Expected Attendance
F-16 DSARC II
11 March 1975 - 1600 - Rm 1E801#7

Secretary of Defense J. Schlesinger

ODDR&E

Dr. M. Currie
(Chairman)
B/Gen C. Spence
C. Myers
Col. T. Davies
G. Sutherland
R. O'Donahue

OASD(I&L)

A. Mendolia
J. Gansler
F. Myers
D. Babione
Dr. Bennett
J. Smith

OASD(PA&E)

L. Sullivan
E. Pyatt
T. Christie
R. Croteau

OASD(C)

T. McClary
N. Eaton
S. Trodden

OSD General Counsel

M. Hoffman

DefSec Assist Agency(ISA)

M/Gen H. Fish

D/DDR&E(T&E)

L/Gen A. Starbird
B/Gen W. Whitlatch
Col. W. Twinting

JCS

RAdm R. Hilton
Capt. E. Woodridge (N)
L/Col. J. Voorhees (AF)

CAIG

M. Margolis
L/Cdr. D. Pilling
H. Manetti

AIR FORCE

J. McLucas, SecAF
F. Shrontz, ASAF(I&L)
Dr. W. LaBerge, ASAF(R&D)
Gen D. Jones
L/Gen W. Evans, AFRD
M/Gen A. Slay, AFRDQ
L/Gen J. Hudson, AFSC
B/Gen H. Leaf, AFTAC
Col. C. Spangrug, AFLG
Col. T. Swalm, AFTAC
L/Col. M. Jones, AFSC
L/Col. T. Woods, RDPM
L/Col. R. Orr, TAC

NAVY

VAdm W. Houser, OP-05
VAdm K. Lee, NAVAIR
B/Gen P. Shutler, MARCORPS
Capt. G. Kelly, OP-98

Briefers

Col. W. Thurman, F-16 SPO
G. Myers, ASD
L/Col. A. Koppen, AFLC
L/Col. J. Gentry, RDQRT
L/Col. E. Bracken, RDQRT
L/Col. F. Dent, AFTAC

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DSARC Notebook, Air Combat Fighter DSARC II
11 ~~Feb~~ Mar 75 - 1400 - Room 1E 801 #7

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75-420 cy 16

Air Combat Fighter DSARC-II

~~11 February 1975~~ - ~~1400~~ 1400 - Room 1E 801 #7

11 MARCH 1975

General Counsel

~~SECRET~~

2C

AIR FORCE RESPONSE

TO THE

OSD LIST OF QUESTIONS ON ACF (F-16)

QUESTION:

1. What are the Air Force's proposed design-to-cost figures for the ACF airframe, engine, radar and avionics (less radar)? How much emphasis will be given to design-to-cost, i.e., will the ACF management philosophy attempt to hold firm to cost goals at the expense of performance if necessary?

ANSWER:

1. The Air Force has established a $4.5 million (FY 75 dollars) design-to-cost goal (DTC) for the F-16 recurring unit flyaway cost. Additionally, DTC goals, again in FY 75 dollars, for the avionics package and for the radar alone are $750 thousand and $250 thousand respectively. The radar contractors have been instructed that performance tradeoffs should be accomplished to ensure achievement of the DTC goals. While the principal objective of the aircraft contract is achieving the DTC goal, the contractor has been tasked to include, as a management objective during the development program, the control of downstream operating and support costs as well. The Air Force will entertain contractor requests for adjusting the DTC goal for real or demonstrable cost of ownership savings which will result in an overall life cycle cost benefit.

QUESTION:

2. What is the basis for the $4.5M DTC goal? As the USAF ICA estimate of $4.7M for the flyaway cost includes a 10% management reserve factor, a DTC goal without this reserve would be $4.3M.

ANSWER:

2. The USAF ICA estimate of $4.63 million for the F-16 recurring unit flyaway cost contains a 10 percent allowance for engineering change orders (ECO). An ECO allowance has historically been required for aircraft programs and is not considered a management reserve per se. The DTC goal of $4.5 million was set below the ICA estimate because of Air Force confidence in achieving this objective.

~~SECRET~~ WHM 4/23/03

QUESTION:

3. Is the $750K recommended as an avionics DTC goal the price to the USAF or does it reflect vendor prices for the equipment, without the addition of the prime airframe contractor's loading? The $250K goal for the radar should also be clarified as to whether it is a vendor or CFE price.

ANSWER:

3. The radar DTC goal is based on the vendor price; however, the DTC goal for the avionics package, which incorporates the radar, includes contractor loading and integration costs, and, as such, represents the cost to the Air Force.

QUESTION:

4. In displaying the cost track from the $4.5M goal to the original $3.0M goal in DCP 120, why was the 10% management reserve ($400K per aircraft) not de-escalated to FY 72$ in calculating the resultant FY 72 cost?

ANSWER:

4. The original LWF DTC goal in DCP #120 did not include an ECO allowance. The current F-16 DTC goal, when adjusted to the 300 aircraft base in FY 72 dollars, is $4.3 million. The 10 percent ECO allowance, actually only $0.4 million, was then used in calculating the resultant FY 72 dollar cost.

QUESTION:

5. What are the structural specifications for the F-16? What is the rationale for these specifications? What is the impact on the F-16 weight of these specifications? What were the same specifications for the F-15?

ANSWER:

5. The structural specifications for both the F-15 and F-16 are compared below. The rationale for the F-16 specifications is that they provide for a longer useful life span, lower life cycle cost and enhanced mission capability.

SPECIFICATION	F-15	F-16
Limit Load Factor (G)	+7.33, -3.0 below 37,400 lbs	+7.33, -3.0 at full internal fuel +9.0 with 70% fuel
Dynamic Pressure (q) Limit	Mach 1.20 Sea Level	Same
Fatigue Life (hours)	4000*	8000

* Currently undergoing evaluation for extension to 8000 hours.

The F-16 fatigue spectra for the air-to-air mission was based on a review of the F-4E slat, F-5E and F-15 and the projected capability desired for the F-16. The F-16 spectra is coincident with the F-15 in the 2 to 6 "G" range and is higher (more exceedances) in the 6 to 12 "G" range. As the air-to-air exceedance spectra is more severe than the air-to-ground spectra by an order of magnitude, the majority of the anticipated fatigue damage can be attributed to air-to-air mission usage.

The number two YF-16 prototype has been used as the baseline for weight changes in the operational version. The contractor estimate of additional structure required to achieve the structural specification is 14 pounds; however, the Air Force estimate is 49 pounds.

QUESTION:
6. Are the F-16 performance goals set in the DCP higher than demonstrated F-15 performance? If not, why not?

ANSWER:
6. The F-16 performance goals were based on the ACF design air superiority mission with a ground rule configuration of 2 AIM-9 missiles and 500 rounds of ammunition. Performance of both the F-15 and F-16 on this mission is very sensitive to the number and type of missiles carried. Consequently, in some cases, the F-16 goals are higher than F-15 performance and, in other cases, they are not. The LWF Prototype Program goals were based on both threat analysis and the need to demonstrate increased maneuvering performance in the visual air combat arena. The F-16 goals were then established based on YF-16 prototype test results and expected performance achievable in an operational version.

QUESTION:
7. The cost, reliability, and maintainability figures in the DCP are not fully defined and do not readily allow a comparison with other systems. Request you define these figures and show a side-by-side comparison of the F-15/F-16.

ANSWER:
7. The cost, reliability, and maintainability data requested on the F-16 are being compiled; however, it is doubtful that the information can be provided to the extent of detail outlined in the OSD format. Additionally, differences in specified reliability and maintainability criteria for the F-15 and F-16 will make a direct comparison difficult, if not meaningless, until the data can be normalized to a common baseline.

QUESTION:
8. How will the Air Force maintain competition in the ACF program in the areas of the airframe, engine, radar and other high cost avionics?

ANSWER:
8. Hughes and Westinghouse are currently competing for the F-16 radar with the flyoff and source selection scheduled for the end of 1975. The inertial navigation system is also in the competitive phase. In addition to tight specifications and contracts which include DTC goals, the F-15 program provides considerable incentive for General Dynamics to control F-16 costs.

QUESTION:
9. Will the R&D program include any cost reduction effort on the engine? What will the engine R&D effort consist of?

ANSWER:
9. The RDT&E program will not include cost reduction efforts on the F100 engine. Such efforts are performed as part of the F100 Component Improvement Program which is to be funded jointly with the F-15 program. The F100 RDT&E portion of the F-16 program will include 18 engines, engineering flight test support, support equipment, and spare parts.

QUESTION:

10. What specific parameters in the computation of Operating and Support costs favor the ACF over other aircraft? What features will enable the ACF to achieve higher sortie rates than the F-4 and F-15 (express in specific, comparable quantitative terms)?

ANSWER:

10. Two major Operating and Support cost factors favoring the F-16 over other aircraft are reduced fuel consumption (approximately 60% and 50% of F-15 and F-4 respectively) and reduced base level maintenance manpower requirements. Specific features enabling higher sortie rates are as follows:

a. Engine. Only two-thirds as many engine changes as the F-4. Each F-16 engine change requires only 40 percent of the time of an F-4 engine change and only one-half as many maintenance actions due to the single engine.

b. Fire Control System. Eight times as many sorties between maintenance actions due to significant design advances over the F-4. Greater Built In Test (BIT) capability provides a faster fault isolation. Few, if any, on-aircraft equipment adjustments will be required.

c. Support Equipment. The jet fuel starter will reduce the need for ground support equipment.

QUESTION:

11. Does the Air Force plan any programmed depot maintenance for the ACF? What is the maintenance concept for the ACF airframe, engine and avionics, and how does this compare with the F-15?

ANSWER:

11. Programmed Depot Maintenance (PDM) is not planned for the F-16. When the F-16 becomes operational, Analytical Condition Inspections (ACIs) will be conducted to verify the structural integrity of sample aircraft. Should the results of the ACIs so indicate, a PDM program would be implemented at that point. The engine will be maintained

at Intermediate and Depot levels under the same concept as the F-15 program. Avionics equipment will be maintained as indicated by the results of Optimum Repair Level Analyses (ORLAs) taking into account operational considerations. The entire F-16 maintenance concept is being defined and will be completed prior to the Critical Design Review in the October-November 1975 time frame.

QUESTION:
12. Prepare a graph to enable cost comparisons of the F-15 and various configurations of the F-16.

ANSWER:
12. Several independent Air Force organizations are preparing this data for comparison with the OSD/CAIG information.

QUESTION:
13. If the F-16 were to incur cost growth over the present estimate, at what cost would an alternative aircraft procurement be preferred?

ANSWER:
13. The Air Force does not expect the F-16 program to incur a cost growth over estimates that have been provided and efforts are ongoing to identify additional means of reducing costs. Should a F-16 cost growth be incurred, and assuming no change in threat posture or increase in F-15 cost, there would be a crossover point where an alternative procurement would be prudent; however, this point has not been quantitatively defined.

QUESTION:
14. What is a reasonable schedule and associated costs for a development and test of an "austere" version of the F-15 as a potential candidate for the ACF role?

QUESTION:
15. Provide the R&D funding required by year in constant FY 75 dollars and then-year dollars. Describe any changes to the funding schedule.

ANSWER:
14 and 15. It is estimated that a minimum of one month would be required to conduct the trade and design studies and then develop the schedule and costs for such a program.

QUESTION:
16. Why are we buying OT&E aircraft with R&D funds, a policy inconsistent with recent Congressional direction? What R&D savings would accrue if these aircraft were bought with procurement funds; any schedule implications?

ANSWER:
16. The primary reason for the procurement of these aircraft is to avoid the very expensive gap in the production line. The Aeronautical Systems Division briefing on the impact of production gaps can be made available if desired. Additionally, the F-16 development program is being examined to assess the feasibility and desirability of reducing the number of DT&E aircraft.

QUESTION:
17. What is the proper funding and delivery schedule for the following procurement alternatives?

- An advanced procurement plus a buy of 18 aircraft fully funded in FY 77 with follow-on buys fully funded annually thereafter.

- Only an advanced procurement in FY 77 with fully funded procurement thereafter.

ANSWER:
17. Several alternative development and production programs, including those requested, are being considered. These alternatives will be discussed with appropriate OSD representatives during the week of 17 February.

QUESTION:
18. Provide a new test schedule with DSARC milestones consistent with the $32M FY 75 budget.

ANSWER:
18. The test schedule and DSARC milestones will be dependent

upon the specific alternative selected. As stated in question 17, these alternative programs will be discussed with DDT&E personnel during the week of 17 February.

QUESTION:
19. What are the quantities of air superiority and ground attack aircraft by type projected for the total force structure during the 1980s?

ANSWER:
19. Attachments 1 and 2 outline the planned active and reserve tactical fighter force structure for the early 1980s.

QUESTION:
20. What are the capabilities of the ANG and Reserves to respond to deployment situations? Will we not depend on these forces in a war in Europe?

ANSWER:
20. The Secretary of Defense, through the Secretary of the Air Force and HQ USAF, announces a mobilization and provides supplemental instructions. A 30 day alert notice is normally provided; however, the reason for the mobilization may dictate an alert of less than 30 days and gaining MAJCOM personnel plans include such requirements and procedures. Historically, warning time has been sufficient to allow the 30 day alert. Plans to insert the reserve forces in a war in Europe take into account the delay inherent in mobilizing such forces. After mobilization of these forces they will be used, in the main, in the air-to-ground role.

QUESTION:
21. What is the modification program planned for the F-4E to increase its air-to-ground capabilities and doesn't this capability of the F-4E force when added to the remainder of the attack-capable forces provide sufficient air-to-ground capability in the 1980s?

ANSWER:
21. The F-4E modification program is oriented towards improving survivability in the threat environment. Late model F-4Es will be equipped with the following specialized ground attack systems: Wild Weasel for defense suppression; EO data link

for standoff; and LORAN/PAVE TACK for an adverse weather, 24 hour precision guided munition (PGM) capability. These F-4Es provide a unique tactical capability; however, by 1983 they will represent only 15 percent of the active force.

At present the active tactical fighter force is comprised of four types of aircraft, the F-105, F-111, A-7, and F-4, all having a substantial ground attack capability. By 1983, the active force will be comprised of five types of aircraft, the F-111, F-4, A-10, F-15, and F-16. Without a ground attack capability in the F-16, only 70 percent of the active force will be capable of performing the air-to-ground mission. To retain an equivalent ground attack posture in the 1980s, the F-16 must be air-to-ground capable. Further, in this time frame, the only PGM capable aircraft will be the aging F-4 and F-111, comprising approximately 25 percent of the active force.. Accordingly, the F-16 should also have a PGM capability.

QUESTION:
22. What are the life extension limits and life extension plans for the F-4E and A-7D?

ANSWER:
22. Structural modifications currently programmed for the F-4E will provide a service life of approximately 4,000 hours. Based on data from the ongoing structural integrity program, it appears technically feasible to extend the life as high as 8,000 hours. The requirement for and the cost effectiveness of extending the service life to 8,000 hours or some intermediate level is being evaluated. The service life of the A-7 is estimated to be approximately 4,000 hours and no extension is currently planned.

QUESTION:
23. What is the operational relationship between the AWACS and the F-16?

QUESTION:
24. What is the operational concept for employing the F-16 cooperatively with the F-15?

ANSWER:
23 and 24. Studies of F-16 interoperability with AWACS and cooperative employment with the F-15 are ongoing. The results of these initial efforts can be provided when completed.

QUESTION:
25. In view of the large numerical advantage of the Warsaw Pact in air superiority aircraft, could a multi-mission F-16 ever be used in a ground attack role? If so, under what conditions?

QUESTION:
26. Should the entire 1980s projected F-16 procurement (6-10 wgs) be multi-mission aircraft? What is the rationale that supports the Air Force position on this issue? Is there objection by the Air Force to a program which envisions at least the first 3 wings of F-16s configured as a basic air combat fighters and any decision on night/all weather attack capability deferred until 1979-1980?

ANSWER:
25 and 26. Air Force studies have shown that, under many plausible scenarios, the F-16 would indeed be used in an air-to-ground role. The results of these studies indicate that, with the introduction of the F-15 and F-16 into US and possibly the Allied tactical fighter inventories, NATO may well achieve local air superiority early in a conventional conflict with the Warsaw Pact. In that case, F-16 aircraft initially used for air-to-air combat would be shifted to support for ground forces. Thus, while an air-to-air only F-16 would enhance chances of achieving air superiority, only a multi-mission capable F-16 would provide the "swing force" which permits full exploitation of that achievement. In view of the present and projected imbalance of NATO-Pact ground forces, NATO Air Forces must contribute more than the mere neutralization of Pact tactical air. To do this, they must be provided with aircraft that can effectively exploit that neutralization.

Studies considering short, intense conflict-scenarios have shown that the most effective employment of tactical-air resources will be accomplished by the early employment of fighter aircraft to provide combat air support for ground units. Although the F-16 was designed as an air-to-air fighter, that design offers substantial capabilities in the ground-attack role, and the F-16 may well be called upon to perform in that role before theater-wide air superiority is achieved.

Air-to-air resources employable in only defensive roles are essentially reactive forces. An aircraft with multiple capabilities provides the air commander with the capability to take the initative and force the enemy to react. Another consideration is that air-superiority can be gained by methods other than aerial engagements. It may be desirable to employ tactical air resources in the airfield attack role which was so successful in the 1967 Israeli/Arab conflict. In that case, the F-16 air-to-ground capability would no longer be merely desirable but mandatory for the aircraft to achieve its primary objective.

Finally, the F-16 is not envisioned as a "multi-mission" aircraft in the same manner as the F-111 in its conceptual phase. Instead, it is being procured to provide a lower cost complement to the F-15, capable of providing a flexible response to a variety of postulated threat scenarios. For these reasons, as well as those pointed out in the response to question 21, the entire F-16 force should be air-to-ground capable. A direct, visual ground attack capability, including EO weapons delivery, is inherent to the F-16 air-to-air configuration. The addition of radar ground map, which would significantly enhance the F-16 interdiction and adverse weather capabilities, can be incorporated into the display system for a relatively small increase in cost.

QUESTION:
27. Can a multi-mission F-16 pilot maintain high air combat proficiency in view of ground attack training requirements and flying time limitations?

ANSWER:
27. Yes. The Air Force has recognized the problem of attempting to maintain mission ready status in several areas on limited flying time. As a result, units are now assigned primary Designed Operational Capabilities (DOCs) and secondary DOCs

for training. For example, a unit would be assigned a primary DOC in air-to-air and would train to mission ready status in that area. The unit's secondary DOC would be air-to-ground and training in this area would be accomplished to a mission capable status after the primary DOC requirements were satisfied. From a mission capable status, aircrews could be upgraded to mission ready in minimum time. Furthermore, the F-16 ground attack training requirements will be considerably less than in the past owing to the incorporation of an automatic bombing system, similar to that of the A-7D, which provides greater accuracies and ease of operation.

2 Atch
1. Projected USAF Fighter/ Attack Force Structure (Active) (
2. Projected USAF Fighter/ Attack Force Structure (Air Reserve Forces) (S)

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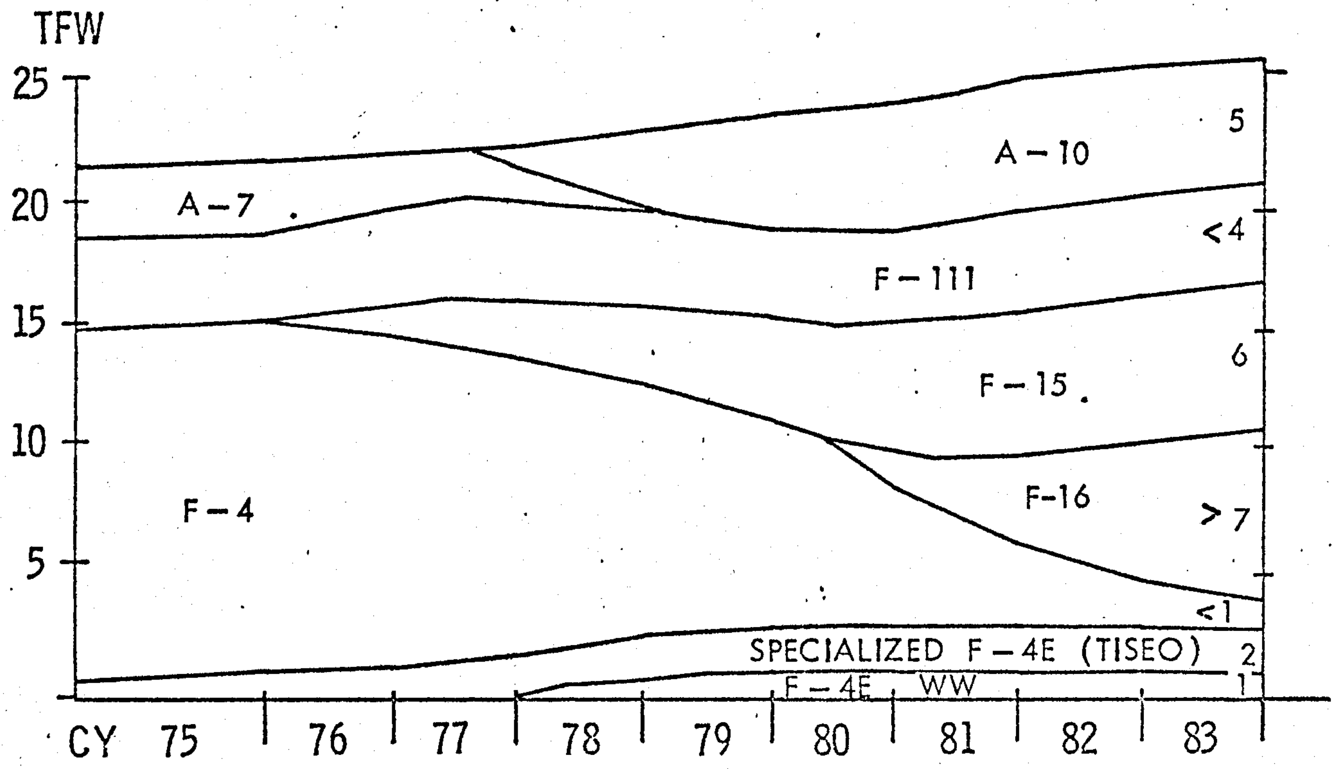
PROJECTED USAF

FIGHTER/ATTACK FORCE STRUCTURE
(ACTIVE)



ATCH 1

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WHM 4/23/83

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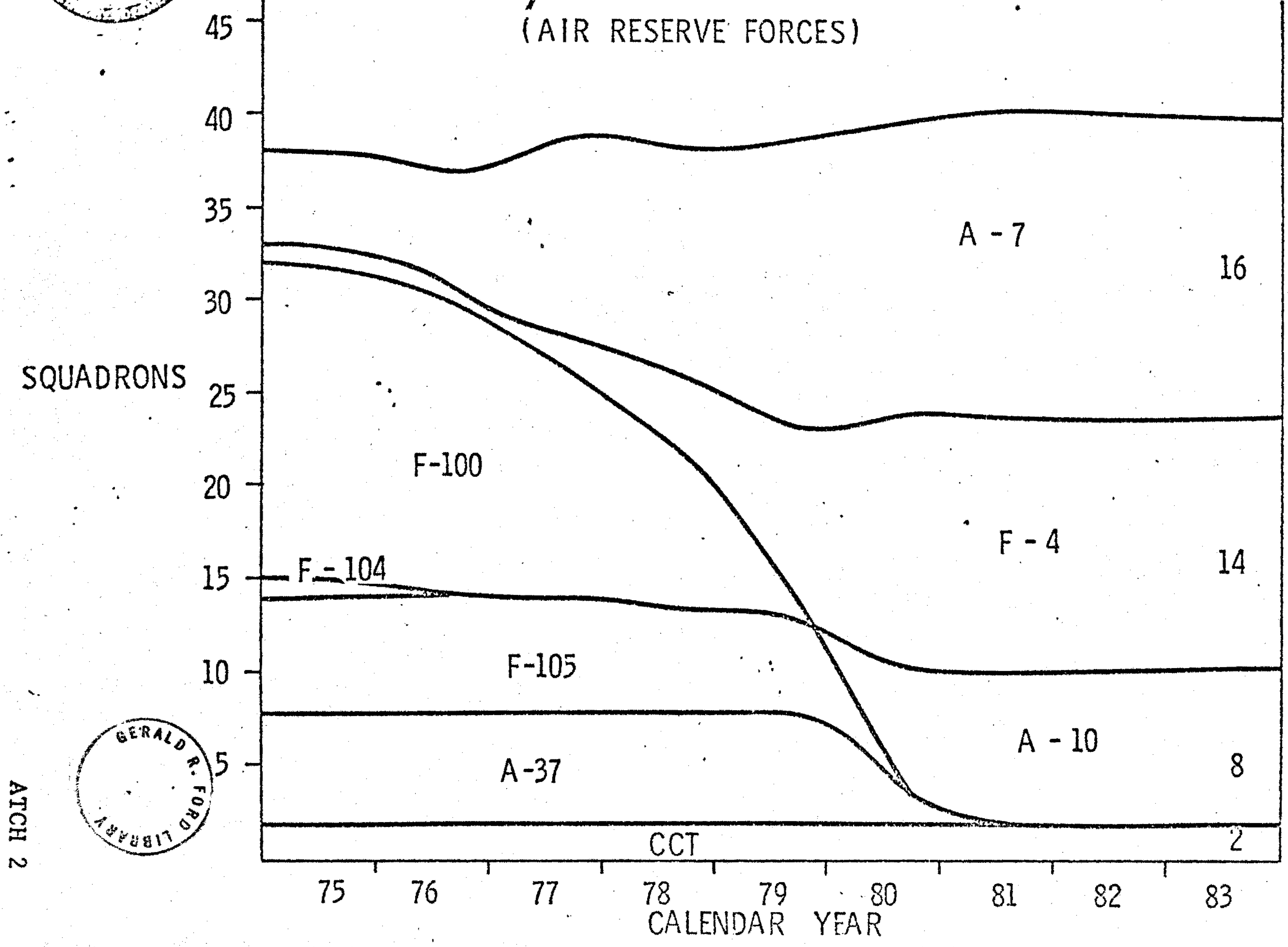
WHm 4/23/03

PROJECTED USAF FIGHTER/ATTACK FORCE STRUCTURE

(AIR RESERVE FORCES)



ATCH 2

2F

Agenda Memo

DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING
WASHINGTON, D. C. 20301

2F

3 FEB 1975

MEMORANDUM FOR Secretary of the Air Force
Secretary of the Navy
Chairman, Joint Chiefs of Staff
Assistant Secretary of Defense (Comptroller)
Assistant Secretary of Defense (Installation & Logistics)
Assistant Secretary of Defense (Program Analysis & Evaluation)

SUBJECT: DSARC Review of Air Combat Fighter Program - Milestone II

The DSARC will meet on 6 February 1975 at 1400 in Room 1E801#7 to review the Air Combat Fighter Program readiness to enter Full-Scale Development.

The agenda for the meeting is as follows:

Item (1) - Air Force Presentation - 30 Minutes

The Air Force proposed program and plan for full-scale development of the Air Combat Fighter in accordance with the "For Coordination" draft DCP #143.

Item (2) - Test and Evaluation Report

D/DDR&E(T&E) evaluation of test results and proposed test plan as they relate to the decision to proceed to full-scale development.

Item (3) - CAIG Report

Chairman of CAIG evaluation of Air Force cost estimates.

Item (4) - DSARC Discussion - 1 Hour

The Navy is invited to send representatives to participate in this meeting.

Please notify Mr. E. J. Nucci (X77266) Executive Secretary for DSARC of the names and security clearances of personnel authorized to attend the meeting.

Malcolm R. Currie

cc: ASAF(R&D)
ASN(R&D)
D/DDR&E(T&E)
Chairman, CAIG
JCS-J5

DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING
WASHINGTON, D. C. 20301

26

5 FEB 1975

MEMORANDUM FOR Secretary of the Air Force
Secretary of the Navy
Chairman, Joint Chiefs of Staff
Assistant Secretary of Defense (Comptroller)
Assistant Secretary of Defense (Installations & Logistics)
Assistant Secretary of Defense (Program Analysis & Evaluation)

SUBJECT: DSARC Review of Air Combat Fighter Program - Milestone II

The DSARC Review of the Air Combat Fighter Program - Milestone II scheduled for 6 February 1975 is hereby postponed until 11 February 1975 to provide additional time to review the "For Comment" draft DCP.

Malcolm R. Currie

cc:
ASAF(R&D)
ASN(R&D)
D/DDR&E(T&E)
Chairman, CAIG
JCS-J5

2H

Issues

AIR COMBAT FIGHTER

I. PROGRAM OVERVIEW:

° Description: The Air Combat Fighter (ACF) program will develop an operational version of the General Dynamics YF-16 Lightweight Fighter (LWF) Prototype. Included are development of the airframe and radar, integration of the Pratt & Whitney F-100 engine, and follow-on testing of the two YF-16 prototypes modified to a near-preproduction configuration.

F-16A/B CHARACTERISTICS

CHARACTERISTIC	F-16A	F-16B
WING SPAN (FT)	32.6	32.6
LENGTH (FT)	48.0	48.0
HEIGHT (FT)	16.4	16.4
WING AREA (FT^2)	300	300
OPERATING WEIGHT EMPTY (LBS)	15,601	16,190
INTERNAL FUEL (LBS)	6,934	5,819
TAKEOFF WEIGHT*	22,535	22,009
ENGINE	F100-PW-100	F100-PW-100
MAXIMUM THRUST (LBS)**	23,840	23,840
INTERMEDIATE THRUST (LBS)**	14,630	14,630
T.O. THRUST/WEIGHT RATIO	1.06	1.08
T.O. WING LOADING (LBS/FT^2)	75.1	73.4
MAXIMUM T.O. WEIGHT (LBS)	33,000	33,000
MAXIMUM EXTERNAL LOAD (LBS)***	10,500	11,000
MAXIMUM SPEED - SEA LEVEL	MACH 1.2	MACH 1.2
MAXIMUM SPEED - ALTITUDE	MACH 2.0	MACH 2.0
AIR-TO-AIR ARMAMENT	6 AIM-9s & M-61	6 AIM-9s & M-61

* Includes full internal fuel, two AIM-9 missiles, and 500 rounds of ammunition.
** Static, sea level, uninstalled.
*** With full internal fuel.

° Purpose: To develop an affordable, high performance air superiority fighter aircraft that can be bought in the quantities required to alleviate our present and forecast deficiency in numbers of fighter aircraft. The ACF will be optimized for "dogfighting" to the degree that it will have a significant air combat maneuvering advantage over the 1980-1990 threat fighters. Further, it will provide a lower cost fighter choice to complement the F-15 and open an avenue for possible force expansion within a constrained budget.

° Cost: (Millions of then-year dollars)

	FY75	FY76	FY7T	FY77	FY78	FY79	FY80	To Comp	TOTAL
R&D	32.0	186.0	59.0	203.0	87.0	15.0	3.0		585.0
Procurement				277.4	876.7	1219.6	1314.2	1520.6	5208.5
Number of Aircraft				16	89	145	175	325	650

° Design-to-Cost Goals (FY75 $M)

Avionics	.75[1]	(1000 Systems)	
Radar	.25[2]	(1000 Systems)	Cost included in Avionics
Aircraft	4.50[1]	(650 Aircraft)	

1. Flyaway Cost

2. Radar price only. Does not include installation, contractor loading, and non-recurring costs.

PROPOSED SCHEDULE

	7T	FY 77	FY 78	FY 79	FY 80	FY 81	

	CY 76	CY 77	CY 78	CY 79	CY 80	CY 81	CY 82
CONTRACT REQUIREMENTS GD		JAN △ LL; SEP △ FF					
P & W	OCT △						
DSARC DATES		JAN △ IIIA; SEP △ IIIB					
DT&E DELIVERIES (8 ACFT)	1	011 000 0B0 010	010 B01				
PROCUREMENT DELIVERIES (QTY / FY)			B0 11B	122 34/5 566 778 (16 / 77)	(89 / 78)	(145 / 79)	(175 / 80)
CY CUMULATIVE				60	186	349	528

II. PROGRAM PROPOSED BY AIR FORCE

° Proceed into Engineering Development:

- Continue flight test of LWF prototypes.
- Develop two prototype radars and fly-off in September 1975.
- Develop 8 preproduction F-16 aircraft for test and evaluation.
- Includes two multi-place models.
- $585.0M (then-year dollars)

° Production Engine Long Lead Release October 1976

- 20 Engines
- $40M

° DSARC IIIA January 1977

- To request approval for $20M advanced funding for first 16 production aircraft.

BASED ON

- 27 aircraft flight test months on modified YF-16 prototypes.
- One aircraft flight test months on one preproduction aircraft.

° DSARC IIIB September 1977

- To request approval to commit the remaining $217.4 of $277.4 FY 77 funds for first aircraft production option of 16 aircraft.

BASED ON

- 30 aircraft flight test months on modified YF-16 prototypes.
- 20 aircraft flight test months on five preproduction aircraft.
- Static and fatigue tests.

° First production delivery - August 1978

° IOC first squadron - 1980

III. BACKGROUND:

° Lightweight Fighter prototype program (DCP #120) initiated in April 1972.

- To investigate promising advanced technology features and design concepts.

- Determine feasibility and operational utility of highly maneuverable lightweight, lower cost fighter aircraft.

- Two contractors selected to design, fabricate, and flight test two prototypes.

- General Dynamics YF-16 completed 316 test flights from February through December 1974.

- Northrop YF-17 completed 278 test flights from June 74 through January 75.

° DoD discussions with NATO consortium in mid-74.

- Consortium replacement requirements for their F-104 aircraft similar to ACF.

- Consortium intended to reach a decision by September 74.

° DepSecDef commitment to Consortium on 11 July 74.

- USAF would make a source selection for the ACF by 1 January 75.

- ACF will enter USAF inventory and be deployed to Europe.

° USAF implemented ACF transition program in July 74.

- Planning, trade studies, analyses.

- Specification preparation.

- Contractor preparation of proposals.

- Re-structured LWF program to provide greater emphasis on operational factors.

° Radar RFP released in August 74.

- six companies bid.

- Two contractors, Hughes and Westinghouse selected to build competing systems.

° Proposal instructions for full scale development issued on 7 September 74.

- Proposals received on 1 November 74.

- Source selection board convened 1 December 74.

° Secretary of Air Force, on 13 January 75, announced that an operational version of the YF-16 was most responsive to Air Force needs.

- SecDef and Secretary of Navy concurred that the F-16 selection would result in no net cost increase to the DoD even if a variant of the YF-17 were chosen by the Navy.

IV. ISSUES:

A. Is the requirement for the Air Combat Fighter valid and will an operational version of the YF-16 meet the requirement.

USAF Position

° Requirement supported by CASE I NATO scenario.

- Large scale aerial engagements (target rich environment).

- Heavy commitment to close air support and local air superiority.

- Requires either a numerical superiority or significant qualitative advantage.

° F-16 to complement the F-15 in close-in action.

° F-16 will dominate FISHBED J.

° F-16 superior to FLOGGER.

° F-16 persistence far exceeds Soviet aircraft.

OSD Position

° Agree except to point out that the F-16 could meet the projected threat with a less sophisticated avionics suite. Further, the F-16 ACM performance could be improved with an attendant decrease in cost (see issue J).

Recommendation

° Avionics suite to be discussed in additional issue B relative to mission purpose and relation to programmed force.

B. Is the YF-16 ready for Full Scale Development?

USAF Position

o The YF-16 is ready for FSD.

- Flight test completed that addressed airworthiness, flutter, stability and control, performance, handling qualities, energy maneuverability, operational factors and air combat maneuvering.
- USAF pilots flew 70 per cent of test missions.
- Test data used to establish ACF performance requirements and goals and to identify improvements in the production aircraft.

OSD (T&E) Position

o Agree with USAF (See attached T&E analysis).

C. Will the cost of the F-16 compare favorably to that of current operational fighters?

USAF Position

o F-16 O&S costs below that of current fighter aircraft.

o F-16 average unit procurement below that of current fighters except F-4.

Operating and Support Costs

	F-16	F-4E	F-15	F-111
USAF Estimate				
$M/Squadron/Year	13.4	18.7	17.9	27.6
MMH/FH (Direct & Indirect)	17	33.6	21	49.3
OSD CAIG Estimate				
$M/Squadron/Year	16.1	22.9	22.7	33.0
MMH/FH (Direct & Indirect)	19	33.6	25	49.3

Average Unit Procurement Cost

	F-16	F-4E	F-15	F-111
Number	650	812	729	473
Cost (FY75 $ in Millions)	5.8	4.0	10.9	16.1

OSD Position (See CAIG Report)

o CAIG estimates are slightly higher but generally proportional to those of the USAF.

o F-15 O&S costs are 42% and the F-4E 39% above that of the F-16.

o The F-16 will not be as inexpensive to maintain, relative to the F-4E and F-15, as originally envisioned.

° The F-16 mission should be constrained to air-to-air close combat with a fall-out visual air-to-ground capability.

o A threshold on O&S costs and/or incorporation of a "people threshold" would tend to make USAF more aware of the total cost burden and perhaps strive to decrease this cost.

o The "people threshold" is preferred in that it is easy to measure; additionally, the O&S costs are proportional to the number of personnel required.

Recommendation.

o The USAF be directed to establish a goal and threshold for the number of people, by wing, involved in the system operation and maintenance of the F-16.

° The DCP should be modified to reflect the following direction:

- The average cost of the avionics system; to include vendor price, installation, contractor loading, and engineering change orders; based on 650 systems in FY75 dollars shall absolutely not exceed $750K. Equipment performance shall be reduced and/or equipment deleted to meet this requirement. Further, avionics costs, broken down into the above categories by item, shall be a special subject in every ACF Selected Acquisition Report.

D. What are the procurement (inventory) implications of the F-16?

USAF Position

° Long range force plan projects F-16 acquisition from a minimum of six wings to as many as ten wings.

° The F-16 in some form will provide for long range force expansion from the current 22 wings to 25 1/2 wings.

OSD Position

° Perhaps

Recommendation

° Develop a configuration and cost which can provide for force expansion.

E. What is the projected impact on the tactical force structure and Air Force resources?

USAF Position.

o F-16 will establish a balanced force.

o F-16 additive to the force structure until $25\frac{1}{2}$ wings attained.

o After the total number of wings reaches $25\frac{1}{2}$, additional F-16s will replace F-4s and the F-4s will go to the reserves.

o Significant savings are expected in O&S costs due to the lower maintenance man-hours required for the F-16.

o Maintenance costs for later model F-4s in the reserve will be decreased.

USAF TACTICAL AIR FORCES
ACTIVE UE

	FY 81	FY 82	FY 83	FY 84	FY 85	FY 86	FY 87	FY 88	FY 89	FY 90
F-15	432	432	432	432	432	432	432	432	432	432
F-4	636	516	372	240	100	48	-	-	-	-
F-16	120	240	384	528	668	720	720	720	720	720
A-10	360	360	360	360	360	360	360	336	288	288
F-111	288	288	288	276	276	252	252	204	180	108
ATF	-	-	-	-	-	24	72	144	216	288
TOTAL	1836	1836	1836	1836	1836	1836	1836	1836	1836	1836

OSD Position.

o Agree, with the following reservations.

- The total number of wings has increased from 22 to $25\frac{1}{2}$ in FY 80, the year after the first F-16s are delivered.

- F-16s are driving the F-4s out of the active inventory into the reserves at a faster than previously planned rate. For example, last year's EPA called for four vice one wing in FY85.

- F-4 transfer to reserve forces does not constitute a loss of air-to-ground capability if ANG readily available.

Recommendaton

° Low visibility attack and other F-4 mission capabilities should not be duplicated by the ACF(F-16).

F. Have Navy requirements for the NACF been accommodated?

USAF Position.

° A Navy request for quotation was released by the Air Force to the two contractors.

° The technical submission was evaluated by the Navy and their preliminary results forwarded to the Air Force for consideration in the ACF source selection process.

° On 13 January 1975, the Secretary of the Navy concurred that the Air Force F-16 selection would result in no net cost increase to the DoD even if a variant of the YF-17 was chosen by the Navy for the NACF.

OSD Position.

° Agree, however, Navy requirements for mission performance and equipment are not supported by OSD.

° It is unlikely that a NACF program will proceed until the differences are resolved.

° The projected NACF based on the Navy stated requirements is remote from the DepSecDef statement to the Cannon Tactical Air Power Sub-Committee in 1974.

Recommendation

° The Navy and OSD convene a working group to resolve the differences which constitute the primary obstacles to the development of a NACF.

H. Is a nuclear capability required in the ACF?

USAF Position.

o F-4 force currently comprises a significant portion of the tactical force nuclear capability.

o F-15 and A-10 aircraft will not have a nuclear capability.

o Only one-third of force will be nuclear capable by 1984 if the F-16 is not nuclear capable.

o Only provisions will be provided in F-16; however, aircraft will be tested and certified during DT&E for centerline carriage.

o Controller components and pylon will not be procured for production aircraft.

OSD Position.

o Agree.

Recommendation.

o None.

I. Is a radar guided missile capability required in the F-16?

USAF Position.

o F-16 will be at a significant disadvantage against the FLOGGER in a beyond visual range engagement without a radar missile capability.

o The F-16 will have provisions only (space, power, cooling) for a radar missile in the event this capability is required at a later time.

OSD Position.

o It is not at all clear that the F-16 would be at a disadvantage against FLOGGER without a radar missile. There is no historical evidence that radar missile equipped fighters will generally yield a more effective force for air-to-air combat. In fact, the introduction of air-to-air anti-radiation missiles will doubtless inhibit the free use use of radar as an airborne acquisition system.

Recommendation

Make it clear that we have ample radar missile interceptors and that additions to the inventory must be preceeded by a clear case as to return on investment.

J. What are the prospects that the F-16 ACM performance advantage over threat fighters will be maintained through the mid-eighties?

USAF Position

OSD Position

° The Soviets can field a superior fighter in the under 20,000 pound/ $4.0M category by 1985 through mere application of state-of-the-art technology coupled with a management decision to:

- constrain the mission purpose of an ACF .
- Discipline the developer to higher T/W and wing loadings of about 60.
- Relax range and strength requirements.

° Such a management decision by the Soviets would nulify the advantage which was a goal of the LWF/ACF program.

° Consideration of such an occurrence has supported the OSD alarm over the weight growth thus far experienced in the F-16.

° Performance of the F-16 is critically effected by increased weight. For example, testing determined that a 2000 pound increase in gross weight caused:

- A 19% increase in time to climb to 45000 feet.
- An 11% increase in acceleration time from 0.9 to 1.6 Mach.

- A 6.5% increase in cruise fuel flow.

Recommendation

° Restrain the mission orientation of the F-16 and institute a program to lighten the airplane by at least 1000 pounds.

° Contractor incentive should be provided to cut weight.

° All specifications for strength and fatigue life should be reviewed.

ADDITIONAL ISSUES NOT ADDRESSED IN DCP

A. The reliability figures in the DCP (page 13, paragraph B) are not directly comparable to those of the F-15.

USAF Position.

o The 2.9 and 1.75 hours MTBF figures are for complete system hardware computed serially. This method of calculating MTBF is affected by every failure.

o F-15 MTBF is stated in terms of mission reliability. Thus, a backup system could substitute for a primary without any affect on MTBF.

OSD Position.

o MTBF figures should be consistent to enable rapid comparisons.

Recommendation.

o Direct the USAF to provide DCP F-16 reliability data in the format of the F-15 DCP.

B. Is the proposed mission of the ACF consistent with the original purpose of the program. (PA&E issue)

To be provided by PA&E

C. Has sufficient reliability/maintainability been built into the F-16?

(CAIG Issue)

The following table compares CAIG estimates of fighter aircraft maintenance-related cost and shows SPO/ASD estimates of F-16 maintainability.

ANNUAL SQUADRON
MAINTENANCE-RELATED COST
(FY 75 $ in Millions)

	F-16			
	SPO/ASD	CAIG	F-4E	F-15
Base-Level Maintenance Manpower	$3.4M	$3.4M	$4.6M	$4.6M
Depot Maintenance	$1.9M	$[illegible].4M	$2.6M	$3.6M
Replenishment Spares	$1.2M	$1.3M	$1.8M	$2.2M
Total	$6.5M	$7.1M	$9.0M	$10.4M

The CAIG F-16 estimate -- as well as the Air Force estimate -- does not take into account the fact that the F-16 will deploy with a radar system not yet out of design competition. If the Air Force encounters design -- and subsequently -- operational problems with the new radar, F-16 maintenance costs can be expected to rise to a level higher than projected above, approaching current F-4E and expected F-15 costs.

Although the initial goal during F-16 concept formulation was to produce a simple, austere, easily-maintained aircraft, it appears that the currently planned F-16 configuration may not achieve that goal.

For example, the radar the Air Force has chosen for design competition will be a pulse doppler-type system. Since a Sparrow capability is not contemplated for the F-16, it could be equipped with a simple, off-the-shelf gun acquisition radar which would cost one-half as much to buy and maintain as a pulse doppler radar.

In summary, the current OSD analysis suggests that the F-16 will not be as inexpensive to maintain, relative to the F-4E and F-15, as originally envisioned. Moreover, the planned complexity of the F-16 avionics system may result in an aircraft that is not capable of rapid turnaround and high sortie rates. The DSARC principals should give serious consideration during the DSARC II decision meeting to the questions of F-16 configuration and its impact upon reliability/ maintainability.

E. R&D funding budgeted in FY76 exceeds requirements. What should be done with excess funds?

Background.

o $273M is budgeted for R&D in FY76.

o $186.0M is required in FY 76.

o $273M was a wag based on accommodating funds for the F-17 if selected. Was known to be in excess at time.

Alternatives.

o Tell Congress only $186.0M is required and to delete the remainder.

o Reprogram into other elements.

OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE
WASHINGTON, D. C. 20301
February 4, 1975

V
2I

PROGRAM ANALYSIS
AND EVALUATION

MEMORANDUM FOR MR. SULLIVAN
THROUGH MR. CHRISTIE

SUBJECT: F-16 DSARC II Position Recommendation

I. Discussion Summary. The F-16 Configuration proposed by the Air Force in the DCP for review by the DSARC is unacceptable for the following reasons.

A. Contrary to SECDEF PDM guidance that the F-16 should have "a minimum of sophistication in fire control and weapon delivery systems."

B. Greatly exceeds original LWF DCP DTC goals.

Unit Flyaway Cost (FY 75$, 650 A/C)

	DTC Goal	ICA Est.	CAIG Est.
Flyaway	$3.16M	$4.69M	$4.92M
Avionics	.51M	.94M*	1.18M*

* CFE + 10% ECO

C. Radar performance requirements do not take into account F-16 operation with AWACS and TACS or cooperative employment with the F-15.

D. Extensive air-to-ground capability of proposed configuration compromises air-to-air capability and adds to costs.

1. Additional structural and landing gear weight reduces performance.

2. Increased radar, INS, computer and display specifications for high resolution ground map adds to cost and complexity.

3. Impact on reliability and MMH/FH would reduce F-16 sortie rate.

4. Night, all-weather and visual free fall/guided weapon system ground attack training requirements dilute primary mission air combat training.

E. Cost growth risk is increased. Cost growth could threaten planned force structure expansion from 22 to 25 1/3 wings. Increased procurement of F-15s could become a viable equal cost option to the F-16 program. See the attached graph for the F-16/F-15 cost cross over points.

F. Extensive F-16 ground attack capability is unwarranted by force structure considerations.

1. Primary ground attack aircraft outnumber primary air combat by more than 2/1 (1/1 Active) through FY 85.

2. The mission ratio of fighter escort to ground attack varies historically from 1:1 to 2:1 when air superiority is contested.

3. Total Force primary night/all weather capability actually increases assuming development of the ATF.

Total Force Structure (EPA)*

FY	Primary Air Combat[1]		Primary Ground Attack[2]		Primary Night All Wx[3]	
81	456	(456)	2064	(1272)	497	(497)
83	576	(576)	2058	(1248)	497	(497)
85	864	(864)	1878	(960)	485	(485)
87	1104	(1104)	1644	(720)	527	(288)
89	1248	(1152)	1692	(672)	605	(384)

* Active force in parentheses.
1. F-15, F-16
2. A-10, A-7, F-4, F-111, ATF
3. F-4E, F-111, ATF

II. Alternatives. Alternative F-16 configurations which vary in capability and cost are presented as "A" - an austere system, "B" - the AF proposed system, and "C" - a compromise system.

Avionics
F-16 Configurations

	A	B	C
Air-to-Air			
Radar/HUD/HDD			
Lookup Rg (NM)	15	24	24
Lookdown Rg (NM)	5	18	18
AIM-9/Gun	Yes	Yes	Yes
AIM-7*	No	Yes	No
Data Link*	Yes	Yes	Yes
Air-to-Ground			
Direct Visual/HUD	Yes	Yes	Yes
Computed Ballistics	No	Yes	Yes
EO (HDD)/Laser	No/Yes	Yes	Yes
Hi Res Grd Map	No	Yes	No
Beacon/Offset	No	Yes	No
PAVE PENNY (Laser)*	No	Yes	No
INS/ILS/TACAN	Yes**	Yes	Yes**
Penn Aids	Yes	Yes	Yes
Nuclear Wiring	No	Yes	Yes
MMH/FH	16	19-20***	17
Total Cost (CFE + ECO)	$.78M	$1.18M $1.23M***	$.98M

* Provisions
** Lo accuracy INS
*** Full AIM-7 Capability.

A. F-16 Configuration C represents a compromise that allows all proposed air-to-air systems except SPARROW and could be acceptable to all. Extensive ground attack capability would be deferred.

1. A night/all-weather ground attack version of the F-16 could be procured after the initial 650 ACF F-16s are in the inventory (FY 85).

2. Current all-weather ground attack capability is only useful against area targets. The technology of the early 1980s may provide more effective and less costly systems.

3. The aided visual ground attack capabilities of the F-15 and F-16 with Configuration C are excellent.

B. Firmly established and precisely qualified DTC goals should be established for the aircraft and avionics package selected. These goals should be maintained at the expense of air-to-ground capability and radar detection range performance.

Configuration C DTC Goal Options
Unit Flyaway, FY 75 $M, 650 A/C

	CAIG	ICA*	ICA
Aircraft	4.69	4.45	4.10
Avionics	.98	.74	.67

* Cost Estimates Include 10% ECO allowance

III. Recommendations.

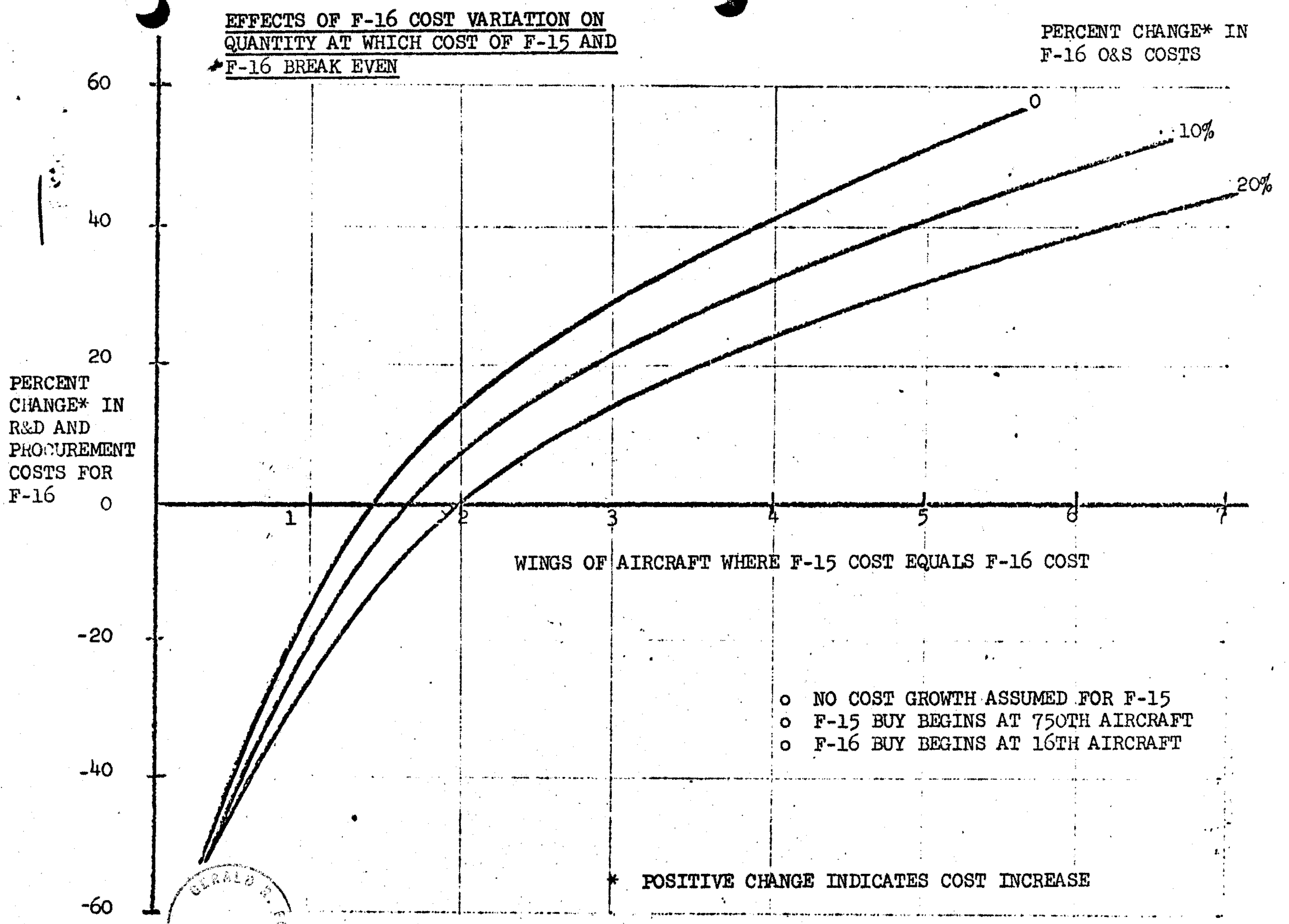
A. Support Configuration A as being most consistent with the original purpose of the LWF/ACF program and SECDEF PDM guidance. Configuration C can be supported as a compromise position as it is consistent with a primary air combat mission concept.

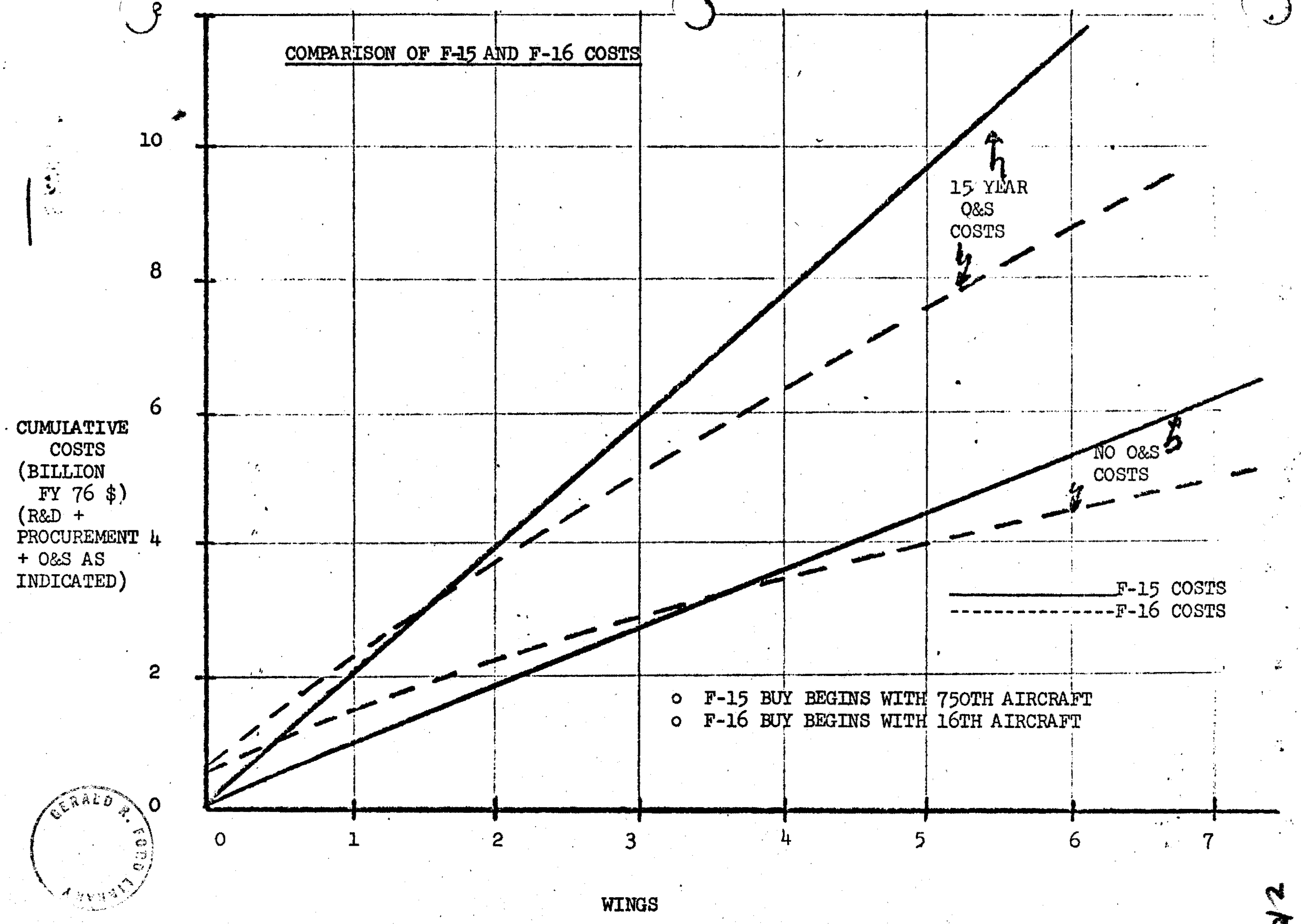
B. Support the first 6 wings (650/432 UE) of F-16s as air combat fighters with the follow-on buy as multi-mission aircraft. Procurement of 3 1/3 wings (350/240 UE) of F-16s as air combat fighters could be supported as a compromise position which would be consistent with the force structure expansion plan to increase air superiority mission capability. The remaining 300 F-16s would be configured with multi-mission capability. The follow-on buy would be treated as a separate future issue.

C. Select the lowest DTC goal practical based on the lowest cost estimate with the ECO allowance being disallowed or reduced. For example, the AF ICA estimate for Configuration C would be $4.45M for the aircraft and $.75M for the avionics. Eliminating the 10% ECO allowance would result in DTC goals of $4.1M and $.67M respectively. The case for eliminating or reducing the ECO allowance would be based on an already developed engine, a well tested prototype airframe, and a radar system based on the F-15s APG-63 technology.

Robert J. Croteau

Enclosure


EFFECTS OF F-16 COST VARIATION ON
QUANTITY AT WHICH COST OF F-15 AND
*F-16 BREAK EVEN
PERCENT CHANGE* IN
F-16 O&S COSTS
0
10%
20%
60
40
20
0
-20
-40
-60
PERCENT
CHANGE* IN
R&D AND
PROCUREMENT
COSTS FOR
F-16
1
2
3
4
5
6
7
WINGS OF AIRCRAFT WHERE F-15 COST EQUALS F-16 COST
o NO COST GROWTH ASSUMED FOR F-15
o F-15 BUY BEGINS AT 750TH AIRCRAFT
o F-16 BUY BEGINS AT 16TH AIRCRAFT
* POSITIVE CHANGE INDICATES COST INCREASE



COMPARISON OF F-15 AND F-16 COSTS
CUMULATIVE COSTS (BILLION FY 76 $) (R&D + PROCUREMENT + O&S AS INDICATED)
0
2
4
6
8
10
0 1 2 3 4 5 6 7
WINGS
15 YEAR O&S COSTS
NO O&S COSTS
F-15 COSTS
F-16 COSTS
o F-15 BUY BEGINS WITH 750TH AIRCRAFT
o F-16 BUY BEGINS WITH 16TH AIRCRAFT

2L

DCP

2L

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OFFICE OF THE DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING
WASHINGTON, D. C. 20301

10 MAR 1975

MEMORANDUM FOR Director of Defense Research and Engineering
Assistant Secretary of Defense (Comptroller)
Assistant Secretary of Defense (Installations and Logistics)
Assistant Secretary of Defense (Program Analysis and Evaluation)
Assistant Secretary of the Navy (Research and Development)
Assistant Secretary of the Air Force (Research and Development)
Director of the Joint Staff, OJCS

SUBJECT: T&E Report of the ACF (F-16) DSARC II

(U) This ACF (F-16) T&E report supersedes my previous T&E reports of February 6, 1975 and January 31, 1975. This revision reflects recent changes in the aircraft configuration and the FSD flight test schedule.

(U) I have reviewed the results of all tests to date and the Air Force schedules of T&E to be accomplished prior to DSARC IIIA and IIIB. As a result of the Air Force source selection announcement, my comments deal only with the F-16 aircraft.

Flight Testing of Prototype YF-16 to Date:

a. (U) Prototype testing of the YF-16 was conducted from February 1974 to December 1974. Three hundred and thirty test missions were flown acquiring 417 flight hours. These missions were about equally divided between the contractor, AFDT&E and IOT&E. Three AFFTC pilots flew the AFDT&E and three AFTEC pilots conducted the IOT&E. The flight test program was well structured and provided a determination of the ability of the YF-16 to meet goals stated in the LWF DCP #120, dated November 1, 1972. Enclosure 1 gives information on actual performance achievements as determined by Air Force flight test, as contrasted with the prototype goals.

Classified by DD(T&E)
SUBJECT TO GENERAL DECLASSIFICATION SCHEDULE OF EXECUTIVE ORDER 11652, ~~AUTOMATICALLY DOWNGRADED AT TWO YEAR INTERVALS,~~ DECLASSIFIED ON 12/31/78

CONFIDENTIAL WHM 4/23/03

b. (C) Significant discrepancies found requiring corrections are: afterburner operation at high altitude/low airspeed, and excessive heat buildup in the brakes and tires following landing rollout and taxi.

c. (C) Changes in design contemplated between the prototypes and preproduction aircraft include: increased landing gear capacity, expanded external stores capability, added tailhook, F-100(3) production engine with a jet fuel starter in lieu of the F-100(2) used in the prototypes to date, recontoured nose and radome, multi-mode radar, missionized avionics, deleted inlet blow-in-doors, a modified emergency power unit, a ten-inch extension to the fuselage and an increase of 20 square feet of lifting surface.

d. (U) Based on my review, I consider the YF-16 test program to date and results achieved are fully adequate to support a decision to proceed with engineering development.

Additional Testing Prior to DSARC IIIA (Long Lead):

a. (U) DSARC IIIA is planned for January 1977. During this period approximately 27 aircraft flight test months will be carried on by the two modified YF-16 prototypes at an expected rate of 15 sorties per month. This represents an 18 test month reduction from that I reported in my February 6, 1975 T&E Report. The 10-inch fuselage extension and increase of 20 square feet of lifting surface prohibits the prototypes from being aerodynamically similar to the pre-production aircraft. For this reason, high angle of attack and stores testing cannot be flown on the prototypes. Prototype modifications do include: F-100(3) engine, parts of the missionized avionics suite, and deleted inlet blow-in-doors. The following configuration changes will not be incorporated into the prototypes: increased landing gear capacity, jet fuel starter, pre-production radar, a complete suite of missionized avionics, modified emergency power unit, tailhook, a ten-inch extension to the fuselage and an increase of 20 square feet of lifting surface. An empty aircraft gross weight increase of about 200 pounds will be incurred between the prototype and pre-production articles. Testing on the pre-production aircraft will begin during this period. One test month of flutter testing should be completed by DSARC IIIA. Other testing includes: the escape system will be qualified to 600 knots at the Holloman AFB, N.M. sled track facility and the selected brassboard radar will be flown five aircraft flight test months in an F-4 aircraft. These test efforts will be performed by the contractor, AFFTC (AFDT&E) and AFTEC (IOT&E). Flying will be about equally divided between the participating agencies.

b. (U) The DSARC IIIA will commit approximately $40M for aircraft long lead items.

c. (U) I assess the test program leading to DSARC IIIA an acceptable basis for long lead procurement if the program is successfully completed.

Testing to be Accomplished Between DSARC IIIA and IIIB (Production Decision):

a. (U) DSARC IIIB is planned for September 1977. During the period from IIIA to IIIB approximately 20 aircraft flight test months on four pre-production aircraft will be flown. Testing to be completed during this period includes: static loads (150%); inflight loads (100%); fatigue (one lifetime); pre-production radar and avionics demonstration; performance/stability and control; high angle of attack evaluation; first flights in a B model; and completion of an IOT&E of approximately six aircraft flight test months. As with previous ACF testing, flying in this period will be about equally divided between the CDT&E, AFDT&E and IOT&E.

b. (U) Funding commitment at DSARC IIIB is estimated to be nearly $278M for the first aircraft production option of 16 aircraft.

c. (U) From the T&E viewpoint, test milestones as indicated in Enclosure 2 should be successfully accomplished prior to DSARC IIIB. It is intended to incorporate the information of Enclosure 2 in the DCP.

d. (U) An AFTEC evaluation of the IOT&E in the FSD is on-going as of this writing. I will provide a verbal report on the adequacy of the IOT&E during the DSARC meeting.

Conclusions: Based on all of the above, I conclude:

a. (U) T&E to date fully supports proceeding with F-16 FSD.

b. (U) The FSD, with the DSARC IIIA and IIIB milestones listed in Enclosure 2 appear capable of accomplishment.

c. (C) Modifications and additional testing is required to correct afterburner light and brake/tire heat buildup deficiencies.

(C) Recommendation: If decision is made to proceed with FSD, I recommend the Air Force be directed to place a high priority on the elimination of afterburner light and brake/tire heat buildup discrepancies. In addition the Air Force should furnish, within 120-days after Secretary action, to DD(T&E) for review and OSD an updated T&E Master Plan.

ALFRED D. STARBIRD
Deputy Director
Test and Evaluation

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PERFORMANCE

	LWF DCP Dtd Nov 1, 72	RFP REQUIRED Dtd Sep 4, 74	RFP DESIRED Dtd Sep 4, 74	FOR COORDINATION ACF DCP Dtd Dec 26, 74	DEMONS. YF-16
Maximum Sustained Turn Rage 1.2M, 30K					
(°/sec)	7.8	6.3	6.8	6.3	7.2
(G)	5.2	4.2	4.5	4.2	4.8
Maximum Sustained Turn Rage 0.9M, 30K					
(°/sec)	9.6	8.8	9.0	8.8	9.2
(G)	4.8	4.4	4.5	4.4	4.6
Accel Time 0.9M to 1.6M at 30K (sec)	50	80	70	80	66
Maximum Full Controlled G A 0.8M, 40K (G)	5.0	4.0	4.5	4.0	5.0
Air Superiority Mission Radius (NM)	500	500	600	500	648
Ferry Range (NM)	None	2,200	2,600	2,200	2,342
Air-to-Ground Mission Radius (NM)	None	400	None	400	Not Demon

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OSD PROGRAM DECISION POINTS/ AF DEMONSTRATION MILESTONES

Event	Milestone Planned	Milestone Actual	OSD Decision Point
A. Development Go-Ahead (DSARC II)	- - - - - -	- - - - - -	Mar 75
1. Prototype contract award	Apr 72	Apr 72	
2. Complete YJ 101 PPFRT	Dec 73	Dec 73	
3. First Flight:			
YF-16	Feb 74	Feb 74	
YF-17	Jun 74	Jun 74	
4. Complete Prototype Eval.	Dec 74	Dec 74	
5. Source Selection	Jan 75	Jan 75	
B. Long Lead Release (DSARC IIIA)	- - - - - -	- - - - - -	Jan 77
1. Complete radar flyoff	Dec 75		
2. First flight of preproduction aircraft	Dec 76		
3. Complete escape system qualification	Sep 76		
C. Production Release (DSARC III)	- - - - - -	- - - - - -	Sep 77
1. Clear basic flight envelope	Jun 77		
2. Basic system flight demon.	Aug 77		
3. Static loads test (150%)	July 77		
4. Inflight loads test (100%)	Aug 77		
5. Durability/component damage tolerance (one lifetime)	Aug 77		
6. Preproduction radar demon.	Sep 77		
7. Avionic integration flight demon.	Sep 77		
8. Performance/S&C/high AOA complete	Aug 77		
9. First flight on B-model	Aug 77		
10. EMC test complete	Jun 77		
11. Lightning test complete	Jun 77		
12. Sufficient IOT&E	Sep 77		

Enclosure 2

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OFFICE OF THE SECRETARY OF DEFENSE
WASHINGTON, D.C. 20301

4 February 1975

MEMORANDUM FOR THE DSARC CHAIRMAN

SUBJECT: CAIG Review of the Air Combat Fighter Program

SUMMARY

- The Air Force appears to have programmed adequate funds to complete Full Scale Development (FSD) although the present schedule makes it appear there will be considerable concurrency between FSD and production.

- Air Force and CAIG estimates of the procurement cost of 650 operational aircraft are in close agreement, $4.7M vice $4.9M in FY 75 dollars assuming no foreign military sales. The agreement masks significant, offsetting differences in airframe manufacturing labor and material cost estimates. The largest difference in total unit cost is a 25% higher CAIG avionics estimate.

- Although Air Force's procurement estimate is reasonable, presently programmed funds are not adequate to meet the planned procurement schedule. For example, $388M above the amount in the present authorization request will be required in FY 77 alone. In addition, the schedule requires substantial commitment of procurement funds prior to any significant flight test/DSARC approval as presently scheduled by the Air Force.

- Both Air Force and CAIG estimates show Pratt Whitney costs on the F-100 engine at a level which will result in the contractor being at or above ceiling for the initial three years on which options have been negotiated. It is believed a potential exists for additional contractor losses in the production of this engine. Some question exists on the validity of F-100 cost actuals received to date. An audit now being conducted of Pratt Whitney costs in procuring the F-100 for the F-15 aircraft by the Air Force should shed considerable light on future costs of this engine.

- CAIG estimates of operating costs are 13% higher than the Air Force's. Principal differences are due to the Air Force costs having been projected on the basis of lower than current OSD/Air Staff planned flying hours for the F-16. The Air Force also used training replacement rates lower than present Air Force practice, omitted pilot training costs and the costs of training missiles, and assumed the F-16 will not receive Programmed Depot Maintenance (PDM) at regular intervals.

CLASSIFIED by CAIG Chairman
DECLASSIFY on December 31, 1981

CONFIDENTIAL WHM 4/23/03

- If the OSD/Air Staff F-16 plan for flying hours is followed, a buy of 729 aircraft rather than 650 aircraft will be required to support a six wing deployment. This will add \$.3B - \$.4B to F-16 acquisition costs.

- Commonality studies carried out by both the Air Force and the CAIG indicate significant savings if the Navy buys a variant of the F-16 as its VFAX. However, they also show the additional costs of the F-17 to the Air Force relative to the F-16 would outweigh the commonality savings associated with both Services buying the F-17 or its variants. Results of these studies appear to justify the Air Force proceeding with the F-16 at this time.

ACQUISITION COSTS

historically used for ECPs

The CAIG's Full Scale Development (FSD) cost estimate is higher than the basic USAF estimate for airframe and avionics development but, as shown below, the difference is offset by the USAF inclusion of a \$65M management reserve in their total for FSD. As a result, the CAIG believes that the Air Force estimate should provide sufficient funding to accomplish development.

The CAIG's estimate of average F-16 flyaway costs is slightly higher than the USAF estimate (\$4.9M versus \$4.7M unit cost for 650 aircraft) with the difference primarily due to a higher CAIG estimate of avionics costs. The Air Force used a proprietary, RCA avionics model which has generally been accurate in the past, while the CAIG based its estimate on comparison to the costs of analogous equipment being procured for the F-15. At the present stage of F-16 avionics development, particularly with the radar design still being competed, this difference may not be significant.

F-16 Acquisition Cost Estimates
(M of FY 75 \$)

	USAF		CAIG	
FSD (15ac)	\$584 1/		\$586	
Procurement (650 ac)				
Airframe	\$1,249 2/		\$1,228	
Propulsion	964		975	
Avionics	609		764	
Armament/Other	185		185	
Non-Recurring	42		42	
	\$3,051	(\$4.7)	\$3,195	(\$4.9)
Spares/Support	\$ 650		\$ 723	
Program Costs	\$4,325	6.7	\$4,505	6.9

1/ Includes \$65M management reserve.
2/ ASD's 10% ECO's spread back to cost elements.

Air Force and CAIG estimates of F-16 airframe cost are very close in total. However, while these totals agree, considerable differences exist between the CAIG and Air Force views of the cost of individual functional elements. The most outstanding of these is the CAIG's 35% higher estimate of manufacturing labor and the offsetting Air Force's 40% higher estimate of material cost.

Both the CAIG and the Air Force estimate labor costs using parametric models developed from stratified samples of high speed fighters or fighter related aircraft. The CAIG model uses thrust to weight ratio and control surface area as principal explanatory variables to attempt to capture the manufacturing complexity of a highly maneuverable, dogfight aircraft. As shown in Appendix A, calculated manhours with the model are exceptionally good approximations of the actual hours of each of the aircraft in the data base. Also, its manufacturing labor estimate of 6.9 manhours per pound of airframe structure for the F-16 at unit 100 is corroborated by a 7.2 hour/lb estimate derived using the generalized RAND airframe model. This compares to a 4.7 hour/lb figure derived using the Air Force model.

The manufacturing labor cost difference is almost offset by the Air Force's significantly higher estimate of material costs as shown in the following table:

F-16 Airframe Unit Cost Comparison
(K of FY 75 $)

	USAF	CAIG
Manufacturing Labor	$ 579	$ 786
Material	1,124	805
Engineering	138	134
Tooling	80	164
Airframe	$1,922	$1,890

Both material estimates are projections of actual cost experience in fabricating the YF-16. The Air Force used an extremely conservative 95% improvement slope assumption while the CAIG used 89%. (Generally speaking estimators have used 85-90% for materials depending upon such factors as per cent of titanium and other exotic metals, commonality, and complexity.) The Air Force's argument for 95% on the F-16 is an interesting one. It maintains that present uncertainties and distortions in the markets in which airframe materials, purchased parts and purchased equipment must be procured do not justify any greater assumption of unit material cost reductions at increased production quantities. It points to the longer lead times and general difficulties associated with procuring castings and forgings, bearings, valves, regulators, actuators, etc. While some of these problems of finding and maintaining vendors may disappear when inflation eases, it maintains there will be some permanent dislocations in these markets which will reduce material learning. However, this grim view of the future would not uniquely impact F-16 acquisition costs but would correspondingly drive up the costs of all aircraft programs. For example, projecting F-15 costs under the same reduced material learning assumption would add about $1½B to the funds required to complete that procurement. Although recognizing the possibility of such an altered unit cost reduction pattern, the CAIG has chosen not to revise its estimating procedure until more evidence is available of the permanence of present market distortions and more data indicating their impact on cost.

The propulsion estimates reflect lower F-100 costs (6-7%) than the estimates made for the October 1975 F-15 DSARC, with the reduction due to the increased production efficiency and overhead sharing for the combined F-15/F-16 program. Both estimates also indicate that Pratt & Whitney (P&W) will realize little or no profit for the initial three year production option period. The Air Force estimates that engine costs will be at ceiling, and under the negotiated contract structure, P&W will realize about 3% profit. (The negotiated contract with P&W is based on a 12% profit rate with the ceiling set at 125% of target cost and a 70/30 share ratio.) Under that contract structure, the CAIG estimates that actual costs will be over ceiling and potential P&W losses will be around $10-$15M for the three year option period.

There is still considerable uncertainty about the reported P&W costs which the Air Force used in making its propulsion estimate. At the request of the CAIG the Air Force has initiated an audit of the P&W Cost Information Reports (CIR) submitted on the engines delivered to date. The results of the audit have not been reported to the CAIG but should prove useful in reducing the uncertainty on F-100 costs and, also increase the credibility of future engine estimates.

The detailed CAIG analysis of acquisition costs is attached as Appendix A.

PRODUCTION SCHEDULE

The negotiated procurement schedule with General Dynamics calls for the obligation of $460M for the first 34 production vehicles in FY 77.

F-16 Procurement Schedule 1/
(Quantity/M of Then Year $)

FY	77	78	79	80	81	TOTAL
	34/$460M	112/$1108M	155/$1307M	179/$1410M	170/$1331M	650/$5615M

1/ FY 77-79 is present contract option period

This ambitious procurement schedule presents several problems for DOD Management:

- The present FY 77 authorization request contains only $72M based on an OSD estimate of long-lead engine procurement requirements when it was believed the first air vehicle procurement would be in FY 78.

- FY 77 procurement would mean obligation of $460M prior to any significant flight test as the first FSD aircraft will not be delivered until the fall of 1976.

- Air Force commitment to FY 77 procurement prior to significant flight test and the DSARC III as presently scheduled by the Air Force. (DSARC III is presently scheduled for October-November 1977.)

OPERATING AND SUPPORT COSTS

In our view, the Air Force underestimated the Operating and Support Cost impact of the F-16, omitting certain relevant costs and underestimating others. The table below compares CAIG and F-16 SPO/ASD best estimates of F-16 squadron and 15 year full force operating and support costs. The estimates are in constant FY 75 $ and reflect current (Jan 75) POL rates.

ACTIVE SQUADRON/15 YEAR OPERATING COSTS

	CAIG	SPO/ASD	% CAIG ABOVE SPO/ASD
Annual Active Squadron Operating Costs	$16.1M	$14.2M	13%
15 Year Full Force Operating Cost (16 Active; 3 CCT Squadrons)	$5,293M	$4,462M	19%

The differences between CAIG and SPO/ASD cost estimates are discussed below:

(1) The CAIG and SPO/ASD estimates assume different operating aircraft and peacetime and wartime utilization rate assumptions. The following table displays these different assumptions and compares them to F-15 program parameters.

EQUIPMENT/UTILIZATION PARAMETERS
(6 Wing Deployment)

	F-15	F-16 CAIG	F-16 SPO/ASD
Equipment			
Force Acft (UE)	432	432	432
Training Acft (CCT)	108	108	78
Pipeline	54	54	51
Attrition Reserve	135	135	89
Total	729	729	650
Utilization			
Peacetime FH/Acft	330	330	300
Wartime FH/Acft	696 a/	696 a/	600 a/

a/ Used only to calculate base-level maintenance manpower requirements. Ensures squadron has manpower to respond to wartime sortie requirements.

The program parameters used in the CAIG estimate are consistent with current OSD/HQ USAF planning rates. Operating aircraft levels used by the CAIG (540 UE and CCT aircraft) equate to a 6 wing deployment and require a buy of 729 aircraft to support it. The Air Force planned buy is 650 aircraft. (The procurement of 79 additional attrition aircraft would add about $.3B-$.4B to F-16 acquisition costs.)

In the CAIG meeting on 16 January 1975 the Air Force acknowledged that the program parameters used by the CAIG were correct and that the 650 aircraft buy would not provide sufficient training and advanced attrition aircraft to support a 6 wing deployment.

(2) The SPO used personnel training replacement rates significantly lower than previous Air Force estimates and did not include the cost of pilot training instruction. The CAIG estimate is based on past replacement rates and includes pilot instruction costs.

(3) Training missile costs are not in the SPO estimate; the CAIG estimate includes these costs as they represent a real cost to the Air Force of owning and operating the F-16.

(4) The SPO/ASD estimate assumes that the F-16 will not receive Programmed Depot Maintenance (PDM) at regular intervals. This assumption is inconsistent with previous Air Force practice. For example, even though there was originally no plan for A-10 PDM, the Air Force now plans to schedule the aircraft into the depot every 48 months. It is unlikely any better scheduling will result for the F-16, particularly since it is a high performance fighter that will need periodic examination for structural fatigue. The CAIG estimate includes PDM costs.

The table below shows the magnitude of these cost differences:

COST DIFFERENCES
(FY 75 $ in Millions)

	SPO/ASD	CAIG	Difference
Annual Active Squadron Cost	$14.188	$16.112	$1.745
. Flying Hours	+.480		
. Training	+.800		
. Training Missiles	+.312		
. Depot Maintenance	+.320		
. Other Adjustments	+.012		
	$16.112		

In summary, CAIG cost projections more closely approximate downstream F-16 O&S costs as they include estimates of additional costs that the F-16 force can reasonably be expected to incur during its operating lifetime.

TACTICAL FIGHTER COST/MAINTAINABILITY COMPARISON

The table below compares CAIG operating and support cost estimates for active force F-16, F-4E and F-15 squadrons.

	Operating and Support Costs Per Squadron per Year (FY 75 $ in Millions)	% Above F-16
F-15	$22.7	42%
F-4E	$22.3	39%
F-16	$16.1	-

An examination of these cost differences reveals that about 70% of the difference between F-16 and F-4E/F-15 costs is attributable to reduced operational and training costs for the F-16. Examples of these reductions are:

(1) Reduced POL consumption (1 F-16 engine vs. 2 engines in F-4E and F-15); and

(2) Reduced aircrew costs (1 pilot in F-16 vs. 2 aircrew members in the F-4E).

30% of the cost difference is related to aircraft maintainability. The following table compares CAIG estimates of fighter aircraft maintenance-related costs and shows SPO/ASD estimates for the F-16.

ANNUAL SQUADRON
MAINTENANCE-RELATED COST
(FY 75 $ in Millions)

	F-16			
	SPO/ASD	CAIG	F-4E	F-15
Base-Level Maintenance Manpower	$3.4	$3.4	$4.6	$4.6
Depot Maintenance	$1.9	$2.4	$2.6	$3.6
Replenishment Spares	$1.2	$1.3	$1.8	$2.2
Total	$6.5	$7.1	$9.0	$10.4

The CAIG F-16 estimate -- as well as the Air Force estimate -- does not take into account the fact that the F-16 will deploy with a radar system not yet out of design competition. If the Air Force encounters design -- and subsequently -- operational problems with the new radar, F-16 maintenance costs can be expected to rise to a level higher than projected above, approaching current F-4E and expected F-15 costs.

Although the initial goal during F-16 concept formulation was to produce a simple, austere, easily-maintained aircraft, it appears that the currently planned F-16 configuration may not achieve that goal. For example, the radar the Air Force has chosen for design competition will be a pulse doppler-type system. By incorporating a CW illuminator into the F-16 avionics package at a cost of about $50,000K per aircraft, the F-16 would have a Sparrow-firing capability. Current Sparrow-firing systems in the F-4E and F-15 show high maintenance costs. If no Sparrow capability were contemplated for the F-16, it could be equipped with a simple, off-the-shelf gun acquisition radar which would cost one-half as much to buy and maintain as a pulse doppler radar.

In summary, the CAIG analysis suggests that the F-16 will not be as inexpensive to maintain, relative to the F-4E and F-15, as originally envisioned. Moreover, the planned complexity of the F-16 avionics system may seriously degrade the aircraft's rapid turnaround and high sortie rate capability. The DSARC principals should give serious consideration during the DSARC II decision meeting to the questions of F-16 configuration and its impact upon reliability/maintainability.

F-16 WARRANTY PROGRAM

Despite the growth in complexity of the F-16 avionic system, the Air Force appears to be emphasizing the reliability/maintainability of the F-16 and realizes the need to hold down F-16 support costs. In an attempt to achieve reduced costs, the Air Force plans to implement a Reliability Improvement Warranty (RIW) program for the F-16. This program establishes MTBF goals for major aircraft subsystems (for example, the inertial navigation unit) and provides incentives to the contractor if these MTBF goals are achieved. The RIW program represents a significant step forward in the drive to improve system performance and lower maintenance and support costs. The Air Force is to be congratulated for this new initiative.

However, the RIW impact on F-16 program costs will not be known until after the aircraft enters the active inventory as the warranty provisions are applied to operational aircraft performance. Thus, there is no real incentive program today to preclude O&S cost growth during full scale development; warranty provisions will be revised as needed to apply to the final production configuration aircraft.

Although the RIW program represents sound planning on the part of the Air Force, it is too early to evaluate its effectiveness in holding down O&S costs.

DESIGN-TO-COST (DTC)

A comparison of the Air Force current estimate of the ACF compared to the DTC goal contained in DCP # 120 is shown below (average cost for 300 aircraft in FY 72 $):

	DCP 120	AF F-16 Estimate 1/
Airframe	$1.7M	$2.3M
Propulsion	.8	1.2
Avionics	.4	.8
GFE/Other	.1	.1
	$3.0M	$4.4M

1/ The Air Force's 10% Management Reserve (ECO) has been allocated to the individual subsystems.

The increase in airframe structure size (15% by weight) over that described in DCP # 120 plus the slight additional costs for the 98 two-seat versions account for some of the increase in airframe cost. It does not account, however, for the total $.6M increase which is at least partly due to a low initial estimate in the DCP. The propulsion increase reflects lack of recognition of actual F-100 engine costs in 1973. The avionics increase is due to the considerable expansion of the avionics package/scope for this program beyond the original $450K goal set in DCP # 120. A revised DTC goal which would reflect the airframe and propulsion increases but not the avionics package expansion and also remove the 10% management reserve in the Air Force estimate would be $3.8M for 300 aircraft in FY 72 $, or $3.9M for 650 aircraft in FY 75 $ (compared to the Air Force most likely flyaway estimate of $4.7M). For better use in monitoring program progress, the DTC goal should probably include a specified improvement slope as well as a point estimate for 650 aircraft.

Possible Commonality Savings with a Navy ACF

In order to determine the possible development and production cost savings that could be realized by combining the Air Force and Navy ACF programs, the Air Force and the CAIG conducted independent assessments of various F-16/F-17/VFAX alternatives. Both studies reached similar conclusions, viz., the cost to the government of the Air Force procuring the F-16 and the Navy procuring any of the F-16/F-17/VFAX candidates, is less than the cost to the government of forcing the Air Force to reverse its ACF selection to the F-17 in order to achieve possible commonality savings from a joint Air Force/Navy buy of F-17's. (The CAIG analysis is attached as Appendix B.)

Milton A. Margolis

Milton A. Margolis
Chairman
OSD Cost Analysis Improvement Group

Appendix A

CAIG F-16 Cost Analysis

Assumptions/Ground Rules:

- All costs adjusted to FY 75 $
- 15 FSD aircraft with 12 to include full-up avionics suites
- 650 production aircraft with 98 being two seat aircraft
- AMPR weights: one seat 9197 #
  two seat 9913 #
- maximum velocity: 1135 Kts.

Full Scale Development

Airframe: The direct labor costs and materials costs were estimated for the 15 ASD aircraft as in the production phase described in the next section. The engineering and tooling costs were estimated using the 1971 RAND airframe model, with General Dynamics (GD) rates applied to the estimated manhours. Development support was also based on the RAND model. As the model estimates these costs in FY 70 $, the ASD R&D escalation rate (45%) was used to escalate the development support estimate to FY 75 $.

In estimating Flight Test Operations, results using the RAND model were found to be questionable. To overcome this problem, the CAIG stratified the RAND data and considered only aircraft whose maximum velocity exceeded 1000 knots. A CER was then developed as a function of airframe weight which indicated that F-16 flight tests (including POL costs and rental of test facilities) should cost $28.5M in FY 70 $. The ASD escalation rate was adjusted to reflect the dramatic increase in POL costs (11¢/gallon to 37.5¢/gallon) since FY 70. This resulted in a 65% escalation rate which was then applied to the FY 70 $ figure calculated above.

The cost elements were then combined, and GD's G&A rate and a 10% profit rate were than applied to the total.

F-16 Airframe Development Estimate
(M of FY 75 $)

Materials	$ 20.9M
Manufacturing Labor	45.9
Engineering	72.8
Tooling	67.3
Development Support	64.2
Flight Test Ops	47.0
	$309.1M
G&A (9.1%)	$ 28.0M
Profit (10%)	37.0M
TOTAL	$373.1M

Propulsion: The recurring costs for the 17 F-100 engines to be used in FSD were estimated as in the production estimates described later. This estimate ($31.5M) was combined with the contractor's estimate of support costs ($14.2M), and ASD's estimate of non-recurring costs ($6.6M) for a total propulsion estimate of $52.2M.

Avionics: The CAIG estimated F-16 avionics development costs by analog with the F-15 development costs. In the latter program, the non-recurring costs plus 15 shipsets of equipment was $298M in FY 73 $. Adjusting this for escalation (21%), $140.8M was calculated as the F-16 avionics development costs in FY 75 $.

Table 1 is a comparison with the ASD development cost estimate (the USAF estimate of $20.6M for AGE/Data/training costs was added to the airframe estimates in both columns):

TABLE 1

F-16 FSD Cost Comparison

	USAF	CAIG	Difference
Airframe	$367.3M	$393.7M	Both are based on the RAND model. CAIG used higher escalation factor to account for POL increas in flight ops.
Propulsion	$ 46.0M	$ 52.2M	CAIG engine estimate is at ceiling.
Avionics	$105.9M	$140.8M	ASD used RCA price model; CAIG used F-15 data
Management Reserve	$ 65.0M	-	
TOTAL	$584.2M	$586.7M	

Production Estimate

Airframe: In order to capture the manufacturing complexity of highly maneuverable, high speed dogfight aircraft, the CAIG developed a new model to estimate manufacturing manhours. The data base consisted of the high speed Century Series fighters (F-101, F-104, F-105, F-106), the F-4 and the F-111. The T-38, although it is slow speed trainer (750 kts), was included to capture Northrop manufacturing expereince as well as the maneuverability characteristics inherent in a supersonic trainer. The aircraft characteristics of the data base are listed below:

Aircraft Characteristics

Aircraft	AMPR Weight (lbs)	Max Velocity (knots)	Max Thrust (T) (lbs)	Design Take-off Weight (W) (lbs)	Wing Area (WA) (ft^2)
F-101	13,146	873	30.0K	48.0K	368
F-104	7,954	1,150	17.9K	22.1K	196
F-105	19,439	1,195	24.5K	47.0K	385
F-106	14,805	1,153	24.5K	34.2K	698
F-4	17,320	1,220	35.8K	53.8K	530
F-111	32,458	1,262	37.0K	92.7K	525
T-38	5,346	750	7.7K	11.7K	170
F-16	9,197	1,135	23.8K	20.7K	280
F-17	11,431	1,135	28.8K	24.7K	350

The CAIG theorized that maneuverability in a fighter is a function of both excess energy (engine thrust minus air vehicle weight) and control surface area (using wing area as a surrogate for control area). We attempted to develop a CER which makes explicit the impact of these variables on cost and possible trade-offs between them in developing equal cost configurations. Table 2 describes the CER adopted by the CAIG as the best predictor, a function of thrust-to-weight ration and wing area. The CER provides an estimate of manufacturing manhours per pound for the one-hundredth airframe. The CAIG applied a 74% slope to the model's output for the first 107 aircraft and then flattened the slope to 80%, a break in learning proposed by GD as it is at the 107th unit where the production rate reaches 10 aircraft per month and then increases more slowly under a "constant

TABLE 2

Derivation of Manufacturing Manhours/Pound CER

Aircraft	Thrust TO Weight X Wing Area $(\frac{T}{W} \times WA)$	Unit 100 Manhours/ Pound of AMPR Weight	(Source)
F-101	230	5.6	(AMPR)
F-104	159	5.0	(AMPR)
F-105	201	6.0	(AMPR)
F-106	500	8.0	(RAND)
F-4	352	7.4	(RAND)
F-111	210	6.2	(RAND)
T-38	112	4.5	(RAND)
F-14	560	8.2	(RAND)

CER

$$T_{100} \text{ Hours/lb} = .692 \left(\frac{T}{W} \times WA\right)^{.398}$$

$R^2 = .938$

Degrees of Freedom = 6

Aircraft	Actual Manhours/lb	Calculated 1/ Manhours/lb	Percent Difference
F-101	5.6	6.0	-7
F-104	5.0	5.2	-4
F-105	6.0	5.7	+5
F-106	8.0	8.2	-3
F-4	7.4	7.1	+3
F-111	6.2	5.8	+7
T-38	4.5	4.5	0
F-14	8.2	8.4	-2
F-16	-	6.89	
F-17	-	7.57	

ASD CER: $T_{100} \text{ Hours/lb} = .44 \text{ (AMPR Wt)}^{.15} \text{ (Max V)}^{.145}$

Aircraft	Actual Manhours/lb	Calculated Manhours/lb
F-16	-	4.74
F-17	-	4.91

1/ The F-15 is considerably beyond (60%) the range of the data base insofar as thrust to weight ratio is concerned; (2.6 vice 2.1) and the model overstates the required manhours for the 100th unit,at least as now projected by both CAIG and the Air Force.

work force" expansion of production capability. Quality control hours were estimated as 13% of manufacturing hours (industry average).

Materials costs were estimated by using the material costs for the two prototype aircraft (reported in the GD proposal) and projecting these costs on an 89% cost-improvement slope, based on the GD experience.

Engineering and tooling hours were estimated utilizing the RAND model equations.

The GD rates were supplied by the Air Force and are displayed in the following table (FY 75 $):

	Wage Rate/Hour	Overhead Rate
Factory Labor	$ 5.57	138.5%
Quality Control	6.48	138.5%
Engineering 1/	8.57	104%
Tooling 1/	6.38	141%
	FSD	Production
G&A	9.1%	6.9%
Profit	11%	10%

1/ $.20 was also added to the engineering rate and $1.70 to the tooling rate to account for materials.

Table 3 displays the CAIG airframe estimate and compares it to the RAND model output and also to the USAF estimate.

TABLE 3

F-16 Airframe Comparison 1/
(M of 75 $)

	RAND	CAIG	RAND - CAIG	USAF 2/
Mfg/OC	$ 526.6M	$ 511.2M	$ 15.4M	$ 376.3M
Mat'l	454.2	523.4	-69.2	730.9
Eng	97.0	87.0	10.0	89.7
Tool	94.2	106.8	-12.6	52.3
	$1172.0M	$1,228.5M	$ 56.4M	$1,249.2M

1/ w/G&A/Profit
2/ Includes $15.2M GFE

Methodology

	CAIG	USAF
Mfg/OC	Used new fighter CER based on thrust-to-weight ratio, and wing control surface area. Used GD rates. T_{100} = 6.9 hours/lb. 74% slope to unit 107, then 80% thereafter.	Used CER based on AMPR weight and velocity. T_{100} = 2.7 hrs/lbs, 77% slope.
Mat'l	Used prototype actuals with 89% slope. T_1 = $180/lb	Used prototype actuals adjusted for scrap, and 95% slope. T_1 = $141/lb.
Eng/Tool	Used RAND model and GD rates.	Used RAND model with downward adjustments for prototype experience.

Propulsion: The CAIG based its estimate on a projection of CIR data for the first 309 F-100 engines with an 89% curve, the slope P&W asserts it is experiencing. The CAIG spread an unreported $90M P&W loss on those engines in calculating its start point. Table 4 is a comparison of the contractor, Air Force, RAND, and CAIG propulsion estimates.

TABLE 4

F-16 Engine Estimates
(M of FY 75 $)

F-100	P&W	RAND	USAF 1/	CAIG 2/
(780 Engines)	$1.15M	$1.374M	$1.349M	$1.500M
	based on proposal & CIR	projecting on JT-9D experience	Price based on F-15 experience with losses included in CAIG estimate.	

1/ $1.349M is the Air Force estimate without programmed ECO allowance which would raise the number to $1.484M.

2/ The CAIG estimate indicates potential P&W loss of $12M during the option period.

F-100 Methodology

USAF	CAIG
Estimated labor and materials based on experience for first 66 engines. Applied overhead and profit rates by year. Initial slope of 94%, with break to 90% after production expands to accommodate both F-15 and F-16.	Spread $90M loss over CIR data for first 309 engines and projected at 89% (consistent with F-15 DSARC methodology)

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Avionics: Table 5 lists the weights of the F-16 avionics package:

TABLE 5

(Avionics Weights (lbs)

	F-16
Fire control Subsystem	
Radar	200
HUD	65
HDD	46
HUD Camera	5
Computer	27
INS	40
Stores Mgt	19
	402
Communications/Navigation Aids	
UHF Radio	9
VHF Radio	9
Intercom	5
IFF	21
Secure Voice	18
Secure IFF	11
TACAN	31
ILS/VOR	11
	115
Penetration Aids	
RAHW	54
ECM Pod Control	3
Interference Blanker	5
	62
Other	31
Total	610
Installation Weight	200

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The CAIG used the current F-15 experience to estimate the F-16 avionics. The F-16 weights used in the computations and the estimated costs are as follows (average unit costs for 650 aircraft in FY 75 $):

CAIG F-16 Avionics Estimate

	CFE 1/		GFE
Fire Control	397 lbs $923 K		5 lbs $9 K
Conventional Avionics	66 lbs $ 88 K		142 lbs $142 K
Installation Weight		200 lbs $17 K	

1/ CFE load factor (material overhead, G&A, and profit) was 28.2%

Below is a comparison with the Air Force estimate.

F-16 Avionics Comparison

USAF	CAIG
$553.9M ($.852M per a/c without 10% ECO) ($.935M per a/c with ECO spread)	$764.4M ($1.176M per a/c)

Non-Recurring: The Air Force estimate of $42M for non-recurring costs F-16 production was accepted by the CAIG.

Spares and Support: The Air Force F-16 factor of 22.5% of flyaway costs was used in the CAIG estimate.

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Appendix B

COMMONALITY STUDY

Six program alternatives were structured to evaluate the impact of life cycle costs of possible program decisions by the Air Force. Four of the Program Alternatives assume the Air Force develops and procures the single turbofan aircraft, the F-16, while the remaining two Program Alternatives are based on the development and procurement of the twin turbojet fighter, the F-17, by the Air Force.

Program Alternative 1 assumes the Air Force selects F-16 as their fighter while the Navy develops a derivative of the F-16, called the 1601, a stretched version of the F-16 which incorporates more internal fuel and the F-100 engine but does not accommodate the Navy's avionics package. At a minimum the 1601 could be unattractive to the Navy as it would not meet the Navy's radar performance requirements. However, the 1601 does include a high degree of commonality with the F-16.

Program Alternative 2 assumes the Air Force chooses the F-16 and the Navy develops a high performance derivative, the 1600, which represents a significant deviation from the basic F-16 in order to meet Navy requirements. The 1600 is a scaled up version of the F-16 and uses the more powerful F-401 turbofan to compensate for the added weight of the larger aircraft. Commonality with the F-16 airframe has been sharply reduced; sufficient space is provided to house the larger Navy radar antenna and to provide for sufficient internal fuel. The more powerful F-401 is assumed to share the same core with the F-16's F-100 engine, and therefore there is some degree of engine commonality between the F-16 and 1600. However, the F-401 requires further money and time for development before it can be made available for incorporation in production aircraft.

Program Alternative 3 assumes the Air Force chooses the F-16 and the Navy decides to develop a derivative of the F-17 as the NACF. This derivative, called F-17N, assumes sufficient internal fuel can be accommodated to meet Navy mission requirements and the nose shape of the basic F-17 is changed to accommodate the Navy's 28-inch radar antenna. This program alternative offers little in the way of aircraft commonality but permits the Navy to take advantage of the prototype demonstration, accruing savings in RDT&E.

Program Alternative 4 assumes the Air Force selects the F-16 while the Navy develops an independent VFAX which is not a derivative of either the F-16 or F-17. This alternative entails the added expense and time of a separate development program for the Navy and offers little, if any, potential for commonality.

Program Alternative 5 assumes the Air Force selects the F-17 and the Navy develops the F-17N discussed above under Program Alternative 3.

Program Alternative 6 also assumes the Air Force selects the F-17 but the Navy develops the independent VFAX discussed above under Program Alternative 4.

The life cycle cost estimates for each of the program alternatives are based on procurement of 650 aircraft for the Air Force and 800 for the Navy and 15 years operation and support for 432 UE aircraft in the Air Force and 480 UE aircraft in the Navy. The higher buy for the Navy, when viewed in terms of UE operating aircraft is required to offset the higher attrition rates and pipeline associated with carrier operations.

Table 1 lists acquisition and operating costs for each of the alternatives described above.

Table 1

COSTS OF ALTERNATIVE AIR FORCE/NAVY ACQUISITION PROGRAMS
(Billions of FY 75 $)

	USAF	Navy	Acquisition Cost	O&S Cost	15 Year Life Cycle Costs
Alt. 1	F-16	1601 (F-100 engine)	9.3	10.0	19.3
Alt. 2	F-16	1600 (F-401 engine)	10.4	10.4	20.8
Alt. 3	F-16	F-17N	10.3	10.9	21.2
Alt. 4	F-16	Independent VFAX	10.7	10.9	21.6
Alt. 5	F-17	F-17N	10.2	11.5	21.7
Alt. 6	F-17	Independent VFAX	11.6	11.5	23.1

Alternative 1 is the most attractive alternative shown from a cost standpoint since only minimal incremental RDT&E ($150M) was assumed for the Navy version of the single engine ACF. This results from maximum commonality with Air Force avionics and 75% commonality with the airframe. However, it probably will not meet Navy requirements.

Alternative 2 is $1 1/2 billion more costly than Alternative 1, since it includes completion of the development of the F-401 engine, a larger, less common airframe (20% by weight with the Air Force version), and the costs of developing and procuring the larger Navy radar. This increased aircraft size and engine thrust impacts upon fuel consumption as well. As in the case of Alternative 1, higher attrition costs were included as a result of operation of one engine aircraft by the Navy. (In the case of the Air Force, higher attrition costs are offset by commonality savings of the F-100 engine with the F-15 program.)

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Alternative 3 retains the F-16 for the Air Force, but includes costs for complete development of a Navy version of the F-17 with an uprated J-101 engine, a totally different airframe, and the Navy's avionics package. It was also costed assuming the higher operating costs of the F-17 previously described for the Air Force which are even more significant in the case of Navy operations, having higher attrition rates and pipeline. It is still half a billion cheaper than Alternatives 4 and 5.

Alternative 4, with the Air Force acquiring an F-16 and the Navy an independent fighter-attack aircraft, is almost $0.5 billion more expensive than Alternative 3. The increased costs are those associated with the particular NACF assumed -- a larger aircraft than the F-17 requiring an even higher thrust version of the J-101.

Alternative 5, which approximates Alternative 4 in cost, is simply the Air Force acquiring the F-17 and the Navy buying a variant of the F-17. The costing was based on 100% engine commonality, 75% for airframe and avionics. Higher operating costs appear for this alternative than any of those previously shown because both Services are employing the higher fuel consumption F-17.

Alternative 6, which exceeds Alternative 5 by $1 1/2 billion, assumes Air Force operation of the F-17 and Navy operation of an independently developed aircraft built around J-101 engines. It is the most costly of the configurations priced since it includes the cost of two complete airframe developments and procurement and operation of a larger aircraft than the F-17 by the Navy.

The maximum hypothetical savings associated with commonality are very real, e.g., almost $2 1/2 billion (roughly 10%) for proceeding with a minimum variant of the F-16 for both the Air Force and the Navy (Alternative 1), as compared with procuring the F-16 for the Air Force and a different fighter aircraft for the Navy (Alternative 4). However, as indicated by the above table, the additional costs to both the Air Force and Navy of acquiring and operating the F-17 and F-17 variants instead of the F-16 and F-16 variants also appear to run about $2 billion (Alternative 5 vs. Alternative 1).

It is also apparent that the F-16 is sufficiently less costly than the F-17 so that the Air Force could procure the F-16 and the Navy procure a major variant of the F-16 with the more powerful F-401 engine whose development is still incomplete (Alternative 2) -- and still save almost $1 billion relative to buying the F-17 for the Air Force and an F-17N for the Navy (Alternative 5).

Even if the Air Force buys the F-16 and the Navy buys a variant of the F-17, savings of half a billion are predicted (Alternative 3 vs. Alternative 5). Thus, despite the savings associated with commonality, the cost advantages of the F-16 over the F-17 appear sufficient to justify going ahead with the F-16 at the present time.

If the Navy finds a minor variant of the F-16 can, in fact, meet the fighter-attack requirements, the full savings of commonality can be achieved. Almost half the savings could still be achieved with a major variant. If the Navy finds it cannot use an F-16 variant and prefers to acquire an F-17 variant -- total costs will still be less than if the Air Force had been required to procure an F-17 as well. The only option more expensive than a common F-17/F-17N buy is for the Air Force to buy the F-17 and the Navy to buy an all-new design (Alternative 6 vs. Alternative 5). In other words, the maximum commonality savings to both Services buying the F-17 will be at least equalled by the additional costs to the Air Force of buying the F-17 rather than the F-16.

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