REPORT TO THE
COMMITTEE ON ARMED SERVICES
UNITED STATES SENATE

F-14 Aircraft Program Cost Analysis

B-168664

Department of the Navy

BY THE COMPTROLLER GENERAL
OF THE UNITED STATES

FEB. 15, 1972

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

B-168664

Dear Mr. Chairman:

By letter of April 9, 1971, you requested our Office to review and analyze projected costs under the Department of the Navy's F-14 program. Since that time we have issued three letter reports to you, dated April 27, June 1, and September 3, 1971, and have held discussions with your staff on several questions raised. This report primarily pertains to specific aspects of the cost estimates prepared by the Grumman Aerospace Corporation for 313 F-14A aircraft. You expressed an interest in these aspects in your letter of July 12, 1971. As requested in your July 12 letter, this report also deals with cost and contractual aspects of the F-14 engine and AWG-9 fire control system programs.

AIRFRAME

Question

How much of the material cost estimate is accounted for by subcontract prices under firm commitments with subcontractors? and how much is Grumman's conjecture of increases that may be claimed by subcontractors?

Response

At the time Grumman was awarded the prime contract in February 1969, it did not have firm commitments from its subcontractors. It took up to 16 months from the award of the prime contract to get firm commitments for lot I from all the major subcontractors. In March 1971 Grumman estimated that its material costs would be $1,214 million, an increase of $543 million since February 1969. Our review showed that the primary reasons for these increased costs were: (1) economic reasons involving inflation and loss of business base by the subcontractors, (2) optimistic estimating of subcontract costs by Grumman, and (3) changes initiated by Grumman in the

work required of the subcontractors. The March 1971 material cost estimate comprised:

	Amount (millions)
Major subcontracts	$ 688.1
Purchased parts	209.3
Raw material	98.0
Escalation	55.7
Anticipated reduction during subcontract negotiations	-21.0
Miscellaneous procurements	147.8
Contingency for price growth	40.2
Test equipment	1.4
Arithmetic error	-5.1
Total	$1,214.4

We reviewed 11 of the larger subcontracts awarded to 10 subcontractors. These subcontracts were selected because their prices were significantly higher than Grumman's earlier estimate. Their current total price is about $464 million and represents about 67 percent of Grumman's estimate of $688 million for subcontracts. We were unable to verify the validity of $132 million of the $464 million estimate because this amount consisted of estimates of changes or of estimates of the cost of future lots which were not covered by subcontract terms and conditions.

The estimates totaling $332 million that we did review generally were based on firm prices negotiated with subcontractors for lots I and II and on not-to-exceed prices for future lots. The purchase orders generally contained not-to-exceed prices for future lots based on a 469-aircraft schedule and provided formulas or other criteria for determining prices of varying quantities.

Since Grumman's March 1971 estimate was based on a 313-aircraft schedule, the terms and conditions of each purchase order had to be examined closely to arrive at the March 1971

estimate. To the basic subcontract prices, Grumman usually applied factors for escalation of lots VI and VII prices, since the subcontracts generally contained provisions for abnormal inflation similar to those in the prime contract, and applied a discount factor to estimate the amounts by which it expected the prices to be reduced through negotiations.

We found that the basic prices for the subcontracts we reviewed were overstated by about $6.7 million, primarily due to incorrect computations of not-to-exceed prices for future lots. We found also, in a review of $38.4 million of the $55.7 million escalation provided, that in some cases escalation had been applied for subcontracts which did not contain escalation provisions and that estimated rates, rather than the rates provided for in the subcontracts, had been used. As a result escalation was overstated by $8.7 million. The application of the Grumman discount factors--about $1 million--to the $6.7 million and $8.7 million overstatements and the adjustment for a $5.1 million arithmetic error resulted in a net overstatement of $9.3 million of the subcontract costs reviewed.

Question

For the 10 subcontractors trace the subcontractor quotes of August 1968 to Grumman's October 1968 proposal, Grumman's revised proposals of January 1969, the F-14 contract signed in February 1969, and ultimately the purchase orders placed with the vendors.

Response

The subcontractors' quotes obtained primarily in August 1968, the October 1968 proposal, and the February 1969 contract were based on a quantity of 469 aircraft. The March 1971 estimate we reviewed, however, was based on a quantity of 313 aircraft. A comparison of available data on both quantities of aircraft and the results of our review of the 313-aircraft estimate for these subcontractors is shown in appendix I.

Question

What is the basis for Grumman's March 1971 estimate of labor costs?

Response

In March 1971 Grumman estimated that its labor costs would be $343.7 million, an increase of $21.9 million over its estimate at the time of contract award. Although the estimated labor-hours have decreased by about 6.5 million hours, the estimated costs have increased due to rising labor rates.

The current labor-hour estimates are based on the actual hours incurred through December 1970, and on the judgment of functional, program, and estimating personnel for the years 1971 through 1977. The total hours have decreased due to the following reasons.

	Increase or decrease(-) in hours (millions)
Change in certain functions from direct to indirect	-1.8
Make-to-buy change	-5.0
Contract changes	1.3
Other reductions	-1.0
Total	-6.5

We found that some errors had been made in assembling the various estimates of labor-hours, which resulted in an understatement of $2.9 million in labor costs.

The labor rates used in Grumman's March 1971 estimate were the actual hourly rates experienced on the F-14 contract through December 1970, the average corporate rates negotiated with the Navy for forward-pricing purposes for 1971 and 1972, a 6.5-percent increase over the 1972 rates for 1973, and a

6-percent annual increase over the prior year's rates for 1974 through 1977. The increased labor rates are due to higher wages and to the effect of the layoff of lower priced employees.

Question

What is the basis for Grumman's March 1971 estimate of overhead costs?

Response

In March 1971 Grumman estimated its overhead costs to be $800.7 million, an increase of $302.7 million over its estimate at the time of contract award.

The overhead rates used in preparing the March 1971 estimate were the actual rates experienced through December 1970, generally the negotiated forward-pricing rates for 1971 and 1972, a 4-percent increase over 1972 rates for 1973, and a 3-percent annual increase over the prior year's rates for 1974 through 1977. A comparison of the original and current estimated overhead costs, by type of overhead, is shown below.

Overhead category	At contract award February 1969	Estimate at March 1971	Increase
	(millions)		
Material	$ (a)	$ 76.2	$ 76.2
Engineering	84.1	86.7	2.6
Manufacturing	242.9	331.4	88.5
General and administrative	171.0	306.4	135.4
Total	$498.0	$800.7	$302.7

[a]Category established January 1, 1970.

The increase in the overhead cost estimate is due, in part, to the reduced business base of Grumman. When the

overhead costs are allocated to a reduced base, an increased rate results. Also the wages of overhead personnel have increased. Further the resulting increased rate of overhead is applied to higher direct costs.

The application of overhead to the overstatements and understatements we found in Grumman's labor and material estimates resulted in a $4.8 million understatement of overhead as follows:

	Basic overstatement or understatement(-)	Applicable overhead
	(millions)	
Labor	-$2.9	-$7.0
Material	9.3	2.2
Total	$6.4	-$4.8

Question

What portion of the cost increase is attributable to inflation, reduced business base, increased subcontractor costs, development problems, and the effect of the recent crash of the initial aircraft?

Response

At the time Grumman prepared its estimate, lots I, II, and III were under contract for a total of 38 aircraft. The options for the remaining lots (lots IV through VII), totaling 275 aircraft, had not been exercised, and a Grumman analysis of the increase in the estimated costs for those lots indicated that about 75 percent of it was due to the effect of inflation and reduced business at Grumman and its subcontractors.

The direct-cost impact of the crash of the initial aircraft has not been included in Grumman's March 1971 estimate since this impact will be the subject of future separate negotiations with the Navy. Grumman feels that the crash was caused by factors beyond its control and thus is not part of its responsibility under the contract. Other development problems at that time were considered to be those normally expected in a development program.

Appendix II shows Grumman's analysis of the reasons for the estimated cost increases, by element of cost, for lots IV through VII.

Question

Were the assumptions made by Grumman in preparing its study valid and reasonable?

Response

The March 1971 estimate was predicated on the basic assumptions that:

--There would be continued inflation and significant reductions in future Grumman business. This appears to have been a reasonable assumption at that time.

--There would be continuous production. This assumption was necessary, since any stretch or gap in production would change the established contract ceiling prices.

--No significant changes would be required as a result of the flight-test program. We believe that this was an optimistic assumption, in view of the loss of the initial aircraft in December 1970 during the start of the flight-test program. Further, according to the Navy, changes generally result from flight-test programs and, due to the complexity of the F-14, they could be major. The assumption that technical objectives would be met as planned could result in a significant understatement of the estimated costs.

--Grumman's estimate of $40 million would be sufficient to cover any demands by subcontractors for upward adjustments to their option ceiling prices due to loss of business base or other problems. This estimate was based on the judgment of Grumman officials, and we were unable to verify it.

Since the total March 1971 estimate of $2,383 million was premised on many judgmental factors and predictions of future economic and business conditions, it is not possible to predict the ultimate cost with any degree of certainty. In addition, while an aircraft is still being developed there is no way to determine with certainty whether the amounts provided in the cost estimate for resolving high-risk areas are adequate. Although our selective review of the estimate showed a total net overstatement of $1.6 million (labor $2.9 million understated, material $9.3 million overstated, and overhead $4.8 million understated), we believe that the estimate was optimistic, at best, in view of the assumptions made.

Events since March 1971 have shown that some of the assumptions were not valid and that some of the estimates were not reasonable. Events contributing further to the difficulty of predicting eventual costs are:

--Aircraft deliveries and the flight-test program are running behind schedule. The delivery of the last aircraft in lot I has slipped 3 months, and the last aircraft in lot II is 2 months behind the contract schedule. The Board of Inspection and Survey trials are expected to slip about 6 months. Due to these and to other delays, potential changes that would have been known by now as a result of flight testing are still unknown.

--The estimated costs for the 10 subcontractors we reviewed have increased by about $88 million since March 1971. It appears therefore that Grumman's $40 million March contingency provision was inadequate.

Our review of Grumman cost estimates was based on the March 1971 cost projection. The Navy's F-14 Project Office recently advised us that it now projects the total Grumman loss on 313 F-14A aircraft at $412.1 million, $44.7 million more than the March 1971 loss estimate prepared by Grumman. The differences between the two estimates are applicable to lots I through IV.

F-14 FIRE CONTROL SYSTEM

Question

What is the current estimate of costs of the F-14 fire control system? and how firm are the contract prices for this system?

Response

Development is covered under three contracts: a cost-plus-incentive-fee contract, covering AWG-9 reconfiguration for the F-14 aircraft; a fixed-price-incentive contract, covering production prototypes; and a cost-plus-award-fee contract, covering flight test and support. Work under the first two of these contracts is largely completed (except for production effort, which is included in the production prototype contract).

Cost performance on the AWG-9 development contracts has generally been on schedule. The combined prices initially proposed for these contracts was $258.5 million. Information currently available indicates that the price of this work at completion will be about $293.8 million. About $4.3 million of this $35.3 million increase is attributable to factors under the control of the AWG-9 contractor. (See apps. III, IV, V, and VI.) The remainder of the price increase is attributable to scope changes, slippages in the dates for receiving two F-14's at Hughes Aircraft Company ($6.9 million), and procurement of provisioned items.

Production of the AWG-9 is covered under options contained in the production prototype contract. This contract

provides for seven annual lot options, beginning with fiscal year 1971. The option provision of the contract specifies maximum and minimum quantities for each year and provides a formula for determining a ceiling price for any selected option quantity.

The fiscal year 1971 and 1972 options have been exercised by the Navy as scheduled. Hughes submitted proposals for definitive prices for these options which were less than the applicable ceiling prices. The proposed unit target price for the first option was $2.79 million. The unit ceiling price for the quantity purchased under that option was $3.04 million. The proposed unit target price for the second option was $2.10 million, whereas the ceiling price was $2.36 million. Since the proposal for the 1971 buy was based on a schedule for delivery of F-14 aircraft to Hughes, which was not met, contractor officials expect that the effect of the revised aircraft delivery schedule to Hughes will be considered in the negotiations.

Although all elements and quantities for the production program have not yet been defined to Hughes by the Navy, the value of AWG-9 production is about $961 million on the basis of current information. This amount is derived by adding the ceiling prices for AWG-9 production and AWM-23 ground support equipment to the Hughes estimates for engineering changes, test equipment, spares, and various other program elements. (See apps. III and VII.)

Trainers for missile control officers are not included in the above estimate because they are being purchased from Hughes separately by the Navy's training command. Their current estimated development and production price is $21.4 million.

F-14A ENGINES

Question

What is the current estimate of F-14A engine costs? and how firm are the contract prices for these engines?

Response

The engines being produced by the Pratt & Whitney Aircraft Division, United Aircraft Corporation, East Hartford, Connecticut, for use in the F-14A aircraft are designated as TF-30-P-412 (P-412) engines.

The P-412 engine was developed by Pratt & Whitney in 1969 and 1970 under two cost-plus-incentive-fee-type contracts issued by the Naval Air Systems Command. The P-412 engine was based on the P-12 engine which Pratt & Whitney previously had produced. Production of the P-412 engine began in calendar year 1971 under an annual fixed-price-incentive-type contract awarded by the Navy to Pratt & Whitney for the delivery of several types of military engines. A production contract calling for deliveries during calendar year 1972 also has been awarded.

Work under the two development contracts has been completed, but final prices have not been determined. The contractor estimates that the final price of this work to the Government will be $33.2 million, which is only $1.6 million greater than the combined initial target prices. This increase in price was associated with routine development effort.

The initial production contract provided for delivery of several types of engines, including the P-412 engine, during calendar year 1971. This contract, dated February 3, 1970, established an initial target price of $715,451 for each of the 22 P-412 engines to be procured. The contract specified that the prices be based on the procurement of a certain minimum quantity of engines and that the prices be converted to Pratt & Whitney's new accounting system, which became effective January 1, 1971.

The new accounting system was instituted at the insistence of the Government, to provide a more accurate reflection of the actual cost of military engines. Pratt & Whitney officials have advised us that the new accounting method permits a closer alignment of total direct material costs and total direct labor costs to engine models than did the former

method, which tended to average direct material and direct labor variations from standard costs over a total volume base.

Pratt & Whitney has submitted three price proposals based on the new accounting system at various times since the establishment of the initial target price; the most recent proposal was made in June 1971. Pratt & Whitney and naval plant representative personnel informed us that a price of $943,500 an engine for a quantity of 37 engines had been agreed upon in November 1971; however, contractual documents have not yet been processed.

The increased costs of about $230,000 an engine, the difference between the initial price and the finally negotiated price, appeared to have been caused primarily by a change from the old to the new accounting system and by an increase in overhead costs due to a decrease in engine production volume. Contractor representatives indicated that a specific amount of the increase could not be attributed readily to any single cause. The following schedule compares the volume of engines anticipated at the time of Pratt & Whitney's original proposal with the volume of engine production used as a basis for the contractor's June 1971 proposal.

Volume of Engines Included in Proposal

	November 1969	June 1971	Difference	Percent of reduction
Military	467	378	89	19
Commercial	1,069	778	291	27
	1,536	1,156	380	25

Because the old accounting system has been discontinued, there is no means of comparing the contractor's June proposal using the new accounting system with similiar data using the old accounting system.

Appendix VIII compares the major elements of costs included in Pratt & Whitney's proposal for the P-412 engine,

upon which the initial unit prices were established, and the proposal submitted in June 1971.

The second F-14A engine contract covers engines to be delivered in calendar year 1972. Like the initial production contract, this contract is for various other Pratt & Whitney engines, as well as for the P-412.

This contract, dated January 29, 1971, established provisional billing prices; however, initial target prices have not yet been negotiated. The billing price for the P-412 engine is $950,000 an engine. Pratt & Whitney submitted a proposal on November 23, 1971, which included a unit price of $941,609 for 98 P-412 engines. Price negotiations have not been initiated by the Navy.

F-14B ENGINES

Question

What is the current estimate of F-14B engine costs? and how firm are the contract prices of these engines?

Response

As we indicated in our preliminary report to you dated September 3, 1971, options under the Navy production contract for advanced-technology engines to be used in the F-14 aircraft had not been exercised, and the use of the advanced-technology engine is no longer included in formal Navy plans. The Navy has indicated that it wants time to accomplish more testing of the new engine before it commits itself to production. Navy officials freely admit the desirability of procuring these engines if testing shows them to be operationally suitable. Because of the likelihood that the advanced-technology engine will be reintroduced into the F-14 program, we included it in the scope of our review efforts.

The Navy is continuing its participation with the Air Force in developing the new engine under an Air Force contract

with Pratt & Whitney. This contract has three line items: (1) development itself, (2) fabrication of prototypes and support of flight tests, and (3) initial production quantities of the Air Force version of the engine. Because the costs incurred under the last two line items were relatively small to date, we limited our concern to the first line item--development.

In July 1971 agreement was reached to increase the estimated cost of the development line item from $271.5 million--the target cost at the time of contract award--to $393.7 million, an increase of $122.2 million. The Navy and the Air Force will bear $110 million of this increase, and the contractor will bear $12.2 million under the cost-plus-incentive-fee arrangement applicable to this part of the contract.

We were told by contractor officials that this revised estimated cost represented agreement on the estimated cost of the total development effort and that the revised estimated cost had not been negotiated by cost element.

In March 1971 Pratt & Whitney estimated that the cost of the development line item would exceed the negotiated target cost by $65.3 million and submitted a proposal for $58.7 million additional, which represented the Government's part of the increase under the 90 to 10 cost-sharing arrangement.

The Air Force-Navy Joint Engine Project Office concluded that greater effort than was provided for in this proposal would be required to ensure successful engine development on schedule. Therefore Pratt & Whitney identified development problems and specific areas of additional work required, indicating additional costs totaling $140 million. (See app. IX.)

Although Pratt & Whitney officials told us that this revised cost estimate was not presented to the Joint Engine Project Office, the contract was subsequently modified, as previously mentioned, to increase the estimated costs of development by $122.2 million.

Labor costs accounted for $23 million of the $140 million increase that was estimated in June 1971. Labor costs were escalated at an annual rate of 5.5 percent for 1970 and 1971 and 5 percent thereafter.

Our analysis of the increases revealed that about $21.2 million of the increase was due to an increase in estimated labor-hours. The remaining $1.8 million of the increase was found to be due primarily to an inadequate escalation provision in the rates originally proposed for manufacturing labor. Differences in projected rates for other types of labor were minor.

The endeavor to manufacture, or to subcontract for the manufacture of, engine components that are sufficiently durable but significantly lighter than existing components has resulted in an increase of about $54 million in the contractor's estimated material costs. The contractor attributes the estimated increase of $38.5 million in manufacturing materials primarily to the need for additional sets of parts for test purposes, to increased costs of major parts and controls, and to higher costs of advanced technology required to develop the fuel pump and the fan blades.

Overhead expenses make up about one third of the additional target cost negotiated. In June 1971 Pratt & Whitney estimated that overhead costs would be about $63 million more than the amount estimated at the time of contract award. The contractor attributes about $36 million of the increase to indirect expenses that vary with changes in direct costs and the remaining $27 million to a greater allocation of fixed expenses to the contract than originally was anticipated. This greater allocation is due in part to the increase in the estimated cost of the program and in part to a projected decrease from $1 billion to $780 million in the contractor's total business volume for calendar years 1970-73.

We noted that, during negotiation of the development contract, the contractor reduced its proposed target price for the development line item from $439.1 million to $271.5 million, a reduction of $167.6 million.

Following receipt of the initial price proposals in August 1969 from Pratt & Whitney and the competing contractor, General Electric Company, the Joint Engine Project Office instructed the contractors to reduce the scope of their development programs and to submit revised proposals with respect to the development line item. The reduced scope included a reduction from 14,000 to 12,000 test hours.

The Joint Engine Project Office advised the contractors that their revised price proposals were to be realistic but that revisions were necessary to negotiate a contract within the constraints of available funding. Therefore the two potential contractors were asked to examine into their programs critically, with a view to reducing costs.

In compliance with the Joint Engine Project Office's request, Pratt & Whitney submitted a revised proposal in December 1969. In this proposal the contractor stated that the new cost estimates were the result of the directed changes to the scope of the program. Further Pratt & Whitney stated that specific cost and engineering data from the initial development program, used in preparing the new proposals, had not been available early in 1969 when cost and planning data were obtained for the August 29, 1969, proposal.

Pratt & Whitney stated that, in addition to the reduced requirements for engine hardware resulting from the directed change from 14,000 to 12,000 engine-test hours, reduced hardware and related costs in the new proposal reflected increased confidence levels resulting from success in surpassing contract performance requirements in the initial development program.

Our review of the two proposals showed that Pratt & Whitney had used historical data from other engine development programs which were considered to be similar to the advanced-technology engine development program. Data from the advanced-technology engine initial development program were used to the extent available for the December proposal. Where comparable historical data were not available,

estimates of material and labor requirements were based on the judgment of responsible contractor engineers.

Naval technical evaluations and Defense Contract Audit Agency reviews, which we consider to have been thorough, were made of both of these proposals. Although the naval technical evaluation recommended some reductions in labor-hours and materials and the Defense Contract Audit Agency questioned some costs, the Joint Engine Project Office considered the revised proposal as an acceptable basis for negotiation purposes.

The procuring contracting officer informed us that, prior to negotiations, the Joint Engine Project Office engineers made a final review of the revised proposals submitted by both Pratt & Whitney and General Electric and that, although both of the contractors' initial development programs indicated no insurmountable problems, the engineers believed that Pratt & Whitney's proposed engines involved less developmental risk than the General Electric engines.

This report was not submitted to the contractors involved or to the Navy for formal, written comments; however, its contents were informally discussed with Navy and contractor representatives.

Grumman considers the information contained in this report to be confidential; therefore the disclosure of that information might violate section 1905 of title 18 of the United States Code. 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,

Comptroller General
of the United States

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

APPENDIXES

COMPARISON OF AVAILABLE GRUMMAN DATA AND

SUMMARY OF GAO REVIEW OF SELECTED SUBCONTRACTS

(Dollars in thousands)

	Multipurpose display indicator group (IBM)	Phoenix launcher (Hughes)	Vertical display indicator group (Kaiser)	Air inlet control system (AiResearch)
469 AIRCRAFT PROGRAM:				
Quotes obtained primarily in August 1968:				
Number	(a)	2	3	2
Amounts	$ -	$10,200 to 47,100	$31,100 to 61,600	$12,300 and 21,900
Amount in Grumman's October 1968 proposal	(d)	11,577	52,251	12,098
Amount in February 1969 contract	7,971	8,994	39,265	10,270
Purchase order award	23,349	17,052	48,819	13,713
Grumman's estimate at completion as of March 15, 1971	23,355	20,006	52,842	22,070
313 AIRCRAFT PROGRAM:				
Purchase order award--basic	18,115	13,660	43,827	10,026
Grumman changes	83	2,624	503	9,265
Navy changes	-	-	3,303	-
Grumman estimates at completion as of March 15, 1971	$18,198	$16,284	$47,633	$19,291
Amount reviewed by GAO	$18,151	$35,791	$47,266	$17,226
Grumman estimate overstated or understated (-)	212	405	4,287	285

[a]None.

[b]Covered slats only with flaps and spoilers to be made in-house by Grumman.

[c]Not applicable.

[d]Not included.

[e]Make item.

[f]Slats based on quote of $9,794,000 and flaps and spoilers based on Grumman's in-house estimate of $20,175,000.

[g]Covered nacelle only.

[h]Included inlet duct.

Sparrow launcher (Raytheon)	Jettison release mechanism (Edo)	Weapons rails (Western Gear)	Slats, flaps, and spoilers (Kaman)	Aft center fuselage (F-H)	Nacelle inlet duct (Rohr)	Glove (Rohr)	Total
2	(a)	(a)	1[b]	1	1	(a)	(c)
$ 8,400 and 18,900	$ -	$ -	$ 9,758[b]	$87,631	$265,478	$ -	$424,867 to 512,367
10,937	(d)	(e)	29,969[f]	80,440	199,109	(e)	396,381
7,960	(d)	(e)	24,833	63,895	160,468	(e)	323,656
10,685	4,665	21,220	42,200	70,264	117,640[g]	185,000[h]	554,607
13,502	6,364	21,220	53,606	94,942	130,077[g]	187,389[h]	625,373
8,590	3,541	14,853	34,056	54,774	91,484[g]	108,981[h]	401,907
4,540	1,062	-	9,421	19,329	8,738[g]	3,249[h]	58,814
-	-	-	-	-	-	-	3,303
$13,130	$4,603	$14,853	$43,477	$74,103	$100,222[g]	$112,230[h]	$464,024
$12,641	$4,511	$ 4,814	$43,477	$54,774	$ 91,143[g]	$ 21,907[h]	$331,701
232	11	90	-96	1,272	-47[g]	10[h]	6,661

APPENDIX II

SCHEDULE OF REASONS FOR ESTIMATED

COST INCREASES BY ELEMENT OF COST

LOTS IV THROUGH VII

	Labor	Material	Overhead	Other direct charges	Total
	(millions)				
ORIGINAL ESTIMATE	$149.1	$457.1	$264.8	$ 8.4	$ 879.4
CHANGES DUE TO:					
Grumman accounting changes	-2.9	-	-8.6	.8	-10.7
Inflation at Grumman	28.5	-	73.0	1.5	103.0
Grumman reduced business	5.6	-	124.2	1.4	131.2
Subcontractor inflation and reduced business including Grumman overhead	-	226.0	53.9	-	279.9
Other vendor changes	-	145.7	34.5	-	180.2
Reduction of sustaining hours	-6.9	-	-12.4	-.3	-19.6
Increase in production hours	15.1	-	32.6	.8	48.5
Tooling increase	1.6	-	3.7	-	5.3
Change from make to buy	-22.9	56.4	-35.5	-1.2	-3.2
Effect of calendar year pricing (note a)	-4.8	-	-17.3	-.3	-22.4
Total changes	13.3	428.1	248.1	2.7	692.2
March 1971 estimate	$162.4	$885.2	$512.9	$11.1	$1,571.6

[a]Grumman's original estimate by lot was based on all the effort being performed in the year of aircraft delivery (calendar year pricing). This results in a higher estimate than pricing based on the years of actual effort. Since the March 1971 estimate was based on the year of actual effort, the above adjustment is necessary to make the estimates comparable.

TOTAL PROGRAM ESTIMATES FOR AWG-9 DEVELOPMENT AND PRODUCTION

Development estimates	Initial proposed price	Current estimate at completion	Difference	Reason for difference
	(millions)			
AWG-9 and AWM-23 reconfiguration for F-14	$127.7	$132.2	$ 4.5	(a)
AWG-9 prototype program	95.7	105.7	10.0	(b, c)
F-14 armament system flight test and support program	35.1	55.9	20.8	(b, d)
Total	$258.5	$293.8	$35.3	
Production estimates				
AWG-9 production at ceiling	$635.2[e]	$635.2		
AWM-23 ground support equipment at ceiling	173.2[e]	173.2		
Engineering change proposals	(f)	28.6		
Test equipment and other ground support equipment	(f)	11.9		
Spares	(f)	111.6		
Other	(f)	.5		
Total	(f)	$961.0		

[a]Price over target ($4.3 million) and minor adjustments.

[b]Scope changes.

[c]Planned procurement of provisioned items.

[d]Slippage of F-14 bailment to Hughes (estimated at $6.9 million).

[e]Based on production option ceiling price provisions in the development contract, except that, for 1 year, the AWM-23 estimate is based on a proposed target price. (See app. VII.)

[f]No formal proposal covering total program.

APPENDIX IV

SUMMARY OF PRICE CHANGES FOR AWG-9 DEVELOPMENT CONTRACT

DESCRIPTION: Pilot production and development effort to reconfigure seven AWG-9 systems and one set of ground support equipment (AWM-23) for the F-14 aircraft program (note a).

TYPE OF CONTRACT: Cost-plus-incentive-fee, with ceiling

FUNDS: Development

	Price change	Cumulative total
	(000 omitted)	
PROPOSALS--DATE AND DESCRIPTION:		
June 3, 1968, change order authorizing phase I work	$ -	$ -
July 16, 1968, phase I proposal (note b)	992.9	992.9
August 16, 1968, phase II proposal	6,302.3	7,295.2
December 3, 1968, phase III proposal, AWG-9	85,464.0	92,759.2
December 19, 1968, phase III proposal, AWM-23	34,910.0	127,669.2[c]
Adjustments to negotiated total (note d):		
Phase I --change from proposal	17.1	127,686.3
Phase II --change from proposal	-1,103.3	126,583.0
Phase III--change from proposal	1,292.3	127,875.3
Negotiated amount over target price, phase III	4,347.4	132,222.7[e]
Current estimate at completion		$132,223.0[e]

[a]Our analysis of this contract covers only that part which is related to the F-14 program--generally those costs incurred subsequent to July 1968.

[b]Phase I was a study to reconfigure the AWG-9 for installation in the F-14A. Phase II consisted of preliminary design effort, detailed functional descriptions, rewriting specifications, and authorized design of ground support equipment. Phase III provided for seven reconfigured AWG-9 systems.

[c]This figure represents the sum total of the initial proposals for the F-14 parts of the contract. (See app. III.)

[d]The breakdown furnished by Hughes is an approximation, since phases I, II, and III were negotiated in total.

[e]Does not include the cost ($74 million) of the contract that relates to the F-IIIB program.

SUMMARY OF TARGET PRICE CHANGES

FOR CONTRACT FOR AWG-9 PROTOTYPE PROGRAM

TYPE OF CONTRACT: Fixed-price incentive (note a)

FUNDS: Development

	Price change	Cumulative total
	(thousands)	
PROPOSALS--DATE AND DESCRIPTION:		
July 15, 1969, basic AWG-9 price proposal		$ 79,112.7
August 15, 1969, addition of ground support equipment to July 15, 1969 proposal (note b)	$16,540.6	95,653.3
October 3, 1969, various scope changes (net change)	4,415.4	100,068.7
May 5, 1969, initial contract definitization (net change)	-6,338.0	93,730.7
August 14, 1970, target price reset proposal	5,842.7	99,573.4
June 10, 1971, definitization of target price reset (note a)	-5,842.7	93,730.7
Other changes:		
Nonprovisioned items (undefinitized)	1,650.2	95,380.9
Provisioned items (note c):		
Definitized	3,440.7	98,821.6
Undefinitized	6,396.7	105,218.3
Other anticipated changes	526.7	105,745.0
Current estimate at completion		$105,745.0

[a]Subject to single target price reset which was negotiated on June 10, 1971, and, as of October 1, 1971, was not reduced to writing in a contract modification.

[b]Contractor stated the ground support equipment proposal was, in effect, a second part of the basic proposal and should not be considered as a change.

[c]Provisioned in basic contract but subject to separate funding limitations and negotiations.

APPENDIX VI

SUMMARY OF TARGET PRICE CHANGES

FOR AWG-9 FLIGHT TEST AND SUPPORT PROGRAM CONTRACT

TYPE OF CONTRACT: Cost-plus-base-fee-plus-award fee

FUNDS: Development

	Price change	Cumulative total
	(thousands)	
PROPOSALS--DATE AND DESCRIPTION:		
December 29, 1969, request for quotation	$ -	$ -
May 14, 1970, basic proposal		35,115.5
June 3, 1970, revised proposal--various decreases in work scope	-7,278.2	27,837.3
December 11, 1970, definitive contract negotiated	-3,277.3	24,560.0
1971 changes definitized:		
Modify missile test set	82.0	
Deletion of certain test equipment	-4.1	24,637.9
1971 changes proposed (not definitized), option items	671.6	25,309.5
Additional items (note a):		
Contractual option items available for exercise	6,500.0	31,809.5
Increased cost due to slippage of F-14A bailment schedule	6,300.0[b]	38,109.5
Added scope	13,100.0	51,209.5
Maximum award fee (9 percent of cost)	4,700.0	55,909.5
Current estimate at completion		$55,909.5

[a]The items and amounts listed did not constitute firm proposals as of October 1, 1971.

[b]If a potential increase in award fees of $550,500 was included, the increased costs would be $6,850,500 ($6,300,000 plus $550,500).

PRODUCTION ESTIMATES FOR AWG-9/AWM-23 PROGRAM

(Dollars in thousands)

Description	Total	Lot I fiscal year 1971	Lot II fiscal year 1972	Lot III fiscal year 1973	Lot IV fiscal year 1974	Lot V fiscal year 1975
Number of AWG-9 systems (note a):						
Number of flyaway systems	303	35	49	52	89	78
Number of trainer support systems	6	3	1	-	2	-
Total forecast quantity	309	38	50	52	91	78
Price Estimates:						
AWG-9 production at ceiling	$635,233	$115,454	$118,185	$105,916	$158,702	$136,976
Engineering change proposals	28,640	4,850	5,206	4,949	7,118	6,517
AWM-23 ground support equipment at ceiling	173,193	26,970[b]	45,204	38,357	35,677	26,985
Special tools and test equipment (AWM-23)	5,300	5,300	-	-	-	-
Other ground support equipment	6,640	1,356	1,597	1,418	1,418	851
Spares:						
AWG-9 (note e)	93,296	13,811	16,221	16,017	24,712	22,535
AWM-23 (note e)	18,283	4,034	4,383	3,742	3,495	2,629
Naval Air rework facility equipment set (NARF)	(d)	4,142	10,300	(d)	(d)	(d)
Environmental test (AWM-23)	518	518	-	-	-	-
Other provisioned items	(d)	14,345	8,870	(d)	(d)	(d)
Program estimate at total for defined elements	$961,103[e]					

[a]Based on contractor projection of AWG-9 program to support an F-14 program of 301 aircraft.

[b]Based on proposed target, because a ceiling price has not yet been established.

[c]Based on contractor estimate of Navy spares provisioning applied to hardware ceiling prices.

[d]Total not shown because insufficient data were available for estimating the total program price for this item. In the contractor's opinion, the amounts for these elements are expected to take a downward trend during fiscal years 1973 through 1975.

[e]NARF equipment and other provisioned items not included. (See note d above.)

COMPARISON OF INITIAL AND MOST RECENT PRICE PROPOSAL FOR THE FIRST F-14A ENGINE PRODUCTION CONTRACT

Cost element	Contractor's proposals		
	November 1969	June 1971	Difference
Material	$349,541	$367,736	$ 18,195
Labor	45,416	52,133	6,717
Overhead	178,076	215,257	37,181
Special tooling	(a)	61,725	61,725
Inventory adjustment	(a)	6,969	6,969
Engineering assistance	13,581	23,578	9,997
Total manufacturing cost	586,614	727,398	140,784
General overhead	76,084	122,130	46,046
Total cost	662,698	849,528	186,830
Profit	99,405	127,429	28,024
Price	$762,103[b]	$976,957	$214,854

[a]Costs of these line items are included in the overhead classification.

[b]The initial target price was about $50,000 less than the proposed price; however, negotiations were on a total cost basis and therefore there was no breakdown of negotiated price by element of cost.

CONTRACTOR'S ESTIMATE OF ADDITIONAL COSTS TO

DEVELOP THE ADVANCED TECHNOLOGY ENGINE

	At contract negotiation January 1970	Estimated June 1971	Increase	Reason for increase
	(millions)			
LABOR:				
Engineering:				
Design	$ 12.2	$ 18.9	$ 6.7	
Engineering	11.8	21.1	9.3	About $9.8 million of the $16 million increase for engineering labor was attributable to additional effort to resolve problems and to accomplish the remaining development work. Most of the remaining amount was due to additional labor to provide liaison with the two military services and two airframe contractors.
Operations:				
Manufacturing	7.1	13.9	6.8	The increase in manufacturing labor was attributable to an inadequate escalation provision ($1.8 million), to an increase in the number of sets of parts needed for the development program ($0.9 million), and to the increased number of labor-hours found necessary to produce each set of parts ($3.9 million).
Test	11.0	10.1	-0.9	These differences were not analyzed, because of their relatively small size.
Quality	2.4	2.8	.4	
Tooling	1.3	2.1	.8	
Assembly	3.5	3.4	-.1	
	49.3	72.3	23.0	
MATERIAL:				
Manufacturing	98.2	136.7	38.5	The increase in manufacturing material costs was attributable to increasing the number of engine parts sets which will be built ($10.2 million), to problems experienced by fuel pump and fan blade subcontractors ($12.6 million), to increased costs for major parts ($6.3 million), and to changes in the number and costs of engine controls and accessories ($9.4 million).
Test	17.7	25.8	8.1	The historical cost experience used in estimating test and tooling material cost was found to be inapplicable to the advanced technology engine.
Tooling	6.9	13.4	6.5	
Design	2.3	6.1	3.8	Increased costs for design, engineering, quality, and assembly materials were due to some expected increases in effort and in the shifting of work load between the East Hartford and Florida plants of Pratt & Whitney.
Engineering	8.7	6.0	-2.7	
Quality	.6	.6	00.0	
Assembly	.3	.1	-.2	
	134.7	188.7	54.0	
OVERHEAD:				
Engineering overhead	20.6	39.1	18.5	Our analysis of projected bases and rates showed that about 70 percent of the increased overhead costs could be related to the increased cost base for this program and that about 30 percent could be related to the higher overhead rates which were affected, to a major extent, by the reduced business base.
Operations overhead	44.1	71.4	27.3	
General and Administrative expenses	22.8	40.0	17.2	
	87.5	150.5	63.0	
Total	$271.5	$411.5	$140.0	