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U. S. GENERAL ACCOUNTING OFFICE

STAFF STUDY

A-10 CLOSE AIR SUPPORT AIRCRAFT

DEPARTMENT OF THE AIR FORCE

MARCH 1974

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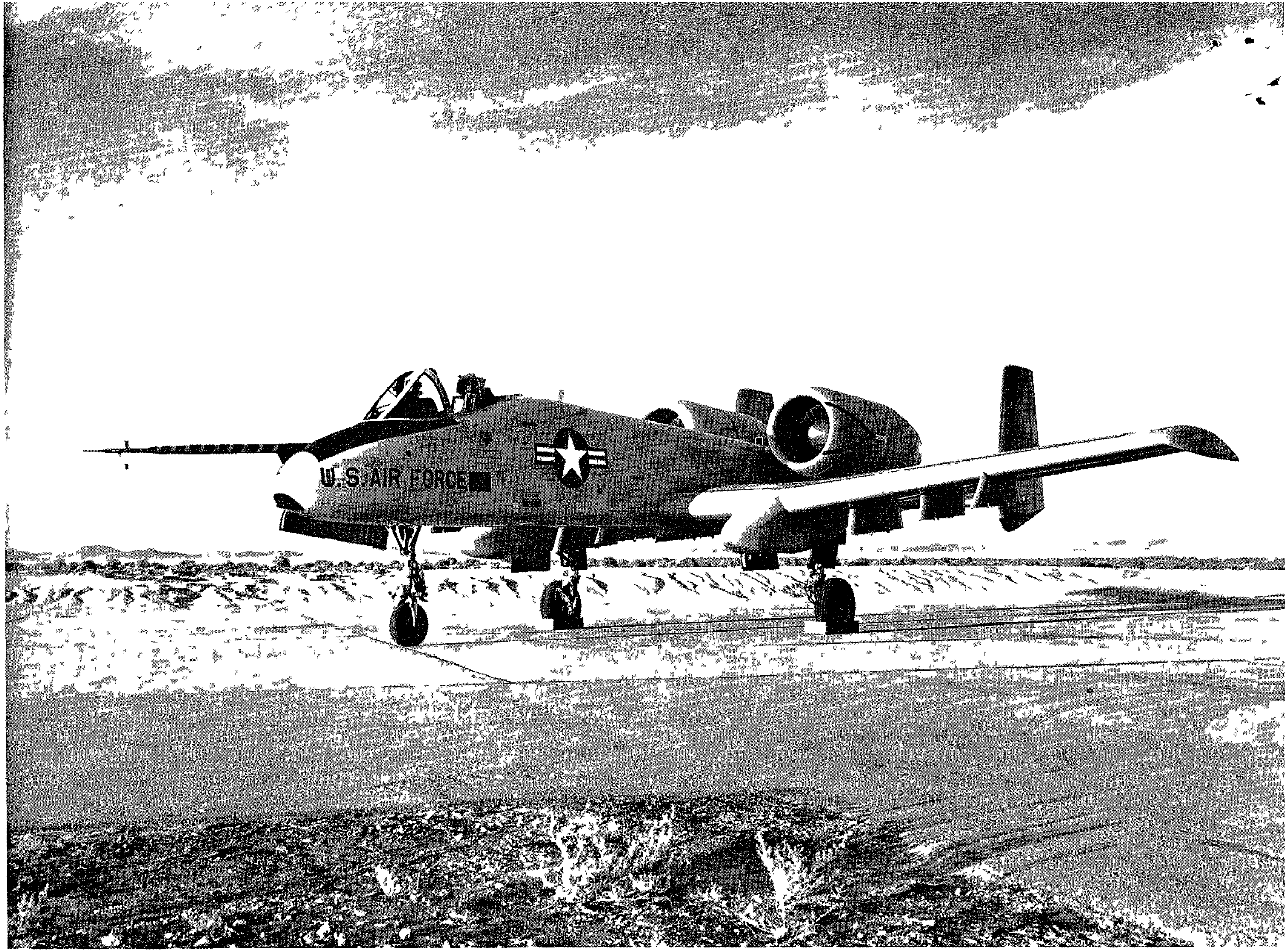
U.S. AIR FORCE

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ABBREVIATIONS

AFLC	Air Force Logistics Command
AGE	Aerospace Ground Equipment
ASD	Aeronautical Systems Division
CAIG	Cost Analysis Improvement Group
CDRL	Contract Data Requirements List
CPIF	Cost Plus Incentive Fee
CPP	Competitive Prototype Phase
CPR	Cost Performance Report
C/SCSC	Cost/Schedule Control Systems Criteria
DCP	Development Concept Paper
DSARC	Defense Systems Acquisition Review Council
DT&E	Development Testing and Evaluation
ECM	Electronic Countermeasure
FPIF	Fixed Price Incentive Firm
FY	Fiscal Year
IFF	Identification, Friend or Foe
IOT&E	Initial Operational Test and Evaluation
OSD-CAIG	Office of the Secretary of Defense - Cost Analysis Improvement Group
PAR	Program Assessment Review
RDT&E	Research, Development, Test and Evaluation
RFP	Request for Proposal
SAIMS	Selected Acquisition Information Management System
SAR	Selected Acquisition Report
SPO	System Program Office
TPM	Technical Performance Measurement

SUMMARY

SYSTEM DESCRIPTION AND STATUS

The A-10 is a twin turbofan aircraft specifically designed to provide a close air support capability in a battle area involving antitank and antimechanized vehicle operations in close proximity to friendly ground forces. The A-10 is capable of carrying up to 16,000 pounds of external munitions as well as a 30mm rapid fire high muzzle velocity gun with a capacity of 1350 rounds of ammunition.

The A-10 program is currently in the full-scale development phase of the acquisition process.

The Defense Authorization Bill for fiscal year 1974 directed that the RDT&E program for the A-10 be reduced from 10 to 6 aircraft. Related to this, the Defense Appropriation Bill for fiscal year 1974 reduced the A-10 development program by $5.0 million As a result, the Air Force initiated action in October 1973, to adjust the A-10 program. This action provides that 4 of the original 10 RDT&E aircraft be placed on option for procurement using fiscal year 1975 and subsequent year RDT&E funds. Further, the procurement of the first 26 production aircraft will be based on release of long lead time funds in July 1974, rather than May 1974, as originally scheduled. Under the adjusted program, the delivery of the first production aircraft will slip from November 1975 to March 1976. For fiscal year 1975, the Air Force has requested $169.2 million for 26 aircraft, $4.6 million for initial spares, and $93.9 million for RDT&E.

The A-10 is scheduled to begin a flyoff with the A-7D in April 1974, to determine which aircraft has the greater capability in the close air support role. The results of the flyoff, scheduled to be available in June 1974, will impact strongly on the future of the A-10 aircraft program.

COMING EVENTS

The following significant events are currently scheduled.

Critical Design Review	March 1974
Design-to-Cost Review	March 1974
Production Readiness Review	April 1974
A-10 Aircraft/GAU-8 Gun Prototype Compatibility Test	April 1974
Flyoff between the A-10 and A-7D aircrafts	April 1974
DSARC IIIA (DSARC recommendation on initial production)	June 1974
Release FY 75 long-lead time production funds	July 1974

COST

The estimated cost of the A-10 program, including modifications and component improvement, as of September 30, 1973, was $2,555.5 million, which is an increase of $286.5 million over the estimated cost of the program at December 31, 1972, and $1,530.0 million increase over the A-X program estimate of $1,025.5 million at April 1970. The $286.5 million increase is attributed to (1) an increase from the Air Force estimated unit flyaway cost goal of $1.5 million

to the OSD-CAIG estimate of $1.7 million, or $175.6 million; (2) additional economic escalation of $68.2 million, (3) a decrease in initial spares of $23.1 million; and (4) an increase in logistics support and additional procurement costs of $65.8 million. The estimated unit program cost for 743 aircraft was $3.35 million as of September 30, 1973.

Economic Escalation

Using fiscal year 1970 as the base year, the program cost estimate at September 30, 1973, included economic escalation totaling $721.3 million or 28 percent of the total program estimate.

The current rate of economic escalation for total program costs through fiscal year 1980 is 4.8 percent compounded annually

Costs Not Included in Program Estimate At September 30, 1973

The program cost estimate for the A-10 excludes costs for the GAU-8 gun development of $49.7 million; survivability/vulnerability testing of $2.5 million, logistics support and additional procurement of $96.3 million, and Group B avionics of over $315,000 per aircraft (for an undetermined number of aircraft).

CONTRACT DATA

On March 1, 1973, the Air Force awarded a cost-plus incentive fee full-scale development contract in the amount of $159.3 million to Fairchild Industries to design, develop, and fabricate ten A-10 aircraft.

In November 1972, the Air Force awarded a fixed price incentive firm contract in the amount of $14.5 million to General Electric Company to develop and qualify the TF-34-GE-100 engine

On March 1, 1973, the Air Force awarded a fixed price incentive firm contract to General Electric Company to supply 32 TF-34-GE-100 engines for ten RDT&F A-10 aircraft.

On June 21, 1973, the Air Force awarded a fixed price incentive firm contract with a target price of $23.8 million for the full-scale development of the GAU-8 gun system and ammunition to General Electric Company for eight preproduction and three refurbished gun systems.

As of October 31, 1973, there had been a total of 26 modifications to the four contracts which will increase contract costs by about $4.0 million. (See pages 28 and 29 for details on contract modifications.)

SCHEDULE

Schedule milestones reported on the SAR for September 30, 1973, have not changed from those reported and discussed in our staff study of July 1973. No milestones were scheduled to be completed during this reporting period.

PERFORMANCE

There have been no reported changes in the performance characteristics of the A-10 since our July 1973 staff study.

As of August 31, 1973, the airframe contractor reported an unfavorable variance for six technical and performance characteristics called for in the contractor specifications, which are generally more stringent than the program goals reported in the SAR. Of those technical and performance characteristics showing an unfavorable variance the contractor estimates that, with the exception of "loiter time" and "sustained load factor at 275 knots", it will meet or exceed all program goals.

STATUS OF FUNDING

The Congress has appropriated $232.4 million for the A-10 Competitive Prototype Phase and full-scale development through fiscal year 1974. As of November 15, 1973, $159.0 million had been obligated and $106.1 million expended.

The status of funding for the A-10 program as reflected in the SAR for September 30, 1973, shows a request for fiscal year 1974, of $112.4 million for RDT&E, and $30.0 million for procurement. Estimates to complete RDT&E and procurement are $99.3 million and $2,123.0 million, respectively. Of the funds requested for fiscal year 1974, $107.4 million were appropriated for RDT&E. The $30.0 million requested for advance procurement was deleted in its entirety.

RELATIONSHIP TO OTHER SYSTEMS

While the A-10 is designed specifically for the close air support role, there are other aircraft in the current DOD inventory that are capable of furnishing some close air support. These aircraft include the Air Force's A-7D, the Navy's A-7E, and the Marines' A-4M and AV-8A.

The engines used in the A-10 aircraft are a modified version of the engines used in the Navy S-3A aircraft. Any change in production quantities or delivery schedules for either aircraft will have an impact on the overall cost of those engines

STATUS OF TESTING

An important upcoming test milestone is the preliminary airframe/gun ground andflight compatibility test which is to be completed in April 1974

Impending program action to conduct an A-10/A-7D flyoff will delay completion of scheduled testing with two prototype aircraft

DESIGN-TO-COST

Design-to-cost, as implemented in the Department of Defense, is a management tool to facilitate design of a weapon system to a predetermined unit production cost based on known parameters, such as system performanc goals, stated equipments, production quantity, production rate, and specified-year dollars. In the case of the A-10, the Air Force design-to-cost goal is $1 5 million per unit flyaway cost, based on a production quantity of 600 aircraft, at a peak production rate of 20 per month, and expressed in fiscal year 1970 dollars.

A Joint Design-to-Cost Guide, A Conceptual Approach for Major Weapon System Acquisition, dated October 3, 1973, has been issued for use by the military services The guide contains the first authoritative delineation of the design-to-cost concept and espouses a single cumulative "average unit flyaway cost" goal

It is too early in the A-10 program to determine whether the A-10 contractors will meet their portions of the $1 5 million design-to-cost goals The first design-to-cost demonstration milestone for the three A-10 contractors is scheduled for March 1974

SELECTED ACQUISITION REPORTING

The September 30 1973, SAR, excluded $148 5 million in costs which have been expended or are planned to be expended for the benefit of the A-10 (see page 3 for costs not included in SAR) Group B avionics costs of about $315,000 per aircraft were also excluded even though the using command feels that these items will be needed on every A-10 used in combat.

We believe that the A-10 SAR should include the above costs In addition, the SARs for this weapon system have never shown the initial program planning estimate of $1,025 5 million as contained in the DCP of April 1970

The baseline now used to track changes in program costs is $2,555.5 million, the estimated cost of the program at December 31, 1972

CONTINUING THREAT ASSESSMENT

A number of Russian made missiles and tanks were obtained during the mid-East conflict A detailed examination of the capabilities of the SA-6 and SA-7 surface-to-air missiles should lead to a better assessment of the survivability and vulnerability of our close air support aircraft which must operate within the threat envelope of these missiles In addition, the testing of the GAU-8 gun against the Russian T-62, T-54, and T-55 tanks could provide an assessment of the effectiveness of the A-10 system against the known tank threat. A similar comparison of other candidate aircraft for this assessment also appears appropriate

MATTERS FOR CONSIDERATION

The Congress may wish to request information of the following matters before authorizing and appropriating production funds

--the ground rules and criteria for conducting, and evaluating the results of the flyoff between the A-10 and A-7D aircraft

--an updated appraisal of the survivability and vulnerability of the A-10 in view of the latest enemy threat data obtained during the mid-East conflict

--an evaluation of the armor piercing capabilities of the GAU-8 30mm combat ammunition against the latest Russian T-62 tank

--the adequacy of planned test results to support the production decision, as a result of the upcoming flyoff and the reduced number of preproduction aircraft.

--the Air Force's plans for funding the remaining 4 of 10 RDT&E aircraft (reduced from 10 to 6 by the Defense Authorization Bill for fiscal year 1974)

--the conditions under which the Group B avionics may be necessary and the number of aircraft which would require this equipment in order to accomplish the basic close air support mission.

--the effectiveness of the design-to-cost concept in the A-10 program since the A-10 is the first major system to adopt a formal design to cost procurement concept, and is the furthest along in the process

AGENCY COMMENTS

A draft of this staff study was reviewed by DOD officials associated with the management of the program, and their comments are incorporated in the report as we believe appropriate. We know of no residual difference with respect to the factual material presented herein.

CHAPTER 1

INTRODUCTION

The General Accounting Office (GAO) established a long-term program to provide the Congress with data on the status of major weapon systems for its use during the regular authorization and appropriation processes. This report on the A-10 Weapon System provides the status of the program as well as information on contracts, management controls, design-to-cost, and testing through September 1973.

SYSTEM DESCRIPTION

The A-10 is a twin turbofan aircraft specifically designed to provide a close air support capability composed of close support fire, armed escort and armed reconnaissance The A-10 will be used against tanks, vehicles, and other targets in close proximity to friendly ground forces The A-10 is capable of carrying up to 16,000 pounds of external load as well as a 30mm rapid fire high muzzle velocity gun and will be used by the Tactical Air Command

A-10 PROGRAM CONTRACTS

The A-10 weapon system entered the full-scale development phase on March 1, 1973, when a cost plus incentive fee contract in the amount of $159 3 million was awarded to Fairchild Industries, Inc , Farmingdale, New York, to design, develop, and fabricate ten preproduction aircraft On the same date, the Air Force awarded a fixed price incentive firm contract in the amount of $27.7 million to General Electric Company, Aircraft Engine Group, to supply 32 engines for the ten A-10 aircraft

During June 1971, research and development contracts totaling $24 3 million were awarded to General Electric Company, Armament Systems Department, Burlington, Vermont, and Philco-Ford Company, Newport Beach, California, to design and build prototype 30mm gun systems for the A-X aircraft. A competitive firing evaluation was conducted by the Air Force at Eglin Air Force Base between January and April 1973, which led to the award of a fixed price incentive firm development contract in the amount of $23.8 million to General Electric on June 21, 1973. The A-10 will be the first major weapon system to use the GAU-8 gun.

SCOPE

Information on the A-10 program was obtained by reviewing plans, reports, correspondence, and other records and by interviewing officials at contractors' plants, the SPO, and intermediate and higher commands of the Department of Defense. We evaluated management policies, procedures, and controls related to the decision making process, but did not make detailed analyses or audits of the basic data supporting program documents. We made no attempt to (1) assess the military threat or the technology, (2) develop technological approaches, or (3) involve ourselves in decisions while they were being made.

IMPENDING PROGRAM ACTIONS

During Hearings for fiscal year 1974 program funding, the Senate Armed Services Committee voted to reduce the RDT&E authorization request of $112.4 million by $20 million and the quantity of development aircraft from ten to six. In addition, the Committee voted to delete the entire $30 million procurement authorization request and insisted that a "fly-off" between the A-10 and A-7D aircraft be conducte

In October 1973, the House/Senate Conference Committee voted to restore $15 million of the $20 million reduction of RDT&E funds to allow for full funding of 6 RDT&E aircraft, but upheld the deletion of the requested $30 million for procurement. In addition, Congress informed the Air Force that funding of the A-10 program for fiscal year 1975 would be influenced by the results of the A-10/A-7D flyoff

As a result of reduced program funding and the requirement for an A-10/A-7D flyoff, the SPO advised the A-10 contractors that the release of long lead time production funds would slip from May to July 1974, that release of full production funds for production option number one (for 26 aircraft) would occur in November 1974, and that delivery of the first production aircraft would slip from November 1975 to March 1976.

We were advised by Air Force officials that the Department of Defense would request restoration of the four RDT&E aircraft in fiscal year 1975.

CHAPTER 2

WEAPON SYSTEM STATUS

The GAO has reviewed the status of cost, schedule and performance of the A-10 program as presented in the Selected Acquisition Report (SAR) for September 30, 1973, and has analyzed changes in the program since December 31, 1972.

Although the A-10 entered the development phase on March 1, 1973, the most recent Development Concept Paper (DCP) for the A-10 program is dated April 6, 1970, and relates to the A-X prototype aircraft, and to the prototype's transition from concept formulation to validation. The Air Force prepared a draft DCP in January 1973, however, as of November 30, 1973, the DCP for the A-10 aircraft had not been approved by the Office of the Secretary of Defense. Therefore, we have no assurance that the cost, schedule and performance baselines reported in the SAR for September 30, 1973, will be comparable to those ultimately established in the DCP.

Discussed below are the changes in the A-10 cost, schedule and technical areas which occurred between December 31, 1972, and September 30, 1973.

COST EXPERIENCE

As of September 30, 1973, the estimated total program cost of the A-10 program including modifications and component improvements was $2,555.5 million. This is an increase of $286.5 million over the estimated cost of the program at December 1972, as reported in our previous staff study (A-10 Close Air Support Aircraft, July 1973). According to SPO officials this cost increase is attributable to the following

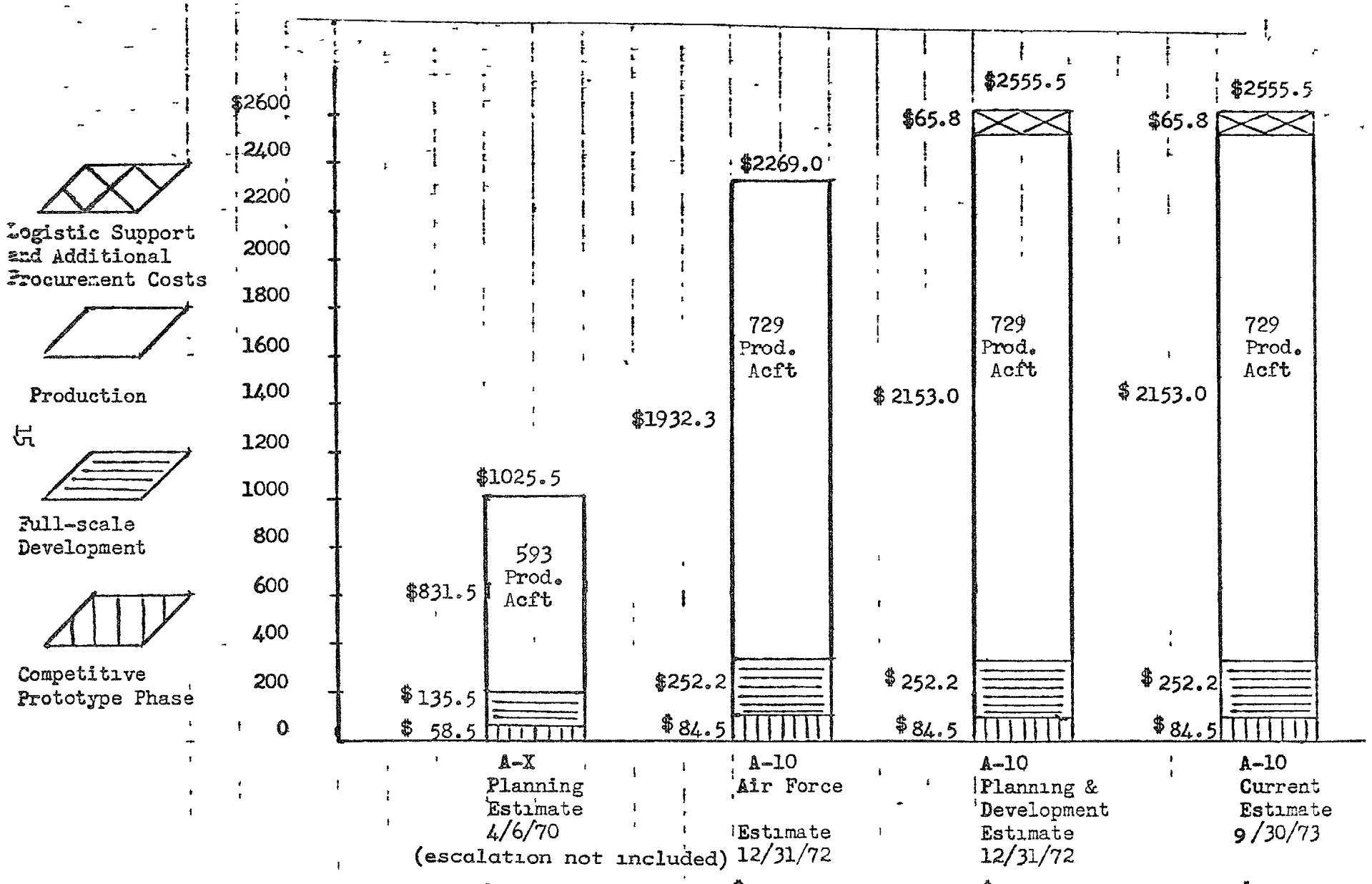
Cause	Amounts in Millions
Change from Air Force estimated unit flyaway cost of $1 5 million to OSD-CAIG estimate of $1.7 million	$175.6
Additional economic escalation	68 2
Decrease in initial spares	(23.1)
Logistic Support and Additional Procurement Cost	65.8
Total Change	$286 5

At the conclusion of our prior review in June 1973, the SARs for December 1972 and March 1973 had not been issued. Consequently, much of our information including the total program cost was based on Air Force cost data available at the time The December 1972 and March 1973 SARs were issued on June 21, 1973, and showed a total program cost of $2,555.5 million.

The chart on page 15 summarizes previous cost estimates for the A-X program and recent estimates for the A-10 program. The cost estimates for the A-X program were made for planning and budgeting purposes only, were based on an A-X aircraft, and did not reflect the specific configuration of either of the competing contractors. The recent cost estimates for the A-10 program are based on Fairchild's winning configuration. The chart also shows the estimated flyaway, procurement and program unit cost (for prototype, 10 RDT&E and 729 procurement aircraft). There has been no change in the estimated total program costs reported in the December 1972 and June 1973 SARs.

The Congress has appropriated $232.4 million for the Competitive Prototy Phase and full-scale development through fiscal year 1974. As of November 15 1973, $159.0 million had been obligated and $106.1 million expended.

A complete cost track of the A-10 program from April 1970 to September 30, 1973, showing the reasons for cost growth, is shown on page 16.



(escalation not included)

Unit flyaway cost	$1.17	$2.11	$ 2.40	$ 2.40
Unit procurement cost	$1.40	$2.65	$ 2.95	$ 2.95
Unit program cost (Exclusive of Logistics Support and Additional Procurement Costs	$1.69	$ 3.05	$ 3.35	$ 3.35

A-X Program Cost Track From The April 6, 1970 Estimate To The September 30, 1973 Estimate
(in millions)

Descriptions	Planning estimate April 6,1970 (escalation not included)	Changes	Development estimate September 30,1973
Competitive prototype phase:	$ 58.5		
Economic escalation		$ 3.8	
Engine hardware cost (Government furnished to Contractor furnished)		12.5	
Test center cost		4.9	
Change from turboprop to turbofan engine		4.8	
Total change		$ 26.0	$ 84.5
Full-scale development:	135.5		
Economic escalation		51.0	
Test center cost		13.8	
Revised test program		15.2	
Change from turboprop to turbofan engine		8.5	
Install and test prototype 30mm gun in prototype aircraft		5.1	
Inclusion of awards fee		4.5	
Change in schedule		7.5	
Change in estimating procedures		10.7	
Miscellaneous changes		.4	
Total change		$ 116.7	$ 252.2
Production.	831.5		
Economic escalation		666.5	
Increase in quantity		190.1	
Change from turboprop to turbofan engine		244.2	
Change in schedule		71.5	
Change in initial spares (not associated with quantity or propulsion change)		(47.3)	
Change in estimating procedure		27.6	
Change from Air Force to CAIG estimate		175.6	
Miscellaneous changes		(6.7)	
Total change		$1,321.5	$2,153.0
Logistic support and additional procurement cost:	0.0	65.8	65.8
Total program	$1,025.5	$1,530.0	$2,555.5

Costs not included

The total estimated A-10 program cost of $2,555.5 million reported in the SAR of September 30, 1973, excludes certain costs which are being expended for the benefit of the A-10.

30mm Gun

As part of the annual authorization request for fiscal year 1973, the Department of Defense was directed by the Senate Armed Services Committee to present certain RDT&E programs as separate program elements so as to allow for Congressional visibility and monitorship. The 30mm Close Air Support Gun system was one of these programs.

The GAU-8 30mm gun is an internally mounted weapon in the A-10 aircraft. Two contractors -- General Electric Company, Burlington, Vermont, and Philco-Ford Company, Newport Beach, California -- designed and built prototype 30mm gun systems Contracts totaling $24.3 million were awarded to the contractors in June 1971 for research and development. The prototype 30mm guns recently completed a competitive firing evaluation and in June 1973, a contract in the amount of $23 8 million was awarded to General Electric Company for the full-scale development of the 30mm gun system.

Although production costs for the gun are included in the total program cost estimate, development costs of $49.7 million for the gun are not included in the A-10 program estimate. (Development costs in the amount of $13.1 million for airframe associated gun integration efforts are included in the total program costs.) According to the airframe contractor, the fuselage of the A-10 aircraft was designed to accomodate the 30mm gun, the aircraft and gun combine to form an integrated weapon system, and no other existing aircraft can carry the GAU-8 internally without major structural redesign.

We were informed by Air Force officials that the gun has possible application to other weapon systems not now identified. The Air Force's position for not including all gun development costs in the A-10 program estimate is that the gun is being developed for a close air support mission, not solely for A-10 application; and, therefore, those costs not specifically identified with the A-10 program are being reported under a separate program element. Whether the gun can or will be used on other weapon systems is speculative at this time. We believe that total development costs for the 30mm gun should be considered a part of the total program cost estimate for the A-10.

Survivability/Vulnerability Testing

The Air Force spent approximately $2.5 million to test A-X fuel tank replicas for survivability/vulnerability during CPP. These tests were performed on realistic production configuration sections of the A-9 and A-10 aircraft. The cost was not included as part of total program cost because the testing was separately funded. SPO officials stated that test results also applied to other aircraft, since test data had never been acquired for the specific enemy projectiles used in the tests

Logistic Support and Additional Procurement Cost

Logistic support and additional procurement costs of $162.1 million have been forecasted for the A-10 program through fiscal year 1979 SAR reporting instructions define logistic support and additional procurement costs to be modification and component improvement costs only. Cost

estimates to cover long range requirements for modifications and component improvements are prepared by Headquarters, U S. Air Force, and estimated requirements for these items for the A-10 program through fiscal year 1979 is reported to be $65.8 million. That amount is included in all A-10 SARs beginning with the December 1972 SAR.

Related to the above, cost estimates to cover long range requirements for modification spares, replenishment spares, common AGE, common AGE spares, and war consumables are prepared by the Air Force Logistics Command. The estimated requirement for these items for the A-10 program through fiscal year 1979 is reported to be $96.3 million, none of which has been reported in the SARs. We were advised that there will be additional support costs in the A-10 program beyond 1979, but current regulations do not require reporting such costs beyond the last year of the Five Year Defense Plan (FYDP).

Avionics

The total estimated program cost of the A-10 aircraft at September 30, 1973, includes a basic avionics package which the Air Force considers as that required to perform the close air support mission. The estimated cost of the avionics package is $151,000 per aircraft However, the basic package does not include Group B avionics items which according to a SPO official, will be necessary to counter such enemy threats as radar-directed anti-aircraft guns and surface-to-air missiles. The Air Force is including provisions for space, weight, power, wiring and racks on the A-10 for the following Group B items:

--Radar Homing and Warning Device
--Electronic Countermeasure (ECM) Pod
--Mode 4 - Identification Friend or Foe, (IFF) Transponder Computer

A-10 SPO officials said that the cost of these items is not included in the A-10 cost estimates because such items will only be used on the aircraft when it is operating in an environment where the threat dictates their use The SPO did not know the unit costs of the Group B items nor how many of them would be procured for A-10 use A representative of the Tactical Air Command (TAC) told us that TAC believes that all these items will be needed on every A-10 used in combat. A SPO official told us that all 729 production A-10s could be used in combat if needed

We found that the Air Force does not yet have firm production unit prices for the electronic countermeasure pod, however, they have established a "not-to-exceed ceiling price" of about $275,000 per unit. We also found that the unit production costs of the radar homing and warning device and the IFF transponder computer are $40,000 and $1,700 respectively

In addition to the basic avionics package and the Group B items the Air Force has also included space, weight, power and cooling provisions in the A-10 to accommodate avionics growth which may be necessary to give the aircraft additional night and all weather capability The Air Force has not decided whether any of the A-10 aircraft should have this additional night and all weather capability.

Program Assessment Review predicts additional cost increases

According to the Air Force's Program Assessment Review (PAR) of November 1973, the total program cost estimate will increase from $2,555 5 million to $2,601 3 million. The increase of $45.8 million is attributed to restructuring the RDT&E program, support and the production delivery schedules as a result of the reduced funding for fiscal year 1974, planned flyoff between the A-10 and the A-7D, and an increase in test center support costs.

Economic Escalation

At September 30, 1973, the Development and Current Cost Estimates for the A-10 program included economic escalation totaling $721 3 million or 28 percent of the total program estimate predicated on fiscal year 1970 as the base year The $721 3 million is $68.2 million greater than the total escalation as of December 31, 1972, as shown in our July 1973 staff study This difference is attributed solely to the increase in the production costs resulting from a change in estimating the unit flyaway cost and not to a change in the method of computing escalation. Total economic escalation in the A-10 program is as follows

Program segment	Economic Escalation (in millions)
Competitive Prototype Phase	$ 3 8
Full-scale Development	51 0
Production	666 5
Total	$721 3

Economic escalation for the competitive prototype phase was based on indices provided by the Assistant Secretary of Defense (Comptroller), and information furnished by prototype contractors For full-scale development, economic escalation is based on a composite of airframe and engine contract factors and indices provided by the Assistant Secretary of Defense For production, economic escalation is based on indices developed by the Air Force Aeronautical Systems Division (ASD) The rate of economic escalation is approximately 4 8 percent compounded annually.

The indices provided by the Assistant Secretary of Defense (Comptroller) were intended for overall DOD budgeting and planning The indices are general in nature and purpose, and do not

compensate for different price levels in different segments of industry. Therefore, specific cost indices were developed by the Aeronautical Systems Division for airframe development, airframe production, engine development, engine production, avionics development, and avionics production. In each category, a higher inflation growth rate was forecasted than the DOD factors would indicate.

SCHEDULE EXPERIENCE

There have been no changes in the schedule milestones reported in the SAR since our prior staff study, nor have any milestones been scheduled for completion during this reporting period As a result of the reduction in fiscal year 1974 funds, the SPO has directed the contractors to restructure their RDT&E programs and to plan for release of long lead time production funds in July rather than May 1974. In addition, one of the two prototype aircraft has been taken out of the testing program to be outfitted for the upcoming flyoff between the A-10 and A-7D aircraft. The impact of these changes will not be fully known until contractor responses are received in March 1974, however, the November 1973 PAR indicates the following revised schedule.

Schedule milestones	Current estimate Sept. 1973 SAR	Revised estimate Nov. 1973 PAR
Complete 30MM gun/A-10 prototype testing	April 1974	April 1974
DSARC III A - (Initial production approval)	May 1974	June 1974
Release FY74 long lead time funds	May 1974	July 1974
Engine qualification testing	October 1974	October 1974
Initial production funding release	November 1974	November 1974
First flight development test aircraft	December 1974	December 1974
Delivery first initial operational test aircraft	June 1975	September 1975
DSARC III B - (full production approval)	October 1975	October 1975
Delivery first production aircraft	November 1975	March 1976
Initial Operational Capability	June 1977	December 1977

PERFORMANCE EXPERIENCE

There have been no changes in the performance characteristics reported in the SAR since our July 1973 staff study. The contractors' technical progress as compared against program goals is shown on page 36.

SELECTED ACQUISITION REPORTING

The September 30, 1973 SAR excluded certain costs which have been expended or are planned to be expended, in part, for the benefit of the A-10. The items excluded are:

--GAU-8 gun development costs		$49 7 million
--Survivability/vulnerability testing		2.5 million
--Logistic support and additional procurement costs		96.3 million
--Group B avionics		
ECM pod	$275,000	
Radar homing & warning	40,000	
IFF transponder computer	1,700	
	$316,700 per aircraft	

The SAR did not reflect the current status of the A-10 program because of recent program changes. These changes include restructured RDT&E program and production delivery schedules, an increase in test center support costs, and the A-10/A-7D flyoff. These changes have resulted in an estimated program cost increase of $45.8 million

The development estimate included in the SAR for December 31, 1972 and all subsequent SARs was based on the CAIG estimate for the A-10 aircraft Prior to the December 31, 1972 SAR, the only estimates included in SARs

for this weapon system were the development and current estimates for the A-X Competitive Prototype Phase As a result, none of the SARs for the A-10 have reflected the initial program planning estimate of $1,025.5 million (as set forth in the April 1970 DCP). We believe that this planning estimate should be included in the SAR for trackability of program progress.

CHAPTER 3

CONTRACT STRUCTURE AND STATUS

CONTRACT DESCRIPTIONS

The full-scale development phase of the A-10 program involves four major contracts between the Air Force and the aerospace industry. These contracts are described below.

The Fairchild Republic Company, Farmingdale, New York, was awarded a cost plus incentive fee (CPIF) contract for $159.3 million on March 1, 1973, to design, develop and fabricate ten aircraft for the full-scale development test program. This contract also includes two fixed price incentive firm (FPIF) options for procuring an initial quantity of 48 aircraft with a variance provision which allows firm pricing for any quantity of aircraft between 13 and 72.

The General Electric Company, Aircraft Engine Group, Lynn, Massachusetts, was awarded a FPIF contract in November 1972 for $14.5 million to develop and qualify the TF34-GE-100 engine. The Aircraft Engine Group was also awarded a $27.7 million FPIF contract on March 1, 1973, for the delivery of 32 TF34-GE-100 engines to support the A-10 full-scale development program. This contract also includes FPIF options for procuring 124 engines and establishes initial target prices for 166 additional engines. There is a plus or minus 50 percent rate variance provision for the production options on this contract.

The General Electric Company, Armament Systems Department, Burlington, Vermont, was awarded a $23.8 million FPIF contract on June 21, 1973, for full-scale development of the GAU-8A 30mm gun system and ammunition This contract also has FPIF options for 48 gun systems and 3 3 million rounds of ammunition for use in the A-10 There is a variance provision applicable to the gun system options which allows firm pricing of any quantity of gun systems between 13 and 72

A table summarizing the pricing provisions of the four contracts is shown on page 27.

A-10 Contract Data
(millions of dollars)

Description	CONTRACTORS			
	Fairchild Industries (Airframe)	General Electric Company / Aircraft Engine Group (R&D Engines)	General Electric Company / Aircraft Engine Group (Prod. Engines)	General Electric Company / Armament Systems Department (30mm Gun)
Development				
Contract Type	CPIF	FPIF	FPIF	FPIF
Target Cost	$147.5	$13.1	$24.7	$22.1
Profit:				
A. Amount	$ 11.8	$ 1.4	$ 2.7	$ 1.7
B. Percent	8%	10.7%	10.75%	7.7%
C. Limits (min-max)	0-15%	N/A	N/A	N/A
Target Price	$159.3	$14.5	$27.4**	$23.8
Ceiling Price:				
A. Amount	N/A	$15.9	$30.9	$26.5
B. Determination	N/A	(121% of target cost)	(125% of target cost)	(120% of target cost
C. Sharing Ratio	70/30	70/30	70/30	70/30
Production Options*				
Contract Type	FPIF	N/A	FPIF	FPIF
Target Cost	$100.2		$52.5	$66.8
Profit:				
A. Amount	$ 10.0		$ 5.6	$ 1.7
B. Percent	10%		10.75%	(2.5% -Guns .6%-Ammo)
Target Price	$110.2		$58.1	$68.5
Ceiling Price				
A. Amount	$125.3		$65.6	$80.2
B. Determination	(125% of target cost)		(125% of target cost)	(120% of target cost,
C. Sharing Ratio	70/30		70/30	70/30

* Options for 48 aircraft, 124 engines, 48 guns, and 3.3 million rounds of ammunition.

** Does not include $.3 million of non-incentive Component Improvement Program cost.

INTERRELATIONSHIP BETWEEN DELIVERY SCHEDULES, PROGRAM MILESTONES, AND MAJOR DECISION POINTS

The contract delivery schedules call for the delivery of engines five to six months prior to the delivery dates of the aircraft in which they are to be installed The 30mm GAU-8A guns are scheduled to be delivered two to three months prior to the delivery dates of the aircraft in which they are to be installed If these schedules are met, the airframe contractor should receive the engines and guns in ample time for installation before the aircraft delivery dates

The release date of production funds for fiscal year 1975 for the first 26 production aircraft is November 1974. This is one month prior to the first flight of a DT&E aircraft and 5 months prior to gun qualification. However, we were informed that the prototype aircraft will have flown approximately 700 flight test hours by the initial production decision date.

STATUS OF CONTRACT CHANGES

As of October 31, 1973, there had been a total of 26 modifications to the four contracts Three of these modifications had not been definitized in terms of price but did have established "not-to-exceed" target price increases The net effect of the 23 definitized modifications was a decrease of $23,464 in the prices of the basic oontracts, and a decrease of $52,661 in the production option prices The maximum effect of the three undefinitized modifications will be an increase of about $2.2 million in the prices of the basic contract ard about $1.9 million increase in the prices of the production options Air Force officials state that the price of the undefinitized modifications will not increase total program costs They represent changes from government furnished equipment to contractor furnished equipment

Seven modifications have occurred in the airframe contract. The portional effects of the modifications were a decrease in contract target price of $76,125 for the definitized modifications, and a not-to-exceed final target price of $4.0 million for undefinitized modifications.

The engine development contract had eight modifications resulting in a net increase in contract target cost of $376,000. The engine acquisition contract had six modifications, resulting in a net decrease of $376,000 in contract target price.

The gun development contract had five modifications. Although the modifications had not been definitized, the parties agreed that the final target price would not exceed $129,700.

CHAPTER 4

MANAGEMENT CONTROLS

An essential element in measuring progress is the establishment of meaningful program and contract baselines from which to measure. The cost, schedule, and technical baselines for the A-10 program are those approved by the Secretary of Defense and reported in the SAR. These baselines are discussed in Chapter 2. The cost, schedule, and technical baselines for each contractor are those required by his contract. In this chapter we discuss the information systems and other concepts used by the Air Force to measure contractor performance.

INFORMATION SYSTEMS AND OTHER MANAGEMENT CONCEPTS

The provisions of DOD Instruction 7000.2 require the use of Cost/Schedule Control Systems Criteria (C/SCSC) for selected major acquisition contracts. The objectives of these criteria are to ensure that contractors use effective management information systems and that these systems provide data from which progress measurements can be made. In addition, each contractor must demonstrate his management information system to determine if it meets the C/SCSC requirements before it can be validated for use.

Both Fairchild (airframe contractor) and General Electric (engine contractor) have management information systems which have been validated by the Air Force for both a development and production application. According to SPO officials, General Electric's (gun contractor) management information system was being evaluated in January 1974.

Selected acquisition information and management system

Data regarding a contractor's progress during a major weapon system program is reported through the Selected Acquisition Information and Management System (SAIMS). The SAIMS reports are the primary vehicles for fulfilling the progress measurement data requirements of the C/SCSC. There are four SAIMS reports being used for the A-10 program. Of these the Cost Performance Report (CPR) and the Technical Performance Measurement (TPM) report are used for contract progress measurement. A CPR is submitted monthly by the contractors for each of the four prime contracts--airframe, engine qualification, engine acquisition, and gun. A TPM is submitted quarterly by Fairchild only and provides data to show technical progress toward contract goals. The remaining two SAIMS reports are the Contract Funds Status Report which provides data for updating and forecasting contract fund requirements and the Cost Information Report which is used to provide information on cost estimating, programming, budgeting, and procurement activities. Copies of the SAIMS reports are sent from each prime contractor to the SPO, the Government plant representatives, Headquarters Aeronautical Systems Division, and Headquarters Air Force Systems Command.

Design-to-cost concept

In addition to the traditional management controls for progress measurement, such as the SAIMS reports, the A-10 is also being managed by the design-to-cost concept which is discussed in Chapter 5. A prime objective during full-scale development is to design the A-10 to a predetermined cumulative average unit production flyaway cost. The CPR will be used to report deviations from the contractor's design-to-cost goal and any actions or tradeoffs he proposes to bring the cost within this goal.

On-site monitoring

Air Force on-site monitors--SPO personnel and Government plant representatives--continually observe, test, and analyze contractor data and activities. Memorandums of Agreement establishing the functions and responsibilities of the plant representatives have been initiated by the SPO at each contractor location. Areas of surveillance responsibility outlined in these agreements include engineering, quality assurance, production administration, contract administration, C/SCSC surveillance, and logistics. In addition, the plant representatives verify data reported in the SAIMS reports. SPO officials stated that the plant representatives will be used extensively to take advantage of their first hand knowledge of the contractor's progress and to keep the SPO abreast of significant events at the contractor sites.

Other reviews and reporting

Further visibility of A-10 development progress is gained through monthly Business Reviews between the SPO and each contractor, and Program Schedule Reports submitted monthly by each contractor.

In order to keep higher headqaarters apprised of A-10 program status, the SPO prepares and presents a monthly Program Assessment Review to the Commander, Air Force Systems Command, Headquarters USAF, and Secretary of the Air Force. In addition, a SAR is submitted quarterly through the above offices to the Secretary of Defense and to Congress.

MEASUREMENT OF CONTRACTOR PROGRESS

The CPRs for the period ending September 30, 1973, show that the Fairchild airframe development program is behind schedule and over cost, the General Electric engine qualification program is behind schedule and over cost, and the General Electric engine acquisition program is behind schedule and under cost as shown below.

The cost and schedule variances for the above program segments are considered to be within acceptable limits established by the SPO

Performance Measurement Baselines
September 30, 1973
(in thousands)

Program	Budgeted cost of work Scheduled	Budgeted cost of work Performed	Actual cost of work performed	Variances Schedule	Variances Cost
Airframe development	$14,281	$13,209	$13,649	$(1,072)	$(440)
Engine qualification	5,672	5,486	5,611	(186)	(125)
Engine acquisition	811	799	751	(12)	48

The baselines for the General Electric 30mm gun program are still being established and cost and schedule status based on the CPRs is not available at this time.

Contractor cost progress

The cost variance in the CPR is the difference between the time phased budgeted cost of work performed and the actual cost of work performed A positive variance indicates a favorable condition whereas a negative variance indicates an unfavorable condition

The airframe development program is 11 percent complete as of September 30, 1973. An unfavorable cost variance of $440,000 exists, which is about 3 3 percent of budgeted cost of work performed The engine qualification program is 48 percent complete as of September 30, 1973 An unfavorable cost variance of $125,000 exists, which is about 2 3 percent of budgeted cost of work performed. Contractor cost progress for both the airframe development program and the engine qualification program are considered to be well within the acceptable limits established by the SPO.

The engine acquisition program is 4 percent complete as of September 30, 1973 A favorable cost variance of $48,000 exists, which is about 6 percent of budgeted cost of work performed and is within the tolerance limit.

As previously stated, the CPRs for the 30mm gun program were not available for our review

Contractor schedule progress

The schedule variance in the CPR is the difference between the time phased budgeted cost of work scheduled and budgeted cost of work performed and gives an indication in dollars if the work is ahead or behind schedule

An unfavorable schedule variance of $1,072,000 exists in the airframe development program which is about 7.5 percent of budgeted cost of work scheduled. According to SPO officials, their prime objective at this point in time is to ensure that the December 1974 goal to fly the first development testing aircraft is met. As of September 1973 all major and intermediate milestones have been met. An unfavorable schedule variance of $186,000 exists in the engine qualification program, which is about 3.3 percent of budgeted cost of work scheduled. The engine acquisition program is in a very early stage (4 percent complete). Contractor schedule progress in each of the above areas is considered to be within acceptable schedule variance limits.

Contractor technical progress

Fairchild reports technical progress through the quarterly TPM. The TPM depicts the status of 13 technical and performance characteristics and shows the variance between the current value and contract specification. Contract specifications are generally more stringent than the program goals reported in the SAR. The following schedule

based on the August 30, 1973, TPM, shows the contractor's current estimated value, the value required by the contract, and the Air Force's program goals for some of the 13 technical parameters.

Technical Performance Measurement Summary

Technical & performance characteristic	Current value	Contract specification	Variance[a]	Program goals
Maximum combat speed (knots)	385	385	- 0 -	300[b]
Takeoff distance (feet)	1,130	1,050	+ 80 (U)	1,200
Landing distance (feet)	1,085	1,050	+ 35 (U)	1,200
Loiter time (hours)	1.93	2	-.07 (U)	2
Sustained load factor:				
At 275 knots (g)	3.22	3.5	-.28 (U)	3.5
At 150 knots (g)	2.24	2.4	-.16 (U)	2.2
Weight empty (pounds)	19,210	19,293[c]	- 83 (F)	19,260
Maximum gross weight (pounds)	45,537	45,108[c]	+429 (U)	45,640
Maintainability (man hours/flight hour)	9.2	9.2	- 0 -	12

a/ This variance is the difference between the current value and contract specified value, (U) = unfavorable variance, (F) = favorable variance.

b/ This represents a cruise speed goal. No maximum speed goal is indicated in the SAR. Fairchild's current value estimate of cruise speed is 340 knots.

c/ Weights are contract design goals rather than contract requirements.

The primary technical problem confronting A-10 development is the increased maximum gross weight of the aircraft. According to a SPO official, this problem is caused primarily by the increased weight of the gun system. This increased weight has adversely affected several other performance parameters. Some of the alternative actions being considered to retain lost performance include: (1) additional drag reduction tests, (2) weight reduction studies for both the airframe and gun contractors, (3) increasing the thrust of the engines, and (4) increasing fuel capacity to regain a 2-hour loiter time. The SPO will evaluate these and any other alternative suggestions on a cost-effectiveness basis to determine what course of action to follow.

According to SPO officials a TPM was not required for the engine development program because this engine is a modification of the Navy's TF34-2 engine rather than a new development. However, General Electric does measure and report the status of thrust and specific fuel consumption after each test. Air Force personnel monitor these tests and verify the data reported. Currently, the thrust and specific fuel consumption data furnished by the contractor indicates that the contract specifications will be met or exceeded.

OBSERVATIONS

The management information systems used by two of the three prime contractors have been validated in accordance with Cost/ Schedule Control Systems Criteria. The gun contractor's system was being evaluated in January 1974.

The Cost Performance Reports are providing visibility as to where the program is in relation to where it should be. On-site surveillance is relied on for making management decisions since it is more timely than the Cost Performance Reports. No deviations in the contractors' design-to-cost goals had been reported as of September 30, 1973.

Few problems have been identified to date and the A-10 program appears to be progressing within cost, schedule, and technical boundaries. One area of concern is the increased maximum gross weight of the A-10. The SPO has requested Fairchild to submit a recovery plan for all parameters reported to be out of tolerance in the TPM.

Based upon reduced fiscal year 1974 funding of the A-10 Program, and the A-10/A-7D flyoff, cost and schedule baselines are being impacted upon. While this action will not effect what management controls the Air Force used, the contractors' progress will have to be reassessed.

CHAPTER 5

DESIGN-TO-COST

Design-to-cost is a concept which the DOD believes will restrain Government-industry teams from designing overly sophisticated and costly systems The concept, as implemented in DOD, is a major effort to design a weapon system to a predetermined unit production cost based on a number of conditions such as system performance goals, stated equipments, production quantity, production rate, and specified-year dollars Some general references to the concept appear in DOD Directive 5000 1, "Acquisition of Major Defense Systems" dated July 13, 1971, but no specific or official guidelines were published until October 3, 1973, when the military departments published a document titled "Joint Design-to-Cost Guide, A Conceptual Approach for Major Weapon System Acquisition", which provided guidance on the application of the concept within DOD

APPLICATION TO THE A-10 PROGRAM

According to a SPO official the design-to-cost goal of $1 4 million per aircraft was established by the Secretary of the Air Force during a review of the proposed RFP with the A-X System Program Director on April 27, 1970 The design-to-cost goal was included in the RFP released to industry in May 1970 It stated

"***During the past several years of conceptual planning for this aircraft two requirements have remained as being crucially important to the program, i.e., weapon system effectiveness and low costs. ***The acquisition and ten-year operational and maintenance costs must be minimized, otherwise approval to proceed into the acquisition phase will be denied. A cost goal has been established of less than $1.4 million per unit fly-away (recurring costs--FY 70 dollars) for a 600 aircraft buy at a peak production rate of 20 aircraft per month.***"

Application of concept during CPP

The CPP was conducted against a set of performance goals with minimal design constraints imposed by the Government. The competing contractors were encouraged to seek ways of reducing unit costs below the $1.4 million goal as well as reducing the operational and support costs while keeping system performance degradation to a minimum.

The contractors were requested to submit budgetary estimates for production of 600 aircraft at a peak rate of 20 per month stated in 1970 dollars as part of their full-scale development proposals.

The full-scale development contract was awarded to Fairchild even though the proposed A-10 aircraft did not meet all the Air Force performance goals. For example, the takeoff ground run distance and the landing ground roll distance for the A-10 exceeded the Air Force goal of 1,000 feet maximum distance by 50 feet. In addition, the maximum speed for the A-10 was slightly less than the 400 knots specified by the Air Force. These deviations from the A-X system performance goals were approved on the rationale that the improved capability would not justify the cost increase associated with the aircraft system changes required.

Application of concept during full-scale development

A prime objective during the A-10 full-scale development is to design the weapon system to a cumulative average unit flyaway cost of $1.5 million expressed in fiscal year 1970 dollars for 600 aircraft at a peak rate of 20 per month. Unit flyaway costs are defined as the sum of all recurring and non-recurring costs, excluding RDT&E costs, necessary to produce a complete aircraft. The design-to-cost goal was redefined from $1.4 million unit recurring flyaway costs to $1.5 million unit production flyaway costs in March 1973. There has been no actual change in the design-to-cost goal since the non-recurring unit flyaway cost estimate was about $100,000. Unit flyaway costs also excludes all costs associated with the production of AGE, training, data, initial spares and a portion of system engineering and program management.

The contractors are required to demonstrate to the satisfaction of the Air Force, in March 1974 and again in August 1975, that their portions of the cumulative average unit production flyaway costs will not exceed the following amounts expressed in fiscal year 1970 dollars.

Contractor	Amount
Fairchild	$825,000 1/
General Electric (two engines)	$430,000 2/
General Electric (gun)	$ 85,000 1/

1/ Based on total production of 600 aircraft and gun systems (less ammunition) at a peak rate of 20 per month.

2/ Based on total production of 1,500 engines at a peak rate of 50 per month.

The remaining $160,000 of the $1.5 million design-to-cost goal is available for Government Furnished Equipment which includes such items as tires, ejection seat, external fuel tank, gauges, some avionics items, etc.

The gun contractor must also design a family of ammunition to an average unit production cost for each type of round expressed in fiscal year 1973 dollars, however, the quantities, rate of production, and average unit production cost for each round will be negotiated at a later date. The cost of the ammunition, however, is not part of the $1.5 million unit flyaway cost goal.

There are no monetary incentives in any of the development contracts (airframe, engine, or gun) for meeting the design-to-cost goal. The goal is based on a procurement of 600 aircraft whereas the Air Force has a maximum of 72 production aircraft under option. The contractors do have a realistic but intangible incentive to meet the design-to-cost goal because of the possibility that the production program will not be approved if the cost goal is not met.

Contractors' proposed methods of applying the concept

We were informed by the contractors that the estimates they submit in March 1974 for the design-to-cost demonstration will be based largely on the same data used in their cost proposals submitted during the source selection for the full-scale development phase.

This is because the contractors will not have much more information, except for manufacturing experience gained on the early deliverable RDT&E aircraft, on production costs by March 1974 than they did in the proposal stage

Air Force plans for managing the application of the concept

The SPO has prepared guidelines for the implementation of design-to-cost and all the contractors will have been briefed on these guidelines by the end of January 1974.

TRADE-OFFS MADE AS A RESULT OF DESIGN-TO-COST

As of October 1, 1973, there had been one trade-off made during the development phase of the A-10 program to keep the A-10 under the $1 5 million unit cost goal. The trade-off involved the Air Force selection of an escape subsystem which had less performance capability than a more costly competitor system According to the A-10 SPO's most probable estimates of the recurring unit cost for a quantity of 600 escape systems stated in fiscal year 1970 dollars, the system selected would cost between $5,000 and $10,000 less than the higher performance escape system

CONTRACTORS' VIEWS OF THE CONCEPT

We obtained the following views from the A-10 contractors regarding the design-to-cost concept

Fairchild

--the design-to-cost philosophy encourages attention to the cost effectiveness of all decisions

--without design-to-cost, the natural inclination would be to select improved performance, survivability, etc rather than cost effectiveness

General Electric Aircraft Engine Group.

--design-to-cost was an excellent concept for the A-10 program in that it resulted in the airframe and engine contractors working together to design the best aircraft within the cost constraints to meet a mission.

--the concept causes the Government and the contractors to seek the least cost method to meet a mission objective.

--the concept is good from a contract point of view but may not withstand the test of time in view of the many changes that occur.

--as individuals become more cost conscious there is less chance that they will take technological risks and this could inhibit progress.

--design-to-cost is nothing more than value engineering which has existed for years.

General Electric Armament Systems Department:

--design-to-cost is a good concept, especially for the gun and feed system because it has numerous mechanisms and parts to which they can look to cut costs.

--the concept is not good for the ammunition because there are only four parts involved which limits the areas for possible cost reductions.

A-10 SPO OFFICIAL'S VIEWS OF DESIGN-TO-COST

The A-10 System Program Director made the following comments about the design-to-cost concept.

--the concept is really not as new as it is proclaimed to be. The cost discipline has always been present in weapon system procurement but has not been emphasized as much as it has under design-to-cost and therefore people have not taken it seriously enough in the past.

--the threat of having a system cancelled if it does not meet its design-to-cost goal will prevent weapon system managers from spending too much money in trying to get the last little bit of performance out of their systems as they have done in the past.

--in today's environment where the American public is very critical of defense spending, design-to-cost appears to be the only way to go in controlling the price of new weapon systems.

--the A-10 was a good system to which to apply design-to-cost because of the low risk involved in the system.

--under design-to-cost there is the danger of putting too much emphasis on achieving the cost goal at the expense of performance.

OBSERVATIONS

The A-10 appears to be an appropriate weapon system on which to apply the design-to-cost concept because of its relatively low development risk. Both the contractors and the SPO believe in the concept as a means of producing a cost effective weapon system. At this time, however, it is too early in the development program to evaluate all of the effects of design-to-cost The contractors have not had to perform any recent trade-off studies to keep within their cost goals, nor have they reported any changes to their original cost goals.

The contractors' initial design-to-cost demonstrations are scheduled for March 1974, just prior to the initial production decision. The contractors' actual cost experiences used in the initial demonstrations will be very limited, and the computations will primarily

be based on the contractors' original cost proposals. Since the initial production decision has been rescheduled from May to June 1974, design-to-cost demonstrations just prior to that decision would be more appropriate.

CHAPTER 6

TEST AND EVALUATION

Current DOD policy encourages: (1) the use of prototypes, (2) more reliance on hardware demonstrations and less on paper studies, (3) the "fly before you buy" approach,(4) less concurrency between development and production and (5) more emphasis on user testing and evaluation.

The extent of implementation and achievement of these policies and requirements and the status of tests and evaluation in the A-10 program will be discussed in this chapter.

TEST PLANS

The airframe, engine, and gun contractors conduct tests in accordance with system test plans included in their respective statements of work. These test plans are subject to Air Force approval. DT&E and IOT&E will be accomplished using prototype aircraft from the CPP and preproduction aircraft from the full-scale development program.

The airframe test plan provides for a 22 month prototype flight test program to refine and verify proposed production design changes and accelerate development and integration of the aircraft. The prototype aircraft are scheduled to be used for testing from March 1973 until the first full-scale development aircraft becomes available in December 1974. Testing of the full-scale development aircraft will be conducted from December 1974 through June 1976 to ensure that the A-10 complies with contract specifications.

The engine test program provides for qualification of the TF34-GE-100 engine for the A-10. According to SPO officials, nearly all engine DT&E is being accomplished under the qualification contract. The engine acquisition contract is to provide 32 engines for the 10 full-scale development aircraft. The TF34-GE-100 engine was derived from the TF34-GE-2 engine which was developed for the Navy's S-3A aircraft. The "-2" engine underwent a 10,000 hour test program and was qualified in August 1972. Eight tests from this program will be accepted as valid for the "-100" engine, therefore, the "-100" engine will undergo only a 2161 hour test program. Qualification testing of the "-100" engine is scheduled for completion in September 1974, with Air Force approval anticipated in October 1974.

The 30mm gun system test plan describes the engineering, acceptance, and qualification tests that will be performed on the mockup, refurbished CPP systems, and preproduction systems. The design and

development of target practice and combat ammunition was subcontracted. The primary requirements of the gun system are that it be compatible with the A-10 and the combat ammunition be effective against tanks and other targets. Gun qualification tests on the ground are scheduled to be completed in April 1975 The armor piercing combat ammunition is scheduled to be qualified in June 1975

According to the A-10 Program Management Plan, the Tactical Air Command will conduct IOT&E in two phases. Phase A will be conducted with a prototype aircraft and will provide input to the production decision recommendation. Phase B will be conducted on a preproduction aircraft and will provide input to the DSARC deliberations in October 1975.

The contractors' test plans should be sufficiently compatible to ensure timely airframe/engine/gun integration. The "-100" engine is scheduled for installation in the first preproduction aircraft to be delivered in December 1974. The 30mm gun is scheduled for installation in the second preproduction aircraft to be delivered in February 1975. It appears that the contractors' test plans are flexible enough to ensure timely completion of all scheduled tests and integration of the airframe, engine, and gun into the preproduction aircraft.

OSD approval for production go-ahead is scheduled for June 1974, and the Air Force expects to release long lead time funding in July 1974. The Air Force also plans to make a full release for the first 26 aircraft in November 1974 in order to have the results of the engine qualification tests and the critical design review of the gun. When the production option is exercised in November 1974, the prototype aircraft will be equipped with "-2" engines and a refurbished prototype 30mm gun The Air Force and the Office of the Secretary of Defense believe that prototype testing and qualification of the "-100" engine will be sufficient justification for exercising the production option in November, however, at that time, the "-100" engine and preproduction gun will not have been installed or tested in the A-10 and a preproduction aircraft will not yet have been flown. In addition, the 30mm gun and combat ammunition will not be qualified. Therefore, the production option will be exercised based on prototype rather than preproduction aircraft performance.

STATUS OF TESTING

The A-10 DT&E program is still in the early stages. Testing of one of the prototype aircraft is progressing as planned, however, testing of the second prototype will be delayed by the A-10/A-7D flyoff. In addition, some problems were encountered during core testing of the engine. The first test of the 30mm gun began in September 1973.

Prototype aircraft testing

Of four tests scheduled for completion by November 30, 1973, two have been successfully completed and two have not. The drag reduction test to improve the aerodynamic styling and the airloads survey to obtain data to measure stress on the airframe have been completed. The slat test to improve the wing design and the manual reversion test of the backup flight control system, being performed on prototype number one, have essentially been completed. These two tests have been discontinued to begin fitting prototype number one with the 30mm gun for ground and flight testing. According to SPO officials, it was originally planned that the gun tests would take precedence over all other tests.

In mid-December 1973, prototype number two was removed from the scheduled testing program and is being prepared for the flyoff with the A-7D. SPO officials state that all scheduled prototype aircraft testing, although delayed due to the flyoff,will eventually be completed. The flyoff will not affect the delivery of the first full-scale development aircraft in December 1974 even though prototype testing may not be completed by that date.

Engine testing

As of October 31, 1973, the engine had undergone 474 of the planned 2161 hour test program. Engine testing completed to date includes the small and medium bird and ice ingestion test, two of three phases of the heat rejection and cooling test, and the core engine tests.

The only problems encountered have been with the core tests. This test was originally scheduled to start in April 1973 and be completed in August 1973. General Electric failed in its first and second attempts to run this test, in April 1973 and June 1973 respectively, because of compressor blade failures. General Electric officials told us that a third core test was completed in October 1973. At the request of the Air Force, General Electric has submitted a proposal for $800,000 for further core testing to reinforce confidence in the "-100" compressor design.

30mm gun testing

Full-scale development testing of the 30mm gun system began in September 1973. Ground firing in an airframe nose section began in December 1973. In addition, a gun mockup was sent to Fairchild in July 1973 to facilitate gun/airframe integration. An important upcoming testing milestone is the preliminary gun/aircraft ground and flight compatibility test which will be completed, using a refurbished prototype gun and a prototype aircraft, in April 1974. At the time of our review, nearly all experience regarding the gun and ammunition was gained during the competitive prototype phase, which was held in early 1973. During this phase each competing gun system was evaluated in terms of gun system goals which were system weight, round capacity, rate of fire, burst capability, barrel life, dispersion, reliability,

maintenance, and loading time. The combat ammunition's armor piercing ability was tested during this phase by using single shot barrels only. To date, only target practice ammunition has been fired in a complete gun system. The first time the armor piercing ammunition is scheduled to be fired in a complete gun system will be in September 1974.

IMPENDING PROGRAM ACTIONS

The impending program actions discussed on page 11 and 12 will adversely affect both prototype and preproduction aircraft testing. The number of preproduction aircraft will be reduced from ten to six and the number of engines and guns to support these aircraft will also be reduced. Since the scope of testing will remain the same, the testing program will be stretched out and delivery of the first production aircraft delayed.

Prototype aircraft number two has been designated as the vehicle for the A-10/A-7D flyoff. This prototype has been pulled out of its scheduled testing and will be modified and flight tested from December 1973 through the spring of 1974. Modifications to the prototype aircraft will include installation of the radio and bomb sights. The flyoff will pit a prototype A-10 against a production A-7D. In addition, the prototype will be equipped with "-2" rather than "-100" engines and will not have the 30mm gun.

The flyoff will also cause some risks to the A-10 development program because the second prototype will not be available for five months of scheduled testing. This means that fewer tests than originally planned will have been accomplished prior to the OSD production decision, scheduled for June 1974, and exercise of the initial production option by the Air Force which is scheduled for November 1974. The flyoff is not expected to effect the engine and gun qualification programs.

OBSERVATIONS

The plan to use the prototype aircraft to provide early accomplishment of all design critical tests is in keeping with DOD policy of less concurrency between development and production. However, the initial OSD production decision will be based on prototype aircraft performance rather than preproduction aircraft performance. It should be noted that the full production decision scheduled for October 1975 will be based on considerable testing of the preproduction aircraft.

The impending program action to conduct a flyoff and reduce the number of preproduction aircraft will delay completion of some scheduled testing. This may provide fewer planned test results than anticipated to support the production decision points, unless the decision points are adjusted.