UNITED STATES GENERAL ACCOUNTING OFFICE
Washington, D. C. 20548

FOR RELEASE ON DELIVERY

STATEMENT OF
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BEFORE THE
PERMANENT SUBCOMMITTEE ON INVESTIGATIONS
COMMITTEE ON GOVERNMENT OPERATIONS, UNITED STATES SENATE
ON
THE F-111 AIRCRAFT PROGRAM

S.1504

I am pleased to appear before this Subcommittee today and participate in your continuing investigation into the F-111 program. The record of the procurement of the F-111 weapon system, established through hearings by your Subcommittee and other committees of the Congress, clearly shows this program has experienced a multitude of problems.

Over the past ten years we have made many studies relating to the acquisition of weapon systems. The studies have pointed up a number of basic problems that have continued to cause the cost of weapon systems to grow, schedules to slip, and anticipated performance to suffer.

My comments today will highlight the results of studies of the F-111 aircraft program since early 1963, and relate the problems encountered on that program to similar problems encountered on other weapon systems. We will also review for you, generally, some of our current thoughts on the subject of weapon systems acquisitions.

Our work on the F-111 program started early in 1963, when this Subcommittee asked us to make an independent review of the cost estimates prepared by the Air Force for use by the Department of Defense in making its decision on the award of the F-111 contract. Since that time we

have furnished reports to this Subcommittee and other committees on various aspects of the F-111 program in which an interest had been expressed.

Our most recent report on the F-111 program was done as part of our work on the status of the acquisition of selected major weapon systems which was reported to the Congress on February 6, 1970. In that report (B-163058) the status of 57 individual programs, including the F-111 program, is presented in 10 separate classified volumes, together with our observations on the completeness and accuracy of cost, schedule, and performance information accumulated to June 30, 1969.

The data on the F-111 program presented here today has been up-dated to December 31, 1969.

Program Costs

Air Force cost estimates on the F-111 program at December 31, 1969, indicate a total cost of $8.672 billion to complete the current Air Force program encompassing 547 aircraft. This includes $1.185 billion which the Air Force considers as non-acquisition costs -- comprised mostly of estimates for future modifications, replenishment spares, and war consumables.

These estimates exclude some $523 million identified principally with the abandoned Navy F-111B and estimates to modify 24 F-111 A's to reconnaissance aircraft.

In November 1963, the Air Force estimated the unit cost of the F-111A to be $3.97 million. At December 31, 1969, the Air Force's unit cost estimate for the F-111 was $13.32 million.

In October 1965, the Air Force estimated the unit cost of the FB-111A (bomber) at $6.75 million; at December 31, 1969, this estimate was $15.67 million.

The increases in unit cost can be attributed to:

1. Decrease in the number of aircraft to be produced;
2. Increase in the number of versions (models) of the planes including those later abandoned;
3. Weapon systems capability improvements;
4. Inflation; and
5. Technical problems.

F-111-B

Program costs were undoubtedly increased by an effort to procure an aircraft with a high degree of commonality to serve the needs of both the Air Force and the Navy. While the Department of Defense believed that the development and production of a common aircraft could save as much as a billion dollars, I am of the opinion that the effort contributed to increased costs and to delays in development of an operational aircraft for both services. For example, the concern on the part of the Navy with increases in the weight of the aircraft--a matter of considerably lesser concern to the Air Force--undoubtedly delayed the availability of an operational aircraft.

Total cost not accurately known

In testimony before the House Committee on Appropriations in May 1969, the Navy estimated its total cost for the F-111B to be $335 million, of which $115 million was considered by the Navy to be "lost cost." While we have made no detailed analysis of the computations lying behind this estimate, we know of no way to develop a precise estimate under the circumstances because of such difficult and unanswered questions as:

1. To what extent were any of the performance problems caused by compromises made in an effort to achieve commonality?
2. How much will the expenditures for the F-14 be reduced by virtue of research and development which took place in connection with the F-111?

3. What share should the Navy plane bear in the total cost of the research and development of the F-111 in view of the fact that the Navy version was subsequently dropped; i.e., should it bear proportionate costs of the total, or only identifiable additional costs required to meet special Navy requirements?

Furthermore, the concurrent production and development, coupled with a large number of changes throughout the program have been major contributing factors to the large cost growth and delayed delivery of the F-111 weapon system.

Selection of the prime contractor for the F-111 aircraft was based on system analysis and wind tunnel testing of models rather than on actual production of hardware; that is, the competing contractors built no substantive hardware. This "paper competition" appears to have contributed to unrealistic cost estimates by both the contractors and Air Force. This is particularly true for those system features and subsystems which involved critical unknown factors and for which there was no visible product on which to base estimated costs.

Cost growth on this program led to funding problems and contributed to schedule stretch-outs. In at least one instance, program cost growth affected the mix of aircraft to be procured. The cost growth of the MARK II system from less than $250 million to $839 million was instrumental in the Air Force's decision in September 1969, to curtail production of F-111D's from 154 to 96 aircraft, a reduction of 58 aircraft. F-111F's incorporating less expensive avionics were substituted for the 58 F-111D's under the current contract and for the balance of F-111D's planned in the total program. In this instance, the cost growth may be attributed, in part, to the fact that a commitment to production was made prior to resolving major design problems.

In some instances both the contractor and the Air Force set unrealistic performance requirements. Efforts to achieve these unrealistic requirements have added to the cost of the program.

Major changes in avionics and engines introduced late in the program resulted in duplicate test efforts, and also contributed to program cost growth.

Many of the explanations for cost growth in the other 56 programs included in our recent report were similar. The work we did convinced us that the reasons cited for cost growth did not provide program managers, the Services or the DCD with the precise causes. We suggested that increased attention be given to the problem of identifying separately:

1. Those cost growth items which, in fact, are not entirely controllable by DOD, such as inflation. For example, the contractor has informed us that inflationary price increases from 1962 through 1969, averaged seven percent a year as against anticipated increases of four percent.
2. Those items which may be desirable and which may be expected to continue, such as upgrading system performances.
3. Those items which cause cost growth and which could be eliminated or reduced considerably by timely and effective DOD action, such as avoiding production of a new system before developmental problems are resolved.

Schedule Experience

The F-111 has experienced a number of problems affecting the program schedule. The effect of these problems is evident in some of the more significant slippages in established schedule milestones. The following schedule slippages were reported by the Air Force as of December 31, 1969.

-- first wing, operationally ready, using F-111A's is expected to slip 22 months,

-- start of category I flight test for the F-111D slipped 14 months,

-- start of category II flight tests for the F-111D is expected to slip about 20 months,

-- delivery of the first production MARK II avionics system for the F-111D is expected to slip 20 months,

-- first wing, operationally ready, using F-111D's is expected to slip 16 months, and

-- first wing, operationally ready, using F-111E's is expected to slip 19 months.

The grounding of the F-111 following a crash on December 22, 1969, will slip the schedule milestones still further.

As of December 31, 1969, fewer aircraft had been delivered than originally scheduled. The initial delivery schedule incorporated in the definitized production contract showed that a total of 449 aircraft were to be delivered by December 31, 1969, but 207 had been delivered as of that date. We found that seven changes to the contract delivery schedule had added 26 months to the time period originally contemplated for final delivery of the 493 production aircraft under contract. As a result of the changes, the contractor was nine aircraft behind his revised delivery schedule.

In general, the Air Force attributed these schedule variances to the effect of changes in the quantities of the various versions to be produced, Southeast Asia deployments, failure of wing carry-through box during fatigue tests, development problems with the MARK II avionics systems, and recent grounding of F-111's.

That similar slippages are being experienced on other systems acquisitions is reflected by our examination of the system milestones schedules as reported at June 30, 1969, which showed that 34 of the 57 systems in our February 6, 1970, report, including the F-111, either had experienced or were expected to experience slippage in the originally established program schedule of from six months to more than three years. Eleven other systems we reviewed were in the early phases of the acquisition process and, therefore, no schedule slippages were reported. On an additional 12 systems either no slippage or slippage of less than six months was reported.

System Performance

There were several major variances, as of December 31, 1969, between original requirements and the estimated (projected) performance of the F-111A aircraft. Some of these indicated variances were:

-- decrease of 86 percent in the specified "dash" distance at supersonic speed,

-- decrease of 34 percent in specified ferry range,

-- increase of 37 percent in take-off distance, and

-- an improvement of 42 percent in navigational accuracy.

The Air Force attributes most of the above mentioned short falls in performance to higher than anticipated fuel consumption, aerodynamic drag, or weight growth.

Officials of the F-111 System Program Office and other Air Force officials have stated to us that the above system degradations are of no real significance because the user (Tactical Air Command) was satisfied with the current capability of the aircraft. These same officials also noted that the current state-of-the-art did not permit meeting some of the initial requirements established for this aircraft.

One of the very serious technical problems encountered on the F-111 program was the premature failure of the wing carry-through box which first occurred on August 27, 1968. A modification was approved to correct this deficiency and further testing began on February 2, 1969. On February 12, 1969, a second failure occurred. A second modification was approved and testing continued. On June 23, 1969, a third failure occurred. As a result of the third failure, a safe service life of about four years was established. In testimony before this Subcommittee on March 25, 1970, Air Force officials stated that tests on a wing box that had received the latest structural modifications indicated an unrestricted service life of at least seven years.

We have been advised that the Government has requested that the contractor proceed with the development of a new box with a longer safe service life. In addition, the contractor has been requested to submit a program plan for the design and development of an alternate box to be made of titanium.

Another significant technical problem was discovered as a result of the crash of an F-111 aircraft on December 22, 1969. The cause of this crash has been attributed by the Air Force to failure of a pivot fitting in a wing. A modification to correct this problem is under study. Following this crash all operational F-111's were grounded and this restriction is still in effect.

In our analysis of the system performance data reported for 57 systems including the F-111 and in discussions with responsible project office officials, we found that significant variances either existed or were anticipated between the performance originally expected and that currently estimated for a large number of the systems. Three of the systems we looked at experienced significant improvements in performance beyond original expectations. Twelve systems had experienced or expected a degradation of system performance from

that originally estimated. At the same time, 17 systems realized improvements to some performance characteristics while experiencing degradation to other characteristics. No significant performance variances were reported for 25 systems.

Analysis of F-111 Contract

In November 1962, General Dynamics was announced the winner of the design competition by the Office of the Secretary of Defense. Approval of the letter contract for research and development of the aircraft was given on December 18, 1962, and development work began on the Air Force and Navy versions.

Two definitized contracts were ultimately awarded for the F-111. The first is contract No. AF-33(657)8260, approved May 22, 1964. This is the research and development (RDT&E) contract. The second is the production contract, contract No. AF-33(657)13403, approved May 15, 1967. Both contracts are of the fixed-price incentive type.

We have been asked to comment specifically on the testimony presented by Mr. John Walsh of your staff on the Government's rights under the contract in the event of deficient contractor performance. ~~We have had the benefit of a draft of Mr. Walsh's statement~~. Based on our independent review of the contracts we agree with the conclusions expressed [redacted] that the protection apparently afforded by certain provisions of the contract is largely vitiated in others.

Thus the RDT&E contract appears to obligate the contractor to develop for a fixed price an airplane meeting certain stated performance characteristics or, if he fails, to suffer certain penalties, reductions in price or even termination for default. However, part II(a) of the contract precludes making acceptance of the aircraft by the Government contingent on their

meeting the performance requirements. Mr. Walsh states that no performance tests have been held or even scheduled. Further, the myriad of ordered changes and the Government's responsibility for furnishing jet engines meeting certain standards raises substantial question as to legal responsibility for the failure of the airplane to perform as contemplated.

With respect to the production contract, the absence of definitive specifications again calls into question the apparent right of the Government to require delivery of an airplane meeting the originally contemplated standards.

Mr. Chairman, I would have to say at this point that the inclusion of performance guarantees, as well as the use of a fixed-price incentive contract, for research and development was unique at the time the development contract for the F-111 was awarded. The technical difficulties experienced in the program suggest that the data upon which the Government relied in support of its use of a fixed-price incentive contract was considerably less firm than the Department believed it was. Previously, such development effort was procured by using cost-type contracts which, in effect, require only a contractor's best efforts.

The Air Force, on its F-15 contract, reverted to the use of the cost-type contract for design, development, and test and evaluation not involving any hardware or fabrication. The apparent reason is that the Department has concluded that the risks involved in major development programs are of such magnitude that fixed-price arrangements for such programs are generally inappropriate.

The RDT&E Contract

The RDT&E contract contains certain standards of performance to be met in terms of weight, speed, range, ceiling and similar factors. The total net penalties for failure to meet the guaranteed basic performance specifications of weight, range, dash, acceleration, ceiling, etc., amount to $6,125,000 and, as indicated by Mr. Walsh, many of the basic performance specifications have no penalties listed. Under Part XV the Procuring Contracting Officer may elect, in lieu of having a deficiency corrected, to negotiate a reduction in price with the contractor.

The Production Contract

Passing now to the production contract, the Correction of Deficiencies Clause (Part XV) is worthy of note. Paragraph 2A of Part XV classifies deficiencies to be corrected into 4 categories:

1. Deficiencies in workmanship or material where correction is directed prior to acceptance.
2. Deficiencies arising from failure otherwise to conform with the production contract requirements where correction is directed prior to acceptance and such correction can be made at an economical point in production and without significant delay in deliveries.
3. Deficiencies corrected at the sole discretion of the contractor.

4. Other deficiencies.

Deficiencies in the first 3 categories are to be corrected without change in target cost, target profit or ceiling price. The costs of these corrections are shared by the contractor and the Government up to the ceiling price and above that are borne solely by the contractor. Corrections directed in the fourth category are to be made without change in target cost, target profit or ceiling price except that at final pricing, if the contractor would have a profit, the cost of such corrections is shared by the contractor and the Government in accordance with the cost-profit formula of the contract. This means, in essence, that the contractor would absorb no more than 25 percent of the cost of the corrections in this category and from the point at which the contractor's profit is eliminated the Government assumes the full cost of such corrections since the ceiling price is increased by their actual cost.

In summary, we believe that the absence of benchmarks in the RDT&E contract considerably weakens the right of the Government to enforce the performance standards and guarantees, the correction of deficiency clause and similar provisions which appear to obligate the contractor to achieve a stated result or suffer financial liability.

Typical Problems in Weapon Systems Management

Many reasons have been advanced for the problems encountered in the F-111 program. In our opinion, however, basic causes of the cost growth and delayed delivery can be traced to several factors. Many of these factors were found to exist in a number of other programs examined during our recent review of the status of 57 major weapon systems.

In our February 6, 1970, report to the Congress we expressed a belief that one of the most important causes for cost growth and delayed delivery is starting the production of a weapon system before it has been adequately demonstrated that there is reasonable expectation of successful development. This problem was evident in a substantial number of the weapon systems. In the case of the F-111, we stated that concurrent production and development, coupled with a large number of changes throughout the program had been major contributing factors to the large cost growth and delayed delivery of that weapon system.

Concurrent production and development with the inevitable changes has been and continues to be a major problem frequently found in weapon systems acquisitions. We have reported this many times. We believe concurrency to be a method of procurement which has merit only if an urgent need is adequately demonstrated. Even then the assessment of risks and alternative solutions should be weighed at the highest levels to determine which option should be exercised.

Another major problem in acquiring weapons systems is the practice frequently followed of selecting the design contractor on the basis of paper design studies where none of the competing contractors have built any substantive hardware. This is a subject that both you, Mr. Chairman, and we have addressed many times. The successful contractor for many of the programs covered in our recent study including the F-111 system was selected on this basis.

Recently, we issued a report to the Congress on our Evaluation of Two Proposed Methods for Enhancing Competition in Weapons Systems Procurement. As indicated in that report, one proposal we feel has merit is parallel undocumented development, which emphasizes development of competitive prototypes. A developmental prototype is a full size, working system or integral subsystem, not necessarily complete, but in a state sufficient to demonstrate that the concept is practicable and that it is cost effective.

Parallel undocumented development appears to us to be a useful strategy for acquiring certain kinds of hardware--not necessarily fully-integrated completely configured weapon systems, but certainly those system features and subsystems involving critical unknown factors. While the expertise of those in DOD would be needed to select weapons and subsystems for application of this strategy, we believe that the hardware selected should meet three criteria:

--Those that would push state-of-the-art frontiers by new or significantly modified systems; unusual interfacings, or novel configurations.

--Those that have sound prospects for volume production; and

--Those for which the cost of competitive development would

result in a low to moderate ratio of development cost to expected total cost.

In the conclusion to that report, we pointed out that there were programs, then in the early stages of development, which might be candidates for competitive prototyping under austere conditions. (We cited the F-15 fighter aircraft, the Subsonic Cruise Armed Decoy-SCAD, and the A-X close support fighter.)

We also stated that the acquisition strategy to be used is the one that best fits the kind of article to be procured, its particularities, and the degree of risk involved. Depending upon the circumstances, this could involve competitive prototyping, developmental prototyping after selection of a single contractor, or other procedures.

Officials of the Department of Defense have also expressed concern about these matters. A statement of the Director of Defense Research and Engineering, Dr. John S. Foster, Jr., as inserted in hearings last July before the Subcommittee of the Committee on Appropriations, House of Representatives, contained the following:

> "We have learned that paper design studies, and even extensive analysis and simulation, are essential. However, studies alone cannot always produce an adequate basis for selecting an effective design and laying out achievable schedules, performance and cost. In some cases it is essential that we reduce critical sub-assemblies or components to hardware, often on a competitive basis, in order to gain adequate assurance of feasibility and design stability. Where the system integration is itself a major source of risk, complete prototypes may be mandatory. Where development costs are small in comparison with acquisition and operating costs, the added costs of competition in hardware may well pay off in total economy. In general, where the total R&D cost represents only a few percent of the total systems cost, competitive prototyping is wise; and we will continue to follow this practice, perhaps in more situations."

Recent statements seem to indicate that the DOD will make more use of competitive prototypes. In a statement on February 20, 1970, before a joint session of the Senate Armed Services and Appropriations Committees, the Secretary of Defense, advised the Committees that competitive prototyping would be used on the A-X. He stated that:

> "We also plan to go ahead in FY 1971 with the development of a new close air support aircraft, the A-X. The Congress provided $2 million for this program last year to begin contract definition. However, we now believe it may be more desirable to go directly to prototype development on a competitive basis. The cost of a sole source contract definition and engineering development program for ten test aircraft (seven of which could later be modified to a tactical configuration) is estimated at about $155 million. We believe a two contractor competitive program involving the construction of two prototype aircraft each, and no further development could, under current estimates, be done for considerably less."
>
> "The competitive approach would provide test aircraft about one year earlier, and would allow a decision on whether to procure the aircraft, as well as the selection of a producer, to be based upon competitive testing of actual hardware rather than paper designs. If we then decided to buy the aircraft, the winning contractor would complete the engineering development and build the necessary ten R&D aircraft. A competitive RDT&E program will, of course, involve greater costs than a sole source program."

The competition on the basis of "paper design studies" for the F-111 program appears to have contributed to the development of cost estimates, by both the contractor and Air Force, which experience shows were not realistic. The problem of developing estimates was no doubt complicated by the fact that certain features such as the air inlets, the MARK II avionics, and the propulsion system involved critical problems for which solutions had not been worked out. In some instances, performance requirements were set which experience shows were not realistic. Efforts to achieve these requirements have added to the cost and otherwise affected the program. For example, the inability to meet the weight requirements on the Navy's F-111B was a primary factor contributing to the termination of that program.

These same type problems were evident in other programs. In our February 6, report on the Status of the Acquisition of Major Weapon Systems to the Congress, we stated that a significant cause for cost growth can be traced to the initial definition of system mission requirements and technical performance specifications, including the estimates of costs to achieve them. We expressed the opinion that improvements in the quality and completeness of preliminary planning including prototyping would provide the knowledge which would contribute substantially to the accuracy of initial cost estimates.

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Mr. Chairman, we have established a group in our Defense Division--the Major Acquisitions Group--to review major weapon systems acquisition programs.

This group will maintain a continuing review of cost growth, schedule slippage, and system degradation involving major programs. The group will have as its primary objective, the determination of basic causes of these phenomena in order to make recommendations for improving the weapon acquisition process. We think that the results of the work of this group will provide your Subcommittee and other committees with the types of information in which an interest has been expressed.

We will keep your Subcommittee apprised of any significant developments which we become aware of that would appear to be of interest to your Subcommittee. We will continue to give urgent attention to any matters on which you express a particular interest.

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Mr. Chairman, this concludes my statement and I will be happy to discuss any of these matters in further detail or answer any questions the Subcommittee may have on our statement.

ATTACHMENT A
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REASONS FOR COST GROWTH
AS REPORTED IN DEPARTMENT OF DEFENSE SELECTED ACQUISITION REPORT FOR THE F-111 SYSTEMS AS AT DECEMBER 31, 1969

	(millions of dollars)		
	F-111 A/C/D/E/F	FB-111A	Total
Contractor Price Changes (increases)			
General Dynamics	$ 218	$ -	$ 218
Pratt-Whitney	188	51	239
Grumman	207	14	221
McDonnell-Douglas	64	4	68
Spares	70	-	70
Miscellaneous	12	-	12
Subtotal	759	69	828
Impact of schedule/production rate changes	458	40	498
Avionics Configuration changes			
F-111D (Mark II)	297	-	297
Mark II support	42	47	89
Change to Mark II components	-	36	36
F-111D/F configuration changes	233	-	233
Subtotal	572	83	655
Penetration aids additions	199	6	205
Engine development/propulsion			
Engine/propulsion improvements	188	51	239
P-100 engine development	79	-	79
Subtotal	267	51	318
Impact of F-111B and F-111K cancellations	99	63	162
Southeast Asia Deployment	30	-	30
Systems testing	37	-	37
Expanded flight test	66	35	101
Addition of Sparrow AIM-7G capability	19	-	19
Data requirements	33	-	33
TAC deployment concept	118	-	118
Test base support	28	-	28
Super Weight Improvement Program	28	-	28
Miscellaneous changes	282	33	315
Facilities expansion (General Dynamics)	60	-	60
Crash position indicator/recorder	8	-	8
Wing box and other correction of deficiencies not included in other categories	65	-	65
Depot AGE	63	-	63
Flight to mission simulator	38	-	38

(UNCLASSIFIED)

	(millions of dollars)		
	F-111 A/C/D/E/F	FB-111A	Total
Spares	86	49	135
SRAM interface	-	34	34
Total	$3,315[1]	$463	$3,778

[1]December 31 SAR's program cost totals indicated cost growth of $3,313 million, exclusive of construction cost of $22.7 million. However, the Air Force's cost variance analysis shown in the SAR accounted for $3,315 million.

(UNCLASSIFIED)