Description of document:	Two Government Accountability Office (GAO) reports: • Analysis Of The F-14 Aircraft Program (B-168664), Aug. 17, 1970 and • Costs And Benefits of The F-111B Aircraft and Costs of The PHOENIX Missile (B-153545), Mar. 14, 1969)
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GAO U.S. GOVERNMENT ACCOUNTABILITY OFFICE
441 G St. N.W.
Washington, DC 20548

PRI-13-225
Follow-up

November 18, 2014

This letter responds to your July 20, 2013, request for a mandatory declassification review of the Government Accountability Office reports entitled Analysis Of The F-14 Aircraft Program (B-168664, Aug. 17, 1970) and Costs And Benefits of The F-111B Aircraft And Costs Of The PHOENIX Missile (B-153545, Mar. 14, 1969).

As promised, we requested a mandatory declassification review of the above classified reports from the appropriate agencies. These agencies has completed their review and determined that the classified report should be declassified in its entirety. Copies of the unclassified reports are enclosed.

Sincerely yours,

Timothy P. Bowling
Chief Quality Officer

Enclosures

~~CONFIDENTIAL~~ UNCLASSIFIED

REPORT TO THE CHAIRMAN, PREPAREDNESS INVESTIGATING SUBCOMMITTEE, COMMITTEE ON ARMED SERVICES, UNITED STATES SENATE

Analysis Of The F-14 Aircraft Program B-168664

This material contains information affecting the national defense of the United States within the meaning of the espionage laws, Title 18, U.S.C., Secs. 793 and 794, as respectively amended, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law.

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BY THE COMPTROLLER GENERAL OF THE UNITED STATES

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UNCLASSIFIED 2014-M-0347

~~CONFIDENTIAL~~ AUG. 17, 1970

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

B-168664

Dear Mr. Chairman:

Your request of March 19, 1970, asked that we make analyses of the contractual features of the F-14 and F-15 aircraft programs. Our analyses were to include the areas of management controls, contractual structure and definitiveness, cost and pricing provisions, and the extent of concurrency probable within the program structure.

The F-15 analysis was reported to you by our letter dated July 7, 1970; our analysis of the F-14 program is enclosed. This analysis is based on (1) a review of contractual and other data obtained from the F-14 Project Office, (2) visits to the prime integrating contractor and suppliers of major subsystems to review program status and contracting arrangements, and (3) consultations with people in the Department of Defense and aerospace industry.

CONTRACTUAL AND MANAGEMENT FEATURES

Our analysis shows that very few contractual or program management innovations have been incorporated into the F-14 program. Service-level management of the program is quite similar to that used in prior Navy acquisition programs. At the Department of Defense level involvement of personnel from the Office of the Secretary of Defense in the day-to-day management of the program is considerably less than that employed on prior programs. This approach is in keeping with the current philosophy of top officials in the Department of Defense and is being applied to other weapons system programs.

The F-14 contract continues the practice followed in recent major weapons system acquisitions of obtaining binding production commitments at the same time development is contracted for. This practice was designed to obtain competition in the pricing of both the development and production portions of the required effort. The production commitments in this contract take the form of not-to-exceed ceiling prices for optional lots of production aircraft. These ceiling prices, however, are not tied to the costs incurred on the initial production run as was the case in the contract for the C-5A aircraft.

The F-14 contract does not contain one feature which has been widely publicized as being a part of recent major weapons system contracts. This is the feature which requires that until the contractor

the presently planned quantity of 26, it (Grumman) might request financial relief from the Government. Such relief would presumably be provided under Public Law 85-804, which allows extraordinary relief to a contractor when it is in the interest of the national defense.

It should be noted that this issue is not confined to the next option. The approved Five Year Defense Plan provides for quantities of F-14 aircraft beyond the next option which are near the minimum quantities permitted by the contract. Further, according to the Navy, budget pressures may allow even fewer F-14's.

4. The F-14 airframe contract was awarded after final competitive negotiations involving two contractors. During negotiations the winning contractor (Grumman) reduced its ceiling prices for optional aircraft by about $400 million. During this same period the losing contractor increased its ceiling prices for the same effort by some $118 million. Grumman's final price was still higher, the difference being some $100 million.

   Navy contract personnel advised us that Grumman's reduction in ceiling price was primarily due to Grumman's reassessment of development risks rather than to reductions in its cost estimates. The record of negotiations does not show the basis for this reassessment. The increase in the losing contractor's ceiling price was said to be attributed to the costs of technical changes in its proposal. If there was not a sound basis for Grumman's price reduction, pressure on the contractor to pass on cost growth to the Government may be expected to develop.

5. Additional costs to the Government due to economic inflation may be substantial. The contract provides for adjustments to the ceiling prices of the last three lot options if inflation reaches certain levels. Considering the current rate of inflation, it appears that such adjustments will have to be made.

   The price of work currently under contract and the ceiling prices for the next three options are not subject to adjustments for economic inflation. If inflation causes an abnormal amount of cost growth before the adjustment formula comes into play, it could cause the contractor to seek relief from the Government or face serious or perhaps ruinous losses. The subject of a potential request for extraordinary financial

relief mentioned above (No. 3) is, of course, related to this matter.

6. The contract prices are predicated on the F-14A rather than the F-14B although the vast majority of the total F-14 aircraft purchased will be the F-14B model. The F-14B will incorporate the new "advanced technology engine."

   The contract contains a $14.6 million ceiling price to cover reconfiguration of the F-14A airframe into the F-14B airframe; however, this ceiling is no longer applicable since the advanced technology engine design has been changed to provide greater thrust. The cost of this work is now estimated by the Navy F-14 Project Office to be about $29 million.

   A contract change is now being negotiated which will establish ceiling prices for (1) reconfiguration of the airframe design (a nonrecurring charge) and (2) the impact of the new engine on the existing airframe (a recurring charge). The increase in the aircraft ceiling prices is estimated by the F-14 Project Office to be from $50,000 to $100,000 per aircraft.

   In view of the financial pressures on Grumman discussed elsewhere in this letter, we believe the validity of the Navy estimates mentioned above may be questionable. In this connection, Navy contract personnel have advised us that Grumman has not yet submitted a firm ceiling price proposal to change the contract to incorporate the F-14B version.

7. Although the contractor is required to furnish aircraft to the Navy for performance trials (Board of Inspection and Survey trials) at specified dates, the Navy has not committed itself to completion of these trials by a specified date. According to the Navy, Board of Inspection and Survey trials on other weapons programs have lasted for extensive periods of time. The importance of this fact is that aircraft performance failures probably cannot be used as a basis for default termination or for requiring reductions in price through the defects clause until at least some of these trials have been completed. In commenting on this, the F-14 Project Manager said he expects the trials of the F-14 will not exceed 4 to 6 months.

8. The contract permits the Government to accept aircraft which do not meet, during Navy performance trials, the performance specifications established by the contract. We were told that this provision was included in the contract as an effort to be realistic since such acceptances have been made in the past anyway.

   The contract provides that if the Government chooses this course of action, the detail specification for aircraft yet to be delivered and for aircraft still to be ordered will be modified to reflect the performance actually obtained. The

[redacted]

prices of aircraft already delivered or on order would be equitably adjusted to reflect the lessened performance of these aircraft; however, for aircraft still unordered the contract provides that the specification modification is to be made at no change in the option ceiling prices.

9. Many of the major subsystems, such as the engine, the fire-control system, the armament, and several other components requiring integration with the airframe, are to be furnished by the Government instead of being acquired by the airframe contractor directly from the manufacturers.

Under the terms of the contract, the airframe contractor is charged with responsibility for integration of these subsystems and for total system performance. This responsibility is contingent on the Government furnishing the contractor with subsystems in a condition suitable for intended use which meet the specification, performance, and acceptance test requirements. Also, if it can be shown that a subsystem failure in flight was due to something which would not have been revealed by the specified subsystem tests on the ground, the airframe contractor is relieved of performance related responsibility until the Government corrects the defect in design or workmanship.

Further, if the Government fails to correct the condition, or fails to deliver the items on time, the airframe contractor is entitled, in addition to any price adjustments to which it may be entitled under the Government property clause, to relief from performance related requirements and from the performance incentives provision of the contract.

We mention this area because the Government has traditionally had problems in furnishing suitable equipment to contractors on schedule. Since such items constitute more than half the flyaway costs of the F-14 program the Government is assuming considerable contractual risk under the program.

10. Most electronic gear aboard the F-14, except for the weapons control system, is designed to be supported by a special ground test system which is under development. This system, the Versatile Avionics Shop Tester, is being designed to be used by other Navy carrier aircraft as well as the F-14.

Completion of the initial shop test system may be delayed because of the late delivery of components from subcontractors to the prime contractor for the Shop Tester. It is unknown

what effect a delay in completing the first Shop Tester will have on the overall F-14 program. However, it is essential that the Shop Tester be operable and installed in the aircraft carriers to support the F-14 avionics because no other backup testing equipment is contemplated. Without this test system it would be impossible to maintain and repair F-14 avionics in the fleet without a costly crash program to develop other special support equipment.

11. The engines which will be installed in the F-14B version of the aircraft are being developed. This engine development entails advances in the state-of-the-art. One of these advances has to do with the high operating temperatures which will be used in the engine. The National Aeronautics and Space Administration (NASA) has advised us that the proposed high temperature entails some risk since new materials, new fabrication techniques, and advanced cooling concepts will be required to attain desired goals. NASA believes the assumed risk and the probability of success to be reasonable.

12. Integration into the airframe of the engine which will be used in the F-14B aircraft may be a potential problem. The Navy has told us that the problem should not occur since both this engine and the airframe were designed from the beginning to accommodate each other. Against this position, however, should be placed the fact, as noted earlier, that some redesign of the airframe will be required.

13. An engine with a common central core section is being developed for the F-14B and F-15 aircraft under a joint Air Force/Navy program. The designs of both the Air Force and the Navy configurations of this engine have been changed. The Navy's version of the engine now provides more thrust than the Air Force's. If either service were to want to depart still further from the original performance specifications, this might necessitate abandonment of the plan for a common central core with resultant cost growth for both programs.

14. Some of the high performance fighters developed in the past have been prone to accidental spins or to difficulty in recovering from such spins. Since the F-14 is a high performance fighter incorporating the latest advances in the state-of-the-art, including variable sweep wings, spin characteristics may be a potential problem area on this aircraft also.

15. The contract provides that Grumman will develop a management reporting and control system in accordance with DOD Instruction 7000.2; however, no date is specified in the contract by which Grumman's system must be validated by the Navy as being acceptable. The system called for by this instruction is intended to provide top management with early visibility of problems in meeting required cost or schedule.

    The F-14 Project Office has told us that a validation visit was made to Grumman during the week of July 20, 1970. It advised us that formal approval of the Grumman system should be forthcoming by August 13, 1970. It should be noted that other validation visits to Grumman have been made. Approval was not granted after these visits, however, because of deficiencies noted in the system.

16. A report has been prepared by a Department of Defense ad hoc working group of Defense and industry experts on air-to-air missiles. Although this report has been released within the Department of Defense it is not yet (as of July 17, 1970) considered official and for this reason it has not been made available to us. It is our understanding that the report does raise some fundamental issues relative to the capability of the PHOENIX, SPARROW, and the other armament missiles planned for use on the F-14 and F-15 programs. The Subcommittee may wish to be knowledgeable of the outcome of this special study before authorizing future funds for the F-14 missile armament.

    We also understand that the Naval Weapons Center, Corona Laboratory, has raised some questions as to the susceptibility of the PHOENIX to electronic countermeasures.

17. The F-14 aircraft will not be compatible with the existing jet blast deflectors on present and planned aircraft carriers. These deflectors are shield-like devices, about eight feet high, which are raised to protect equipment and men on deck from jet blasts when aircraft are launched. We have been advised that the design of the F-14 cannot be changed to correct this problem, therefore the jet blast deflectors on the aircraft carriers must be modified. The Navy is aware of this problem and efforts are being made to come up with an appropriate carrier modification program. Cost information associated with this effort is not available at this time.

18. The next aircraft lot option is intended to be procured with production funds. Of the 26 aircraft, eight will be used initially for flight tests and operational tests and evaluation. The intent of DOD Instruction 7220.5, which governs

the sources of funds for weapons acquisition programs, is that preliminary production articles are to be financed from research and development appropriations in those cases where the articles are to be employed in test and evaluation.

SUGGESTED ACTIONS TO MINIMIZE PROGRAM RISKS

The significance of the problem areas discussed above or the probability of their impacting seriously on the F-14 program cannot be fully assessed by us. We believe the Department of Defense is in a better position to assess the significance of these areas. In this connection, the Defense Systems Acquisition Review Council is scheduled to hold a meeting in August or September 1970, concerning the F-14. The purpose of this meeting is to decide whether the F-14 weapons system is to be officially approved for production.

You may wish to bring the matters discussed in this letter to the attention of the officials in the Department of Defense involved in making this decision to obtain the Department's assessment of the problem areas identified.

Regardless of the conclusions reached by the Department of Defense concerning the potential problem areas we have mentioned, it seems reasonable that assurances should be obtained that the F-14 weapons system will be truly combat useful before the Government makes major production commitments. This could be accomplished by making assessments of the operational capability of the F-14 weapons system at the earliest possible time in simulated combat with probable enemy aircraft. These assessments should be as independent as possible of the Navy's research and development community.

The primary purpose of these independent assessments would of course be to determine, based on the most current and complete data which could be gathered, the capability of the F-14 system to counter the expected threats. A secondary purpose would be to confirm that the system will meet the specifications and capabilities established for it during concept formulation.

Accordingly, we suggest your Subcommittee consider the following. Two operational assessments could be made. One assessment could be made by an independent military group with the capability of evaluating the tactical worth of F-14 performance specifications against its expected opposition. This assessment could be strongly supported by tests and analytical work done by the National Aeronautics and Space Administration (NASA). The other assessment could be made, as discussed later, by Navy pilots reporting directly to the Chief of Naval Operations.

It should be noted that independent evaluations of the type we have described are seldom if ever made on new weapons systems. It would appear, however, that such evaluations would give greater assurance that a combat useful weapon is being added to the operational inventory. The mere fact that a weapons system meets technical specifications set forth in the contract does not always assure its usefulness as a combat weapon.

Military/NASA Analyses

These analyses could begin this year on the F-14A model of the aircraft. A subsequent evaluation could be made of the F-14B model. The military/NASA analyses would consist primarily of utilizing wind tunnel tests and analytical techniques, short of actual flight testing, to evaluate the aircraft's capability. They could, however, use flight test data when they become available next year.

The basic role of NASA in these evaluations would be to determine (1) the probable performance of the F-14 aircraft and (2), based on the best data available, the probable performance capabilities of expected enemy aircraft. The role of the independent military group would be to use the data generated by NASA in assessing the combat potential of the F-14 weapons system in encounters with postulated enemy fighter and bomber aircraft. These tests would compare not only the basic aircraft but as much as possible of the total weapons system, including armament and electronic systems.

It should be noted that NASA has considerable experience and expertise in military aircraft research and development work. Also it is already acquainted with the F-14 and F-15 programs, having participated to some extent in the concept formulation phases of both. Some six months ago it did further studies concerning the F-14 at the request of the Director, Defense Research and Engineering. These studies were addressed to the degree the F-14 design would meet its performance specifications. Later studies would probably be more representative of the weapons system being produced.

Congressional testimony has been provided to the effect that tests participated in by NASA in the F-111 program disclosed, as early as 1963, some of the areas in which that aircraft ultimately failed to meet specifications. The same testimony indicates that the results of these tests were not acted on, however. (See the statement of April 7, 1970, by Edward C. Polhamus, Langley Research Center, NASA, before the Permanent Subcommittee on Investigations, Committee on Government Operations, United States Senate).

Navy Operational Evaluations

Independent Navy tests of the F-14A model hardware by personnel representing the fleet could begin as quickly as sufficient units are available and have passed critical research and development flight tests. The same would be true of the F-14B model.

Navy practices do provide for operational tests and evaluations of new aircraft weapons systems. In the case of the F-14 program the last four of the 20 test airplanes are scheduled for these evaluations. Our concern with this test and evaluation is with its scope and timing. As will be more fully developed in a separate report to you on air-to-ground missiles, the military services' operational tests and evaluations in the past have not been concerned primarily with determining the capability of newly developed weapons systems to meet and overcome the probable enemy weapons and techniques for which they were designed. Instead, they have been more concerned with developing tactics for the systems or as many people have said, "learning to live with the system".

In short, operational tests for the using commands have been concerned primarily with the most effective utilization of the weapons systems being procured rather than with the relative combat usefulness of the systems before quantities are ordered for the operational inventory. Because of the nature of the services' operational tests, therefore, they have not been major factors in the decision to procure new weapons systems. Further, the degree of development-production concurrency in past programs has been so great that operational tests and evaluations have come too late in the program to influence design and program decisions.

The type of operational flight tests described above could be performed as a part of the regular Navy operational tests and evaluations. Alternatively it could be performed separately by another group reporting directly to the Chief of Naval Operations.

After the analyses, tests and evaluations discussed above are completed, various alternative courses of action could be considered. Such alternatives could be explored at a fourth or final meeting of the Defense Systems Acquisition Review Council. At this meeting an "inventory decision" could be made as to whether or not the F-14 aircraft should be procured in the planned quantity and at the full, planned rate of production. Some of the alternatives that would be available are:

1. If no serious problems are indicated, continue the F-14 program as scheduled in the Five Year Defense Plan.

2. If less serious problems are indicated, redesign and retrofit the F-14 to provide the desired operational capability if feasible and cost effective.

3. If catastrophic problems are indicated, acquire additional F-4 aircraft until a suitable substitute is developed. It might also be possible to adapt the F-15 to the carrier mission if it proves to be a better aircraft than the F-14.

We have not obtained formal comments from the Navy or from the contractors involved in the F-14 program. However, informal comments were obtained and considered in preparing our analysis.

We plan to make no further distribution of this report unless copies are specifically requested, and then we shall make distribution only after your agreement has been obtained or public announcement has been made by you concerning the contents of the report.

Sincerely yours,

Elmer B. Staats

Comptroller General
of the United States

Enclosures

The Honorable John C. Stennis, Chairman
Preparedness Investigating Subcommittee
Committee on Armed Services
United States Senate

CONTENTS

ABBREVIATIONS

BIS	Board of Inspection and Survey
CAINS	Carrier Aircraft Inertial Navigational Systems
DOD	Department of Defense
GAO	General Accounting Office
NPE	Navy Preliminary Evaluation
NTE	Navy Technical Evaluation
OSD	Office of the Secretary of Defense
RDT&E	Research Development Test and Evaluation
VAST	Versatile Avionics Shop Tester
NASA	National Aeronautics and Space Administration

CHAPTER 1

INTRODUCTION

The Chairman, Preparedness Investigating Subcommittee, Committee on Armed Services, United States Senate, by letter dated March 19, 1970, requested that our Office provide the Subcommittee with analyses of the F-14 and F-15 aircraft programs (See appendix I).

We were told that our analyses should include the areas of management controls, contractual structure and definitiveness, cost and pricing provisions, and the extent of concurrency probable within the program plans. We were also asked to advise the Subcommittee of any potential problem areas that we felt should be monitored.

The letter indicated a particular interest in the merits of any changes made in the manner these programs are conducted as contrasted to similar previous programs. The Chairman mentioned that the results of prior programs have indicated contractual ambiguities, increased costs, and developmental and production problems created, to some extent, by concurrency in the programs.

This analysis is devoted exclusively to the F-14 program; a separately provided analysis deals with the F-15. The F-14 program is approximately one and one-half years along in development. First flight is expected in December 1970 or January 1971.

Defense Systems Acquisition Review Council

This is the vehicle for program review at the OSD level. Unless a program threshold has been crossed, as discussed above, or some other special circumstance arises, the Council reviews a program three times during its life, that is (1) prior to entering contract definition, (2) prior to initiating engineering development, and (3) prior to a production decision. In this connection, the Council is scheduled to meet in August or September 1970, relative to a production decision on the F-14. This is because the contract provides for the first option for production units to be exercised by October 1, 1970.

Selected Acquisition Reports

Selected Acquisition Reports are prepared and updated quarterly during the acquisition cycle of major weapons systems. They are prepared by the responsible program manager and are reviewed within OSD. These reports compare current estimates of technical performance, schedule, and cost with previous estimates. In this way they show the extent to which the development of major systems is progressing as originally expected.

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The F-14 Project Office has told us that it expects the management reporting and control system maintained by Grumman Aerospace Corporation

will be approved by the Department of Defense (DOD) by August 13, 1970. This follows a validation visit to Grumman by a DOD team during the week of July 20, 1970. Management reporting and control systems and their validation are required by DOD Instruction 7000.2. This system provides the military services and their major weapons system contractors with a common management reporting and control system relative to contractors' cost and schedule performance.

Previous validation visits have been made to Grumman; however, approval of the system was not given due to various deficiencies.

CHAPTER 3

DISCUSSION OF THE AIRFRAME CONTRACT

COMPARISON WITH PRIOR CONTRACTING TECHNIQUES FOR WEAPONS SYSTEMS

Our review of the contractual features of the F-14 program was largely confined to the system prime contract (the airframe contract). All our comments having to do with contracts concern this contract unless noted otherwise.

This contract continues the practice followed in recent major weapons system acquisitions of obtaining binding production commitments at the same time development is contracted for. This practice was designed to obtain competition in the pricing of both the development and production portions of the required effort. This feature is one essential element of the so-called "total package procurement" concept; however, other important aspects of total package procurement, as commonly defined, are not present in this procurement. These aspects include relatively little Government involvement in the contractor's operations and letting the weapons system prime contractor provide all, or nearly all, of the subsystems needed to make up the total aircraft system.

The contract does not include what was probably the most controversial feature included in the total-package procurement of the C-5 aircraft. That feature allowed for repricing of optional production runs to reflect costs (including losses) incurred on the initial production run. The F-14 contract merely establishes ceiling prices for each optional quantity of aircraft.

The F-14 contract does not contain certain features which have been widely publicized as being a part of recent major weapons system contracts. For example, it does not contain the provision which requires that until the contractor demonstrates that development of the system has passed certain technical milestones the Government may delay allotment of funds and the exercising of options for additional aircraft. However, the contract for the engines which will be used in the F-14B model of the aircraft does have this feature. The "demonstration milestone" provision is an attempt to avoid the adverse situations associated with entering production before significant problems of development are solved.

CONTRACT NEGOTIATIONS

A "Business Clearance for the Record" was prepared by Navy contract personnel following negotiation of this contract. The purpose of this document is to trace in some detail the history of contract negotiations. We noted that the business clearance for the F-14 contract shows that Grumman Aerospace Corporation, the winning system prime contractor, lowered its ceiling prices for 469 optional aircraft by over $400 million during the course of negotiations. During this same period the losing contractor in the final competition increased its ceiling price for the same effort by some $118 million.

Navy contract personnel advised us that Grumman's reduction in ceiling price was primarily due to Grumman's reassessment of development risks rather than to reductions in its cost estimate. The Business

Clearance does not show the basis for this reassessment. The increase in the losing contractor's ceiling price was said to be attributed to technical changes in its proposal.

CONTRACT PRICING AND OPTIONS

The F-14 contract with Grumman is a fixed-price-incentive contract, with incentives on cost and performance. The initial phase of the contract (Lot I) provides for design, development, testing, weapons system data and the furnishing of six F-14A research and development aircraft at a target cost of $352.7 million, a target profit of $35.3 million, and a ceiling price of $441 million. Under the fixed-price incentive formula, the contractor is to receive 30 percent of the amount by which his costs underrun target costs and pay 30 percent of the amount by which his costs exceed the target cost.

Contract profit is also subject to adjustment, upward or downward, based on performance parameters. Prices for Lot I support equipment and repair parts are not included in the contract prices but are to be established separately.

The contract provides for installment funding of Lot I. The provision limits the Government's obligation on Lot I solely to the funds obligated. Such funds must be provided by certain specified dates or the contract will be terminated. The next installment date is August 15, 1970, for $183.6 million, and the next and final one for Lot I is due August 15, 1971, for $56.8 million.

In addition to Lot I, the F-14 contract also includes options for production aircraft up to fiscal year 1976, as follows:

FY Options	No. of Aircraft	Ceiling Price	Option Expiration
1970 Lot II	6	$ 104,063,132	10/1/69
1971 III	30	233,265,430	10/1/70
1972 IV	96	419,881,745	10/1/71
1973 V	96	340,002,059	10/1/72
1974 VI	96	319,982,241	10/1/73
1975 VII	96	311,661,915	10/1/74
1976 VIII	43	145,871,102	10/1/75
	463	$1,874,727,624	

It should be noted relative to future F-14 aircraft buys that although the contract provides for optional quantities of aircraft as listed above, the current Five Year Defense Plan provides for only 284 F-14 aircraft beyond Lot II.

The Navy intends to procure only 66 units of the F-14A model aircraft. All other units procured will be the F-14B model, which is distinguished by a different engine. It should be noted that the contract only provides for procurement of F-14A models; however, changes to the contract are now being negotiated which will allow for the F-14B model. These matters are discussed in more detail in subsequent sections of this analysis.

The number of aircraft in each option lot can be varied plus or minus 50 percent. For example, on Lot III, the Government has the right to order from 15 to 45 aircraft. Ceiling prices have been established in the contract for the varying quantities of aircraft which may be ordered under each option lot. The unit price of each aircraft in the lot will increase or decrease depending on the quantity ordered; that is, smaller quantities will mean higher unit prices and greater quantities will mean lower ones. The [redacted] delivery

schedule is also subject to adjustment in accordance with guidance set forth in the contract.

The option ceiling prices are contingent upon authorization of long-lead-time funding by April 1 and July 15 of the year in which the option is to be exercised. Failure to provide full and timely long-lead-time funding entitles the contractor to an adjustment in ceiling prices and delivery terms as may be appropriate.

The contract provides that prices (firm fixed-price or incentive target) for option items in no event shall exceed the ceiling prices. However, the ceiling prices may be adjusted for the following reasons:

(a) as a result of Government-directed change orders;

(b) as a result of additional clauses, or modifications to existing clauses, required at time of option exercise by public law, executive order or Armed Services Procurement Regulation which cause increases or decreases in the costs of performance; or

(c) as a result of escalation or de-escalation for Lots VI, VII, and VIII based on fluctuations in the national economy. A price adjustment formula is established to provide for such fluctuations based on certain established indices.

Firm option prices are established by negotiation as the options are exercised. The first optional lot (Lot II) is being procured under a modification to the development contract. Following optional lots will be procured under separate contracts.

The first option (Lot II) for 6 additional aircraft was exercised on December 31, 1969. Actually, as indicated in the table above, the option was due to be exercised on October 1, 1969, but the parties agreed

to extend the option exercise date. While it was originally intended that these aircraft would be procured with production funds they were procured with research and development funds as a result of congressional action. A definitive price for Lot II has not yet been negotiated.

Long-lead-time production funds have been released by the Navy for the second option (Lot III). The number of airplanes (26) for which long-lead-time funds are authorized is specified by contract amendment.

CONTRACTUAL FLEXIBILITY SHOULD MAJOR DEVELOPMENT PROBLEMS ARISE

The contract requires the various options to be exercised by certain dates. Failure to exercise any of the options as scheduled due to a development problem results in the Government's loss of that option and all subsequent options. This tends to place considerable pressure on the Navy to exercise options as they fall due, even in the face of considerable uncertainty. The Navy does have the flexibility of ordering the minimum option quantities (50 percent of the scheduled option quantity).

The flexibility indicated by the variable quantity option feature may not actually exist. In a recent memorandum to the Director, Defense Research and Engineering, the Secretary of the Navy stated that Grumman might have to seek financial relief from the Government if the minimum number of aircraft were procured under the second option (15 aircraft) rather than the currently planned quantity of 26. Public Law 85-804 permits extraordinary financial relief to a contractor when it is in the interest of the national defense.

The memorandum indicated that various factors were putting financial pressure on Grumman. These factors include a much lower level of company-wide defense and aerospace business and a much higher rate of economic inflation than Grumman anticipated when it prepared the F-14 price proposal. Grumman was also said to be concerned that it might have to renegotiate contracts with many of its subcontractors if the minimum quantity of F-14 aircraft were to be procured under the option.

F-14B MODEL NOT YET PRICED

The work which will have to be done by the system prime contractor to modify the F-14A aircraft design to accommodate the advanced technology engine is not covered under the contract. This new engine will be used in the vast majority of the aircraft presently contemplated under the F-14 aircraft program. The aircraft configuration using this engine will be known as the F-14B. The Navy currently estimates the cost of aircraft redesign and testing to accommodate the new engine to be approximately $29 million. We noted that the contract establishes a ceiling price for this work of only $14.6 million. The Navy informed us that this ceiling is no longer applicable since the engine design upon which the ceiling price was predicated had been changed. The new design calls for an engine with considerably greater thrust than originally contemplated.

The cost estimate of $29 million does not include the cost impact on the price of the lot options since the options pertain to hardware rather than design effort. The F-14 Project Manager told us that he

did not believe the cost increase would exceed $100,000 per aircraft; the Navy and Grumman are currently negotiating the matter.

PRICING OF TOOLING

The Grumman contract provides for certain fixed increases in the prices negotiated for Lots II and III to allow for recovery of special tooling and test equipment costs not recovered on Lot I. Such amounts will be added to the negotiated prices for Lots II and III without regard to the contract ceiling prices for these lots. Lot II has already been exercised. If Lot III is not exercised the contract provides for increasing the target cost, target price and ceiling price on Lot I to recover the remaining tooling costs which would otherwise have been recovered on Lot III. The increases involved are $17,454,545 in target cost, $19,200,000 in target price and $21,818,182 in ceiling price. The installment funding provision would also be revised to provide for such additional payment under Lot I.

A noteworthy point about tooling costs is that although these tools are necessary for development, some of their cost (target price of $19,200,000) is being applied against production funds. Had not the decision been made to procure Lot II with research and development funds, as mentioned previously, additional tooling charges of approximately $36,000,000 would similarly have been applied against production funds.

ESCALATION PROVISION

The contract provides for adjustments for economic escalation or de-escalation in the ceiling prices established for some of the optional

quantities of aircraft. Of the seven yearly options, this provision is applicable to the last three (fiscal years 1974, 1975, and 1976.) Since the ceiling prices of the optional quantities are based on an estimated price rise of four percent compounded annually, it appears likely that, in view of the current inflation rate, upward adjustments may have to be made in the ceiling prices of the three lots affected.

CHANGES CLAUSE

Controls are incorporated in the contract to discourage an excessive number of contractor initiated engineering change proposals. The applicable clause provides generally that changes of less than $50,000 will be negotiated at no change in contract price and that changes valued between $50,000 and one percent of the original cost of the aircraft affected by the change will be negotiated at a lesser profit rate than would normally be expected.

A further control over contractor initiated engineering change proposals is a provision that the price finally negotiated for each change shall not exceed the target price or ceiling originally proposed by the contractor for the change.

The provisions described here do not apply to changes submitted by the contractor in connection with the value engineering program established by the contract. Value engineering programs are established to encourage elimination of "nice-to-have" but unessential technical features. These provisions also do not pertain to certain other types of changes, including changes resulting from contractor-proposed improvements in the F-14 aircraft which would overcome deficiencies in Government-furnished equipment.

SPECIFICATIONS AND CORRECTION OF DEFICIENCIES

A basic consideration in any major weapons system contract is the protection afforded the Government in the event the contractor does not provide an article meeting contractual requirements.

The first aspect of this consideration is whether the contract obligates the contractor to provide a system which meets specific performance parameters. The F-14 contract, by reference, contains "guarantees" of minimum performance concerning at least 13 key performance parameters. Special incentives and penalties are included in the contract to encourage the contractor to exceed the guaranteed minimum performance relative to five of the 13 parameters. Grumman is also required to correct any deficiencies in the aircraft, including those having to do with the contractually specified performance.

The manner in which performance requirements were written into the contracts for the F-111 aircraft was a major weakness of those procurements. The chief differences between the F-14 contract and the F-111 contracts with respect to performance requirements are briefly discussed below.

In the F-111 procurement there were two contracts: one for research and development and one for production. Although certain performance parameters were specified ("guaranteed") in the research and development contract, other features of the contract negated them. One of these features provided that meeting performance specifications

was not to be a condition for acceptance of the aircraft to be produced under the research and development contract. Another feature was the fact that no date was established for performance demonstrations which would show whether the guarantees were met. These two features effectively precluded the F-111 research and development contract from being terminated for default due to poor performance. The workings of the correction of deficiencies clause was confused because the contract did not specify how and when negotiations of equitable reductions in price for deficiencies (including performance deficiencies) were to take place.

The weaknesses in the F-111 research and development contract were carried over to the production contract. This contract also set out performance guarantees but it stated further that the production units of the aircraft were to be manufactured anddelivered in accordance with a specification which would "evolve from" the development program (research and development contract). No date was established in the contract for when the specifications were to be finalized. These features appear to preclude the Government from terminating the production contract until the performance specifications are finalized at some indefinite future time. Also there was difficulty in enforcing the correction of deficiencies clause for performance failures since there was little basis for determining whether the aircraft were deficient.

The F-14 contract does not include a clause similar to the one in the F-111 contract to the effect that acceptance of research and development aircraft is independent of performance demonstrations. Also the

F-14 contract establishes a schedule by which the contractor delivers test aircraft for performance demonstrations (Board of Inspection and Survey trials). However, the Navy has not obligated itself to completion of this performance testing by any particular date.

We understand that performance demonstrations in connection with certain prior Navy major weapons systems have lasted for extensive periods of time. Our discussions with Navy personnel indicate that aircraft performance failures probably could not be used, until Board of Inspection and Survey trials, as a basis for terminating the contract for default or for requiring a reduction in price through the defects clause.

The F-14 Project Manager stated in connection with the above discussion that not all Board of Inspection and Survey trials would have to be completed before action could be taken to terminate the contract or to require corrections, but only the tests necessary to prove the particular performance parameter in question. He also stated that he expects the Board of Inspection and Survey Trials will be completed in a period of about 4-6 months.

The contract follows standard practice in requiring that each aircraft delivered to the Government for acceptance be inspected by its representatives. If this inspection shows the article does not conform to contract specifications, the contractor, at the Government's option, is required to either correct the deficiency or equitably reduce the contract price. If the contractor cannot make the necessary corrections, the Government will require an equitable reduction in contract price.

Acceptance of aircraft not meeting specifications

In connection with the matters discussed above, the contract permits the Government to accept aircraft which do not meet, during Navy Board of Inspection and Survey trials, the performance specifications established by the contract. A special provision provides that if the Government chooses this course of action, the detail specification for aircraft yet to be delivered and for aircraft still to be ordered will be modified to reflect the performance actually attained. The prices of aircraft already delivered or on order would be equitably adjusted to reflect the lessened performance of these aircraft; however, for aircraft still unordered the contract provides that the specification modification is to be made at no change in the option ceiling prices.

Navy personnel indicated that this special provision was included in the contract because of experience with prior Navy aircraft programs. They stated that final acceptance of many aircraft from prior programs was delayed for extensive periods of time since these aircraft could not meet performance specifications. The provision in the F-14 contract is intended to provide a measure of "realism" in this regard.

Contractor's liability under defects clause

The contract also contains a clause permitting the Government to require correction of any deficiency for up to one year from the date the last aircraft is accepted for Board of Inspection and Survey trials or two years from the date the first aircraft is accepted for such trials, whichever is earlier. Board of Inspection and Survey trials are scheduled to begin in June 1972. This clause, called the defects clause, extends the Government's rights in that its rights to correction

of deficiencies are not limited to latent defects after inspection and acceptance as provided in the standard inspection clause but rather apply to any defect.

There is included in the defects clause a feature which warrants special mention. This feature provides that in the event of destruction of or damages to an aircraft caused by a contractor deficiency, the contractor's liability for damages will not exceed $100,000. This provision is designed to place the risk of destruction or damages over $100,000 on the Government. In return, Grumman has warranted that the contract price does not include any charge or reserve for insurance for such loss or damage. The Navy has advised us that placing the entire risk of aircraft destruction on the contractor would have involved a substantial insurance charge. The subject of Government self-insurance in such cases is currently under study by the Armed Services Procurement Regulation Committee.

CONTRACTUAL PROVISIONS RELATIVE TO MAJOR SUBSYSTEMS AND COMPONENTS TO BE FURNISHED BY THE GOVERNMENT

About 50 percent of the total flyaway cost of a complete unit of the F-14 weapons system is not covered under the Grumman contract. Costs not included have to do with engines, armament and various avionics subassemblies and components.

Under the terms of its contract, the system prime contractor is charged with responsibility for total system performance. This responsibility, however, is contingent on the Government furnishing the

contractor with subassemblies which meet the specification, performance, and acceptance test requirements. Upon completion of testing and subsequent delivery by the Navy of the Government-furnished subassemblies, the prime contractor assumes responsibility for their performance as integral components of the total weapons system. If, however, it can be shown that a subsystem failure was due to something which would not have been revealed by the specified subsystem tests, the system prime contractor is relieved of performance responsibility until the defect in design or workmanship is corrected.

If Government-furnished subsystems are furnished to the system prime contractor which do not meet specified tests, or which are otherwise not suitable for the intended use, the contractor could receive an equitable adjustment from the Government for work required to correct the deficiency and for any incidental delays.

To help minimize any subsystems integration problems arising out of the relationship of Grumman to the five major associate contractors--Hughes Aircraft Company, Pratt & Whitney Aircraft, PRD Electronics, Litton Systems Incorporated and Raytheon--Grumman has entered into an "Agreement of Responsibility" with each. These agreements set up machinery for promoting cooperation among the six contractors, for fixing responsibility between the system prime contractor and each of the associate prime contractors when the total weapons system does not perform as required, and for deciding upon courses of action to correct deficiencies.

The Agreements of Responsibility are, by reference, part of the system prime contract and of the contracts for the subassemblies, as applicable. We were told that the F-14 contract represents the first time the Navy has required such agreements although contractors have typically set up informal arrangements to accomplish the same purposes.

CHAPTER 4

EXTENT OF PROBABLE CONCURRENCY

As a framework for understanding the extent of probable concurrency in the F-14 program this analysis first sets forth the major subsystems' and the airframe manufacturer's status of development, contract definitiveness, and areas of technical risk. Then the extent of production overlapping the development and the flight test schedule is discussed.

The F-14 airplane depends on the successful integration of Grumman's airframe with a number of major subsystems which are being supplied to Grumman as Government-furnished equipment. The major Government-furnished equipment contractors and the subsystems they are to supply include:

Pratt & Whitney	Engines
Hughes Aircraft Company	AWG-9 Fire Control System and PHOENIX missile
PRD Electronics	Versatile Avionics Shop Tester (VAST) Ground and/or Ship-based Support System
Litton Systems Inc.	Carrier Aircraft Inertial Navigational Systems (CAINS)
Raytheon Company	SPARROW missile

These subsystems are composed of highly sophisticated components each of which must work well within its respective configuration. Each of the subsystems, in turn, must be compatible with the other subsystems so that the end result will be an F-14 weapons system that effectively performs its intended air superiority, fleet air defense and strike missions.

AIRCRAFT ENGINE: F-14A VERSION

The Pratt & Whitney TF30-P-12 engine was initially developed for the F-111B program. That engine with some modifications and redesignated TF30-P-412, will be used in the planned procurement of about sixty-six F-14 "A" models. Some of these initial sixty-six F-14A's are planned for future conversion to F-14B's.

In the program to modify the P-12 engine design (F-111B) to the P-412 design (F-14A) Pratt & Whitney has three contracts.

The first contract involves development studies for the conversion of engines to prototypes of the P-412. The major differences between these two engines are that the P-412 will have: (1) increased hydraulic pump drive capacity, (2) a relocated rear engine mount, (3) an improved performance afterburner, and (4) a variable area iris convergent/divergent nozzle. The iris nozzle is a device consisting of thin, overlapping metal panels that can be adjusted to vary the size of the engine exhaust opening. The contract requires studies of the engine and inlet compatibility, preliminary flight rating test, military qualification tests, and providing a converted P-12 (Government-furnished) engine to Grumman for use as a ground test engine. This contract was definitized in October 1969 as a cost-plus-incentive fee with target costs and fee of about $20.5 million.

The second contract is for the conversion of six Government-furnished P-12 engines and for the manufacture of 13 original P-412 prototype engines. This contract was definitized in February 1970 as a cost-plus-incentive fee contract with target costs and fee of about $11 million.

The third contract was definitized in March 1970 as a fixed-price incentive with successive targets for the manufacture of 26 production engines. The contract contains a formula by which the future successive target prices will be established. The initial prices are about $715,000 per engine.

All 45 of these engines (six conversion prototypes, 13 new prototypes, and 26 new production engines) are expected to be released to the manufacturing process (production) by July 1970.

Pratt & Whitney officials advise that there have been no significant problems or delays in the development of the P-412 engines. The ground test engine was delivered to Grumman on May 15, 1970. The distortion and turbulence tests (inlet compatibility) were scheduled for completion in December 1969; the estimated completion date was delayed until June 1970. The Navy has indicated that this 6-month delay was not due to technical problems but rather to increases in the scope of the distortion and turbulence testing.

The first flight test of the TF-30-P-412 engine, installed on a B-45 test airplane, is scheduled for September 1970. The preliminary flight rating test is also scheduled for the same month. The military qualification tests of endurance and performance on the F-14A engines are not scheduled to be completed until February 1971, one month after first flight.

On the basis of our discussions with Pratt & Whitney officials, the P-412 engine should not present a significant technological risk to the F-14 program. The really complicated portions of the engine (fan, compressor, turbine, fuel nozzles, etc.) have been proven in the F-111 program. The iris nozzle and the improved afterburner are not considered to be high risk items.

In the F-14A portion of the program the airframe is the major "unknown" and the engine is of relatively low risk. When the shift is made to the F-14B the positions are reversed because the airframe should have been tested enough so that it will not be an "unknown", and the advanced technology engine becomes the major "unknown".

AIRCRAFT ENGINE; F-14B VERSION

The F-14 "B" model will have the Pratt & Whitney advanced technology engine which is being developed under a joint Air Force/Navy program.

An 18-month competitive Initial Engine Development program for the advanced technology engine for tactical aircraft was concluded in February 1970. This Initial Engine Development Program cost the Government about $117 million and resulted in Pratt & Whitney being selected as the winner over the General Electric Company. Pratt & Whitney personnel advised us that this 18-month program has provided them with a technological base essential to developing and producing the advanced technology engines which will be used in the Navy F-14B and the Air Force F-15 aircraft.

The heart of the advanced technology engine is its mid-section, or core. The core will be identical in both Air Force and Navy engines. The forward and aft sections of the Air Force engine will be somewhat smaller than the Navy engines and will have less thrust. The expected maximum thrust at sea level in the Air Force engine will be about 23,470 pounds; in the Navy engine about 28,100 pounds.

The major differences between the F-14A engine and the F-14B advanced technology engine is that the new engine will weigh about 550 pounds less, have about 9,300 more pounds of thrust, and will be about three feet shorter. To make up for the difference in length, because it will be installed in the F-14 airframe which is designed to accept both engines, the new engine will have a "stub duct" attached to its forward section.

According to Pratt & Whitney officials, the unique feature about the initial flight testing of the new engine will be that the F-14 test plane

will carry one "A" version engine and one "B" version engine. This will enable flight testing to proceed more quickly because the test airplane will have a proven "A" version engine as a source of power should the new engine fail during a test flight.

Pratt & Whitney has two definitized contracts for the advanced technology engine: one with the Air Force and the other with the Navy. The Air Force contract is for development of both Air Force and Navy versions of the engine, support for both Air Force and Navy airframe contractors during the testing period, and initial production quantities of the Air Force version of the engine. These tasks are set forth under three items in the same contract.

The Navy contract provides for all Navy production engines and, after June 1975, all Air Force production engines. This contract has options by calendar year.

The Pratt & Whitney officials stated that firm specifications have been established for both the Air Force and Navy engines. The first demonstration milestone, a "Preliminary Design Review", was completed during the week of April 27 - May 1, 1970. The next major milestone will be a "Critical Design Review" in early 1971.

An example of a developmental unscheduled incident occurred in May 1970 when one of the Air Force test engines (No. FX203) failed to operate as planned. Broken metal pieces got into the aft section of engine FX203 while it was running on the test stand and damage resulted. Pratt & Whitney officials stated that the trouble was traced to an installation error of one vane. This caused a distortion of air flow, which in turn caused the breakaway

of four compressor blades. The pieces of broken metal passing through subsequent sections of the engine caused peripheral damage. The Pratt & Whitney report of this incident indicated that major engine program milestones would not be affected and that engine FX203 should rejoin the test program by the end of June 1970.

Another engine test failure occurred on June 11, 1970, involving engine FX201. The details of this incident were reported to the Subcommittee by the Joint Engine Project Office in response to an inquiry by a member of the Subcommittee staff.

One of the matters of development risk is the "hot section" of the engine. This is the combustion section in the basic common core where the fuel is ignited. The problem is one of temperature control and distribution. The operating temperatures are about 2,400°F. If the cooling mechanism fails to control these temperatures the metal will start to deteriorate; if the temperature is reduced too much by cooling, then the engine loses thrust. The goal is to strike a precise balance for maximum heat and maximum thrust without deterioration of the metal parts.

We requested comments from the National Aeronautics and Space Administration (NASA), Lewis Research Center, on the probability of success and the consequences of not attaining the desired temperature levels in the advanced technology engines for both the Air Force F-15 and the Navy F-14B airplanes. NASA's opinion is that the proposed temperature limits entail some risk since new materials, new fabrication techniques, and advanced cooling concepts will be required to attain desired goals. In summary, NASA considers the assumed risk to be reasonable on the basis of anticipated

technological advances in the time period 1970-75. NASA also considers that the probability of success is also reasonable, given proper effort and support in the intervening years.

As to the consequences of Pratt & Whitney not being able to attain the present temperature goals, NASA states that these depend on which of the many available alternative assumptions one selects. The hot section temperature impacts the whole airplane and affects such things as the available thrust, the specific fuel consumption, the size of the engine, the weight of the airplane, and the range, to name a few. In general, NASA believes that a substantial reduction of 100° to 150°F in the hot section temperature or blade metal temperature would not be catastrophic to the missions of the F-15 and the F-14B since such a change would result in a 4 to 8 percent decrease in range, or with another set of assumptions, an increase in airplane gross weight of 2 to 4 percent. These figures used by NASA are approximate and were given only to indicate the general magnitude of the effects.

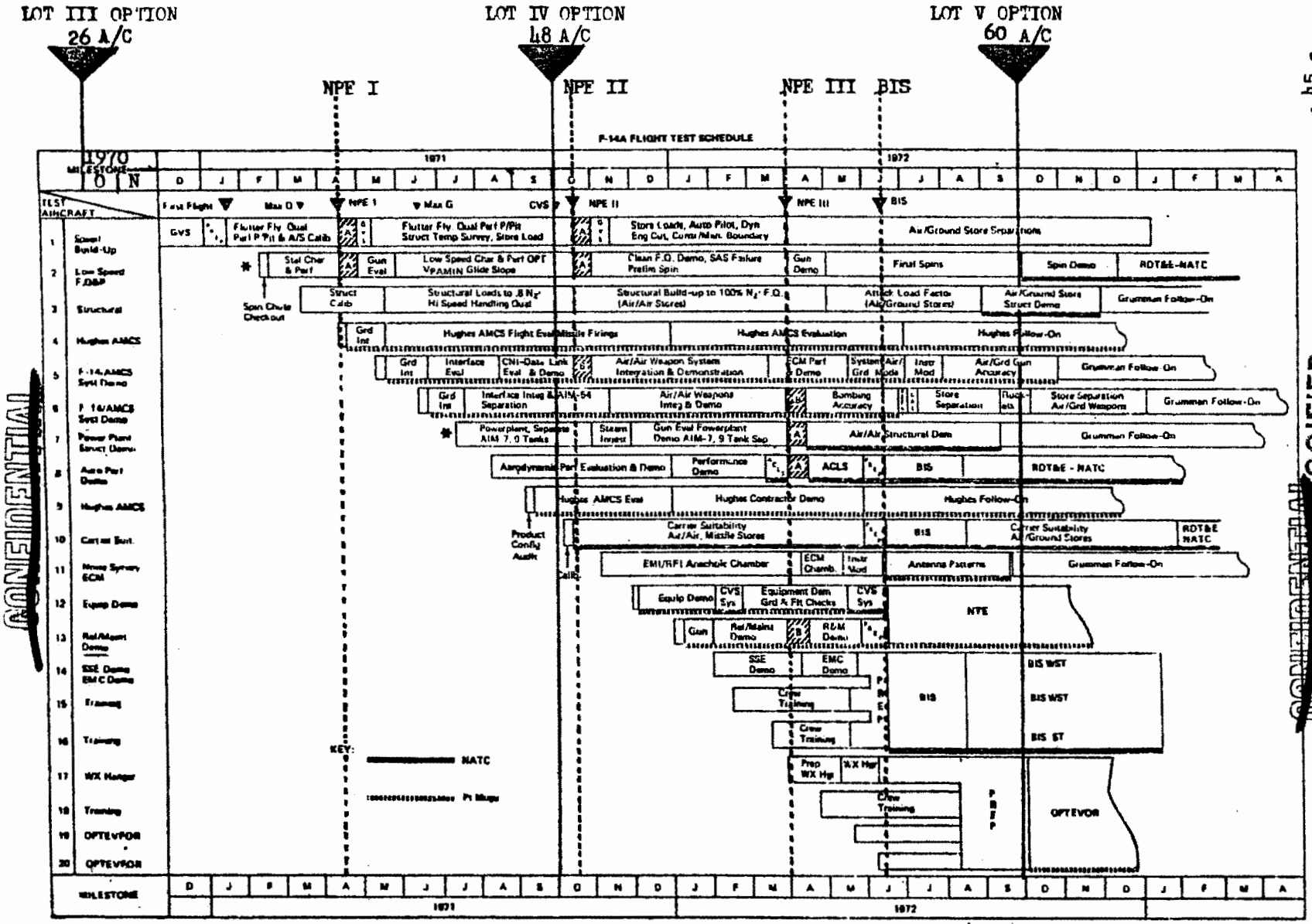
If an engine development program does not have problems, according to Pratt & Whitney officials, either the engine is over-designed or not tested hard enough. They stated that thousands of hours of running time on the test stands are needed to build up gradually to desired performance characteristics of the engine under development. At the time of our field visit (May 13, 1970) the Pratt & Whitney development program was only about 3 months old.

The official approval of the qualification testing on the F-14B engine is not scheduled until May 31, 1973. This is the engine which is intended to provide the true operational capability desired by the Navy. By May 1973 about 134 airplanes to accomodate this engine will have been ordered, 58 airplanes will have been delivered, and Grumman will be turning out four airplanes a month.

PHOENIX MISSILE SYSTEM

Hughes Aircraft Company is supplying the total PHOENIX missile system which essentially consists of the Airborne Weapon Control System (AWG-9), PHOENIX missile (AIM-54A), ground support equipment, special support equipment, and the Missile Control Officer Trainer. The total PHOENIX missile system is covered by multiple contracts, some of which are not yet definitized, for the development, fabrication and test of the various system elements. These systems were initially intended for use on the F-111B; however, in 1968 Hughes' effort was redirected to the F-14 program.

Since fiscal year 1963 the research and development cost for the missile and AWG-9 is about $414 million, plus about $129 million for adapting it from F-111B to F-14 and adding a capability for controlling SPARROW missiles. The Navy is planning to purchase about 69 PHOENIX missiles in fiscal year



*NOTE: Aircraft #2 and #7 are currently scheduled for testing under the F-14B Program incorporating the advanced technology engine.

will be the first time Navy test pilots from the Naval Air Test Center will fly the first two delivered research and development test aircraft Nos. 1 and 2. Personnel of the Naval Air Test Center have told us that these two aircraft will not be complete weapon systems as such, but rather the basic F-14A airframe and engines with the necessary instrumentation to conduct preliminary assessment of the flying qualities of the aircraft. This means that aircraft Nos. 1 and 2 will not be equipped with the electronic fire control system (AWG-9) or other complementary armament fixtures installed in later test aircraft and ultimately in all production aircraft. The first test aircraft to have an AWG-9 installed is aircraft No. 4.

The purpose of the NPE I test flights, as stated by personnel of the Naval Air Test Center, is to fly aircraft Nos. 1 and 2 to the limits of the "flight envelope" that were previously validated by the Grumman engineers and test pilots. Personnel at both the F-14 Project Office and Naval Air Test Center have said that NPE I will disclose major problems relative to the flying characteristics of the F-14A. Upon conclusion of NPE I a detailed technical report will record all the Navy's test flight observations of flight characteristics and will set forth the Naval Air Test Center's recommendations on those aspects of the F-14A that must be corrected to meet Navy flying standards.

This NPE I takes place about seven months after Lot III (26 aircraft for $517 million in production funds) is scheduled to be exercised.

The second Navy Preliminary Evaluation (NPE II) is scheduled for October 1971. This will be the first time the Navy evaluates an F-14A aircraft equipped with the AWG-9 fire control system--the same month in which the Navy is scheduled to exercise Lot IV option for an additional 48 aircraft using production funds. The third Navy Preliminary Evaluation (NPE III) is scheduled for April 1972. This will be the first time the Navy evaluates the F-14A completely equipped as a carrier suitable weapon system containing the AWG-9, the M61 gun, armament facilities as well as PHOENIX or SPARROW missiles--six months after the exercise and funding of Lot IV option. By this time 86 aircraft will have been ordered.

Should major design changes to the aircraft be required as a result of flight testing, then Grumman must not only redesign the appropriate aircraft part but also incur the cost of producing new parts and modifying the parts already produced. The redesigned part must then be retested and should additional problems be disclosed, the cycle must be repeated until the problem is corrected. Any changes made necessary by flight test experience may also require changing the existing tooling because the initial tooling used to build the first airplane is essentially the same as the tooling that will be used in full-scale production.

The Navy verification of the F-14 design by flight testing for the Board of Inspection and Survey (BIS) trials and Navy Technical Evaluation (NTE) is scheduled to begin June 1972. (See page 45.) This is about 20 months after the decision for the 26 production airplanes of Lot III and

8 months after the decision for the 48 production airplanes of Lot IV. The Navy advised us that the completion dates for BIS and NTE are not fixed. Usually these tests have taken extensive time and it is probable that they will not be completed by October 1972, when the decision for 60 production airplanes of Lot V is made.

The Navy's operational test and evaluation is to develop combat tactics to be used with the F-14 weapons system in the "user" or "fleet" environment. These evaluations are scheduled to begin in October 1972 after commitment to Lots III, IV and V. At this time, 134 production airplanes will have been ordered. Should NPE, BIS trials, or the operational evaluation disclose deficiencies requiring correction, a significant cost and schedule penalty may be incurred for modification of the airplanes already on order or production.

These examples, in our judgment, appear to be in conflict with the Subcommittee's concern that concurrency of research and development and procurement is to be avoided so that a more orderly progression can be achieved to ensure that technical problems have been minimized by the time production is started.

CHAPTER 5

POTENTIAL PROBLEMS TO BE MONITORED

As requested, potential problem areas which the Subcommittee may wish to monitor are listed below.

1. HIGH DEGREE OF CONCURRENCY

As noted in Chapter 4 of this analysis there is a high degree of development-production overlap within the F-14 program. We believe this concurrency evolves from the Navy's requirement for an Initial Operational Capability 51 months after the award of the development contract. The Navy, while conceding that the program contains concurrency, points to the fact that subsystems like the electronic fire control system and F-14A engines were already developed, or largely developed, before the airframe contract was awarded. Other major subsystems, however, as well as the airframe itself have not been developed.

The degree of development-production concurrency is illustrated by the fact that the Navy will have ordered Lot III 26 production aircraft for about $517 million before the contractor demonstrates the first flight in January 1971 using the first of twelve previously ordered research and development aircraft. The Navy through its NPE I, will not assess the flying qualities of the first two aircraft until 90 days after the contractor's first flight. By October 1971, when the Navy's NPE II evaluates an F-14A equipped with the highly complex and sophisticated electronic fire control system, the option for an additional 48 production aircraft under Lot IV will have been exercised. This will bring the total of aircraft on order to 86.

Six months later, in April 1972, the Navy begins to flight test during NPE III a completely integrated carrier suitable F-14A weapons system equipped with electronic fire control system, air-to-air missiles, gun, etc. The purpose of NPE III is also to determine that the deficiencies disclosed by NPE I and II have been corrected and that the F-14A will be ready for the formal acceptance trials scheduled to begin in June 1972 by the Board of Inspection and Survey (BIS) trials. The BIS trials, in all probability, will not be completed by October 1972, when Lot V is due to be exercised for an additional 60 production aircraft bringing the total of aircraft ordered to 146.

The F-14 development and testing schedule is compressed and does not appear to make allowances for the effects of major technical problems. Although a great deal of planning, computer simulations, ground testing of minor and major elements, avionics testing, missile testing, etc., have been accomplished, the real capabilities and/or deficiencies of the F-14 weapons system will not be fully disclosed until actual test flights are conducted. There are forces acting on an airplane in flight that cannot be completely simulated on the ground; this is the reason for the flight testing of research and development aircraft. Until at least six months preferably one year of flight testing, it is difficult, we are told, to assess the extent of or the seriousness of development problems and the production risks involved.

In the development of a highly complex weapons system like the F-14 there is always the strong possibility that the contractor(s) will experience significant problems that could not be anticipated prior to testing. If major problems are disclosed during testing; it will require aircraft redesign and modifications; retesting of those modifications; retrofitting of aircraft and subsystems already produced; and perhaps changes in the tooling that was used to produce those aircraft. The latter is a possibility caused by the use of production-type tooling starting with the first airplane. Grumman told us that the F-14 program is unusual in the extent to which production tooling is used so early in development.

2. RELATIVELY INFLEXIBLE CONTRACT

The Navy, in the exercise of its contract options, is committed to specific calendar dates rather than to the degree of demonstrated success realized in the development program. There will be considerable pressure to continue exercising options even in the event of poor performance, because failure to exercise an option invalidates both it and the remainder of the contract options.

3. ORDERING MINIMUM PROGRAM QUANTITIES MAY RESULT IN CLAIMS FOR FINANCIAL RELIEF

The ordering of minimum quantities allowed by the options may not be as viable an alternative as it appears. Grumman has indicated to the Navy that if the Navy chooses to exercise the next aircraft option for Lot III in the minimum quantity of 15 aircraft, Grumman might request financial relief from the Government. Such relief would presumably be

provided under Public Law 85-804, which allows extraordinary relief to a contractor when it is in the interest of the national defense. Economic inflation and reductions in other Government programs that Grumman had not contemplated have been cited as contributing factors.

The approved Five Year Defense Plan provides for quantities of aircraft less than the F-14 contract baseline quantities as shown in the following table:

	Five Year Defense Plan	F-14 Contract Quantities (-50%) Low	Baseline	(+ 50%) High
Lot III	26	15	30	45
Lot IV	48	48	96	144
Lot V	60	48	96	144
Lot VI	60	48	96	144
Lot VII	90	48	96	144
Total	284	207	414	621

The quantities in the Five Year Defense Plan are near the low quantities permitted by the contract. Further, according to the Navy, budget constraints may force the Navy to order only minimum option quantities for the remainder of the program.

4. PRICE REDUCTIONS DURING NEGOTIATIONS MAY IMPACT FUTURE COST GROWTH

The F-14 airframe contract was awarded after a competition among five firms, three of which were eliminated prior to final negotiations. During the final competitive negotiations with the two remaining firms, the winning contractor (Grumman) reduced its ceiling prices by about $400 million while the losing contractor increased its ceiling price by about $118 million. Grumman's overall price was still higher by about $100

million, but its bid was judged more responsive from a technical standpoint.

Navy contract personnel advised us that Grumman's reduction in ceiling price was primarily due to its reassessment of development risks rather than to reductions in its cost estimates. The record of negotiations does not show the basis for this reassessment. The increase in the losing contractor's ceiling price was said to be attributed to the costs of technical changes in its proposal. We believe the scope and circumstances of Grumman's price reduction may very well be indicative of an unrealistically low price. In this event, pressure on Grumman to pass on cost growth to the Government may be expected to develop.

5. ECONOMIC INFLATION

Cost growth due to economic inflation may be substantial. The contract provides for adjustments to the ceiling prices of the last three option lots if inflation reaches certain levels. Considering the current rate of inflation, it appears that such adjustments will have to be made.

The price of work currently under contract and the ceiling prices for the next three options are not subject to adjustments for economic inflation. If inflation causes an abnormal amount of cost growth before the adjustment formula comes into play, it could cause Grumman to seek relief from the Government or face serious or perhaps ruinous losses. The subject of a potential request for extraordinary financial relief is mentioned under item No. 3 above and is related to this matter.

6. PRICE CHANGE FOR TRANSITION FROM F-14A TO F-14B

The current contract with Grumman covers the F-14A version of the aircraft and does not establish definitive prices for the F-14B version which will be equipped with the new "advanced technology engine" and is still under development. More than 90 percent of the aircraft to be purchased will be the F-14B version. The contractual change to provide for the engine is currently (as of July 24, 1970) being negotiated.

Cost growth could result from negotiation of the change to the aircraft design to accommodate the new engine. The contract change will be in the form of price increases to the contract and to the future-year option ceiling prices. The change will cover: (1) nonrecurring costs relative to changes in the airframe design and (2) recurring costs relative to the impact of the design changes on production aircraft (airframes) under future options.

The F-14 Project Office estimates the increase in ceiling price to cover the required nonrecurring design changes will be about $29 million. The former ceiling price for this effort ($14.6 million) is no longer applicable because the F-14B design calls for an advanced technology engine with considerably greater thrust than originally contemplated.

The F-14 Project Office estimates the future option lot ceiling price relative to the recurring cost for production aircraft to be in a range of $50,000 to $100,000 per aircraft. We have been advised by

Navy contract negotiators that Grumman has been unwilling to submit a proposal covering the cost impact on future option lots.

7. INDEFINITE DATE TO CONCLUDE FORMAL BOARD OF INSPECTION AND SURVEY TRIALS

Grumman is required to furnish F-14 aircraft to the Navy for the formal performance trials by the Navy's Board of Inspection and Survey in June 1972. However, the Navy has not committed itself to completion of these trials by a specified date. According to the Navy, these tests on other weapons programs have required as much as a year and in some instances longer. The importance of this is fact is that, until at least some of these tests have been completed, aircraft performance failures probably cannot be used as a basis for default termination or for requiring reductions in price through the corrections of deficiencies clause.

In commenting on this point, the F-14 Project Manager said he expects the trials of the F-14A will not exceed 4 to 6 months.

8. SPECIFICATIONS CAN BE RELAXED FOLLOWING BOARD OF INSPECTION AND SURVEY TRIALS

It is possible that performance specification will be relaxed following the Naval Board of Inspection and Survey trials. The Navy has advised us that Grumman will present to the Board for these trials its "best effort". As noted previously, (See page 19) the contract specifically gives the Navy the option to accept less than the performance specified in the contract in return for an "equitable" price reduction on aircraft already delivered or on order. The prices of aircraft already

delivered or on order would be equitably adjusted to reflect the lessened performance of these aircraft. For aircraft still unordered, the contract provides that the specification modification reflecting the performance actually attained is to be made at no change in the ceiling prices.

9. GOVERNMENT'S ASSUMPTION OF CONTRACTUAL RISKS BY FURNISHING EQUIPMENT

A significant number of the F-14 subsystems (engines, avionics, etc.) are to be Government-furnished items. The Government will purchase the items and furnish them to Grumman for installation in the F-14A and F-14B. The rationale for this is to reduce cost to Government by avoiding Grumman's add-ons if it were to perform the effort. Grumman is supposed to be fully responsible for "total Model F-14A weapon system performance", but that responsibility is contingent upon the Government furnishing subsystems and/or components on time and "suitable for intended use." If any of the Government-furnished items received by Grumman are in a condition not suitable for intended use, the Government must correct that condition. If the Government fails to correct the condition, Grumman shall be entitled, in addition to any adjustments to which it may be entitled under the "Government Property" clause, to adjustment in performance related requirements of the F-14A specification and the performance incentives provisions of the contract.

We mentioned this matter of Government-furnished equipment because the Government traditionally has had problems in furnishing suitable

equipment to contractors in a timely manner. In past programs significant claims against the Government have been attributed to the failure to supply Government-furnished equipment on time and/or in a condition suitable for intended use. In the F-14 program Government-furnished items constitute more than half of the flyaway costs of the airplane.

10. AVIONICS SUPPORT OF EQUIPMENT MAY NOT BE AVAILABLE FOR FLEET DEPLOYMENT

The Versatile Avionics Shop Tester described on pages 36 and 37, entails a complex development effort. Present schedules for delivery of this equipment are "extremely tight." This avionics diagnostic system must be ready to support the F-14 when it is deployed at sea. No other back-up equipment is presently contemplated to accomplish this task. The efficient and effective repair of an aircraft's avionics has a direct impact on its availability for operational service. Without this shop tester it would be impossible to effectively maintain the F-14 avionics on board a fleet aircraft carrier; unless a crash program was undertaken to develop other special support equipment as a substitute.

11. ADVANCED TECHNOLOGY ENGINE TEMPERATURES

The consequence of Pratt & Whitney not being able to attain the temperature goals in the hot section of the advanced technology engine could affect such things as the (1) available thrust, (2) specific fuel consumption, (3) size of the engine, (4) weight of the airplane, and

(5) range of the airplane just to name a few. In the opinion of NASA experts, the proposed temperature limits entail some risk since new materials, new fabrication techniques, and advanced cooling concepts will be required to attain desired goals. In summary, NASA believes the assumed risk and the probability of success to be reasonable.

12. INTEGRATION OF AIRFRAME WITH ADVANCED TECHNOLOGY ENGINE

Integration into the airframe of the engine which will be used in the F-14B aircraft could be a potential problem. The Navy has told us that no such problem should occur because both this engine and the airframe were designed to accommodate each other. This unique feature about the initial flight testing of the new engine will be that the twin-engine F-14 test airplane will carry one F-14A engine and one F-14B engine. Against this position, however, is the fact that some redesign of the airframe will be required. (See potential problem No. 6 above.) It should also be noted that there was great difficulty in the earlier F-111 program due to airframe-engine integration problems.

13. CHANGE IN THRUST MAY JEOPARDIZE COMMON CORE ENGINE

The advanced technology engines which will be used on the F-14B and F-15 aircraft are currently being developed under a joint Air Force/Navy program. The designs of both the Air Force and the Navy configurations of this engine have been changed. The Navy's version of the engine now provides

more thrust than the Air Force's. If either service were to want to depart still further from the original performance specifications, this might necessitate abandonment of the common core concept with resultant cost growth for both F-14B and F-15 programs.

The Office of the Director of Defense Research and Engineering, Department of Defense is monitoring the development of these engines to assure that if two separate cores are developed, there is adequate justification for the additional cost that would be incurred.

14. SPIN TESTING

Preliminary spin testing will be performed on an F-14A (test aircraft No. 2) sometime during the period November 1971 through March 1972. Then test aircraft No. 2 will be converted into an F-14B and the final spin testing will be resumed in the period March 1973 through July 1973.

Aircraft which engage in missions requiring high maneuverability are subject to accidental spins. In a spin the aircraft stops flying and spins downward. Much can be done to design aircraft which are relatively "spin proof", however, some degree of spin susceptibility remains. Thus it is necessary to spin test a new aircraft to ascertain its ability to recover from spins.

In jet aircraft spins can cause loss of engine power (not necessarily a flame-out). Such loss of power is due to irregularities of air flow entering the engines brought on by the spin. Fan-jet engines, such as those which will be used on the F-14, are particularly sensative to air flow irregularities.

Spins and their implications are particularly important in the case of the F-14 because of still another factor. The F-14 uses variable sweep wings. If engine power is completely lost there is no power to move the wings. This is critical if the spin occurs at a time when the wings are in a position which is not optimum for spin recovery. Finally, the type engine which will be used in the F-14A version of the aircraft is a modification of the type engine used in the F-111 aircraft. Installed in the F-111 this engine occasionally experienced loss of power.

We submitted a list of questions to the F-14 Project Office concerning F-14 spins. These questions, together with the answers provided, are attached. See appendix II. It will be noted that the answers indicate a high degree of confidence that spins will not present a significant problem in the use of the F-14. Nevertheless, based on our discussions with knowledgeable people, as related above, we believe the contractor and Navy spin tests are highly significant.

15. UNRESOLVED FUNDAMENTAL ISSUES RELATED TO MISSILE ARMAMENT

A report (No. 70-2990, July 1970) has been prepared by a Department of Defense ad hoc working group of Defense and industry experts on air-to-air missiles. Although this report has been released within the Department of Defense it is not yet (as of July 17, 1970) considered to be "OFFICIAL" and for this reason it has not been made available to us. It is our understanding that the report does raise some fundamental issues relative to the capability of the PHOENIX, SPARROW, and the other

armament missiles planned for use on the F-14 and F-15 programs. Depending on how these issues are resolved, they could have an impact on the F-14 program.

The research and development test reports indicate some questions as to whether the PHOENIX missile can handle a maneuvering fighter threat at long-range. We also understand that the Naval Weapons Center, Corona Laboratory has raised some questions as to the susceptibility of the PHOENIX to electronic countermeasures.

16. COMPATIBILITY OF F-14 WITH AIRCRAFT CARRIERS

The F-14 aircraft is not compatible with the existing jet blast deflectors on present and planned aircraft carriers.

The jet blast deflector is a water cooled "flat-plate" like device hinged at the forward edge and raised hydraulically behind an aircraft being readied for catapult take-off. The deflector thus diverts jet exhaust of the aircraft on the catapult thereby protecting other aircraft being readied for launch as well as personnel and other equipment on the carrier flight deck from the high exhaust temperatures and velocities.

The problem is that the F-14 tailpipe is about 8 feet high and existing jet blast deflectors are also about 8 feet high. Therefore a problem exists due to F-14 exhaust impingement at the top edge of the deflector.

We have been advised by personnel at the F-14 Project Office that the design of the F-14 cannot be changed to correct this problem, therefore, the jet blast deflectors on the aircraft carriers must be modified. The Navy is aware of this problem and efforts are being made to come up

with an appropriate carrier modification program. Tests are due to be completed in June 1970 and design layouts in August 1970; for this reason, cost information associated with the changes is not available at this time.

Other carrier modifications will give consideration to such things as the avionic shop modifications to support the F-14 and the barricade compatibility which is needed to stop the F-14 in a crash or in an emergency situation.

17. USE OF PRODUCTION VS. R&D FUNDS FOR LOT III

The next aircraft lot (Lot III) option is intended to be procured with production funds. Of the 26 aircraft, eight will be used initially for flight tests and operational tests and evaluation. The intent of DOD Instruction 7220.5, which governs the sources of funds for weapons acquisition programs, is that preliminary production articles are to be financed from research and development appropriations in those cases where the articles are to be employed in test and evaluation.

18. UPGRADING OF OPERATIONAL TEST AND EVALUATION

The real tactical capabilities of the F-14 weapons system in the "user" or "fleet" environment will not be demonstrated until Operational Test and Evaluations are conducted. Such tests are not scheduled to start until October 1972, after a total of 146 airplanes (12 research and development and 134 production) may have been ordered.

Our concern is with the scope and timing of these tests. Traditionally the military services' Operational Test and Evaluations have

not been primarily concerned with determining the military worth of newly developed weapons systems in a simulated combat environment. Rather, Navy operational test pilots confirm that these tests have been concerned primarily with learning to live with the new weapons systems despite their limitations. The operational testing in the past have been concerned almost exclusively with developing tactics and training manuals for the new systems.

Concerning the timing, the degree of development-production concurrency in past programs has been so great that Operational Tests and Evaluations have come too late in the programs to influence weapon design and program decisions.

Consideration might be given to making these tests serve as a basis for a critical milestone decision as to whether or not the F-14 should be procured at the full-scale production rate for "inventory".

APPENDIXES

APPENDIX I

United States Senate

COMMITTEE ON ARMED SERVICES

WASHINGTON, D.C. 20510

March 19, 1970

Comptroller General of the United States
General Accounting Office
441 G Street, N. W.
Washington, D. C.

Dear Mr. Comptroller General:

The purpose of this letter is to request your office to provide the Preparedness Investigating Subcommittee with your analysis and interpretation of the contractual features of the contracts entered into for the F-14 and F-15 aircraft.

As you are aware, we are currently at a point in time when the results of the total package procurement concept and its contractual features are beginning to come forth with the C-5A program. As we are advised, the results have indicated contractual ambiguities, increased costs, and developmental and production problems created to an extent from the concurrency within the program.

The F-14 and F-15 programs are relatively new and, we are advised, incorporate management and contractual improvements intended to eliminate or minimize problems experienced with prior programs.

I would appreciate it, therefore, if your office could advise the Subcommittee on the merits of the improvements in the management and contractual aspects of these programs and your opinions of any potential problem areas that should be monitored. Your analysis should include the areas of management controls, contractual structure and definitiveness, cost and pricing provisions, and the extent of concurrency probable within the program structure.

Your early response to this request will provide great assistance to the Subcommittee's efforts in this area.

Sincerely,

John C. Stennis

John C. Stennis
Chairman, Preparedness
Investigating Subcommittee

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SPIN TEST
QUESTIONS AND ANSWERS

27 May 1970

Question: Since the character of an air superiority fighter combat and/or training mission involves maneuvering to the maximum capability of the aircraft, is it not probable that pilots will on occasion induce an accidental spin?

Answer: It is true that the mission of an air superiority fighter is such that accidental spins may be encountered. The frequency of encounter, however, is a function of not only the aircraft's mission but also of the handling characteristics of a particular aircraft as it approaches and penetrates beyond its stall angle of attack, as well as pre-stall warning provided the pilot. An "honest" aircraft which does not have an abrupt change in its aerodynamic characteristics at stall is much more likely to remain in controlled flight. In particular, an aircraft which does not possess a tendency to yaw or roll sharply as the limits of its maneuvering envelope are approached will encounter spins only infrequently. This cause and effect relationship is recognized by both NAVAIR and Grumman with the result that good handling qualities at the extremes of the maneuvering envelope are designed into the F-14.

Question: In a swing-wing airplane, may spins occur while at other than optimum recovery wing positions?

Answer: In a swing wing airplane, spins can certainly occur with the wing in a number of wing sweep positions. However, it is not clear that that fact in itself is of any consequence. It is entirely conceivable that recovery can be affected at any wing sweep with only a moderate increase in difficulty with the wing at an off "optimum" position, if indeed it can be presumed that a true optimum exists. In the case of the F-14, the spin program will investigate the full sweep range at which time the dependence of recovery technique upon sweep angle will be determined. In any event, it can be stated even now with virtual certainty that sweep angle will be much less significant with regard to recovery than the type and timing of application of the proper control motions.

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Question: Is it true that yaw and pitch angles during a spin are apt to be so great (60-70 degrees) that the TF30-P-412 engine will flame out?

Answer: Extremely high angles of attack or yaw are possible on a great many aircraft, depending upon the particular spin mode that may develop at any given time. The spin mode is in turn a function of , among other things, the way in which the aircraft entered the stalled region and the types of control motions applied. When such high angles are encountered, particularly with jet-powered aircraft, loss of engine power (not necessarily a flame-out) often occurs, particularly if high power settings are maintained on the engines. A recent example was the double loss of power during a recent EA6B spin test, even though that aircraft is powered by J-52 engines which are quite tolerant to flow irregularities.

In the case of the TF30-P-412 engine, F-111 experience has shown that like all fan engines, it is somewhat more susceptible to flow irregularities than most "pure-jets". However, it should be noted that the particulars of the inlet design are also highly significant. The type of inlet employed by the F-14 is a two dimensional type similar to that used by the A-5 which has had considerable success with regard to keeping the engines operable even in extreme attitudes. By comparison, the F-4 which has the same engines as the A-5 has been much more likely to encounter engine problems during spins. In summary then, while the TF30-P-412 engines are similar to those which on occasion stalled during F-111 spins, the details of the inlet are sufficiently different - and much improved from the standpoint of tolerance to a highly angular flow - that it is logical to expect the F-14 experience to be satisfactory.

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Question: After flame-out and at the associated very low engine RPM, will the available hydraulic pressure be sufficient to power the wings to the best position for spin recovery with a production airplane and would there by enough pressure remaining to effect spin recovery?

Answer: If it is presumed that complete engine power will be lost (and this does not appear to be the case), then it is possible for the engines to "wind-down" such that hydraulic power would be essentially lost with the production aircraft as it is now envisioned. The flight test aircraft are to be equipped with an emergency power source so that this possibility can be investigated safely. Such a precaution is normal in early flight test work. Similarly, an alternate power source could be included in the production aircraft but it is not now expected that such a device will be required.

Question: What F-14A system design alteration does Grumman and the Navy plan to solve this problem and at what point in the program will it be incorporated?

Answer: The Navy and Grumman do not have plans to solve this "problem" as postulated since it is far from obvious that it exists. Rather, effort is being expended to assure that the problem will not exist by pursuing the problem at its source, namely, the elimination of the tendency of an aircraft to spin. It appears entirely feasible to effect this "spin-proof" design by a combination of aerodynamic and automatic control techniques which will in effect prevent a fully developed spin from ever occurring.

Question: At what cost, in dollars and in weight?

Answer: The cost in weight of "spin-proofing" the F-14 would be negligible - being confined essentially to a very modest amount of additional electronics.

Question: Will the airplane used in final BIS spin tests incorporate the appropriate fix?

Answer: It is fully intended that the BIS aircraft will be representative of the production model in all respects. Therefore, any changes which are required as a result of the stall/spin aspects will be incorporated.

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Source: F-14 Project Office

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REPORT TO THE
COMMITTEE ON APPROPRIATIONS
HOUSE OF REPRESENTATIVES

Costs And Benefits Of The F-111B Aircraft And Costs Of The PHOENIX Missile B-153545

Department of the Navy

This material contains information affecting the national defense of the United States within the meaning of the espionage laws, Title 18, U.S.C., Secs. 793 and 794, as respectively amended, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law.

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BY THE COMPTROLLER GENERAL
OF THE UNITED STATES

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(UNCLASSIFIED IF DETACHED FROM REPORT)

COMPTROLLER GENERAL OF THE UNITED STATES

WASHINGTON, D.C. 20548

B-153545

Dear Mr. Chairman:

This is our report on costs and benefits of the F-111B aircraft program and costs of the PHOENIX missile program in the Department of the Navy.

The significant contents of the report are summarized in the digest which is bound in the report.

As shown in the report, the Air Force budgeted for all development costs of the F-111 Aircraft. With the advent of numerous changes to the F-111B configuration, the Navy, beginning on July 1, 1966, funded development effort peculiar to the F-111B aircraft. In developing total costs of the F-111B, we did not determine that portion of research and development costs funded by the Air Force which should be considered allocable to the Navy version nor determine the additional costs that may have been incurred in attempting to maintain commonality in the F-111 aircraft program. We are giving further consideration to these matters and shall advise you of our conclusions.

The report has been reviewed by the Department of the Navy for security classification. It has not been formally presented to the Department of the Navy or to any of the contractors mentioned for comments.

We plan to make no further distribution of this report.

Sincerely yours,

Elmer B. Staats

Comptroller General
of the United States

The Honorable George H. Mahon
Chairman, Committee on Appropriations
House of Representatives

(UNCLASSIFIED IF DETACHED FROM REPORT)

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COMPTROLLER GENERAL'S REPORT
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COSTS AND BENEFITS OF THE F-111B AIRCRAFT AND COSTS OF THE PHOENIX MISSILE
Department of the Navy
B-153545

D I G E S T

WHY THE REVIEW WAS MADE

The Chairman, Committee on Appropriations, House of Representatives, requested that the General Accounting Office (GAO) review the F-111B aircraft program, in particular its cost and the costs incurred as a result of its cancellation. The F-111B was part of a program to develop a single aircraft to be used by both the Air Force and the Navy.

In addition, the Chairman requested information on spin-off benefits derived from the F-111B including the extent to which these are being incorporated into other aircraft and related programs. The Chairman requested also a review of the cost history of the PHOENIX missile program.

The report has been reviewed by the Department of the Navy for security classification. It has not been presented to that Department or to the F-111B and the PHOENIX missile contractors for comment.

FINDINGS AND CONCLUSIONS

Serious development problems resulting in the inability of the F-111B aircraft to meet required performance specifications ultimately led to cancellation of the program.

As of September 30, 1968, the Navy had recorded obligations of $304.7 million and expenditures of $212.7 million for research and development and procurement of the F-111B aircraft. Final program costs are not available since the costs to terminate F-111B contracts have not been negotiated. The Navy declined to provide its estimate of termination costs at this time for fear of prematurely revealing the Government's termination objectives. (See p. 8.)

GAO will furnish information on F-111B contract termination action when it is made available by the Navy.

The Navy plans to use the PHOENIX missile system, originally designed to be a part of the F-111B/PHOENIX weapon system, on the F-14A aircraft--the F-111B's successor.

As of September 30, 1968, the Navy had recorded obligations of $496.1 million and expenditures of $425.5 million for the PHOENIX missile system. The major portion of this funding was applied to PHOENIX development and production contracts awarded to Hughes Aircraft Company.

INTRODUCTION

The General Accounting Office has made a review of selected aspects of the F-111B aircraft and PHOENIX missile programs. This review was made pursuant to the request of the Chairman of the Committee on Appropriations, House of Representatives, by letter dated August 6, 1968, a copy of which is included as appendix I.

As requested by the Committee Chairman, the review was directed toward ascertaining (1) the cost of the F-111B aircraft program, (2) the benefits which will be derived from the F-111B aircraft program, including the extent to which any developments therefrom are being incorporated into other aircraft and related programs, and (3) the cost history of the PHOENIX missile program.

In performing our examination, we reviewed contract files and fiscal and other related documents at the responsible Navy project offices, the Naval Air Systems Command, and the Naval Material Command. Further, we held numerous discussions with Navy officials to obtain additional information not contained in the files and documents we reviewed. We also obtained information at the General Dynamics Corporation, Fort Worth, Texas, and the Hughes Aircraft Company, Culver City, California.

The principal officials of the Department of Defense and the Department of the Navy responsible for administration of the activities discussed in this report are listed in appendix VII.

F-111B AIRCRAFT PROGRAM

BACKGROUND

Development of the F-111B aircraft was based on the desire of the Department of Defense to achieve significant savings through the development and procurement of an aircraft for the Air Force and the Navy which was basically common in design.

Although development of a single, highly common aircraft was attractive due to the potential for savings to the Government, the program encountered a series of major technical problems and increased development costs. Many of the problems encountered were associated with the weight and performance characteristics of the Navy's version of the aircraft. The basic F-111B aircraft incorporates changes resulting from weight improvement programs plus carrier-suitability changes, and an improved engine--the TF30-P-12 turbofan engine.

Numerous hearings have been held by committees of both the Senate and the House of Representatives with regard to the F-111 program, and in particular the F-111B aircraft. Extensive discussions at these hearings have highlighted the more significant problems in the development of the F-111B and the deviation of the actual performance from the planned performance of the aircraft. The inability to develop an aircraft that would meet the Navy's requirements ultimately led to congressional action which eliminated funding for production of the F-111B aircraft for fiscal year 1969.

In reporting the fiscal year 1969 procurement authorization bill, the Senate Armed Services Committee recommended that all funds requested for the F-111B be disallowed and that funds be provided for the development of a substitute aircraft referred to as VFX (later designated by the Navy as the F-14A). The Senate concurred in these recommendations.

The Committee's approved recommendations resulted in disallowance of the F-111B aircraft program budget submission of $388.8 million for procurement of 30 F-111B aircraft and $71.8 million for F-111B research and development effort. The recommendations also resulted in an additional reduction of $151.5 million based on recoupment and use of prior year F-111B aircraft program procurement funds. The Senate Appropriations Committee approved funds totaling $130 million for F-14A aircraft development although no funds for this purpose had been included in the Navy budget submission for this aircraft inasmuch as it is the substitute for the F-111B aircraft. The $130 million was subsequently included

in the appropriation enactment by the Senate and the House of Representatives for fiscal year 1969. (UNCLASSIFIED)

The Navy has taken action to discontinue the F-111B program. On July 9, 1968, the Navy notified the Air Force contractor involved in F-111B production to stop all but specified F-111B work. The Navy's instructions provided for completion and delivery of the second production model F-111B aircraft--number 7--which was in process of fabrication. A total of 24 F-111B aircraft were to be produced under contract; however, as a result of the Navy's instructions, work was stopped on the remaining 22. Subsequently, the Navy contracted for development of the F-14A to replace the F-111B aircraft. (UNCLASSIFIED)

Program management

Management of the F-111 aircraft program has been, to a large extent, the responsibility of the Air Force. On September 1, 1961, the Secretary of Defense directed that the Air Force assume program management responsibility for development and procurement of all versions of the F-111 aircraft. This was followed on September 14, 1961, by a joint Air Force-Navy agreement for management and funding of the program. The agreement provided that the entire F-111 weapon system program be managed as an integrated single program by an Air Force System Program Office located at Wright-Patterson Air Force Base, Ohio. It also provided that the Air Force budget for all development costs of the F-111 aircraft. (UNCLASSIFIED)

We were informed that, with the advent of numerous changes to the F-111B configuration, this agreement was modified, effective fiscal year 1967, to provide that the Navy assume funding for research and development for F-111B peculiar changes or additions to contractual specifications. Although the Air Force has maintained program administrative responsibility through both the development and the production phases of the F-111 program, funding for production models was budgeted on an individual service basis.
(UNCLASSIFIED)

The original development plan for the F-111B, approved by the Chief of Naval Operations, provided that the aircraft

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be available for operational evaluation tests by 1967 and for fleet introduction by 1968. Just prior to the order to terminate, the Navy had planned to commence tests and to introduce the aircraft to the fleet in late 1970--a delay of at least 2 years. The Navy has attributed failure to meet operational dates to delays in initiating development of the two-service effort, the superweight improvement program, and development problems in the aircraft engine and airborne missile control system programs. We were advised by F-111B Project Office officials that, although the F-111B program was extended 2 years, in their opinion actual slippage of the program was about 1 year and the remaining year resulted from delays in the PHOENIX program. ([redacted]

Development problems and delays in the program apparently caused substantial growth in anticipated program cost over estimates formulated during the program. Following is a comparison of Research, Development, Test, and Evaluation funds allocated by the Navy for the F-111B development program with estimates of the cost of the development program as shown by Navy financial plans in effect as of April 1963 and August 1965. (UNCLASSIFIED)

	1963 plan	1965 plan	Actual fund allocations by year
	(millions)		
RDT&E:			
1963	$10.5		$ 9.9
1964	25.3		19.9
1965	25.0		26.8
Total 1963-65	$60.8	$58.0	$ 56.6
1966	11.0	22.3	74.8
1967	7.0	3.2	86.4
1968	-	0.6	26.2
Total (note a)	$78.8	$84.1	$244.0

(UNCLASSIFIED)

[a]These amounts include funds for tasks related to the PHOENIX missile system.

We did not prepare a similar comparison for procurement fund estimates for the F-111B aircraft because the significant changes in production aircraft quantities would make the comparison meaningless.

OBSERVATIONS

F-111B budgetary data

Navy records show that a total of $428.6 million was allocated for the development and production of the F-111B as of September 30, 1968. At that date $304.7 million was obligated, of which $212.7 million had already been expended. Details of the status of funds for the F-111B aircraft program, as disclosed by Navy records, are shown in the schedules attached as appendix III. The schedules are arranged to show the total program funding by (1) fiscal year, (2) major program item, and (3) type of procurement action. The information also shows Research, Development, Test, and Evaluation (RDT&E) funds and Procurement of Aircraft and Missile (PAM) funds.

Funding as shown in the schedules does not necessarily indicate total funding for the F-111B aircraft. As stated on page 5, development funding for the F-111 aircraft was provided by the Air Force. Development funding for tasks peculiar to the F-111B aircraft was provided by the Navy. In addition, F-111B funding related to the PHOENIX system, which was previously included in the F-111B fund accounts, has been transferred by the Navy to PHOENIX accounts.

The F-111B Project Office was requested to provide a current termination plan and a dollar range of estimated costs for each possible mode of termination. The Project Manager advised us on November 5, 1968, that a termination negotiation team, composed of Air Force and Navy personnel, had been established by the Air Force. However, the Project Manager declined to provide the information we requested until negotiations are completed, as premature disclosure of the Government's termination objectives would not be prudent. A copy of the F-111B Project Manager's memorandum of November 5, 1968, is included as appendix II.

We will furnish information on F-111B contract termination action to the Committee when it is made available by the Navy.

The following table reflects funds that the Congress has actually appropriated to the Department of the Navy for the F-111B aircraft, compared with funds the Navy has actually allocated to the aircraft program for development and production.

Fiscal year	Congressional appropriations (notes a and b)	Navy allocations (note b)
	(millions)	
RDT&E:		
1963	$ 13.0	$ 9.9
1964	25.3	19.9
1965	27.8	26.8
1966	74.3[c]	74.8
1967	88.2	86.4
1968	38.2	26.2
	$266.8[c]	$244.0
PAM:		
1965	$ 1.5	$ -
1966	103.0[c]	71.3
1967	86.1	78.5
1968	167.2	146.3
	$357.8[c]	$296.1

[a]Information as shown on records of the Financial Management Division, Naval Air Systems Command, which, according to the cognizant official, represents amounts appropriated by the Congress.

[b]Includes F-111B funding transferred to the PHOENIX missile system.

[c]Fiscal year 1966 RDT&E amount includes $52 million appropriated as PAM funds. This has been deducted in the amount shown for fiscal year 1966 PAM.

Recoupment of unexpended F-111B funds

It appears to have been the intent of the Congress that prior year unexpended funds appropriated for the F-111B aircraft program should be applied, in part, to the F-14A program. The fiscal year 1969 appropriation action by the Congress required that a total of $151.5 million of unobligated procurement funds, appropriated in prior years for the F-111B aircraft program, be applied to Navy procurement requirements for fiscal year 1969, making possible an offsetting reduction in congressional authorization.

On October 28, 1968, a total of $98.8 million of unexpended F-111B procurement funds was set aside. Of this, a total of $89.8 million had, as of December 16, 1968, been officially recouped from prior years' F-111B aircraft program unexpended procurement funds. This leaves a balance to be recouped of $61.7 million if the Navy is to meet the amount established by the Congress.

F-111B Project Office reports show that Project Office officials estimate that a total of $28 million of unexpended research and development funds for the F-111B aircraft program could also be recouped. Navy documentation shows that as of December 16, 1968, a total of $8.8 million of unexpended research and development funds had been officially recouped from prior years' funds for the F-111B program.

The F-111B Project Officer was of the opinion that total recoupment of procurement funds would generally approach the $151.5 million goal.

F-111B contract information

Navy records show that as of June 30, 1968, the total dollar value of major Navy F-111B aircraft program procurement actions totaled about $353.5 million. This amount consisted of (1) $111.4 million for certain portions of the F-111B segments of the Air Force development contract and $103.4 million for the Air Force procurement contract for the F-111 aircraft and (2) $138.7 million for Navy prime contracts, various Navy project orders, work requests, and allotments to Government activities.

The $353.5 million does not include the cost of Government-authorized changes to the scope of work for which price negotiations had not been completed or the cost of authorized changes negotiated but not definitized at June 30, 1968; nor does it include cost for common F-111 development effort funded by the Air Force.

Major contracts

The Air Force awarded two major contracts to General Dynamics, one for the development and one for the production of the F-111 aircraft. A letter contract was awarded to General Dynamics Corporation on February 1, 1962, for the development of the F-111 aircraft, including the F-111B. This contract was definitized as a fixed-price incentive research and development contract on May 22, 1964.

As of September 30, 1968, Navy funds obligated on this development contract totaled $111,356,201, of which $61,808,573 had been expended. (Funds obligated as of June 30, 1968, were the same as on September 30, 1968.) Data provided by General Dynamics showed a total definitized Navy F-111B portion of the development contract target price as of October 30, 1968, to be $70.5 million. The data also showed that costs incurred at September 30, 1968, were $86.5 million.

The Air Force fixed-price incentive production contract with General Dynamics for F-111 aircraft was definitized and approved on May 10, 1967. This contract followed a letter contract which had been approved on April 9, 1965. Navy production funds obligated on this contract as of June 30, 1968, totaled $103,429,531. At September 30, 1968, funds obligated on this contract totaled $98,751,276, of which $69,251,018 had been expended.

In addition to the above contracts, the Navy issued numerous other procurement documents to contractors and various Government activities for F-111B aircraft program research and development effort and production effort. At June 30, 1968--the latest date for which statistics were available--the total dollar value of these procurements totaled about $138.7 million. Of these procurements,

$122.8 million worth constitute eight Navy contracts that exceeded $1 million in value at June 30, 1968. Descriptions and related data for each of these are shown in appendix V to this report.

Benefits derived from F-111B program

F-111B development aids to other programs

According to the Navy, development effort expended under the F-111 program will, to some extent, be beneficial to other Navy and Air Force programs. Moreover, the Navy believes that the entire amount of cost incurred on the F-111B aircraft program will not be lost but could have the effect of reducing the cost of the F-14A aircraft program being advanced to fulfill the role intended for the F-111B.

The Navy F-111B Project Office provided information concerning the benefits accruing to other programs. The Project Manager considered that a number of developments under the program had contributed significantly to the "state of the art" in aircraft design and development that would benefit future Navy and Air Force aircraft. The Project Officer informed us that the most significant benefits derived were (1) the variable sweep-wing design, (2) the TF30-P-12 turbofan engine development, and (3) the design of the crew compartment as an escape-capsule vehicle.

Navy officials pointed out that it is not possible to quantify the monetary value of the design advances accruing from the F-111B. The information provided to us was not verified because the data could not be provided in specific values or proportions susceptible to audit.

Variable sweep-wing design--The information provided by the F-111B Project Office shows that the Navy considers that the variable geometry wing has proved to be technologically sound and that it should improve aircraft range and speed performance in high and low operating environments.

The Project Office information shows that F-111B aircraft No. 1 will be used by the Navy to conduct aircraft carrier barricade effectiveness tests of sweep-wing aircraft. This is the first variable sweep-wing aircraft used to develop such information, and it will be of benefit to the F-14A program and possibly to versions of the F-111 aircraft other than the F-111B.

Navy officials informed us that the second aircraft to be used--F-111B No. 5--had been transferred to the Ames Research Center of the National Aeronautics and Space Administration at Moffett Field, California. Navy officials stated that the National Aeronautics and Space Administration would utilize F-111B aircraft No. 5 for basic aeronautical research in sweep-wing design and associated stability control performance for sweep-wing aircraft.

TF30-P-12 engines--The F-111B Project Manager advised us that the TF30-P-12 engine was the first turbofan jet engine with afterburner to be placed into operational-type aircraft. This engine permits aircraft to operate at a lower specific fuel consumption than existing aircraft engines; provides a higher thrust to weight ratio; and has improvements and innovations not incorporated into less sophisticated engines.

The Navy plans to utilize the TF30-P-12 engine design in the F-14A aircraft. However, it appears that this will be a modified version of the P-12 engine. Further, according to a Navy official, the plan is to use the modified P-12 engine only in the early model F-14A aircraft, and a new engine is already under development for the later model F-14-type aircraft.

Escape-capsule vehicle--The F-111B Project Office information shows that this module development by the McDonnell Douglas Aircraft Corporation permits a shirt-sleeve environment that improves crew efficiency at lower altitudes and provides for zero speed and zero altitude escape capability over land or water, which significantly increases the probability of survival of highly trained pilots and missile control officers. Although the development of the escape-capsule vehicle may be of future benefit to other aircraft programs, the Navy, at this time, does not plan to include the escape-capsule vehicle in the F-14A aircraft.

Salvage value of F-111B assets

In the judgment of F-111B project officials, a salvage value of about $249 million may be assigned to the residual assets from the F-111B aircraft program. This estimated

amount, comprising $105 million of RDT&E funds and $144 million of PAM funds, is the Navy's estimated residual value return on the $304.7 million estimated total Navy fund obligations for the F-111B program as of September 30, 1968.

The values attached to the residual assets are estimates of the project officials. We did not attempt to determine the accuracy or appropriateness of the salvage value amounts.

The estimated amounts given as residual values for F-111B assets by project officials and their rationale in each case, are as follows.

Research and development funding ($105 million)--

1. $.25 million--This amount is the estimated residual value of the F-111B No. 1 transferred to Naval Air Station, Lakehurst, New Jersey, for purposes of exploring barricade effectiveness tests of sweep-wing aircraft. The high cost, critical, and readily removable items--e.g., engines, avionics and hydraulic actuators--were removed for support of the on-going F-111B and F-14A effort.

2. $0.5 million--This amount is the estimated residual value of F-111B No. 5 transferred to the National Aeronautics and Space Administration in October 1968. This amount is somewhat conservative in that this aircraft was transferred in a flyable condition with the TF30-P-1A engines and communication and navigation aids which were excluded from barricade test aircraft referred to above at the Naval Air Station, Lakehurst.

3. $1.0 million--This amount is the estimated residual value of F-111B No. 3 allocable to the F-14A aircraft for purposes of conducting PHOENIX development tests at Hughes Aircraft Company.

4. $43.0 million--This amount represents the development cost of the TF30-P-12 engine which is considered applicable to the Navy and the Air Force on an equal basis. The development of the TF30-P-12 engine is

of value to both the Air Force FB-111 aircraft and the Navy F-14A program.

5. $50 million--This amount includes PHOENIX development efforts funded by F-111B RDT&E funds, with the exception of those funds required for carrier suitability changes and T-20 weapons bay tests. Items, such as missile control officer training engineering study, L/X/AWG-9 equipment, gravity bomb computers, AWG-9 pilot production, and MAU-83A/84A launchers, are examples of the items considered to accrue primarily to the F-14A program.

6. $10 million--It is estimated that this amount of Government-furnished equipment, avionics, and support equipment can be utilized on other Navy and Air Force aircraft. This is an estimated residual amount applicable to specific equipment for navigation, communication, and aircraft support. Most of these items are usable as is or they can be modified to be used in the F-14A and other Navy ongoing programs.

Procurement of aircraft and missiles ($144.0 million)--

1. $12 million--This is the estimated value of F-111B No. 7, used to conduct flight tests for support of the PHOENIX development effort.

2. $44 million--Estimated cost of common parts to the Air Force.

3. $36 million--Estimated cost of TF30-P-12 engines for use in F-111B Nos. 6, 7 and associated backup in support of the F-14A PHOENIX development program.

4. $41 million--This amount provides for AWG-9 electronics and avionics special support equipment and facilities and MAU-83A/84A launcher procurements, all of which are considered applicable to the F-14A PHOENIX development.

5. $11 million--This amount is provided for procurement of Government-furnished equipment and support

applicable to a variety of Navy and Air Force aircraft that can be used as is or with a minimum amount of modification; i.e., navigation, communication, and support equipment.

Status or planned use of residual F-111B aircraft

In the course of the F-111B program, the Navy has accepted for delivery or plans to accept a total of seven F-111B aircraft. Five of these aircraft were funded from research funds and the remaining two from procurement funds. As noted on page 15, aircraft Nos. 1 and 5 will be used for test purposes. Aircraft No. 2 crashed in September 1968 and No. 4 crashed in April 1967.

The current status and/or planned use of the remaining three F-111B aircraft is as follows:

Aircraft number	Aircraft use/projected use
F-111B No. 3	This aircraft commenced its F-111B flight test program in April 1966. It is being used in the development of the PHOENIX missile system at Hughes Aircraft Company, Culver City, California.
F-111B No. 6	This aircraft was accepted by the Government on June 30, 1968. It is the first F-111B incorporating the TF30-P-12 engine; it incorporates the nose stretch (2 ft.), 40° flaps, and the direct lift control and approach power compensator devices. This plane is conducting limited supersonic testing for comparison with F-111B No. 5 and will support the F-14A/PHOENIX development effort.
F-111B No. 7	This aircraft, which is scheduled to be accepted in February 1969, will be utilized in the F-14A/PHOENIX development effort. It will incorporate the latest avionic equipment and, as far as possible, be compatible with the F-14A/PHOENIX development. Its sole purpose will be to accelerate the development of the PHOENIX missile system for the follow-on sweep-wing aircraft--F-14A.

PHOENIX MISSILE PROGRAM

BACKGROUND

In conjunction with the development of the joint Air Force-Navy aircraft, the Navy was directed to develop a long-range missile and associated control system for use on its version of the aircraft. The missile system, although an integral part of the F-111B, is considered a major associated system since it is being developed separately by the Navy. This system, designated the PHOENIX missile system, was to be the primary armament of the Navy's F-111B aircraft. Together, they constituted the F-111B/PHOENIX weapon system.

The mission of the PHOENIX missile system was to provide the F-111B with capability to perform its primary mission of interception of aerial targets in order to maintain air superiority in Navy and Marine operating areas. The PHOENIX missile system, as designed to operate with the F-111B aircraft, comprised four major components. These consisted of the AN/AWG-9 airborne missile control system; the AIM-54A guided missile; the weapons bay launcher--the MAU-83/A launcher-ejector; and the wing pylon launcher--MAU-84/A launcher-ejector. The missile control system was designed to utilize data from other on-board navigation and sensing systems.

Program management

On September 6, 1961, the Chief, Bureau of Naval Weapons, was directed to assume program management responsibility within the Navy for the F-111B aircraft and the PHOENIX missile system and to provide Navy representation to the Air Force during its development and procurement of the aircraft. Subsequently, an F-111B/PHOENIX Project Office was established in the Bureau of Naval Weapons. Since that time responsibility for the PHOENIX missile system has been reassigned from the F-111B Project Office to the VFX (later designated the F-14A) Weapons System Project Office in the Air Systems Command. As of July 29, 1968, the Commander, Naval Air Systems Command, was assigned the responsibility for the development of the F-14A aircraft and the PHOENIX missile system.

A review of Navy records with regard to management of the PHOENIX program showed that some deviations had occurred from the originally scheduled milestones and estimated program cost. We were advised that the program had been extended about 2 years. Project officials were of the opinion that actual slippage of the program was about 1 year and that the additional year resulted from delays in the F-111B program.

The Navy had originally estimated in 1962 that the total cost for the PHOENIX missile system would amount to approximately $769 million. As indicated by a recent Navy development plan, costs expected to be incurred have increased to about $824 million. The initial cost estimates for RDT&E and procurement were $148 million and $621 million, respectively. Current estimates are $406 million and $418 million, respectively.

OBSERVATIONS

PHOENIX budgetary data

Navy records indicate that a total of about $531 million was allocated by the Navy for development and production of the PHOENIX missile system as of September 30, 1968. At that date, about $496 million was obligated, of which about $425 million had actually been expended. These amounts include previously mentioned transfers of funds by the Navy for PHOENIX-related tasks from F-111B fund accounts to PHOENIX fund accounts. Our examination did not include a review of the propriety of these fund transfers.

Details of status of funds for the PHOENIX missile system, as disclosed by Navy records, are shown in the schedules attached as appendix IV. These schedules are arranged to show total program funding (1) by fiscal year, (2) by major program item, and (3) by type of procurement action. The information is also broken down to show RDT&E and PAM funds.

PHOENIX contract information

At June 30, 1968, contracts to Hughes Aircraft Company; other contractors; and various Government project orders, work requests, and allotments for the PHOENIX missile system amounted to about $459.3 million. This amount does not include contract changes authorized but not negotiated or changes negotiated but not definitized in contracts at June 30, 1968.

The PHOENIX system development contract amounting to about $315 million at June 30, 1968, constituted the largest single item of the above total. In addition, Hughes had been awarded three contracts totaling about $99.1 million as of June 30, 1968, for the production of the major components of the PHOENIX missile system, namely, the AWG-9 missile control system, the AIM-54A missile, and the launchers.[1] Hughes had also been awarded 13 contracts to provide services or to conduct studies in connection with the PHOENIX program. During the PHOENIX development program, a number of contracts were awarded to other companies for various work on the missile system. A schedule of all contracts awarded for the PHOENIX missile system is included as appendix VI.

In addition to the contracts awarded for the PHOENIX missile system, project orders and work requests were issued by the Navy to various Government activities for research and production work related to the PHOENIX system. As of June 30, 1968, costs authorized under these orders and requests amounted to about $13.4 million. Further, the Navy issued allotments to various field-station activities for research and development and production amounting to about $25.5 million.

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[1]Due to the termination of the F-111B efforts, the contract for launchers was terminated on August 2, 1968. The contract was originally awarded for $4,634,000, and, as of September 30, 1968, obligations on contract amounted to $3,613,892.

Following is a recap of the amounts authorized for the PHOENIX missile system as of June 30, 1968.

Type of document	Number of actions	Contract or authorized amount (millions)
Contracts awarded to Hughes:		
Development contract	1	$315.0
Component production contracts	3	99.1
Other contracts	13	6.1
Contracts awarded to other companies	4	0.2
Navy project orders	12	4.0
Navy work requests	34	9.4
Navy field-station allotments	35	25.5
Total		$459.3

As shown above, Hughes has been the principal recipient of contracts awarded for the development and production of the PHOENIX missile system. Of these contracts, the development contract constitutes the largest commitment on the part of the Navy. On January 15, 1963, Hughes was awarded a letter contract for the development of the PHOENIX missile system. During the period January through March 1963, changes were made in the statement of work by the Navy, and Hughes amended its original proposal to a final proposed price of $217,816,599.

Negotiations were conducted, and, on June 30, 1963, the letter contract was definitized into a cost-plus-incentive-fee contract in the amount of $201,153,570. The contract calls for the design, development, and testing of the PHOENIX missile system and for providing related services and equipment. The negotiated amount for this contract as of June 30, 1968, was $314,959,915. Actual costs incurred under this contract at June 30, 1968, were $319,232,357. The latter amount includes changes authorized but not negotiated.

The Navy also awarded three production contracts for the major components of the PHOENIX missile system to Hughes Aircraft Corporation. A brief description of each contract follows.

Contract number	Date awarded and contract amount	Quantity	Description
N000-19-67-C-0160[a]	November 1967 $4,634,000	10	MAU-83/A (XN-2) weapons bay launcher
		41	MAU-84/A (XN-2) wing pylon launcher
N000-19-68-C-0295[b]	March 1968	26	Prototype AIM-54A missiles
N000-19-67-C-0240	April 1967 $72,212,800	11	Pilot production AWG-9 missile control systems

[a]Contract terminated on August 2, 1968.

[b]Contract not definitized. Amount obligated as of September 30, 1968, was $28,047,800.

Total cost incurred on these contracts as of June 30, 1968, amounted to $61,294,356.

The budgetary status of major Navy contracts with Hughes at September 30, 1968, as shown on the Navy's records was as follows:

Summary of Budgetary Status for the Major Contracts Awarded to Hughes Aircraft Company for the PHOENIX Missile System as of September 30, 1968

	Commitments	Obligations	Expenditures
	(millions)		
RDT&E contract:			
Contract number: NOw 63-0379			
Award date: January 15, 1963			
Description: Design, development, and test the PHOENIX guided missile system			
Funded by PHOENIX budget	$325.5	$325.5	$316.4
F-111B transfers to PHOENIX funded by F-111B budget	4.4	4.4	4.3
Total RDT&E contract	329.9	329.9	320.7
Major PAM contracts:			
Contract number: N00019-67-C-0240			
Award date: April 1967			
Description: AWG-9 pilot production			
Quantity: 11 AWG-9 systems			
F-111B transfers to PHOENIX funded by F-111B budget	90.1	87.7	62.2
Contract number: N00019-68-C-0160[a]			
Award date: November 1967			
Description: Launcher production			
Quantity: 10 MAU-83/A and 41 MAU-84/A launchers			
F-111B transfers to PHOENIX funded by F-111B budget	3.8	3.6	0.4
Contract number: N00019-68-C-0295			
Award date: March 1968			
Description: PHOENIX missile prototype			
Quantity: 26 preproduction prototype missiles			
Funded by PHOENIX budget	40.6	28.0	6.0
Total major PAM contracts	134.5	119.3	68.6
Total major contracts awarded	$464.4	$449.2	$389.3

[a]Contract terminated August 2, 1968.

Changes in the PHOENIX system

The Navy authorized three major changes in the PHOENIX system and considered an additional one in an attempt to reduce the weight of the F-111B/PHOENIX weapon system. The three changes concerned (1) redesign of the PHOENIX launcher, (2) incorporation of Shrike computer functions into the PHOENIX computer, and (3) change in the F-111B aircraft weapon system's alternate missile capability. The details of each of these changes are presented below.

Redesign of the PHOENIX launcher

The research and development contract awarded to Hughes provided for the fabrication of 24 MAU-48 missile launchers. Six of these launchers were fabricated and scheduled for flight tests to be conducted on an A-3A aircraft. In November 1964 fabrication of the remaining 18 launchers was canceled in favor of developing a lighter integrated launcher. After submitting two proposals, Hughes was directed by the Navy on May 10, 1965, to proceed to design, develop, and fabricate 18 integrated weapons bay/pylon launchers designated MAU-83/A and MAU-84/A.

We found that the Navy had decided to redesign the MAU-48 launcher as one means of reducing the total F-111B aircraft weight. It was estimated that a weight reduction of 260 pounds for each launcher would be achieved by the redesign. Navy officials informed us that the capability of the redesigned launcher was about the same as that of the MAU-48 launcher. Navy records show that little technical risk was involved in the redesign since the redesigned launcher included essentially the same components as the original launcher.

At the time Hughes was directed to proceed with the redesign, Hughes was authorized about $2.4 million to perform the work necessary to design, develop, manufacture, and test the 18 new missile launchers. Navy negotiation records indicated that the amount allocated for unexpended effort and related profit for the original 18 MAU-48 launchers was approximately $800,000. We did not review the reasonableness of this amount or the $2.4 million for the redesign effort.

Incorporation of Shrike computer functions into the PHOENIX computer

Hughes submitted a proposal to the Navy on December 30, 1964, to study the feasibility of incorporating certain functions of the Shrike missile computer into the PHOENIX AWG-9 computer which would eliminate the need for the Shrike computer in the F-111B aircraft and further reduce the overweight condition of the weapon system. On June 28, 1965, the Navy accepted the proposal and awarded a firm fixed-price study contract to Hughes in the amount of $19,966. (UNCLASSIFIED)

The results of this study showed that the change proposed by Hughes was feasible and would reduce the weight of the weapon system by approximately 50 pounds. The study showed also that the change would enhance the secondary armament capability of the F-111B aircraft. (UNCLASSIFIED)

In April 1966 the Navy approved the deletion of a total of nine Shrike computers from the F-111B aircraft program. Since each Shrike computer costs $16,000, the change resulted in a cost reduction of $144,000. On September 13, 1966, the Navy issued a change order in the amount of $300,000 to the PHOENIX development contract, authorizing Hughes to proceed with the computer changes. Because of this effort, a net additional cost of $156,000, excluding the study contract cost of about $20,000, was incurred in the research and development program. (UNCLASSIFIED)

Change in the F-111B aircraft's alternate missile capability

The specific operational requirement for the missile system provided that the airborne missile control system have an alternate capability of controlling the SPARROW 111-6(b) (AIM-7E) missile as long as such capability did not degrade the aircraft or missile performance or contribute excessively to weight and space requirements. Navy officials advised us that the Navy's consideration of the SPARROW missile for the F-111B had been based upon the planned use of either the SPARROW AIM-7E or the pulse doppler SPARROW AIM-7F. [redacted]

Subsequently, the Navy decided that the SPARROW AIM-7F would be deleted because the pulse doppler radar had not been developed. Use of the SPARROW AIM-7E was also deleted because the continuous wave injection to the PHOENIX AWG-9 computer would entail a system increase of 170 pounds and 3.8 cubic feet. ([redacted])

Additional subsequent changes were negotiated for the PHOENIX missile system affecting the development contract and the AWG-9 missile control system pilot production contract. A description of the change orders and modifications affecting target price for both the above contracts are as follows: (UNCLASSIFIED)

Subcontractor change for control system computer

A change to the PHOENIX development contract was negotiated to provide for a change of subcontractors to Hughes for the missile control system computer. This change order, which amounted to $200,000, was effected in order to fund additional work required by the replacement subcontractor--Control Data Corporation--to make its generally compatible computer conform to the weight/space constraints of the already approved F-111B/PHOENIX weapon system. Hughes terminated its subcontract with the original computer source because of unsatisfactory performance. (UNCLASSIFIED)

Qualification of nonstandard computer parts

The Navy issued a change order under a Hughes contract in the amount of $147,378 to provide for the qualification of nonstandard parts to be used in the missile system computer being produced by the Control Data Corporation. This qualification of parts was done so that the computer would conform to the constraints of the F-111B/PHOENIX weapon system. Navy officials informed us that without this total qualification the system may not be accepted by the Navy. (UNCLASSIFIED)

Installation change for contact fuze sensor UNCLASSIFIED

A change was negotiated with Hughes to provide for a contractor installation of the Government-furnished contact ([redacted])

fuze sensor in the missile. Originally, the Navy planned that this item would be Government installed. The contractor was chosen to install the sensor because of a new mounting location on the bulkhead of the electronic guidance section which the contractor was already responsible for assembling. ([redacted])

The purpose of the contact fuze sensor is to ensure fuzing of the missile in the case of a direct hit. This expedites the fuzing system, solving the problem of the missile glancing off the target, with little velocity loss, and traveling beyond the lethal range of the missile by the time the fuze receives indication of contact, fuzes, and detonates the warhead. This change amounted to $67,109. ([redacted])

Modification of missiles for testing

A change order amounting to $95,000 was issued to Hughes for the modification of three missiles used in testing programs. These missiles were loaned to Grumman Aircraft Engineering Corporation as T-14-type missiles, for use in the F-111B flight program for the period July 1 through November 30, 1966. The missiles were then returned to Hughes to be utilized in the completion of the PHOENIX development program. ([redacted])

Accelerated delivery of first missile control system

A modification was made to the Hughes contract to provide for accelerated delivery of the first missile control system to General Dynamics. The original date for this delivery was March 1, 1966; however, it had been revised to July 15, 1967. The modification called for accelerated delivery to be accomplished by November 15, 1966. Delivery was actually accomplished on October 26, 1966.

(UNCLASSIFIED) UNCLASSIFIED

The accelerated delivery modification increased the contract target cost plus target fee by $1,337,500. This increase, according to the Navy, was necessary because the missile control system had to be built with "soft tooling."

(UNCLASSIFIED)

The original plan called for waiting until the low-cost "hard tooled" systems were available. According to Navy officials, the overall weapons system benefited significantly by having early analysis and solution of the avionics integration problem. (UNCLASSIFIED)

Modification of the PHOENIX system for use on the F-14A aircraft

The Navy has directed the Hughes Aircraft Company to perform work to modify the AWG-9 missile control system to provide for its use in the F-14A aircraft. The new features of the proposed modified AWG-9 are to provide for a machine gun which will enable the F-14A aircraft to possess close-in "dogfight" capabilities; remodeled pilot displays and controls which are necessitated by the change in the F-14A of having the copilot seated behind the pilot, whereas on the F-111B the pilot and copilot were seated side-by-side. The reconfigured AWG-9 will have the capacity to handle all versions of the SPARROW and SIDEWINDER missiles, the addition of "identification friend or foe" Mark XII radar capacity, and increased navigational capability. ([redacted])

The change order for the modification established a three-phase study and development program for expanding the capabilities of the airborne missile control system. Phase 1 of the three-phase study consisted of developing technical information on incorporating the additional capabilities into an AWG-9, conducting limited investigations and recommendations on trade-offs, and performing a design review. Phase 2 consisted of comprehensive system function mechanization descriptions of the reconfigured AWG-9 with additional capabilities. Phase 3 will consist of a modification and test of one modified AWG-9 system. ([redacted])

Navy established dollar limitation amounts for Phase 1 and Phase 2 are $1,000,000 and $5,200,000, respectively. The modification for Phase 3 has not been issued. We were advised by a PHOENIX Project Office official that the Navy had placed an informal dollar limitation on the final phase (Phase 3) of the effort. (UNCLASSIFIED)

Effect of termination of the F-111B program on the PHOENIX program

The Navy has indicated that the termination of the F-111B program will result in some delay in the completion of the PHOENIX missile system program. According to a Navy official the F-111B termination will affect the PHOENIX program in the following areas:

Delay in the PHOENIX missile test firing schedule

According to the Navy official, the termination of the F-111B has caused a partial delay in the test firing schedule for the PHOENIX missile. Further, this delay was compounded as a result of the F-111B crashes and the down-time of the aircraft being significantly greater than anticipated. The original test firing schedule was to be completed by June 1968; however, the test firings of the PHOENIX missile are still being conducted.

Delay in production schedule and in fleet introduction

Since the PHOENIX missile system was designed to be used solely on the F-111B aircraft, its production schedule and date of fleet introduction were to coincide with that of the F-111B aircraft. However, the production schedule and date for the PHOENIX missile system fleet introduction are presently planned to coincide with that of the F-14A aircraft.

Termination of the launcher follow-on contract on August 2, 1968

Due to the termination of the F-111B aircraft, the launcher contract was terminated because its design was strictly for this aircraft and could not be used as part of another weapon system. The Navy is presently designing a new launcher for the F-14A aircraft which will be a part of the aircraft and not related to the PHOENIX missile system.

APPENDIXES

APPENDIX I

UNCLASSIFIED

Congress of the United States
House of Representatives
Committee on Appropriations
Washington, D.C. 20515

August 6, 1966

Honorable Elmer B. Staats
Comptroller General of the United States
Washington, D. C.

Dear Mr. Staats:

Further authorization for funding of the F-111 aircraft program has recently been denied by the Congress. As a result, this program is being cancelled [illegible]. It would be appreciated if you would cause a review to be made of certain aspects of this program. The [illegible] is interested in determining the actual cost of [illegible], including the costs incurred as a result of the [illegible].

As a separate but related matter, the Committee would like a review of the cost history of the PHOENIX missile program.

In addition, we are interested in determining the benefits derived from the F-111B program, including the extent to which developments therefrom are being [illegible] other aircraft and related programs.

Sincerely,

George Mahon

Chairman

UNCLASSIFIED

APPENDIX II

DEPARTMENT OF THE NAVY

F-111B/[redacted] WEAPONS SYSTEM PROJECT OFFICE
WASHINGTON, D. C. 20360

IN REPLY REFER TO
PM2-31:BCT

NOV 5 1968

From: Project Manager, F-111B
To : GAO Senior Site Auditor for F-111B
Room 4404 Munitions Building
Washington, D. C. 20360

Subj: GAO Request for Information in Support of Mahon Committee; information concerning

Ref : (a) Informal Discussion Between GAO Representative (Mr. A. J. Leo) and PM-2 Representatives on 25 and 31 Oct 1968

Encl: (1) Utilization of F-111B Assets
(2) List of F-111B New or Newly Applied Design Features

1. During reference (a), it was requested that certain information and data be provided to assist in preparing information for the Mahon Committee. The requested information has been provided except for a current termination plan, a range (upper and lower values) of contract termination costs and the estimated benefits derived from the F-111B program, including the extent to which developments are being incorporated into other aircraft and related programs.

2. Recently, an F-111B termination negotiation team was established by SecAF and is headed by Honorable R. H. Charles (ASAF - I&L). This team, composed of both Air Force and Navy personnel, is directed to negotiate a settlement covering the cancellation of 22 F-111B ship sets. Until a settlement of such negotiation is consummated, it is not possible to provide a final termination plan, nor would it be prudent to prematurely reveal the government's termination objectives.

3. Enclosures (1) and (2) provide "ball park" type estimates as to the asset and design benefits that will accrue to the Navy, Air Force and NASA. It must be recognized, however, that a certain degree of judgement is involved in the allocation of these benefits to the different elements of the Government. Quantification of advances in the state-of-the-art achieved by the F-111B is difficult. However, many benefits were derived in that several new or newly applied design features were employed as indicated on enclosure (2).

THOMAS T. SCAMBOS
By direction

Copy to:
AIR-1021
AIR-5102D
AIR-PMA2-41

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F-111B AIRCRAFT

PROGRAM FUNDING BY FISCAL YEARS

As of September 30, 1968

	Allocations	Commitments	Obligations	Expenditures
	(millions)			
RDT&E:				
1963	$ 9.9	$ 9.9	$ 9.9	$ 9.7
1964	19.9	19.9	19.8	20.4
1965	26.8	26.8	26.8	26.7
1966	69.2	69.2	69.1	61.5
1967	40.0	39.8	30.7	3.7
1968	17.9	17.5	8.6	2.8
Total	183.7[a]	183.1	165.0	124.8
PAM:				
1966	71.2	63.0	59.5	46.4
1967	30.2	8.9	8.5	3.6
1968	143.5	73.1	71.7	37.9
Total	244.9[a]	145.0	139.7	87.9
Program total	$428.6[a]	$328.1	$304.7	$212.7

[a]Excludes funds transferred to PHOENIX missile program. Computation of this amount based on unverified data obtained from the F-111B Project Office.

F-111B AIRCRAFT

PROGRAM FUNDING BY MAJOR PROGRAM ITEM

As of September 30, 1968

	Allocations (note a)	Commitments	Obligations	Expenditures
	(millions)			
RDT&E	$183.7[b]	$183.1	$165.0	$124.8
PAM:				
Airframe items		88.0	84.4	60.4
Engine items		27.1	27.0	9.4
Technical publications		5.4	5.2	5.1
Airframe support equipment		2.9	2.9	2.3
Engine support equipment		2.1	1.9	1.5
Trainers and other support		4.2	4.0	3.0
Spares and spare parts		15.3	14.3	6.2
Total	244.9[b]	144.9	139.7	87.9
Program total	$428.6[b]	$328.1	$304.7	$212.7

[a]Sufficient information to show comparative allocations by program item was not available.

[b]Computation of this amount based on unverified data obtained from the F-111B Project Office.

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F-111B AIRCRAFT

PROGRAM FUNDING BY TYPE OF PROCUREMENT ACTION

As of June 30, 1968

Type of action	Allocations (note a)	Commitments	Obligations	Expenditures
		(millions)		
RDT&E:				
Contracts (note b)		$171.8	$171.7	$114.8
Project orders		0.5	0.5	0.5
Work requests		1.1	1.1	0.8
Field station allotments		6.5	6.5	5.8
Total		179.9	179.8	121.9
PAM:				
Contracts (note b)		139.8	138.5	48.1
Project orders		0.4	0.4	0.4
Field-station allotments		2.0	2.0	0.1
Total		142.2	140.9	48.6
Program total		$322.1	$320.7	$170.5

[a]Sufficient information to show allocations was not available.

[b]Navy military interdepartmental purchase requests funding the Navy portion of Air Force contracts are included in these amounts.

PHOENIX MISSILE SYSTEM

PROGRAM FUNDING BY FISCAL YEARS

AS OF SEPTEMBER 30, 1968

	Allocations	Commitments	Obligations	Expenditures
	(millions)			
RDT&E:				
1963	$ 22.0	$ 22.0	$ 22.0	$ 22.0
1964	64.3	64.3	64.3	64.3
1965	84.6	84.6	84.6	84.5
1966	68.6	68.6	68.6	68.4
1967	71.8	71.8	71.4	69.6
1968	32.8	32.8	32.7	31.2
1969[a]	32.3	22.0	16.1	6.5
F-111B transfers	60.3[b]	57.3	57.3	45.3
Total RDT&E including F-111B transfers to PHOENIX	436.7	423.4	417.0	391.8
PAM:				
1968	30.2	30.3[c]	24.7	6.1
1969[a]	13.0	12.8	5.8	-
F-111B transfers	51.2[b]	51.2	48.6	27.6
Total PAM including F-111B transfers to PHOENIX	94.4	94.3	79.1	33.7
Total for program	$531.1	$517.7	$496.1	$425.5

[a]Represents only first quarter of fiscal year 1969.

[b]Computation of these amounts based on unverified data obtained from the F-111B Project Office.

[c]Commitments exceed allocations by $102,000.

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PHOENIX MISSILE SYSTEM

PROGRAM FUNDING BY PROGRAM ITEM

AS OF SEPTEMBER 30, 1968

Item	Allocations	Commitments	Obligations	Expenditures
	(millions)			
RDT&E (note a)	$376.4	$366.1	$359.7	$346.5
F-111B transfers	60.3[b]	57.3	57.3	45.3
Total RDT&E	436.7	423.4	417.0	391.8
PAM	43.2[a]			
Procurement		39.5	28.9	5.8
Production support		1.8	1.1	0.1
Fleet support		0.6	0.5	0.2
Publications		0.1	-	-
Spare parts		1.1	-	-
F-111B transfers	51.2[b]	51.2	48.6	27.6
Total PAM	94.4	94.3	79.1	33.7
Total for Program	$531.1	$517.7	$496.1	$425.5

[a]Information was not available to distribute these amounts to major program items.

[b]Computation of these amounts based on unverified data obtained from the F-111B Office.

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PHOENIX MISSILE SYSTEM

PROGRAM FUNDING BY TYPE OF PROCUREMENT ACTION

AS OF SEPTEMBER 30, 1968

Type of action	Allocations (note a)	Commitments	Obligations	Expenditures
		(million)		
RDT&E:				
Contracts		$382.1	$381.5	$363.2
Project orders		4.0	4.0	3.8
Work requests		13.0	10.3	7.4
Field station allotments		20.8	20.8	16.4
Total RDT&E		419.9[b]	416.6[b]	390.8[b]
PAM.				
Contracts		88.7	73.5	30.5
Project orders		0.1	0.1	0.1
Work requests		0.1	0.1	0.1
Field station allotments		5.4	5.4	3.2
Total PAM		94.3	79.1	33.9[b]
Program total		$514.2[b]	$495.7[b]	$424.7[b]

[a]Sufficient information to show allocations was not available.

[b]Although all information was taken from Navy records, the totals shown on this schedule do not agree with the totals on the two preceding schedules. The causes for these disagreements were not readily ascertainable.

APPENDIX V

SUMMARY OF THE I

AWARDED FOR THE F

Contract	Contractor	Contract amount	Actual contractor cost as of June 30, 1968	Contract status as of June 30, 1968
NOw 62-0773	Pratt and Whitney Division, United Corporation	1968		
NOw 65-0562	Radio Corporation America	935	$10,186,327	Completed
NOw 66-0638	Pratt and Whitney Division, United Corporation	911	1,206,594[b]	Ongoing
NOw 63-0140	Pratt and Whitney Division, United Corporation	990	29,636,583	Completed
NOw 65-0613	Grumman Aircraft neering Corporat	500	3,639,951	Do.
NOw 66-0155	Pratt and Whitney Division, United Corporation	000	1,850,000[b]	Do.
NO0019-67-C-0332	Pratt and Whitney Division, United Corporation	000	2,981,694	Do.
NO0019-67-C-0060	Litton Systems,	660[c]	4,693,736[b]	Ongoing
	Total as of June	229	2,272,000	86% complete
		425	$56,466,885	

[a] This is the date of the first modificatio
sic contract and previous modifications d

[b] This is the amount shown as expended by N
available.

[c] Modification number P026, dated August 7,
part for the convenience of the Governmen
$61,739,028.

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APPENDIX VI

SUMMARY OF CO

THE PHOENI

Contract	Contractor		Actual costs as of June 30, 1968	Contract status as of June 30, 1968
NOw 63-0086	Hughes Aircraft Co.	Perf cati	$ 1,[illegible],246	Completed
NOw 63-0379	do.	Desi	31[illegible],232,357	Ongoing
NOw 65-0621	do.	Cond P-11	1[illegible],[illegible]59	Completed
NOw 65-0622	do.	Cond ried	13,732	Do.
NOw 66-0483	do.	Cond	[illegible],000	Do.
NOw 66-0557	do.	Inve its	73,500	Do.
N00019-67-C-0056	do.	Cond cont	65,000	Do.
N00019-67-C-0036	do.	Cond cati	50,376	Do.
N00019-67-C-0123	do.	Prov Orum tem	1,372,[illegible]67	Do.
N00019-67-C-0126	do.	Prep syat	[illegible]5,000	Do.
N00019-67-C-0178	do.	Alte	1,749,[illegible]80	Ongoing
N00019-67-A-0374	do.	Basi	11,075	Completed[a]
N00019-67-C-0240	do.	AWD-	54,[illegible]42,657	Ongoing
N00019-68-C-0160	do.	La in	2,243,902	Terminated 8-2-68
N00019-68-C-0235	do.	Miss	[illegible],[illegible]31,737	Ongoing
N00019-68-A-0[illegible]	do.	Basi	2,725	Unknown
NOw 64-0157	do	Mall		Completed
NOw 63-0405 (modification 24)	General Dynamics Corp.	Perf	Readily available	Do.
N00019-68-C-0224	Veda, Incorporated	Cond of t itie simu	do.	Do.
N00019-68-C-0291	do.	Prep and P-11	do.	Unknown
NOw 63-0724	Cornell Aeronautical Laboratory, Inc.	Perf	do.	Completed

Total amount of contracts as of June 30, 1968

Contract	Contractor	
	(Additional definitized contract	
N00019-68-C-0584	Hughes Aircraft Co.	Bail
NOw 63-0379	do.	Addi
N00019-67-C-0240	do.	Fund
N00019-68-C-0295	do.	Addi
N00019-68-C-0613	Veda, Incorporated	1. P comp
		2. P grat
		3. P syat
N00019-69-C-0078	Resource Management Corp.	Inve pric

Total amount of all contracts awarded, as of November 1968

[a]Contract amount is only a dollar limitation.

[b]Contract expired September 1968.

[c]Contract amount as of November 1968.

PRINCIPAL OFFICIALS

OF THE DEPARTMENT OF DEFENSE

AND THE DEPARTMENT OF THE NAVY

RESPONSIBLE FOR ADMINISTRATION OF ACTIVITIES

DISCUSSED IN THIS REPORT

	Tenure of office	
	From	To
DEPARTMENT OF DEFENSE		
SECRETARY OF DEFENSE:		
Clark M. Clifford	Mar. 1968	Dec. 1968
Robert S. McNamara	Jan. 1961	Feb. 1968
DEPUTY SECRETARY OF DEFENSE		
Paul H. Nitze	July 1967	Dec. 1968
Cyrus R. Vance	Jan. 1964	June 1967
Roswell L. Gilpatric	Jan. 1961	Jan. 1964
ASSISTANT SECRETARY OF DEFENSE (INSTALLATIONS AND LOGISTICS):		
Thomas D. Morris	Sept. 1967	Dec. 1968
Paul R. Ignatius	Dec. 1964	Aug. 1967
Thomas D. Morris	Jan. 1961	Dec. 1964
DEPARTMENT OF THE NAVY		
SECRETARY OF THE NAVY:		
Paul R. Ignatius	Aug. 1967	Dec. 1968
Vacant	July 1967	Aug. 1967
Paul H. Nitze	Nov. 1963	June 1967
UNDER SECRETARY OF THE NAVY:		
Charles F. Baird	July 1967	Dec. 1968
Robert H. B. Baldwin	July 1965	June 1967

PRINCIPAL OFFICIALS

OF THE DEPARTMENT OF DEFENSE

AND THE DEPARTMENT OF THE NAVY

RESPONSIBLE FOR ADMINISTRATION OF ACTIVITIES

DISCUSSED IN THIS REPORT (continued)

	Tenure of office	
	From	To
DEPARTMENT OF THE NAVY (continued)		
UNDER SECRETARY OF THE NAVY (continued):		
Kenneth E. Belieu	Feb. 1965	July 1965
Paul B. Fay, Jr.	Feb. 1961	Jan. 1965
ASSISTANT SECRETARY OF THE NAVY (INSTALLATIONS AND LOGISTICS):		
Barry J. Shillito	Apr. 1968	Dec. 1968
Graeme C. Bannerman	Feb. 1965	Apr. 1968
Kenneth E. Belieu	Feb. 1961	Feb. 1965

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Line	Article Number	Name of Addressee, Street, and Post-Office Address	Remarks
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14			

Total Number of Pieces Listed by Sender	Total Number of Pieces Received at Post Office	Signature of Receiving Employee	Postmark of
1			**Receiving Office**

FLC 5119-1 Rev (4-12)