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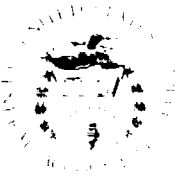
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Under a multinational commitment, the United States, Belgium, Denmark, The Netherlands, and Norway plan to purchase at least 998 F-16 fighter aircraft--650 for the United States and 348 for the European countries. Ultimately the U.S. Air Force plans call for procuring 1,388 aircraft. The European countries will participate in co-producing the first 650 U.S. Air Force F-16's, the 348 European aircraft, and a share of sales to other countries. The participation of the four NATO countries has great influence on the program. Program decisions could be affected by European industrial production capability, mission requirements, ability of Europeans to meet funding requirements, and the need to obtain European approval of modifications to the aircraft. Findings/Conclusions: In its evaluation of the F-16 development and procurement program, GAO found that the Air Force is concerned with several potential F-16 problems: F100 engine stalls, demonstration of an improved aerial restart capability, and excessive taxi speed. Tactical Air Command Officials believe that the F-16 needs additional equipment; and that it doesn't have sufficient available space for all desired new capabilities. There is some controversy concerning the combat vulnerability of the aircraft; the inclusion of more air-to-surface operations in the F-16 mission does make it more vulnerable. The program has shown a \$7.7 billion cost increase in 1976 due to the 738 aircraft quantity increase and the new capabilities and program estimate revisions. The Air Force contends that the increase in aircraft procurement quantities as a result of European participation will lower the cost of domestic production enough to offset the increased cost of co-production. Schedule delays could threaten the test schedule. Recommendations: The Secretary of Defense should: reassess the F-16 survivability features to determine if they are adequate; not allow European pressure to hamper performance of testing necessary to justify a full production decision and invite the European countries to participate in any assessment of the test schedule so that any changes can be mutually agreed upon. (Author/QM)

00100

# REPORT TO THE CONGRESS



*BY THE COMPTROLLER GENERAL  
OF THE UNITED STATES*

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## Status Of The F-16 Aircraft Program

Department of the Air Force

The F-16 fighter aircraft is being developed by the United States and will be jointly produced by the United States and four European countries. This report deals predominantly with the United States development and procurement of the aircraft as it enters production in September 1977.

In December 1976 the Air Force added 738 aircraft to their original buy of 650 F-16 aircraft. The Air Force reported cost growth of \$1.4 billion on the original 650 aircraft and a total program cost of about \$13.8 billion.

The Secretary of Defense should reassess the survivability features of the F-16, not allow European pressure to hamper the performance of the testing, and invite the Europeans to participate in any assessment of the test schedule.



F-16 FIGHTER AIRCRAFT

(PHOTO COURTESY OF U.S. AIR FORCE.)



COMPTROLLER GENERAL OF THE UNITED STATES  
WASHINGTON, D.C. 20548

B-163058

To the President of the Senate and the  
Speaker of the House of Representatives

This report gives a status of the Air Force F-16 Fighter Aircraft development and procurement program. The report covers the U.S. Air Force program and portions of the F-16 multinational program. The F-16 multinational program is covered in detail in a separate GAO report.

For the past several years we have annually reported to the Congress on the status of selected major weapons systems. This report is one of a series of 29 reports that we are furnishing this year to the Congress for its use in reviewing fiscal year 1978 requests for funds.

A draft of this report was reviewed by pertinent Department of Defense officials and their comments are incorporated as appropriate.

We made our review pursuant to the Budget and Accounting Act, 1921 (31 U.S.C. 53), and the Accounting and Auditing Act of 1950 (31 U.S.C. 67).

We are sending copies of this report to the Director, Office of Management and Budget, and the Secretary of Defense.

A handwritten signature in black ink, appearing to read "James B. Starnes".

Comptroller General  
of the United States

COMPTROLLER GENERAL'S  
REPORT TO THE CONGRESS

STATUS OF THE F-16 AIRCRAFT  
PROGRAM  
Department of the Air Force

D I G E S T

The F-16 is a single-engine, highly maneuverable fighter aircraft that will be used for air-to-air and air-to-surface missions by the U.S. tactical air forces and four North Atlantic Treaty Organization countries. The F-16 program is in full-scale development with a production decision scheduled in September 1977.

Under a multinational commitment the United States and four European countries--Belgium, Denmark, The Netherlands, and Norway--plan to purchase at least 393 F-16s--650 for the United States and 348 for the European countries. Ultimately the U.S. Air Force plans call for procuring 1,388 aircraft. In conjunction with the above purchase, the four European countries will participate in co-producing the first 650 U.S. Air Force F-16 aircraft, the 348 European aircraft, and a share of sales to other countries.

The four NATO countries have a great influence on the decisions made on the F-16 because of their participation in the program. Program decisions could be affected by European industrial production capability, mission requirements, ability of Europeans to meet funding requirements, and the need to obtain European approval for modifications to the aircraft. These and other multinational aspects of the F-16 program are covered in a separate report which will be issued shortly. The participation by the four NATO countries has made the program both complex and unique and the comments below should be considered in this light.

GAO found that:

- Based on early test data, the Air Force is concerned about several potential F-16 problems: F100 engine stalls, demonstration of an improved aerial restart capability, and excessive taxi speed. (See p. 5.)
- Tactical Air Command officials believe that the F-16 needs additional equipment, such as an internal electronic countermeasures set, an information distribution system terminal, and a new air-to-air missile. The F-16 does not have sufficient space available for all desired new capabilities. (See p. 7.)
- A 1975 Air Force review team was critical of the combat vulnerability of the F-16. Based on a subsequent assessment by the contractor, the Air Force is considering adding two vulnerability reduction features. In the opinion of System Program Office officials the problem of vulnerability is not significant. (See p. 9.)
- Subsequent to the vulnerability review, the F-16 mission has been revised to include more air-to-surface operations. In this role it is more vulnerable than in the air superiority role because it is subject to a greater variety and concentration of hostile fire. (See p. 11.)
- The F-16 program cost estimate in the December 31, 1976, Selected Acquisition Report shows an increase of \$7.7 billion from the December 31, 1975, Selected Acquisition Report. Of this, \$6.3 billion is attributed to a quantity increase of 738 aircraft. The remainder is for new capability for the original aircraft buy and program estimate revisions. The Selected Acquisition Report was received too late for GAO to analyze the changes as to reasonableness and accuracy. (See p. 12.)
- It is generally considered that the cost of European production will be higher than U.S. production cost. The Air

Force does not yet know what impact European coproduction will have on the cost of U.S. aircraft. They contend, however, that the increase in aircraft procurement quantities as a result of European participation will lower the cost of domestic production enough to offset the increased cost of coproduction. (See p. 14.)

- The F-16 program is experiencing schedule delays that could, if not corrected, affect completion of testing required to demonstrate F-16 performance before the full production decision scheduled for September 1977. Program officials believe the delays will not seriously threaten the test schedule. (See pp. 16 to 19.)

#### CONCLUSIONS AND RECOMMENDATIONS

Greater emphasis is now being placed on the F-16 air-to-surface mission and some of the significant survivability/vulnerability problems identified by the Air Force review team have not yet been corrected.

The existing schedule for several critical test items seems optimistic and leaves little room for further delays or unanticipated test problems. Should either or both occur, the Air Force will have to decide between delaying the production decision or revising test requirements.

The Secretary of Defense should:

- Reassess the F-16 survivability features to determine if they are adequate.
- Not allow European pressure to hamper performance of testing necessary to justify a full production decision.
- Invite the European countries to participate in any assessment of the test schedule so that any changes can be mutually agreed upon.

This report was reviewed by agency officials. Their comments are incorporated as appropriate.

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#### ABBREVIATIONS

DCP	Decision Coordinating Paper
EPG	European Participating Government
GAO	General Accounting Office
JTIDS	Joint Tactical Information Distribution System
LWF	Lightweight Fighter
NATO	North Atlantic Treaty Organization
ROC	Required Operational Capability
SAR	Selected Acquisition Report
SPO	System Program Office
USAF	United States Air Force

## CHAPTER 1

### INTRODUCTION

The F-16 multinational program is in full-scale development with a production decision scheduled in September 1977. Under a multinational commitment the United States and four European countries--Belgium, The Netherlands, Denmark, and Norway--plan to purchase 998 F-16s--650 for the United States and 348 for the European countries. In conjunction with the purchase, the four European countries will also participate in producing 10 percent of the first 650 U.S. F-16 aircraft, 40 percent of the 348 European aircraft, and 15 percent of third country sales. Ultimately, the U.S. Air Force (USAF) plans to purchase 1,388 F-16s.

### BACKGROUND

The F-16 program is a follow-on to the Lightweight Fighter (LWF) prototype program which was initiated to investigate the feasibility and operational utility of a highly maneuverable, lower cost fighter. Program objectives were to (1) demonstrate advanced technology, (2) reduce technical and cost uncertainties, and (3) provide a variety of hardware options in anticipation of future military needs.

LWF was approved for prototyping in January 1972. Two contractors, General Dynamics Corporation and the Northrop Corporation, each built and flew two prototypes.

During late 1974, the Air Force evaluated the LWF prototypes and solicited full-scale development proposals from the contractors for the Air Combat Fighter. In January 1975, the Air Force selected a derivative of the General Dynamics prototype to be the Air Combat Fighter or the F-16. On January 13, 1975, the Air Force awarded a F-16 full-scale development contract to General Dynamics. At that time, the using command, Tactical Air Command, had no specific requirement (Required Operational Capability (ROC)) for the lightweight fighter aircraft.

In June 1975, the four European Governments entered into a detailed Memorandum of Understanding and preliminary contracts with the U.S. Government specifying the planned coproduction and the five nation procurement of the F-16.

Although the Secretary of Defense signed the Memorandum of Understanding and the preliminary contracts, he has not signed the F-16 Decision Coordinating Paper (DCP) which

becomes an agreement between the Air Force and the Office of the Secretary of Defense for program cost, schedule and performance goals, and thresholds. As of January 31, 1977, the Air Force has prepared three drafts of DCP 143 for the F-16 aircraft program. The latest DCP draft, dated May 18, 1976, is being reviewed by the Office of the Secretary of Defense. Although an F-16 DCP has not been signed, the draft version is used as a source document for program management.

The F-16 program is managed by the F-16 System Program Office (SPO) located at Wright-Patterson Air Force Base, Ohio. Personnel from each European Participating Government (EPG) are assigned to SPO and participate in F-16 program management. To provide management functions in Europe, a joint USAF/European F-16 Office has been established in Brussels, Belgium.

#### SYSTEM DESCRIPTION

The F-16 is a single-engine, highly maneuverable fighter aircraft that will be used by the U.S. Air Force tactical air forces and four North Atlantic Treaty Organization (NATO) countries. It is a multimission aircraft with air-to-air and air-to-surface missions.

The Air Force plans to have single and two seat models of F-16 aircraft. Both models will be capable of performing all the F-16 missions. The Air Force plans to use the two seat aircraft primarily for training. Currently, about 85 percent of the USAF F-16s will be single seat models.

The F-16 is powered by a single Pratt & Whitney F100 engine, the same engine used in the F-15. The F100 is fully qualified for production. Each engine will cost about \$2 million.

The F-16 avionics will include a pulse-doppler radar that will have an air-to-air and air-to-surface capability. The F-16 radar is being developed by Westinghouse Corporation.

#### RELATIONSHIP TO OTHER SYSTEMS

According to the May 18, 1976, DCP, the F-16 will complement the F-15 in the air superiority mission role. It will also supplement the air-to-surface capabilities of the F-4, F-111, and A-10 as required. As the Air Force acquires the F-16 aircraft, it will form operational units and will transfer some F-4s to the Air Force Reserve.

The F-16 will be used by the European Governments to replace their current F-104 and other fighter aircraft. Iran signed a Letter of Intent in October 1976 for the purchase of 160 F-16 aircraft which will complement its F-14 aircraft.

#### Air-to-air mission armament

The F-16 air-to-air armament consists of the 20-mm. M61A1 cannon and up to six AIM-9J/L Sidewinder missiles. The Sidewinder is a short range infrared guided missile. In anticipation of the development of a new, more effective radar missile, the Air Force has directed the F-16 contractor to provide the space, weight, power, and cooling provisions necessary for such incorporation.

#### Air-to-surface mission armament

The F-16 air-to-surface armament includes the Maverick missile, a close air support antiarmor weapon. It will also carry a variety of guided and unguided bombs and will be certified to carry nuclear weapons. Currently, the Air Force considers the F-16's mission mix to be 50 percent air-to-air and 50 percent air-to-surface.

#### COMING EVENTS

In September 1977, the Office of the Secretary of Defense is scheduled to make a full-scale production decision for the F-16 program. Before this decision is made, the Air Force must demonstrate the accomplishment of the following milestones:

June 1977	Complete electromagnetic compatibility and lightning tests.
July 1977	Complete static loads test at 150 percent of normal static loads.
August 1977	Basic system performance demonstration. Complete component damage tolerance test. First flight of the two-seat aircraft. Complete initial performance, stability, and control testing. Complete in-flight loads test.
September 1977	Complete functional demonstration of pre-production radar. Demonstrate basic avionics integration. Complete one lifetime durability test on airframe.

## SCOPE

Our review was made at Headquarters USAF, Washington, D.C.; Headquarters, Tactical Air Command, Langley Air Force Base, Virginia; and the following organizations at Wright-Patterson Air Force Base, Ohio: the F-16 SPO; the Electronic Warfare SPO; and the Aero Propulsion Laboratory. We also obtained information from the F-16 prime contractors--General Dynamics, Fort Worth, Texas, and the Pratt & Whitney Aircraft Group of United Technologies Corporation, East Hartford, Connecticut, and West Palm Beach, Florida.

## CHAPTER 2

### PERFORMANCE

DCP 143 establishes performance thresholds for the F-16 aircraft. The Air Force performance estimates as of September 30, 1976, exceed the thresholds DCP established. Although the Air Force's estimates exceed the performance thresholds, potential new capabilities requested by the Tactical Air Command could have an impact on mission effectiveness, program costs, and life cycle costs.

#### POTENTIAL PERFORMANCE PROBLEMS

As of January 5, 1977, the Air Force had a limited number of flight hours on the full-scale development F-16 aircraft. Notwithstanding this limited information, the Air Force has considerable test data regarding F100 engine problems in the F-16 test program accumulated during 939 test hours flown by the YF-16, the prototype for the F-16. Based on F-15/F100 experience, however, the Air Force is concerned about these potential F-16 problems: engine stall/stagnation, demonstration of an aerial restart capability, and excessive F-16 taxi speed.

#### Engine stall/stagnation

Engine stall/stagnation is a condition which to date can only be corrected by shutting down the engine and restarting it. All of the incidents to date except one have occurred on the F-15 aircraft which had the same engine. It is caused by disturbed airflow through the engine or failure of various engine control system components. Since the F-16 is a single-engine aircraft, whereas the F-15 is twin-engined, the shutting down of the engine to correct the problem poses a more serious problem than in the F-15 aircraft.

Under the F100 component improvement program Pratt & Whitney has improved various engine parts including engine control system components. As a result, the current F100 engine stall/stagnation rate on F-15 aircraft is approximately 4.5 per 1,000 flight hours. Although the modifications have reduced the occurrence of stalls under low power conditions, stalls experienced by the F-15 under high altitude, high power conditions are still a problem. During the continuing component improvement program Pratt & Whitney has been directed to develop improvements to further reduce the stall frequency.

## Demonstration of an improved aerial restart capability

When an engine flames out, or is shut down, the F-16 pilot must be able to effect an aerial restart of the engine if he is to avoid an emergency landing or ejection. When the aircraft has a low airspeed and a low altitude, however, restarting is hazardous since there is very little time for the pilot to effect a restart.

The F100, which was designed for the twin-engined F-15, is required to have a 350 nautical miles per hour (knots) aerial restart capability. The Air Force has demonstrated that the F100 can consistently restart at 250 knots airspeed. Headquarters Tactical Air Command considers it desirable that the F100 unassisted restart airspeed be lowered to 180 knots.\*

Under the component improvement program, the Air Force and Pratt & Whitney have investigated ways to reduce the F100 aerial restart speed. Tests in F-15 aircraft have demonstrated that the F100 can be restarted at 10,000 feet altitude and 200 knots airspeed with the current engine design. The F-16/F100 engine will have a jet fuel starter which could further improve the aerial restart capability. This capability will be demonstrated during early 1977.

## Excessive F-16 taxi speed

Since the F100 engine develops so much thrust at normal idle, an F-16 with little fuel, no ordnance, and without braking, will taxi at about 45 to 50 knots. The high taxi speed will require the pilot to frequently apply the brakes to keep the aircraft within acceptable ramp speed. This can result in the accelerated wear out of brakes.

The engine contractor has demonstrated a means to reduce idle thrust about 40 percent when the aircraft is on the ground. Reduced idle thrust will lower taxi speeds to about 30 knots without braking, which should result in less brake wear. As of January 1977, the Air Force, however, had made no decision to incorporate the reduced idle thrust modifications in the production F-16 aircraft.

Although landing any aircraft on an icy runway is hazardous, the F-16 may be more of a risk than other aircraft because of its current high idle thrust. Norway, in particular is concerned and had requested a feasibility study for the installation of a thrust reverser on the F-16/F100 engine.

Because of weight, complexity, and high development costs, Norway decided against a thrust reverser and is currently considering installing a drag chute on its aircraft.

#### POTENTIAL NEW REQUIREMENTS

The Tactical Air Command did not have a ROC prepared for the F-16 when full-scale development was started in January 1975. The Tactical Air Command's ROC document for the F-16 is still being reviewed by Headquarters USAF. We are unable to comment on the reasonableness of the requirement, however, because Headquarters USAF denied us access to the document.

Tactical Air Command officials stated that the F-16 needs the following equipment to enhance its mission effectiveness or to reduce life cycle costs: an internal rather than a podded external electronic countermeasures set, a Joint Tactical Information Distribution System terminal, a new beyond-visual range air-to-air missile, an engine diagnostic system, a global positioning system receiver, and a video tape recorder. Currently, the F-16 has approximately 6.2 cubic feet of suitable growth space to incorporate new capabilities. Considering space and cost limitation, Headquarters USAF must determine which, if any, of Tactical Air Command's requested capabilities will be incorporated in the F-16. The rationale behind Tactical Air Command's requested capabilities are discussed below.

#### Internal electronic countermeasures set

Tactical Air Command wants the Air Force to develop a new internal electronic countermeasures set with reprogrammable software for the F-16. Tactical Air Command considers the requirement for an internal electronic countermeasures set to have a high priority.

SPO officials, however, expressed the following concerns about incorporating an internal electronic countermeasures set.

- The incorporation of an internal electronic set would use a significant portion of the available space and could prohibit the incorporation of some other new requirements.
- The earliest possible incorporation of an internal electronic countermeasures set would be mid-1982 and will have a significant development and production



cost impact. A substantial number of aircraft must therefore be built with a pod capability.

--The extent that technology could be released to the foreign F-16 users, if an internal countermeasures set is selected.

SPO officials stated the new reprogrammable pod, the ALQ-131, being developed for the F-4, is an alternative to the internal electronic countermeasures set requested by Tactical Air Command. The new pod is reprogrammable to meet new threats and it would not use any of the F-16's available space.

Compounding the issue further, Belgium, one of the European buyers, wants internal electronic countermeasures and is considering the installation of such a system in its F-16s. Belgium is also considering asking its European partners in the F-16 procurement to adopt its system as the European standard for the F-16 aircraft.

A decision to develop internal countermeasures for the F-16 will be made later in 1977 at which time the EPG will be invited to retain the same configuration as the United States.

#### Joint Tactical Information Distribution System (JTIDS)

JTIDS is a data system that will provide secure, jam-resistant exchange of command and control information.

In operation, JTIDS will make some information available throughout the theater while reducing the workload of the aircrew. It is currently in the advanced development stage with prototype and production development planned for completion by 1980 to 1981.

The Tactical Air Command considers that JTIDS is a high priority requirement for the F-16 aircraft.

#### New beyond-visual-range missile

Tactical Air Command in conjunction with the Navy has developed a Joint Service Operational Requirement (JSOR) for a lightweight, beyond visual range missile that can be carried in the F-16, F-15, F-18, and F-14.

SPO officials said incorporation of a radar missile in the F-16 would probably require a modification of the

F-16 radar and the stores management system, incorporation of missile interface units, and new pylons.

#### Engine diagnostic system

The engine diagnostic system as currently envisioned will provide maintenance personnel assistance in isolating F100 engine malfunctions. Since the system will reduce the number of unnecessary engine changes and afford the Air Force more opportunity to take advantage of the F100 modular construction, advocates of the engine diagnostic system claim it will lower F-16 life cycle costs. The F-16 SPO is funding demonstration of a prototype engine diagnostic system, but has made no commitment regarding acquisition.

#### Global positioning system receiver

The Navstar global positioning system is a satellite navigation system currently under development. To interface with this system, the F-16 will require a special receiver. When the system is fully operational in 1984, this receiver will be capable of determining position and aircraft velocity using data transmitted from satellites orbiting the earth.

#### Video tape recorder

The video tape recorder would provide a visual record of mission performance. Tactical Air Command plans to use the visual record as a real time training aid during pilot briefings and debriefings and also as another tool for assisting maintenance personnel in isolating avionic faults. Tactical Air Command officials said the video tape recorder would improve the effectiveness of the F-16 pilot training program.

#### SURVIVABILITY/VULNERABILITY

During the lightweight fighter program, two competing contractors developed prototypes to demonstrate the feasibility of a low cost, highly maneuverable fighter for the air superiority mission. Since the lightweight fighter program was to demonstrate technology, there was no USAF requirement to incorporate survivability/vulnerability technology in the design.

In the transition phase from prototype to full-scale development, each of the competing contractors conducted survivability/vulnerability studies and prepared a survivability program for an aircraft that would have an air superiority mission with a secondary air-to-surface

capability. According to SPO officials, the Air Force evaluated the survivability features of both prototypes during source selection assessment, and incorporated a survivability/vulnerability program plan in the F-16 contract.

Later, at the direction of Headquarters Air Force Systems Command, an Air Force Independent Survivability Review Team evaluated the F-16 characteristics. In an August 1975 report, the review team was critical of some of the survivability features incorporated into the F-16.

The review team stated that major vulnerability existed relative to engine fuel ingestion from fuel tank/inlet duct wall wounds; a large potential for fuel fires/explosions in dry bays and void space caused by leaking fuel from combat damaged fuel tanks; and singularly vulnerable components in the engine fuel feed, flight control and hydraulic systems, loss of which will cause immediate loss of aircraft or early loss of aircraft control. The review team also pointed out that the vulnerability of the flight control system in a nuclear environment has not been adequately assessed. The team concluded that the F-16 design is highly vulnerable to projectile and missile warhead fragments from both air-to-air and ground-to-air enemy systems.

The review team also pointed out that the overall F-16 design/configuration had become essentially stabilized to the point that major rearrangement to "design out" many of the identified problems are probably no longer possible. The alternative approach, to add or retrofit survivability/vulnerability features where possible, rarely leads to optimum aircraft characteristics because of cost, weight, performance, and schedule penalties.

As a result of the concerns expressed by the review team, the Air Force directed the contractor to accelerate its planned reassessment of F-16 survivability/vulnerability. In a June 1976, report, the contractor discussed the impact that the following vulnerability reduction techniques would have on the F-16: (1) the dry bay fire extinguishing system, (2) the ingestion suppression system, (3) a hydraulic fusing and shutoff system, and (4) a kit armor system for protection of critical flight control system components.

Currently, SPO is reviewing engineering change proposals for the dry bay fire extinguishing system and the ingestion suppression system. If incorporated into the F-16 design, these two techniques would extinguish fires in dry bays adjacent to fuel tanks and prevent a massive fuel dump and fuel ingestion into the engine.

Since the contractor's analysis indicated that other techniques contributed little to reduce F-16 vulnerability, the SPO does not plan to take any action to protect critical components in the engine fuel feed system, flight control system, and hydraulic systems which, if hit, will cause immediate loss of the aircraft.

Since the independent survivability review, the role of the F-16 has been revised to include more air-to-surface missions. It is designated as a multi-mission aircraft with 50 percent air superiority and 50 percent air-to-surface missions. In the air-to-surface role the F-16 is more vulnerable than in the air superiority role because the aircraft is subject to a greater variety and concentration of anti-aircraft weapons.

In the opinion of SPO officials the problem of vulnerability is not significant. This position was not substantiated to us and must be considered a subjective assessment.

#### CONCLUSIONS AND RECOMMENDATIONS

The Air Force's September 30, 1976, F-16 performance estimates exceed DCP thresholds. Based on the YF-16 prototype test program and F100 engine performance under the F-15 test program, however, there are potential problems regarding engine stall, improved aerial restart capability, and excessive taxi speed.

The Tactical Air Command has requested additional F-16 capabilities which could have a significant impact on program costs, life cycle costs, and mission effectiveness. The F-16 may not have enough space to incorporate all of them. Eventually, the Air Force must determine which, if any, of the new capabilities will be incorporated.

F-16 survivability and vulnerability could become an issue if aircraft modifications to enhance survivability significantly reduce aircraft performance and increase program cost. It could also become an important issue if the Air Force does nothing further to improve F-16 survivability.

Since greater emphasis is now being placed on the F-16 air-to-surface mission and some of the significant survivability/vulnerability problems identified by the Air Force Review Team have not been corrected, we believe there is a need to further review this matter. Therefore, we recommend that the Secretary of Defense reassess the F-16 survivability features to determine if they are adequate.

### CHAPTER 3

#### COST STATUS

The F-16 program cost estimate in the December 31, 1976, Selected Acquisition Report (SAR) identified a cost increase of \$7.7 billion from the December 31, 1975, SAR. This increase is due to an increase of 738 aircraft and changes to the original program. SAR was received too late for us to analyze the changes as to reasonableness and accuracy.

Other items currently under study for F-16 application, if adopted, could further increase the program estimate. In addition, the impact of European coproduction on U.S. aircraft cost is not included in the SAR estimate because it was not yet known.

#### ACQUISITION COST ESTIMATES

In our March 1976 Staff Study, we reported the 650 aircraft F-16 program acquisition cost estimate as of December 31, 1975, to be \$6,054.5 million. At December 31, 1976, the estimate had increased \$7,778.8 million to \$13,833.3 million.

#### Comparison of F-16 Program Cost Estimates as Reported in Selected Acquisition Reports (in millions of then-year dollars)

	<u>December 31, 1975</u>	<u>December 31, 1976</u>	<u>Increase</u>
Development	\$ 659.1	\$ 891.1	\$ 232.0
Procurement	<u>5,395.4</u>	<u>12,942.2</u>	<u>7,546.8</u>
Total	<u>\$6,054.5</u>	<u>\$13,833.3</u>	<u>\$7,778.8</u>
Quantities:			
Development	8	8	0
Procurement	<u>650</u>	<u>1,388</u>	<u>738</u>
Total	<u>658</u>	<u>1,396</u>	<u>738</u>
Unit cost:			
Procurement	\$8.30	\$9.32	\$1.02
Program	9.20	9.91	.71

The net increase between the December 31, 1975, and the December 31, 1976, Selected Acquisition estimate is as follows (in millions, then-year dollars):

Development

New Task-Added Capability	+\$ 67.6
Peculiar Ground Support	+127.2
Program Estimate Revision	+43.1
Changes in Testing/Test Support	-12.7
Training/Data Refinement	-1.1
Contract Award Fees	<u>+3.3</u>

\$ 227.4

Procurement

Increases associated with additional 738 aircraft procurement.

Procurement Increase	+\$5,364.7
Peculiar Ground Support	+383.4
Training Equipment	+298.2
Data	+36.8
Initial Spares	<u>+276.1</u>

6,359.2

Increases associated with original 650 aircraft program.

New Tasks for Added Capability	+\$159.4
Initial Spares	+71.7
Program Estimate Revision	+288.7
Provide Full Mission Simulator	+188.4
Definition of Depot Requirements	+105.7
Identification of Procurement and Engineering Data	+70.8
Reliability Improvement Warranty	+29.7
Contract Award Fees	<u>+9.0</u>

923.4

Previous Changes

Escalation Increase (identified in Sept. 30, 1976, Selected Acquisition Report)	+\$307.8
Revision in Estimating Methodology	<u>-39.0</u>

268.8

Total Program Change

\$7,778.8

## OTHER ITEMS UNDER STUDY

Other items including those shown below, are being studied for F-16 application and may have a significant impact on future F-16 cost estimates.

- Engine diagnostic systems.
- Auxiliary power units.
- Internal electronic countermeasures.
- Joint tactical information distribution systems.
- Global positioning system receivers.

The magnitude of possible cost impact has yet to be defined.

## EUROPEAN COPRODUCTION

The present F-16 program is for 650 U.S. and 348 European aircraft. Eventually the United States will procure 1,388 aircraft. Although European industries will produce 10 percent of the value of the 650 U.S. aircraft, the cost impact of European coproduction has not been assessed as yet. In fact, none of the current program documents consider the impact of coproduction.

Air Force officials said that European-produced parts will be more expensive than the same parts produced by U.S. contractors. They believe, however, that the European participation will not increase the cost of the USAF F-16 program beyond what it would have cost to domestically produce 650 USAF F-16s. They contend that the increases in quantities as a result of European participation will lower the cost enough to offset the increased cost of European parts. At this time SPO does not have a cost estimating system that includes coproduction costs and does not know what impact coproduction will have on the cost of USAF aircraft.

## DESIGN-TO-COST GOAL

In April 1975 the Secretary of Defense set a design-to-cost goal of \$4.5 million fiscal year 1975 dollars based on the U.S. production of 650 F-16 aircraft at a rate of 15 per month. The goal is defined as the average unit flyaway cost

and does not include nonrecurring costs or the costs of development, initial spares, training, data, ground support equipment, and portions of engineering and management. According to the May 18, 1976, DCP the goal was increased \$55,000 to \$4.555 million to add nuclear capability to the F-16.

In December 1976, F-16 SPO officials said the current design-to-cost estimate should probably be about \$4.8 million. We were unable to analyze the data supporting current estimates because the Air Force would not make it available to us.

### CONCLUSIONS

The F-16 program cost estimate as of December 31, 1976, has identified major cost changes to the program. These increases are predominately associated with the increased quantities of 738 aircraft but the program has also incurred an approximate \$1.4 billion increase to its baseline. The Air Force does not know what impact the European coproduction program will have on the program.



## CHAPTER 4

### PROGRAM SCHEDULE

Although all scheduled major milestones in the F-16 program have been met the schedules for testing required before the full production decision in September 1977 are optimistic. Currently, test aircraft, radar, and the stores management system are behind schedule. Further slippages could result in a failure to accomplish required testing prior to the production decision.

The Air Force has also experienced delays in completing an engineering change proposal which established firm target prices for the EPG aircraft and restructures the U.S. and European option quantities under the aircraft contract. Because of schedule slippages for early test aircraft, late submission of engineering change proposals, and other problems, the SPO has withheld a portion of the progress payments to General Dynamics.

### PROGRAM MILESTONES

The following table shows the program milestone dates as reported in the December 31, 1976, SAR.

<u>Milestone</u>	<u>Schedule date</u>
Contract award	accomplished
DSARC (note a) II	accomplished
First flight F-16A	accomplished
DSARC IIIA (approval of long lead items)	accomplished
DSARC IIIB (approval of full production)	9/77
First flight production aircraft	8/78
First aircraft to Tactical Air Command	9/78
Delivery of 100th production aircraft to USAF	5/80

a/Defense Systems Acquisition Review Council.

In addition to these milestones, other scheduled events are first F-16B flight in August 1977 and initial operational capability in mid-1980.

The next major program milestone will be the DSARC IIIB decision currently scheduled for September 1977. According to SPO officials the full production decision depends on a successful flight test program.

Prior to this decision a total of four aircraft will have been delivered including the first F-16B (two seat model). These aircraft are scheduled to make about 200 to 240 test flights to demonstrate performance characteristics prior to the production decision.

### TEST SCHEDULES ARE OPTIMISTIC

The schedule for completion of the tests required before the full production decision (DSARC IIIB) in September 1977 is optimistic. Test aircraft, radar, and the stores management system are currently behind schedule. Program officials have placed a high priority to resolving these issues in order to maintain the schedule. Continued slippage could result in a failure to complete required testing prior to the scheduled full production decision.

### Delay in aircraft assembly

The aircraft and airframes required for DSARC IIIB testing are scheduled for delivery as shown below:

<u>Item</u>	<u>Scheduled delivery</u>	<u>Test requirements</u>
Aircraft A-1 (note a)	Dec. 1976	Test flights
Airframe	Dec. 1976	Static load testing
Airframe	Jan. 1977	Durability testing
Aircraft A-2 (note a)	Feb. 1977	Test flights
Aircraft A-3	May 1977	Test flights
Aircraft B-1	Aug. 1977	Test flights

a/These test aircraft will not contain all F-16 components. Among those deleted are the gun, radar, operational heads-up display, fire control computer, and stores management system.

Aircraft A-1 was delivered on December 17, 1976, and the static test airframe began scheduled testing in the same month. SPO officials stated that the schedule slippages are slight, and are being recovered. A-2 was delivered on schedule on February 23, 1977, and was accepted by USAF on February 24, 1977.

Two of these items are particularly critical to the test program. Aircraft A-3, for example, will be the first F-16 with full mission equipment and many test requirements can be done only with this aircraft. Aircraft B-1 must

make its first flight prior to the September 1977 DSARC. Any extensive delay in the delivery of either of these aircraft could delay accomplishment of test requirements.

#### Durability test airframe

Before the production decision, the durability of the F-16 airframe, which will not be ready for testing until March, must be demonstrated by undergoing simulated stresses equivalent to 8,000 flight hours. Even if no significant problems develop, this testing will not be completed until the end of September 1977, the month of the scheduled production decision. Although a certain amount of test time has been built into the test schedule, there is little time for recovery if further delays are experienced.

#### Radar production behind schedule

Prior to the full production decision the contractor must successfully demonstrate all radar functions and the integration of the radar with the other F-16 avionics subsystems. This will require that a properly configured radar unit begin ground testing at least 2 months before its installation in test aircraft A-3 in May 1977.

A flight model of the F-16 radar has demonstrated most radar functions in an F-4 aircraft, but this set is 20 percent larger than the one to be used in the F-16 aircraft. The first radar set configured for the F-16 airframe has not been completed. Radar production is currently 6 weeks to 2 months behind schedule. Delivery of the radar unit is scheduled for mid-March which barely meets the requirements for ground testing. There is little time available for further production slippages or if significant testing problems occur.

#### Schedule slippage in stores management system

The F-16 stores management system coordinates the weapons functions with other aircraft avionics systems such as radar and optical displays. The system consists of a number of electronic units throughout the aircraft.

In August 1976 Air Force officials reviewed the F-16 stores management system progress and considered it unsatisfactory. The redesign of the system and other problems have caused schedule slippages. SPO officials stated that

these slippages will not affect the test schedule because the stores management system is not needed until Aircraft A-3. If the current problems persist, however, and the system is not available as scheduled, it will interfere with completion of DSARC IIIB testing.

#### MULTINATIONAL INFLUENCE ON PROGRAM SCHEDULE

From its inception the F-16 program has been heavily influenced by the desire of the United States Government to have the F-16 adopted by NATO allies and subsequently, by the requirements of the European Participating Governments. The time frame for aircraft selection, and the coproduction requirements, have caused conflicts with normal USAF acquisition procedures, and have resulted in these procedures being either ignored or circumvented.

The USAF and European production decisions are scheduled for September 1977. The current schedule slippages and related test program problems, however, may require that the Air Force choose between delaying the production decision or revising test requirements. Because of the multinational commitments, which include a firm delivery schedule for European F-16s, there is some question as to what options will be available at that time. For instance, in DCP 143 dated May 18, 1976, the Air Force has indicated that if unforeseen difficulties arise it will be prepared to accept the first few aircraft without the radar and retrofit them later so as not to delay the aircraft delivery schedule.

The multinational aspects of the F-16 program are more thoroughly discussed in a separate GAO report.

#### ENGINEERING CHANGE PROPOSAL 0006

Engineering Change Proposal 0006, which restructures the U.S. and European production option quantities under the General Dynamics' contract, was scheduled to be submitted by General Dynamics on September 30, 1976. During negotiations, however, Air Force officials determined that General Dynamics had not provided adequate supporting cost and pricing data and directed the contractor to supply additional information. Currently, Air Force officials estimate the cost of this change proposal will be negotiated during the spring of 1977.

While SPO officials would not discuss the cost impact until negotiations had been completed, they told us the following items would be included in this change:

1. Changes to USAF F-16 production program
  - (a) Includes eight engineering changes.
  - (b) Reduces the total USAF aircraft option quantity from 301 to 250 and changes the unit pricing table.
  - (c) Reduces specific fiscal year option quantities.
2. Changes in the European F-16 production program
  - (a) Includes eight engineering changes and European peculiar configurations.
  - (b) Increases the total option quantities for the first 3 fiscal years from 141 to 192 aircraft procurement.
  - (c) Includes provisions for additional tooling cost for European production.
  - (d) Establishes firm target and ceiling prices for 192 European aircraft.

This change proposal will reflect a major part of the coproduction impact on the F-16 program and is required for the completion of definitive multinational agreements.

CONTRACT PAYMENTS WITHHELD DUE  
TO UNSATISFACTORY PROGRESS

On August 31, 1976, the F-16 SPO directed that \$10 million of General Dynamics' progress payment be withheld pending remedial action on a number of problem areas including the following:

- Submission of Engineering Change Proposal 0006 which will reflect much of the impact of European participation in the F-16 program.
- Submission of change proposal for maintenance test equipment.

- Submission of change proposal for nuclear capability.
- Other late responses to requests for change proposals.
- Problems with stores management set.
- Schedule slippages on full-scale development.

As of December 3, 1976, satisfactory progress had been made in some of these areas and \$5.5 million had been released. The remaining \$4.5 million was still being withheld pending further General Dynamics' action. The principal concerns were Engineering Change Proposal 0006 which SPO officials stated was fundamental to development of an adequate Air Force budget for 1978 and beyond, and some slippage in the full-scale development aircraft delivery schedule.

#### CONCLUSIONS AND RECOMMENDATIONS

The F-16 program is experiencing schedule delays that could affect completion of testing required to demonstrate F-16 performance prior to the full production decision scheduled for September 1977. Program officials believe the delays will not seriously threaten the test schedule. Nevertheless, the existing schedule for several critical test items seems optimistic and leaves little room for further delays or unanticipated test problems. Should either or both occur the Air Force will have to decide between delaying the production decision or revising test requirements. The multinational aspects of the program restrict and could unduly influence the final choice.

We recommend that the Secretary of the Defense:

- Not allow European pressure to hamper performance of testing necessary to justify a full production decision.
- Invite the European countries to participate in an assessment of the test schedule so that any changes are mutually agreed.