaptations has proven elusive in the era of modern jet aircraft. Nevertheless, the Navy was confident early in the program that developing a derivative of the British Aerospace Hawk would be a straightforward task with less technical risk than would be encountered in developing a completely new aircraft.

A report by DOD's Product Engineering Services Office challenged the Navy's assessment, even before full-scale development began. The September 1984 report acknowledged that "on the surface, the [T-45] program may appear to be low risk...." However, the report cited the major

changes that would be required to adapt the Hawk design for carrier operations and concluded: "This redesign effort is certainly no minimal task and may in fact be more complex than designing from scratch." The report also concluded that "cost, schedule, and performance all have to be considered high risk when making a decision whether or not to proceed" into full-scale development.

Difficulty of Adapting Land-Based Aircraft to Carrier Roles

We recently reported that studies have shown the difficulty of accommodating Navy missions and carrier-basing with an airframe originally designed for Air Force missions and land-basing.[1] The Navy and Air Force have successfully shared aircraft components, and they have had limited success with common aircraft initially designed for carrier operations. Since World War II, no U.S. fighter or attack aircraft bought by both of the services has been initially developed to operate from land bases and then been successfully adapted to operate from carriers.

The problem is that aircraft which fly on and off of carriers have special design requirements. They must be equipped with tail hooks and with reinforced structures to withstand the stresses of catapult takeoffs and arrested landings, both of which add weight and alter aerodynamic qualities when retrofitted onto land-based aircraft. Aircraft that land on carriers also must be capable of slower approach speeds, as well as more precise flight control during approaches. This is especially critical when, as in the case of the T-45A, the aircraft will be piloted by student aviators making their first landings on the pitching and rolling deck of a carrier.

Features That Increased Acquisition Risks

The T-45 acquisition strategy adopted in 1984 included a number of features that could have reduced development costs and expedited production. However, these features also increased the risk that problems would develop and compound if adapting the Hawk design proved to be more difficult than estimated. Features that made the strategy a greater risk were:

- A firm fixed-price development contract: this type of contract is suited to acquisition of commercial products whose uncertainties and costs can be identified but is inappropriate for risky development efforts.

[1] Aircraft Development: Navy's Participation in Air Force's Advanced Tactical Fighter Program (GAO/NSIAD-90-54, Mar. 7, 1990).

- A scaled-down development program: funding development at well below original cost estimates of about $810 million caused, among other reductions, a 212-hour (34 percent) cut in the contractor's flight-test hours with an "increased reliance on existing Hawk test data" and a $29.5-million (60 percent) cut in the Navy's in-house management of the program.
- Time-based production options: option periods specified in the contract were not directly related to the system's maturity, the contractor's performance, or test results that demonstrated the system was ready for production.
- A high degree of concurrent production: the large overlap in development and production schedules, called concurrency, precluded Navy flight tests before the first production commitment and deferred completion of operational testing until after commitments had been made for 20 percent of the aircraft procurement quantity.

Technical Challenge Was Greater Than Estimated

The Navy's initial tests in 1988 revealed that adapting the Hawk design to the T-45 mission was more technically challenging than had been estimated. The aircraft the contractor delivered to the Navy for testing proved to be ineffective and unsafe for training student aviators in a carrier environment. The engine lacked thrust and responsiveness, and the aircraft lacked the lateral and longitudinal stability needed for carrier operations. Major design changes needed to correct the deficiencies included a more powerful and responsive engine, new wings with moveable leading edges, a modified rudder, and other changes to improve stability.

By this time, however, the Navy had already contracted to produce the aircraft and was approaching the deadline for exercising the second production option with the not-to-exceed prices that had been a key part of the development contract. Since the option was not contingent on accomplishment of required testing, the Navy could not unilaterally extend either the deadline or the not-to-exceed prices.

Ultimately, the second and third production options lapsed because of the deficiencies revealed in the 1988 tests. The program manager at the time summarized his views on the cause and effect of the Navy's situation:

"...while the government had some leverage, the program office strongly pressed for tying the option exercise dates to accomplishment of the required testing and acquisition approval...[but was] overruled on the rationale that if the contractor fell

behind it was possible to negotiate an extension....With respect to the...[second] production lot, the contractor has fallen behind, a DAB decision has not been possible, and the option date has passed without being exercised. We have lost certainty of price and schedule protection and we do not have significant leverage to regain it."

Navy and OSD Response to Program Problems

The Navy and OSD faced a dilemma after it became apparent that the T-45 program had gone into low-rate production with an ineffective and unsuitable design. The choice was whether to halt or to continue production commitments while attempting to achieve a stable design. OSD briefly elected the former option by withholding fiscal year 1989 procurement funds and canceling the fiscal year 1990 budget request. Ultimately, however, the Navy and OSD responded to the contractor's "stop-work assessment" by electing to proceed with an additional production commitment, as discussed in chapter 1.

In pursuing this course, the Navy and OSD took a number of actions intended to reduce risks. The Navy brought in an independent team to assess the design changes needed to correct the aircraft's deficiencies. It slowed the procurement rate, opting to contract for only 12 aircraft a year through fiscal year 1991.

The DAB, chaired by the Under Secretary of Defense for Acquisition, attached risk-reduction conditions to its release of regular procurement funds for the fiscal years 1989/1990 production lot and long-lead funds for the 1991 production lot. The DAB directed that the Navy obligate the funds only in increments based on validation of the design corrections. The DAB also directed that before regular procurement funds are released for the 1991 production lot the Navy must have (1) demonstrated through development testing and operational testing that the aircraft's deficiencies have been corrected, (2) obtained recommendations from the test agencies to proceed, and (3) installed a ground-training system at the first base scheduled to receive T-45 aircraft. In commenting on a draft of this report, DOD officials told us that the DAB "authorized the 1991 long lead funds with the stipulation that the Navy base the subsequent release of these funds to the contractor on validated long lead items...and to date [September 28, 1990] has not released any of these funds to the prime contractor."

Restructured Program Postponed Testing and Increased Concurrency Risks

Probably the greatest risk in the T-45 acquisition strategy was the high degree of concurrency that allowed no opportunity for operational testing before the first production commitment. Recent program changes made by the Navy and OSD have increased that risk by (1) postponing tests that were to have supported additional production commitments and (2) increasing the number of aircraft to be produced before development and operational testing are completed.

Concurrency can be an effective technique for expediting acquisition programs. The practice also increases the risk that systems will be produced and deployed with design flaws that make them incapable of accomplishing their missions. Safeguards should be built into concurrent programs to compensate for these additional risks. We have reported that an especially important safeguard for concurrent programs is at least one phase of operational test and evaluation before the initial production commitment.[2] This position is consistent with Navy policy, which requires that for all programs at least one phase of operational testing be completed before a decision is made to commit procurement funds for production start-up.

In restructuring the program since the aircraft's initial test failures, the Navy and OSD increased the level of concurrency by postponing important tests. In our 1985 report, we emphasized that the degree of concurrency in an acquisition program should be planned, not dictated by uncontrolled or unforeseen circumstances. This means that delays in scheduled tests should be accompanied by corresponding delays in production commitments.

In the T-45 program, initial test failures caused both production commitments and subsequent tests to be delayed—but not to the same degree. The commitment for the second production lot of 24 aircraft was made without successful completion of the 1988 test objectives, as previously planned. As now scheduled, the decision to contract for the 1991 production lot of 12 additional aircraft will also be made before tests that were to have been conducted in support of this decision.

The DAB-imposed requirement that testing verify the success of planned deficiency corrections before proceeding with the 1991 production lot does little to reduce technical risks. Even if that testing is successful, the

[2]Production of Some Major Weapon Systems Began With Only Limited Operational Test and Evaluation Results (GAO/NSIAD-85-68, June 19, 1985); Weapons Testing: DOD Needs to Plan and Conduct More Timely Operational Tests and Evaluation (GAO/NSIAD-90-107, May 17, 1990).

program essentially will be only at the point on the test schedule that it was supposed to have been in 1988. Successful completion of the 1988 test objectives–which is, in effect, what the DAB decision requires—was to support the decision to increase production commitments from 12 to 36 aircraft. However, that decision was made in 1989 despite the aircraft's poor performance in initial tests and the subsequent delay of follow-up tests.

The 1988 schedule called for operational tests of the aircraft's carrier suitability and other critical issues before deciding to produce more than 36 aircraft. Under a March 1990 draft of the program's revised test and evaluation master plan, all of those operational tests have been postponed until after commitments will have been made for 48 aircraft. Similar or longer postponements also have been scheduled for development tests involving initial sea trials, high angle of attack/spin testing and other important technical issues.

Under earlier program schedules, production commitments were planned for 60 LRIP aircraft (20 percent of the planned procurement quantity) during the development phase before all initial operational test phases were completed. Under the revised schedule, commitments will be made to produce 72 LRIP aircraft (24 percent) before development and initial operational test and evaluation are completed.

Difference in OSD and GAO Assessments of T-45 Concurrency

In April 1990, the Under Secretary of Defense for Acquisition provided congressional committees a report on concurrency in major defense acquisition programs. The report, required by the National Defense Authorization Act for fiscal years 1990 and 1991, categorized the T-45 program as having only a moderate degree of concurrency. The report defined "moderate" and "high" degrees of concurrency as follows.

"A program with moderate concurrency proceeds into LRIP with only part of early [initial operational test and evaluation] completed to support that decision.

"A program with high concurrency typically proceeds into LRIP before significant [initial operational test and evaluation] is completed."

Under those definitions, we believe the T-45 program clearly has a high degree of concurrency, since the program proceeded into LRIP before any initial operational test and evaluation was completed. The difference in the OSD and GAO assessments is at least partially attributable to disagreement over the point at which the program entered, or will enter, LRIP.

According to an OSD official, the assessment in the Under Secretary's report was based on information provided by the Navy which indicated that LRIP has not yet begun. Actually, however, the program entered LRIP with the first production authorization in November 1987. In commenting on a draft of our report, DOD said the categorization of moderate concurrency for the T-45 program "was derived as the percentage of procurement funds committed before the end of operational test and evaluation, relative to the total procurement of the program...." That, however, was not a definition the Under Secretary's report cited as the basis for assessing degrees of concurrency.

Revised Baseline Likely to Be Breached

The DAB approved a new program baseline at the same December 1989 meeting that released funds for additional T-45 procurement. A new baseline was required by the statute on Defense Enterprise Programs. Several months were required for preparation and review of the new baseline, which was submitted to the Congress on May 1, 1990. However, events which occurred in the interim make it likely that the new Defense Enterprise baseline will also be breached.

Within days of the DAB's December 1989 meeting, Navy officials said McDonnell Douglas representatives informed them of the company's decision to relocate aircraft assembly operations to St. Louis, Missouri. According to Navy officials, the company will suspend deliveries from December 1990 until January 1992, when aircraft can be delivered with the new, redesigned wings. The resulting delivery break means that the program will not be able to meet the schedule approved by the DAB. It also means, according to Navy officials, that the program will breach the baseline submitted to the Congress in May 1990. In the revised baseline, the IOC target date was reported as June 1991, but with the delayed deliveries, the Navy does not now expect to reach the IOC milestone until November 1992.

According to Navy officials, the decision by McDonnell Douglas to suspend deliveries will reduce the level of concurrency by allowing the contractor extra time to develop and install corrections. They pointed out that, with the delay, fewer aircraft will be delivered with known deficiencies which require corrections to be retrofitted. For example, under the revised schedule only the first two aircraft will require the new wings to be retrofitted after assembly, versus the first 19 aircraft under the former schedule.

We agree that the suspended delivery schedule has the potential to reduce retrofitting requirements, but we disagree that it will have a significant effect on reducing concurrency. The Navy still plans to buy 72 aircraft before development and testing are completed.

Additional Delays Are Possible

Additional delays can be expected if problems develop with either the planned corrections or the performance areas that have yet to be tested. Up to a 2-year delay has been projected by the Navy, for example, if even one of the planned wing, rudder, or speed-brake corrections proves inadequate. The Conventional Systems Committee also reported in December 1989 that high angle-of-attack/spin testing, then scheduled for 1991, "has the potential of discovering unexpected deficiencies which could cause further delays in the program." This testing has since been postponed until April 1992.

Cost Risks Remain

Cost risks will not be substantially reduced by the DAB's proviso that the Navy obligate the remaining funds in increments based on successful validation of the fixes to be demonstrated at the next phase of development and operational testing. In January 1990, the Navy obligated $60 million in 1989 procurement funds as the first increment under the DAB's guidelines, and Navy officials said they obligated a second increment of $33 million in August 1990. These obligations were made before a production version of the new wing was available and before any of the planned corrections had been operationally tested.

Moreover, validating the corrections, as prescribed by the DAB, will not resolve a major cost uncertainty: liability for correcting the aircraft's deficiencies. This liability includes costs associated with developing and testing the corrections, plus costs related to the schedule disruption caused by the deficiencies. Recurring costs of the new wing on aircraft already under contract, as well as those yet to be bought, also remain undetermined.

Navy officials contend that the added development and schedule costs are the contractor's responsibility under the fixed price established by the development contract. However, the Conventional Systems Committee reported in December 1989 that there was a strong possibility the contractor would attempt to recover costs through "either claims or the courts." In January 1990, the contractor gave the Navy written notification that the company (1) considers the original aircraft design compliant with the contract, (2) considers changes to that design beyond the

scope of the contract, and (3) is in the process of preparing a proposal for an "equitable price and/or schedule adjustment." In discussing a draft of our report, Navy officials said that in August 1990 they received the contractor's claim for $293 million in price and schedule adjustments under the fixed-price development and initial production contract. The recurring costs of the installed corrections, and the price the Navy pays per aircraft, will not be known until (1) the contract modification for the fiscal year 1989 production lot is definitized and (2) prices are negotiated under a new contract for subsequent production lots. Program officials said the Navy expects to definitize the 1989 contract modification in April 1991.

Low Technical Risks Have Not Been Demonstrated

The DAB reported that its support for maintaining production under the restructured program was based, in part, on the belief that technical risks were low. However, DOD's acquisition policy is to advance programs on the basis of demonstrated performance.

Low technical risks for the T-45 program have not been demonstrated. To the contrary, the only phase of operational flight testing yet completed demonstrated that the Navy's earlier assessment of "low to moderate" technical risk was overly optimistic.

The Navy emphasized that it considers all of the aircraft's known deficiencies to be correctable with existing technology. However, not all of the corrections have been completed, let alone subjected to operational testing as an integrated system. Even components that have been tested in isolation or that have been effective in other applications can fail to perform adequately when integrated into a new system.

Moreover, the aircraft's technical risks are not limited to correction of the deficiencies revealed during the brief development and operational tests conducted in 1988. Postponed tests related to high angle of attack, sea trials, weapons delivery, carrier suitability, and other critical operational issues involve some risks. Those risks may be low, as the DAB reported, but the Navy has no operational test results to support that assessment.

Effects of Deferring Fiscal Year 1991 Procurement

The DAB cited three reasons for its decision to release advance procurement funds for the 1991 production lot: (1) the Navy's and Joint Staff's reaffirmation of an urgent need to replace the T-2 and TA-4 trainer aircraft currently in service, (2) the consensus that technical risks were low, and (3) the Navy's projected cost increase of $55 million if long-lead funds were withheld.

The second of those reasons, technical risk, was discussed in chapter 2. This chapter will address the other two justifications offered by the DAB—that is, the need for the 12 aircraft in the 1991 production lot and the projected cost increase of deferring their production.

Effect of the 1991 Production Lot on the Need for Replacement Aircraft

Our review did not include an assessment of the Navy's requirement for T-45A aircraft. We did, however, discuss with Navy officials their training requirements and the general status of training aircraft currently in the inventory. Based on those discussions and our review of other program elements, we believe certain facts regarding the 1991 production lot are pertinent to the need for replacement aircraft.

First, according to the Navy, only 12 aircraft (plus associated systems) are needed to equip the first training unit and attain IOC. The Navy already has contracted for three times the number of aircraft needed to achieve that milestone. Delivery of the 12 aircraft needed for IOC will be unaffected by either making or foregoing an additional production commitment in 1991.

Second, estimates of the urgency to replace T-2 and TA-4 aircraft have fluctuated. In 1975, the Navy reported a need to replace those aircraft by 1985. At the outset of full-scale development, the Navy reported that the T-45 system had to be operational no later than fiscal year 1991. More recently, officials at the Air Training Command said that their training requirement and the condition of existing aircraft dictate that the Command begin receiving the T-45 system in 1994. The 36 aircraft already under contract are scheduled for delivery between October 1990 and November 1993.

Third, the Navy's Air Training Command has stated that its requirement can be met only by replacement aircraft that are fully carrier-capable and in the final configuration to train students. Proceeding with the planned 1991 production commitment before a stable design has been demonstrated increases the possibility that aircraft coming off the

assembly line will not be carrier-capable or will have to be retrofitted to their final design configuration.

Projected Cost Increase If 1991 Procurement Is Deferred

A large part of the $55-million projected cost increase cited by the DAB is no longer a consideration. A key element in the Navy's computation was the assumption that deliveries of both the fiscal year 1988 and the fiscal year 1989/1990 production lots would have to be stretched to compensate for deferred 1991 procurement. In this Navy scenario, prices for those aircraft would have to be renegotiated at an estimated cost increase of $50 million.

Under the schedule adopted in January 1990, aircraft will be delivered at even a slower rate than the hypothetical rate the Navy used in its November 1989 computation of the $50-million price increase. Under the latest schedule, the Navy has revised its projected price increase to about $30 million if the 1991 procurement is deferred. Program officials based this revised estimate on the delayed delivery of some aircraft in only the 1989/1990 production lot. The 12 aircraft in the 1988 production lot would not be affected under the projected schedule.

The projected cost increase of about $30 million is not a certainty, however. The Navy could choose to expedite delivery of the planned fiscal year 1992 production lot to prevent the gap from occurring. Navy officials said they have not estimated the additional costs that option may entail.

The previously negotiated not-to-exceed price for the 1989 production lot will be adjusted because it excluded recurring costs of the new wing. Any recurring costs attributable to that change will probably result in equitable adjustment of the price and the delivery schedule.

According to Navy officials, about $136 million of the requested $306 million in procurement funds will be needed even if no aircraft and only two simulators, the minimum sustaining production rate, are bought in 1991. This includes the $30-million estimate for the increased prices discussed above and $36 million for the two simulators, plus $70 million in costs that program officials say they are going to have to ultimately pay—in later years if not in 1991. These latter costs include such obligations as prorated reimbursement of tooling investment and logistics support.

Simulator Procurement Exceeds Aircraft Procurement

Development of the T-45 flight simulators (and other system components) has proceeded without problems comparable to those encountered in development of the aircraft. The Navy has contracted for a total of eight simulators through fiscal year 1990 and has requested funds for five more in fiscal year 1991.

Scheduled simulator deliveries are ahead of aircraft deliveries, and the imbalance will increase at least into fiscal year 1993, regardless of whether additional aircraft are funded in fiscal year 1991. By May 1993, for example, the contractor is scheduled to have delivered only 22 aircraft but enough simulators to support 72 aircraft. Navy officials said that two simulators a year is the minimum rate needed to sustain production.

Fiscal Year 1990 Funding Cut in Simulator Procurement

The Navy requested funds for five simulators in fiscal year 1990, but the Congress appropriated funds for only one simulator, citing the need to slow production while awaiting a stable aircraft design. However, the Navy contends that procuring the four additional simulators under the already negotiated price will be cost-effective. Consequently, the service plans to procure all five of the simulators already under contract, using reprogrammed funds from as yet undetermined sources to pay for the additional four simulators.

In commenting on our report, DOD said the Navy is evaluating options to further align procurement of aircraft and simulators, considering the requirements of the naval training stations and the desire to maintain a minimum sustaining rate.

Conclusions, Recommendations, and Agency Comments

The T-45 program entered production prematurely, without a stable aircraft design and before any Navy flight testing. The aircraft's ensuing performance problems disrupted the program schedule and caused development and procurement costs to increase.

After testing showed the aircraft's problems, we believe the most prudent approach would have been to halt further production commitments until the Navy had achieved a stable design. That approach would also have been consistent with DOD's policy of advancing systems on the basis of demonstrated achievement. However, the Navy and OSD proceeded with a new production commitment while design corrections were being developed. As a result, the Navy now has production commitments for 36 aircraft but still does not have a stable design.

The program's situation can be attributed to an optimistic assessment of the technical challenge involved in adapting the Hawk design to the T-45A mission. That assessment led to the use of an acquisition strategy which minimized development, testing, and government oversight and encouraged early commitments to concurrent production.

Neither of the two options now facing DOD is free of risks and costs. Halting further production commitments until a stable design is developed and demonstrated will likely entail additional costs. But continuing to make production commitments without a proven, stable design perpetuates the type of strategy that led to the program's current dilemma.

The DAB attempted to reduce the risks inherent in continuing production by requiring both incremental obligations of appropriated funds and test results that demonstrate design corrections have been successful. However, those measures are limited in the effect they can have in reducing the uncertainties the T-45 program faces. The restriction on obligations applies only to fiscal year 1989 funds; it does not preclude the Navy from making further contractual commitments for subsequent production lots using later fiscal year appropriations. The requirement for testing of deficiency corrections can also reduce uncertainties, but, at most, will only ensure that the program has achieved the level of design maturity it was supposed to have achieved in 1988.

The Navy and OSD have also attempted to reduce risks by decreasing the rate of production commitments. With the extended development phase that has resulted from the aircraft's deficiencies, however, even the reduced rate will result in a more highly concurrent program—with all of the risks that an overlap in development and production entails.

Moreover, critical tests have been postponed to a greater extent than planned procurement decisions, so that under the restructured program they now follow the decision points they were originally scheduled to support.

At this point in the program, expediting—instead of deferring—testing would be a reasonable risk-reduction measure. Postponing tests has had the opposite effect, increasing the risks that further commitments will be made to produce an aircraft that cannot safely land aboard carriers or otherwise cannot be made effective and suitable for the T-45 mission.

Cost and schedule risks also have increased since the DAB approved a restructured program in December 1989. The program schedule has been further disrupted, the IOC date in the revised Defense Enterprise baseline submitted to the Congress in May 1990 has become unachievable, and the contractor reportedly has submitted a $293-million claim for adjustments under the fixed-price contract. Other cost and schedule impacts can be expected if the postponed tests reveal additional performance problems. In the meantime, the Navy has been unable to determine the price it ultimately will pay for either the redesigned aircraft already under contract or the aircraft to be produced through future commitments.

There appears to be no compelling reason for the Navy to proceed with the planned fiscal year 1991 production commitment. The 12 aircraft in that planned production lot will not affect the system's IOC, and apparently will have minimal effect on either training rates or replacement of existing trainer aircraft. There will probably be some cost increase from deferring the 1991 production lot, but the Navy has not determined either the certainty or the amount of that expected increase. The $55-million projected increase reported by the DAB has been invalidated by subsequent events. A more recent Navy projection puts the expected increase at about $30 million, but that estimate is based on only one of at least two possible scenarios. Moreover, even the $30-million estimate must be balanced against the risk of continuing to make production commitments for a system that has not yet demonstrated its effectiveness and suitability for the Navy's training mission.

We believe that at this point a more prudent approach would be to halt additional production commitments for T-45A aircraft until cost, schedule, and performance risks are reduced. Reduction of performance risks is especially important because of their residual effect on cost and

schedule. We also believe that simulator procurement should be reduced to a level more commensurate with aircraft procurement.

Recommendations

We recommend that the Secretary of Defense withhold authorization for the Navy to proceed with additional production commitments for T-45A aircraft until the service has taken the following minimum risk-reduction measures:

- completion of the operational test phase to verify deficiency corrections,
- completion of the operational test phase to assess carrier-suitability and other critical operational issues,
- completion of initial sea trials and high angle-of-attack/spin testing, and
- definitization of aircraft prices in existing contracts and negotiated prices for subsequent production contracts.

We also recommend that the Secretary of Defense direct the Secretary of the Navy procure only two T-45 simulators in fiscal year 1991.

Related Congressional Actions

DOD requested $305.9 million in fiscal year 1991 funding to procure 12 T-45A aircraft and associated items. Our review of the T-45 program demonstrated that additional commitment to production of this aircraft should be deferred until redesigned models have successfully completed certain critical tests that the Navy postponed until fiscal year 1992. We communicated this result to the Committees on Armed Services and Appropriations in testimony, staff briefings, correspondence, and distribution of our draft report from April through August 1990. The DOD Authorization and the Appropriations bills adopted our view and reflect a $147.8-million reduction.

Agency Comments

In commenting on our draft report, DOD partially concurred with our findings and recommendations. DOD did not concur with the suggestion that the Congress consider appropriating no funds for additional T-45A aircraft in fiscal year 1991. The Department stated that correction of the aircraft deficiencies will be satisfactorily demonstrated in operational tests prior to the spring 1991 Defense Acquisition Board review to consider approval of the next production lot.

We do not believe that testing scheduled for completion in fiscal year 1991 can reduce technical risk sufficiently to warrant additional commitment to T-45A procurement. Development of a new wing for the T-45

Comments From the Department of Defense

DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING

WASHINGTON, DC 20301-3010

28 SEP 1990

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 the General Accounting Office (GAO) draft report, "T-45 TRAINING SYSTEM: Navy Should Reduce Risks Before Continuing Procurement," Dated August 6, 1990 (GAO Code 394319), OSD Case 8441. The Department partially concurs with the GAO findings and recommendations. The Department disagrees with the matter for Congressional consideration suggesting that the Congress consider appropriating no funds for additional T-45 aircraft in FY 1991. Withholding authorization for additional aircraft until the Navy has completed flight testing to the degree recommended by the GAO is not necessary. The DoD has, however, made the 1991 procurement contingent upon successful completion of critical development and operational testing.

The development of the T-45 aircraft has encountered technical problems, particularly in the performance of the aircraft in the low speed, carrier approach configuration. It also encountered problems in manufacturing start up. As a result, costs have risen and scheduled deliveries have been pushed back. Fixes for the technical deficiencies have been identified and manufacturing has been transferred from the Douglas Aircraft Division of McDonnell Douglas Corporation to McDonnell Aircraft Division in Saint Louis, which has more experience with Navy carrier aircraft. While all of the fixes for the developmental problems and production start up have not yet been demonstrated, the current restructured program and acquisition strategy will achieve the program objectives and deliver a suitable Navy jet training aircraft without further delay or cost escalation.

The issues addressed by the GAO in its report were considered, among other factors, by the Defense Acquisition Board in December 1989. The decisions reached by the Board were based on a careful weighing of the technical, schedule, and concurrency risks against the financial risks and pilot training needs of the Navy. The development phase of the program was extended to enable additional testing to be conducted on the aircraft prior to committing funds for follow on production. The production

program has been slowed and buildup to rate delayed. The decision to allow procurement of T-45s to continue at no more than 12 aircraft per year reflects the Department's caution until the aircraft deficiencies are corrected and demonstrated in testing. In addition, specific measures in the form of exit criteria have been instituted to contain the overall T-45 program risk and provide a basis for the fiscal year 1991 procurement decision.

Simulator procurement has been reduced along with aircraft reductions, although not to the extent recommended by the GAO. The Navy is evaluating options to further align procurement of aircraft and simulators, considering the requirements of the Naval training stations and the desire to maintain a minimum sustaining production rate.

Detailed DoD comments on each finding and recommendation are provided in the enclosure. The DoD appreciates the opportunity to comment on the draft report.

Sincerely,

Charles Kirsfeld

Enclosure

is one of the major corrective actions that have been instituted in the wake of the deficiencies discovered in 1988, and the Navy does not expect to receive delivery and begin testing of an aircraft fitted with this new wing until fiscal year 1992. Our reasons are discussed in chapter 2.

- the Defense Acquisition Board directed the Navy to obligate funds only in increments, based on validation of the design corrections; and

- the Defense Acquisition Board directed that, before release of 1991 procurement funds, the Navy must have (1) demonstrated through development testing and operational testing that the aircraft deficiencies have been corrected, (2) obtained recommendations from the test agencies to proceed, and (3) installed a ground training system at the first base scheduled to receive the T-45.

The GAO reported that probably the greatest risk in the T-45 acquisition strategy was the degree of concurrency that allowed no opportunity for operational testing before the first production commitment. The GAO concluded that recent program changes have increased that risk by (1) postponing tests that were to have supported additional production commitments, and (2) increasing the number of aircraft to be produced before development and operational testing are completed. The GAO observed that an especially important safeguard for concurrent programs is at least one phase of operational test and evaluation before the initial production commitment. The GAO further concluded, therefore, that in restructuring the program, the DoD increased the degree of concurrency by postponing important tests. The GAO asserted that delays in scheduled tests should be accompanied by corresponding delays in production commitments. The GAO found, however, that the commitment for the second production lot of 24 aircraft was made without successful completion of the 1988 test objectives, as planned. The GAO further found that, as now scheduled, the decision to contract for the 1991 production lot of 12 additional aircraft will also be made before completion of the tests that were to have been conducted in support of the decision.

The GAO also found that, under a March 1990 draft of the program's revised test and evaluation master plan, all of those operational test have been postponed until after commitments will have been made for 48 aircraft. The GAO noted that similar or longer postponements have been scheduled for development tests for other important technical issues. In addition, the GAO found that, under the revised schedule, commitments will be made to produce 72 low rate initial production aircraft (24 percent of the planned total buy) before development testing and initial operational testing are completed. (pp. 34-37/GAO Draft Report)

Now on pp. 19-20.

DOD RESPONSE: Partially Concur. Four review teams assessed the aircraft design deficiencies and the design changes. The

The GAO reported that the Navy's initial tests in 1988 revealed that adapting the Hawk design to the T-45 mission was more technically challenging than had been estimated. The GAO found that the aircraft delivered to the Navy for testing proved to be ineffective and unsafe for training student aviators in a carrier environment. The GAO noted that, by this time, the Navy had already contracted to produce the aircraft and was approaching the deadline for exercising the second production option with the not-to-exceed prices that had been a key part of the development contract. The GAO pointed out that, since the option was not contingent on the accomplishment of required testing, the Navy could not unilaterally extend either the deadline or the not-to-exceed prices. The GAO further noted that the program manager, referring to the second production lot, indicated that (1) the contractor has fallen behind, (2) a Defense Acquisition Board decision has not been possible, (3) the option date has passed without being exercised, and (4) the Government has lost certainty of price and schedule protection and does not have significant leverage to regain it. (pp. 30-33/GAO Draft Report)

Now on pp. 16-17.

DOD RESPONSE: Partially Concur. Several features of the acquisition strategy were adapted to reduce risk to the Government. The program's initial development and technical risks were considered to be controllable because the firm-fixed-price contract placed the development risk on the contractor who maintained the performance requirements could be met. Also, the derivative concept was strongly supported by ongoing HAWK testing, production, and operations in the United Kingdom and in other foreign applications. The second production option was established prior to the Defense Acquisition Board program review in December 1989 and is under a Not-to-Exceed type contract. Consequently, the Navy has cost and schedule protection consistent with the rebaselined program.

- **FINDING E: Navy and Office of the Secretary of Defense Response to Program Problems.** The GAO reported that the Navy and the Office of the Secretary of Defense faced a dilemma on whether to halt or continue production commitments, while attempting to achieve a stable design. The GAO noted that, after initially deciding to halt production commitments, the DoD elected to proceed with an additional commitment. The GAO reported that the Navy and the Defense Acquisition Board took a number of steps to reduce risk, including the following:

  - the Navy brought in an independent team to assess the design changes needed to correct the aircraft deficiencies and slowed the procurement rate;

submitted to the Congress on May 1, 1990. The GAO concluded, however, that events occurring in the interim make it likely that the new Defense Enterprise baseline will also be breached. The GAO reported that, in the revised baseline, the initial operational capability target date was reported as June 1991--but with delayed deliveries, the Navy does not now expect to reach initial operational capability until November 1992. The GAO reported that some Navy officials maintained that the decision by McDonnell Douglas to suspend deliveries will reduce the level of concurrency by allowing the contractor extra time to develop and install corrections. The GAO disagreed, asserting that the Navy still plans to buy 72 aircraft before development and testing are completed.

The GAO also reported that additional delays can be expected if problems develop with either the planned corrections to the deficiencies discovered in 1988 or the performance areas not yet tested. The GAO noted that, in December 1989, the Conventional Systems Committee reported that high angle of attack/spin testing, then scheduled for 1991, has the potential for discovering unexpected deficiencies, which could cause further delays in the program. The GAO observed that testing has since been postponed until April 1992. (pp. 38-40/GAO Draft Report)

Now on pp. 21-22.

DOD RESPONSE: Partially Concur. A program baseline breach notification to Congress, which explains the production program change and benefits of the initial-operational-capability adjustment, is currently in work. The GAO reported that high angle-of-attack/spin testing has been postponed until April 1992. This is not entirely true. High angle-of-attack testing is composed of stall tests and post-stall/spin tests. Stall testing is a critical phase of development where the aircraft wing must be refined in order to develop acceptable flying qualities for the mission. Refining the wing can result in a long development period and major redesign, as seen on the T-45A.

It should be noted that the T-45 development program attacked this area of testing early in Development and Operational Testing-IIA. Deficiencies were found and corrections will be demonstrated in Development and Operational Testing-IIB. The post-stall/spin testing, which has been rescheduled, is a continuation of tests with the refined wing configuration. Risk will be minimized by the successful completion of stall testing, wind tunnel testing, and simulation. This approach to high angle of attack testing has been successfully demonstrated on the AV-8B.

by the Navy in FY 1989. The rebaselined program stretched-out the procurement of T-45 aircraft, including deletion of the entire FY 1990 buy. While the intent of the Defense Enterprise Program is streamlined acquisition, the T-45 program did not experience reduced scrutiny, as the GAO states, because the program encountered significant problems early on that led to breeching the baseline thresholds. The T-45 program receives Office of the Secretary of Defense oversight to the same degree as any other major defense acquisition program. The $72 million released by the DoD in August 1989 was considered the minimum termination liability necessary to maintain the Douglas Aircraft Company commitment on the T-45 program until after the Defense Acquisition Board program review in December 1989, and also provided the Navy the basis for a Not-to-Exceed agreement on the FY 1989/FY 1990 procurement option.

The schedule change after the Defense Acquisition Board affects only production deliveries. All test and evaluation schedules and milestone decision points in the development program have remained essentially the same as presented to the Defense Acquisition Board. The change in the production program was based on the business decision not to deliver fixed leading edge wing aircraft which would require costly retrofit, but rather to wait until slatted wing aircraft could be delivered.

- **FINDING C: Acquisition Risks.** The GAO concluded that, from the outset of development, the Navy T-45 acquisition strategy was a calculated gamble. The GAO noted, however, that technical risks were assessed by the Navy as only low to moderate--and there was a perceived need to have the system operational no later than FY 1991. The GAO found that, in practice, adapting the Hawk design to the T-45 mission proved more challenging than either the Navy or the contractor envisioned. The GAO reported that, when the design flaws became apparent, the Navy and the Office of the Secretary of Defense took a number of measures to reduce risk, but those measures will not reduce all of the risks that have evolved since the aircraft's deficiencies became apparent. The GAO further concluded that the recent restructuring of the program has actually heightened program risks by postponing key tests and increasing the number of aircraft to be bought before development is completed and before operational testing has demonstrated that a production representative model of the aircraft is effective and suitable for its mission. The GAO referenced a 1984 Office of the Secretary of Defense report, which concluded, "This redesign effort is certainly not a minimal task and may in fact be more complex than designing from scratch." The GAO noted that, since World War II, no U.S. fighter or attack

Now on p. 23

The GAO reported that, while the Navy considers all deficiencies correctable with existing technology, not all of the corrections have been (1) determined (two rudders are still under consideration) or (2) developed (development of the new wing is incomplete), or (3) tested as an integrated system. The GAO pointed out that the Navy has no test results to support the position that the technical risks may be low, as the Defense Acquisition Board reported. (pp. 42-43/GAO Draft Report)

DOD RESPONSE: Partially Concur. The DoD does not agree with the GAO statement that the Navy test results do not support the position that technical risks may be low, as the Defense Acquisition Board reported. Recent test results indicate those problems that have been surfaced are being corrected and substantiate the judgement made by the Defense Acquisition Board. For example, extensive wind tunnel testing of the slatted wing in 1989 and early 1990 confirm the robustness of the fix. Contractor testing to demonstrate all the deficiency corrections is currently underway with Navy development and operational testing to follow in November/December 1990. Additionally, the baseline rudder design has been established as the no-float rudder.

- **FINDING J: The Defense Acquisition Board Decision To Release Long-lead Funds For The 1991 Production Lot.** The GAO reported that the Defense Acquisition Board cited three reasons for releasing funds for the 1991 production lot, as follows:

  - the Navy and Joint Staff reaffirmation of an urgent need to replace the T-2 and TA-4 trainer aircraft;
  - the concensus that technical risks were low; and
  - the Navy's projected cost increase of $55 million, if long-lead funds were withheld.

  The GAO reported the Navy indicated that only 12 aircraft are needed to equip the first training unit and attain initial operational capability. The GAO found, however, the Navy has already contracted for three times the number needed to achieve that milestone. The GAO also concluded that estimates of the urgency to replace the T-2 and TA-4 aircraft have been fluid. The GAO observed that officials at the air training command indicated that the condition of existing aircraft dictate that the command begin receiving the T-45 system in 1994. The GAO noted that 36 aircraft already under contract are scheduled for delivery between October 1990 and November 1993--which is considerably before that date.

**GAO DRAFT REPORT - DATED AUGUST 6, 1990
(GAO CODE 394319) OSD CASE 8441**

"T-45 TRAINING SYSTEM: NAVY SHOULD REDUCE RISKS BEFORE CONTINUING PROCUREMENT"

DEPARTMENT OF DEFENSE COMMENTS

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FINDINGS

Now on pp. 2, 9-10.

- **FINDING A: The T-45 Training System.** The GAO reported that the T-45A Goshawk is the major component of a $5.9 billion flight training system McDonnell Douglas Corporation is developing for the Navy. The GAO further reported that, after contracting for the first production lot of 12 aircraft before development was complete, during initial flight tests in 1988, the Navy discovered that the aircraft design was seriously flawed. The GAO noted the Naval Air Test Center conducted development testing, reported 24 deficiencies, and concluded that the aircraft had limited potential for its mission, but would be satisfactory after the deficiencies were corrected. The GAO further noted the Navy Operational Test and Evaluation Force found that the aircraft (1) was potentially effective in a non-carrier environment, (2) was not effective in a carrier environment, (3) was not operationally suitable because of safety deficiencies--and concluded that a recommendation for limited production could not be supported until correction of the deficiencies had been verified by additional operational testing. The GAO found that no additional operational testing is scheduled until September 1990. (p. 2, pp. 16-20/GAO Draft Report)

  DOD RESPONSE: Concur. The Navy Operational Test and Evaluation Force actually said that the T-45A aircraft, as then configured, did not have the potential to be operationally effective or suitable in the aircraft carrier environment. Configuration changes are being made to the aircraft to provide satisfactory operation in the carrier environment.

- **FINDING B: Funding Withheld and Baseline Breach.** The GAO reported that, after the tests, the Office of the Secretary of Defense (1) prohibited the Navy from obligating FY 1989 procurement funds for the planned second production lot of 24 aircraft and (2) canceled that portion of the FY 1990 budget request that would have funded procurement of the 24 additional aircraft in the third production lot. The GAO

- **FINDING K:** Simulator Procurement Exceeds Aircraft Procurement. The GAO reported that the development of the T-45 flight simulators has proceeded without problems comparable to those of the aircraft. The GAO noted that the scheduled deliveries of simulators is ahead of aircraft deliveries--and the imbalance will increase, at least into FY 1993, regardless of whether additional aircraft are funded in FY 1991. The GAO observed that, by May 1993, the contractor is scheduled to deliver only 22 aircraft--but enough simulators to support 72 aircraft.

  The GAO reported that, in FY 1990, the Navy plans to procure all five simulators under contract by using reprogrammed funds--even though the Congress appropriated funds for only one simulator and citing the need to slow production while awaiting a stable aircraft design. The GAO noted that the Navy contends that the procurement under the already negotiated price will be cost effective. The GAO nonetheless concluded that simulator procurement should be reduced to a level more commensurate with aircraft procurement. (pp. 47-48/GAO Draft Report)

Now on p. 26.

  DOD RESPONSE: Partially Concur. With the T-45 Training System concept of delivering a total training system, the importance of the timing of simulator delivery is critical to the program. Lead-time for simulators is a full year longer than aircraft lead-time. Simulators are being procured at minimum sustaining production rates which should be maintained. Additionally, procurement of simulators ahead of aircraft is necessary to provide timely introduction of the integrated system at the Naval training facilities.

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RECOMMENDATIONS

- **RECOMMENDATION 1:** The GAO recommended that the Secretary of Defense withhold authorization for the Navy to proceed with additional production commitments for T-45A aircraft until the Navy has taken the following risk-reduction measures:

  - completion of the operational test phase to verify deficiency corrections;
  - completion of the operational test phase to assess carrier-suitability and other critical operational issues;

teams agreed on the corrective actions. The GAO reiterates its discussion about the revised test program in the rebaselined program identified in Finding C. (See the DoD response to Finding C.) Regarding the procurement of 12 aircraft in FY 1991, the Defense Acquisition Board authorized the 1991 long lead funds with the stipulation that the Navy base the subsequent release of these funds to the contractor on validated long lead items. To date, the Navy has not released any of those funds to the prime contractor. Additionally, the Navy does not plan to contract for the 1991 aircraft until after the completion of testing to support the decision.

- **FINDING F: Concurrency.** The GAO reported that the Under Secretary of Defense for Acquisition provided congressional committees a report on concurrency in major defense acquisition programs that categorized the T-45 program as having only a "moderate" degree of concurrency. The GAO strongly disagreed, asserting that the T-45 clearly has a "high" degree of concurrency since the program proceeded to low rate initial production before any initial operational test and evaluation was completed. The GAO also reported that an official of the Office of the Secretary of Defense maintained that low rate initial production has not yet begun--it is the GAO position, however, that it began with the first production authorization in November 1987. The GAO contended that "pilot production" (12 aircraft per year) is clearly within the Navy definition of low rate initial production (24 aircraft per year). (pp. 37-38/GAO Draft Report)

Now on pp. 20-21.

DOD RESPONSE: Partially Concur. The determination of the T-45 program being of moderate concurrency was derived as the percentage of procurement funds committed before the end of operational test and evaluation, relative to the total procurement of the program, which was consistent with the assessment of concurrency risk of major programs recently reported to Congress. The Navy's procurement plan provides for the orderly establishment of a production base leading to a full production decision after operational testing is completed. The DoD will continue to review low rate initial production quantities to ensure consistency with procurement and budgetary guidelines. The derivative nature of the aircraft, combined with the intermediate operational test and evaluation phases, continue to support the moderate categorization.

- **FINDING G: Revised Baseline Likely To Be Breached.** The GAO reported that, at the same December 1989 meeting, the Defense Acquisition Board approved a new program baseline--which released funds for additional T-45 procurement and which was

Now on p. 29.

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MATTER FOR CONGRESSIONAL CONSIDERATION

- The GAO suggested that the Congress consider appropriating funds for no additional T-45A aircraft and appropriating funds for only two T-45 simulators in FY 1991. (p. 54/GAO Draft Report)

DOD RESPONSE: Non-Concur. Although the DoD agrees that some concurrency and risk remain in the program, previous DoD budget decisions have removed 84 aircraft and 10 simulators from FY 1990 through FY 1992 to reduce risk and concurrency. In addition to other factors, the December 1989 Defense Acquisition Board considered the same factors that the GAO presented in its report. The Defense Acquisition Board judged (1) that additional aircraft procurement was not warranted beyond the FY 1989/FY1990 procurement lot until deficiency corrections were satisfactorily demonstrated and (2) that simulator procurement could proceed at a minimum sustaining rate. Progress has been made in correcting aircraft deficiencies and success has been demonstrated in aircraft flight and wind tunnel testing. Corrections to aircraft deficiencies will be satisfactorily demonstrated in operational tests prior to the Spring 1991 Defense Acquisition Board review to consider approval of the next production lot.

- **FINDING H: Cost Risks Remain.** The GAO reported that the cost risks will not be substantially reduced by the Defense Acquisition Board proviso that the Navy obligate the remaining pilot production funding in increments, based on successful validation of the fixes to be demonstrated at the next phase of development and operational testing. The GAO found that the Navy obligated $60 million in January 1990 and plans to obligate about $40 million in June 1990--before a production version of the new wing is available and before any of the planned corrections will have been operationally tested. The GAO also pointed out that validating corrections will not resolve a major cost uncertainty--i.e., the liability for correcting the aircraft deficiencies. The GAO reported that, while Navy officials contend the contractor is responsible for added development and schedule costs, in December 1989, the Conventional Systems Committee reported there was a strong possibility the contractor would attempt to recover costs through either claims or the courts. The GAO noted that, in January 1990, the contractor notified the Navy in writing that it is preparing a proposal for an equitable price and/or schedule adjustment. The GAO also reported that the recurring costs of the installed corrections will not be known until the contract modifications for the FY 1989 production lot are definitized and prices are negotiated under a new contract for subsequent production lots. The GAO noted a Navy official indicated that price quotations for the replacement engine and wing are expected between April and September 1990. (pp. 41-42/GAO Draft Report)

Now on pp. 22-23.

DOD RESPONSE: Partially Concur. The foreign exchange rate continues to fluctuate and this is a major source of cost risk. The DoD has based release of funds for the FY 1989-FY 1990 production lots and the FY 1991 long lead items--on revised termination liability estimates. No more than the minimum funding required to cover termination liability is provided to the contractor to accomplish milestones established by the Navy. Funding for the FY 1991 production will not be released to the contractor until flight test results are known. As mentioned earlier, the firm fixed price contract also provides an incentive for cost control, by placing the burden of risk with the contractor.

- **FINDING I: Low Technical Risks Have Not Been Demonstrated.** The GAO reported that the Defense Acquisition Board support for maintaining production under the restructured program, was based, in part, on the "concensus" that technical risks were low. The GAO found, however, that low technical risk has not been demonstrated and, to the contrary, the only operational test yet completed demonstrated that the earlier Navy assessment of low to moderate technical risk was very optimistic.

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The GAO also reported the Navy training command stated its requirement can only be met by replacement aircraft that are fully carrier-capable and in the final configuration to train students. The GAO concluded, however, that proceeding with the planned 1991 production commitment before a stable design has been demonstrated, increases the possibility that aircraft coming off the assembly line will not be carrier-capable or will have to be retrofitted.

The GAO reported that a large part of the $55 million projected cost increase cited by the Defense Acquisition Board is no longer a consideration. The GAO noted that, under the Navy scenario, the prices for the FY 1988 and FY 1989-FY 1990 production lots would have to be renegotiated at an estimated cost of $50 million, because of stretched out procurement to compensate for the deferred 1991 procurement. The GAO found that, under the latest schedule, the Navy has revised its projected price increase to about $30 million--if the 1991 procurement is deferred--because the 12 aircraft in the 1988 production lot would not be affected under the projected schedule. The GAO also pointed out that the projected increase of $30 million is not a certainty, because the Navy could choose to expedite delivery of the planned FY 1992 production lot to prevent the gap from occurring. The GAO reported that the previously negotiated price for the 1989 production lot is probably going to be adjusted and changes will probably require that price negotiations be reopened. The GAO observed that, according to Navy officials, about $136 million of the requested $306 million in procurement funds will be needed even if no aircraft and only two simulators, the minimum sustaining rate, are bought in 1991. The GAO concluded that there appears to be no compelling reason for the Navy to proceed with the planned FY 1991 production commitment. The GAO further concluded that the DoD should halt additional production commitments until cost, schedule, and performance risks are reduced. (pp. 44-47/GAO Draft Report)

Now on pp. 24-25.

DOD RESPONSE: Partially Concur. The initial operational capability with 12 aircraft provides only an initial capability to train pilots at the Naval Air Station, Kingsville. Continuous deliveries for 6 years are needed to achieve full operational capability. Delaying the delivery of additional aircraft forces the training command to use the aging T-2C and TA-4J longer than planned. As noted previously, procurement of FY 1991 aircraft will not be initiated by the Navy until critical development and operational testing of the aircraft fixes has been conducted.

- completion of initial sea trials and high angle-of-attack/spin testing; and

- definitization of aircraft prices in existing contracts and negotiated prices for subsequent production contracts. (p. 53/GAO Draft Report)

Now on p. 29.

DOD RESPONSE: Partially Concur. The DoD continues to emphasize risk reduction as a primary management tool and has implemented some of the above measures. However, completing flight testing to the degree suggested by the GAO prior to further procurement results in attendant cost increases which are not justified. Completion of the operational test phase in November/December 1990 will validate deficiency corrections and assess carrier-suitability, high angle-of-attack (stall) and other critical operational characteristics. Additional production commitments will not be authorized until this testing is satisfactorily completed. Completion of follow-on high angle-of-attack/spin testing and initial sea trials are not necessary prior to a decision to proceed with additional low rate production commitments, but will be required prior to a full rate production approval. While the FY 1989/1990 procurement is not yet definitized, the Navy has established a Not-to-Exceed contract for this procurement. Consequently, certainty of price and schedule protection have been achieved.

- **RECOMMENDATION 2:** The GAO recommended that the Secretary of Defense direct the Navy to reduce the rate of simulator procurement to a minimum sustaining rate more commensurate with the rate of aircraft procurement. (p. 53/GAO Draft Report)

Now on p. 29.

DOD RESPONSE: Partially Concur. The Navy has previously reduced simulator procurement profiles along with those of the aircraft. While the GAO is correct that simulator procurement exceeds aircraft production, this is a result of a considered business decision to reduce costs. The T-45 simulator provides a significant percentage of the business base of the simulator contractor, so the impact of procurement restructuring on the contractor must also be considered. The Navy is evaluating procurement options to align simulator and aircraft deliveries more closely, while maintaining minimum sustaining production rates.

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