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MILITARY AIRLIFT

The C-17 Program Status and
Proposed Settlement

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Mr. Chairman and Members of the Subcommittee:

I am pleased to be here today to discuss the status of the C-17 program. Based on the continuing work that we have been doing for the House and Senate Committees on Armed Services, we will provide updated information on C-17 cost, schedule, and performance issues and our observations on the Department of Defense's (DOD) proposed settlement agreement with McDonnell Douglas Corporation, the prime contractor on the C-17 aircraft.

RESULTS IN BRIEF

Since last March when I testified, the C-17 program continues to experience cost, schedule, and performance problems. Total C-17 program costs continue to grow; the current \$43 billion estimate for the 120 aircraft program now exceeds the last DOD estimate to acquire 210 aircraft by \$1.3 billion. In addition, the average unit price the government is paying McDonnell Douglas to build the C-17 also continues to increase. Delivery schedules have again slipped and aircraft are being delivered with increasing amounts of unfinished work or known deficiencies that must be corrected after government acceptance. More important, additional slippage may be cause for invoking a funding restriction in the Fiscal Year 1994 Defense Authorization Act. The act prohibits DOD from obligating funds for more than four

C-17s in any given fiscal year subsequent to the act, unless all aircraft in the prior 6 months are delivered within 1 month of the contract delivery date.

Estimates of flight test completion appear to be optimistic. Also, C-17 reliability is significantly less than expected. This is important because the aircraft must achieve planned reliability and maintainability rates to demonstrate the life cycle cost advantage that is key to its cost-effectiveness. Furthermore, the C-17 cannot meet current payload/range specifications. Finally, while the contractor is fixing technical problems involving the wing, flaps, and slats, other problems continue. These include immature mission computer software and inadequate built-in-test (BIT) capability.

In addition to our review, the Defense Science Board (DSB) assessed the C-17 program last summer. The DSB rightly recognized a number of problems which beset the program: poor contractor performance, overly ambitious cost and schedule goals, too much concurrency, greater than anticipated complexity, and poor Air Force management.

In December 1993, the Secretary of Defense announced a decision to stop the C-17 program at 40 aircraft unless the contractor made significant investments in management and productivity improvements. On January 6, 1994, DOD and McDonnell Douglas

agreed to a settlement designed to ensure a viable 120 aircraft program. However, DOD has not established specific cost, schedule, and performance criteria against which to evaluate improvements in the contractor's performance and which will enable DOD to make an informed decision on whether to continue the program beyond 40 aircraft. In addition, the program's schedule calls for this decision to be made before the effects of these investments can be assessed with any certainty. The DSB estimated that these investments could decrease total program costs by \$1.4 billion or, under a worst-case scenario, limit program cost growth to about \$800 million for the 120 aircraft program.

Congress should realize that the first 40 C-17s will not benefit significantly from the provisions in the settlement. Before deciding whether the settlement is a good deal for the government, two issues must be addressed. First, more complete information is needed on the details of the contractor's potential delay and disruption claims and the consideration due the government for revising contract specifications and waiving its claims against McDonnell Douglas. Second, analysis to identify the minimum number of C-17s needed to meet specialized requirements should be completed as soon as possible.

The cost to the government may be more than the settlement specifies. The DSB estimates of consideration for changes in

payload/range specifications and waived claims for late delivery of aircraft ranged from \$750 million to \$3 billion. On the other hand, the potential claims given up by the contractor could, based on the contractor's proclaimed estimate, add up to about \$1.25 billion. None of these estimates have been validated. We also question the \$237 million in claims recognized in the settlement because one claim, valued at \$234 million, represents a contractor claim for which no legal or price analysis was done. We believe that without additional information on both the contractor and government claims, it would be difficult for Congress to decide whether to endorse the settlement.

Based on a recent cost and operational effectiveness analysis (COEA) sponsored by DOD, there are alternatives that can now meet DOD's airlift shortfall at a lower cost than the full C-17 program. DOD has acknowledged that the COEA identified significantly cheaper alternatives that can get the job done. However, DOD has decided to execute a settlement with the contractor and to launch a new study to determine another strategy for a mixed force of C-17's and nondevelopmental aircraft. By doing so, DOD will effectively delay making a decision on the most cost-effective mix of aircraft for meeting its airlift requirement until November 1995.

Delaying a decision on the quantity of C-17s until November 1995 will leave the government with another \$5 billion invested in

this problem-plagued program with, in our opinion, little more additional information upon which to make an informed decision. At that time, DOD will have obligated about \$21.3 billion, including the settlement costs, or about 50 percent of the total estimated program cost for only 40 of the 120 planned C-17s.

In 1987, we reported¹ that the C-17 was the most cost-effective alternative to meet U.S. airlift requirements if the program came close to meeting its cost and performance objectives and was used for routine direct delivery in wartime. The changed world environment, rising costs, less than anticipated performance, and lengthy delays in this concurrent acquisition program, raise serious doubts about the C-17's cost-effectiveness. We believe DOD should vigorously pursue an acquisition strategy for nondevelopmental wide-body aircraft to fill the airlift shortfall that would occur if the C-17 program were terminated. According to the COEA, this solution meets DOD's minimum airlift requirements at a lower cost than the full C-17 program.

The C-17 is intended to provide certain unique capabilities to the airlift fleet, such as the ability to land on small, austere airfields and airdrop outsized cargo. If it is decided that these capabilities are necessary and outweigh the enormous uncertainties in the program, and, therefore, the proposed

¹Military Airlift: Air Force Analysis Supports Acquisition of C-17 Aircraft (GAO/NSIAD-87-97, Mar. 20, 1987).

settlement goes forward, we believe DOD should establish specific cost, schedule, and performance criteria to evaluate improvements in the contractor's performance, information that will be needed to make an informed decision on whether to continue the program beyond 40 aircraft. We also believe that Congress should specify legislatively that (1) all existing statutory requirements applicable to the C-17 program remain in effect unless specifically amended or revised legislatively and (2) there is nothing in the settlement that commits the government to buy more than 40 aircraft.

BACKGROUND

The C-17 military transport, being developed and produced for the Air Force by the McDonnell Douglas Corporation, is being designed to airlift substantial payloads over long ranges without refueling. The Air Force is intending the C-17 to be its core airlifter and the cornerstone of future airlift forces. The Air Force originally planned to buy 210 C-17 aircraft. However, in April 1990, the Secretary of Defense reduced the program to 120 aircraft. Through fiscal year 1994, the Congress has appropriated over \$15 billion for the C-17 program, including (1) \$5.5 billion for research, development, test and evaluation; (2) \$9.8 billion for procurement; and (3) \$163 million for military construction.

Although some of these funds have been used to cover government costs, such as management and testing, the majority of funds have been for development and production contracts with McDonnell Douglas. Through fiscal year 1994, the Congress has authorized the procurement of 26 production C-17 aircraft (P1 through P26) and provided the advance procurement funds for another eight aircraft (P27 through P34). Advanced procurement involves buying parts that need to be ordered the year before production is scheduled to start.

In addition to the development contract, which included a test aircraft and low-rate initial production of 6 aircraft, the Air Force has awarded three contracts for low-rate initial production of 14 additional aircraft. The Air Force has also awarded McDonnell Douglas an advance procurement contract for eight aircraft and plans to award another advance procurement contract for six more aircraft in March 1994. The Air Force has accepted delivery of the test aircraft and 9 (P1 through P9) of the 20 production aircraft. The test aircraft and five of the production aircraft are being used in flight testing. The four remaining production aircraft have been delivered to the Air Mobility Command.

UPDATE ON COST, SCHEDULE,
AND PERFORMANCE ISSUES

Total C-17 program costs continue to grow; the current \$43 billion estimate for the 120 aircraft program is now \$1.3 billion more than DOD's last estimate to acquire 210 aircraft. Delivery schedules have again slipped and estimates of flight test completion remain optimistic.

Cost Issues

For the fiscal year 1991 President's budget, DOD estimated that total program costs would be \$41.8 billion to acquire 210 aircraft. Three years later, in the 1994 President's budget, DOD estimated that total program costs would be \$39.5 billion for the reduced C-17 program of 120 aircraft. An August 1993 Congressional Budget Office study showed that decreases in inflation and the reduced aircraft buy decreased program costs by \$15.5 billion. However, this reduction was offset by \$13.2 billion in cost growth. The C-17 Program Director recently estimated that total program cost would increase another \$3.5 billion, from \$39.5 to \$43 billion. Thus, the total program cost estimate to acquire 120 aircraft now exceeds the last DOD estimate to acquire 210 aircraft by \$1.3 billion.

Production Cost Growth Continues

In March 1993, we testified that contractor development and production costs continued to increase as efficiency deteriorated. The Cost Performance Index (CPI), which measures the value of work performed per dollar expended, is an indicator of cost efficiency. There has been a further decline in the CPI for the development and lot III contracts. In addition, while the efficiency under the new lot IV contract is higher, the trend for lot IV is downward.

Since March 1993, the cumulative CPI for the development contract decreased slightly from 0.67 to 0.66. In part due to this decrease, the Defense Plant Representative Office (DPRO) increased the government's estimate-at-completion (EAC) for the development contract from \$7.9 billion to \$8.1 billion, about \$1.4 billion over the contract ceiling price of \$6.7 billion. The cumulative CPI for the lot III contract also showed a downward trend from 0.91 to 0.85 from March to November 1993. Again, the DPRO increased its EAC for the lot III production contract another \$100 million, from \$1.1 billion to \$1.2 billion, which approximates the contract ceiling price of \$1.215 billion.

As of November 1993, the cumulative CPI for the lot IV contract was better than the lot III contract, but the lot IV CPI is showing the same downward trend since contract award in May 1993.

Even though the cumulative CPI trend for lot IV is decreasing and is no better than the contractor's performance on lot III at the 80 percent expended level, the DPRO projects that the contractor will make a profit of approximately \$100 million. However, the principal reason for the contractor's improved financial position on lot IV is that the government is paying the contractor about \$119 million more to build the same number of aircraft under lot IV as compared to lot III.

Table 1 shows the unit price comparison for the lot III, IV, and V contracts at the target and ceiling prices.

Table 1: Price Comparison for Production Lots III, IV and V (Dollars in Millions)

Lot	Number of aircraft	Unit price		Total price	
		Target	Ceiling	Target	Ceiling
III ^a	4	\$237.8	\$281.5	\$951.2	\$1,126.0
IV	4	267.4	301.2	1,069.7	1,204.9
V	6	270.7	303.7	1,624.3	1,821.9
Price increase Lot III to IV		29.6	19.7	118.5	78.9
Price Increase Lot III to V		32.9	22.2		

^aLot III engine prices have been excluded for purposes of comparison. Engines are government furnished equipment on lots IV and V.

Normally, one would anticipate that as the production processes improve and the aircraft design matures, the average unit prices would decline from production lot to production lot. However, as shown in table 1, contract aircraft unit prices have increased, not decreased.

Productivity Remains Inadequate

In the past, we reported that McDonnell Douglas' production efficiency, as measured by the learning curve, was improving with each successive aircraft, but the rate of improvement had not increased enough to meet program cost and schedule objectives. We noted that the C-17 program had experienced severe personnel disruptions because of bumping by senior workers on commercial projects and that this bumping would continue to prevent achieving needed improvement in the learning curve.

During 1992, 1,448 workers, or 42 percent of the C-17 assembly work force, were displaced through bumping. During the first three quarters of 1993, 1,567 workers were displaced. As a result, a little over three-quarters of the assembly work force had been newly assigned to the program since January 1992. The effects of this turnover in assembly personnel were reflected in a recent DPRO analysis that showed improvement in the learning curve rate between production lots II and III, but that the improvement was still not sufficient to achieve cost and schedule

goals for lot III. The displacement of C-17 assembly workers declined significantly in the third quarter of 1993 and should not be a significant obstacle to improving the learning curve in the future.

In April 1992, we reported that contractor officials believed that out-of-position work--work performed at other than the designated work station--was a major contributor to the low learning curve. The contractor has since reduced out-of-position work. For example, the amount of out-of-position work on aircraft P4 to P10 decreased from 13 percent to 5 percent at major join (where major sections of the aircraft fuselage and wings are joined together).

However, at the major assembly tool level, which in the DPRO's opinion is a better indicator of production efficiency, a significant amount of work is still being accomplished out-of-position. For example, five major assembly tools are used to manufacture the aft fuselage. The contractor reported that for P10, 21 percent to 51 percent of the required work to assemble the aft fuselage was done out-of-position as the fuselage assembly moved through the five major assembly tools. While improvement in the contractor's learning curve reflects a decrease in the amount of out-of-position work at major join, the improvement would have been greater if more work had been

completed in-position as the major sections of the aircraft moved from one assembly tool to the next.

Last year, we discussed the impact of assembly quality as measured by off-standard hours (primarily for rework and repair) on cost and schedule trends. Since then, off-standard hours have declined from approximately 40 percent, for the first five aircraft delivered, to about 34 percent on the 10th production aircraft. This trend shows improvement, but the goals established by the company are still not being achieved. Scrap, rework and repair costs for all departments, including assembly, were about \$44 million in 1993. This adds about \$7.3 million per aircraft at a production rate of 6 equivalent aircraft per year. In August 1993, the Acting Deputy Assistant Secretary of Defense for Production Resources recommended that a 50 percent reduction in scrap rework and repair costs over a 12 month period be tied to the next major C-17 program funding decision.

The DSB, in its mid-1993 review of the C-17 program, observed that if the contractor continued with its current manufacturing and quality assurance processes, it could not maintain the planned production schedule and at the same time reduce unit cost.

Schedule Issues

During 1993, the contractor delivered five aircraft. The last lot II aircraft, P5 and P6, were each delivered about 5 months late. Also, even after the Air Force significantly extended the contract delivery schedule for lot III aircraft, the contractor missed the scheduled delivery for two of the three lot III aircraft delivered in 1993 by a month.

Both the System Program Office and the DPRO are forecasting that each of the next seven aircraft (P10 through P16) is at risk of being delivered at least 1 month late. This is significant because the Fiscal Year 1994 Defense Authorization Act imposed a requirement that prohibits the Secretary of Defense from obligating funds for more than four C-17s in any fiscal year subsequent to the act, unless a number of milestones have been met. One milestone is that all aircraft, delivered in the 6 months prior to obligating new funds, must be delivered within 1 month of the contract delivery date.

This requirement was met for aircraft P7 through P9; however, the aircraft were delivered with increasing amounts of unfinished work or known deficiencies that had to be corrected after government acceptance. For example, the uncorrected deficiencies on P9 included minor inspection items, such as loose screws and missing fasteners, while major deficiencies included a cargo ramp

that would not unlock and open. At the time of our review, the contractor had not yet quantified the number of work hours involved in completing this work. However, the contracting officer withheld \$10,000 for P7, \$65,000 for P8, and over \$3 million on P9 for the unfinished work at the time of delivery.

These aircraft were also delivered with a number of major waivers. For example, P9 had 126 major waivers for which the contracting officer withheld about \$7 million. The government defines a major waiver as acceptance of an item not conforming with contract or configuration requirements involving, among other things, performance, reliability, or maintainability. Both the Air Force and the contractor had hoped to reduce the number of major waivers required to deliver the aircraft. We found, however, that the number of major waivers granted remained relatively constant from P5 to P9, the five aircraft delivered during 1993.

Estimated Date For Completing
Flight Test is Optimistic

In March 1993, we reported that the C-17 flight test program had slipped at least 13 calendar months to January 1995 with a high probability of additional slippage. The Air Force now estimates it will complete the flight test program by March 1995. We believe even this is an optimistic estimate.

In April 1993, the Air Force rebaselined the test program from the original 80 aircraft-month (27 calendar month) program, which ended in November 1993, to a 135 aircraft-month (42 calendar month) schedule ending in March 1995.² Air Force and contractor officials believe that the flight test program is generally tracking to the 135 aircraft-month schedule. However, they point out that it is difficult to determine the exact status of the flight test program due to the uncertain nature of developmental testing.

The Air Force and the contractor use a variety of indicators to judge the status of the test program, such as test points, credit flight hours (time to perform a specific task), and flight test milestones. As of January 1994, the Air Force has completed about 73 percent of the 6,899 test points and about 69 percent of the required 1,885 credit flight hours, which is ahead of schedule. The Air Force has completed approximately 69 percent of key flight test milestones, which is slightly behind schedule.

Overall, test aircraft have averaged a monthly flight rate below the assumed 40-flight hour average rate per aircraft per month identified as a necessary requirement for completion of the flight test program as scheduled. From April through December 1993, overall flight credit hour efficiency averaged 51.3

²For test purposes, an aircraft month is defined as the use of one aircraft for one calendar month.

percent, which is below the 62-percent efficiency rate the Air Force assumed for the remainder of the 135-month rebaselined program. Additionally, the flight test program is still experiencing a significant amount of aircraft down time. For example, as of January 1994, nearly half (1,315 days) of the available test days (2,836 days) were lost because the aircraft were being worked on. Of the remaining test days, 565 days were lost because technical problems and other conditions kept the aircraft from completing intended missions.

The DSB found the 135 aircraft-month program at risk. It recommended adding 17 aircraft-months to increase the flight test program from 135 to 152 aircraft-months. Although the Air Force plans to manage the flight test program against the 135 aircraft-month schedule, it has developed a preliminary 152 aircraft-month (45 calendar month) schedule which extends the flight test program to June 1995--3 months beyond the currently planned flight test completion date. (In March 1993, we projected the test program would not be completed until July 1995).

While a series of Air Force and contractor reports, through January 1994, show the test program is generally on schedule, the Air Force has identified the following areas of concern that we believe may present a substantial risk to the completion of the program as scheduled:

- Software immaturity has restricted assessment of the operationally representative 2-pilot flight crew.
- Paratroop and airdrop problems could delay the test schedule.
- Completion of developmental testing for selected critical mission systems and some significant aero performance milestones (such as completion of short field landings) are scheduled at the end of the test program.

Air Force operational test reports and officials have also expressed concerns that the Air Force may not be able to independently maintain the aircraft during operational testing, a reliability, maintainability, and availability (RM&A) evaluation requirement. They indicate that the Air Force may have to request a waiver if their ability to maintain the aircraft does not improve. Air Force personnel estimated that the contractor currently provides about 33 percent of flight test aircraft maintenance. The lack of a working BIT system and inadequate technical manuals are key contributors to the Air Force's concern regarding its ability to independently maintain the aircraft during operational testing.

Performance Issues

In March 1993, we reported that the C-17 could not meet payload and range specifications. Since then, DOD has proposed relaxing these specifications to levels that both the Air Force and the contractor believe can be achieved. In addition, initial operational capability (IOC), which is scheduled for January 1995, may slip because the Air Force may not have 12 similarly configured aircraft. Finally, test results to date show reliability values to be about half of expected requirements.

Specifications

In March 1993, we reported that the C-17 could not meet its payload and range specifications primarily because of growth in aircraft weight, increase in aircraft drag, and failure of engines to meet specific fuel consumption expectations. Since then, DOD has proposed relaxing the C-17 specifications to levels that the C-17 will be fully capable of achieving. The Air Mobility Command has asserted that, although several of the proposed specification changes do not meet current operational requirement objectives, aircraft performance and mission capability will not be significantly degraded. The C-17 is expected to meet the threshold requirement for the Command's key payload/range mission.

Table 2 shows that the proposed specification changes do not meet current C-17 operational objectives for the heavy logistics, maximum payload, medium logistics, and ferry range missions.

Table 2: Comparison of Current and Proposed Range and Payload Specifications with Operational Requirements

		Payload/range (Thousand pounds/nautical miles)		
Mission	Threshold ^a or objective ^b	Operational requirement	Specification	
			Current	Proposed
Heavy logistics	Threshold	110/3,200	130/3,200	120/3,200
	Objective	130/3,200		
Maximum payload	Objective	160/2,400	160/2,400	157/2,400
Medium logistics	Objective	120/2,800	120/2,800	114/2,800
Ferry mission	Objective	0/4,600	0/4,600	0/4,300

^aA threshold is the minimum acceptable operational requirement identified by the Air Mobility Command.

^bAn objective value is an acceptable operational requirement.

Although the basic design of the C-17 is nearly complete, the aircraft does not meet contracted payload/range specifications. DOD now defines the C-17's primary mission as the 3,200 nautical mile (heavy logistics) mission. The contract specification currently requires the C-17 to carry 130,000 pounds 3200 nautical miles. The settlement proposes revising this specification to

120,000 pounds, while the Air Mobility Command's threshold requirement is 110,000 pounds.

The DSB found that the C-17's performance on the 3200 nautical mile mission is only 93,345 pounds. The primary reasons for the payload shortfall are still aircraft weight growth, aircraft drag increase, and failure of the engine to meet specific fuel consumption expectations. McDonnell Douglas has proposed several low-risk initiatives to improve payload/range performance. According to the DSB, these initiatives are feasible and, if implemented, the C-17 will carry 101,796 pounds 3200 nautical miles--still below the threshold requirement.

The DSB recommended that the method for calculating C-17 payload and range performance be changed from a traditional methodology to an operational methodology. Differing assumptions between these methods pertain to fuel consumption rates. While the operational methodology shows how the C-17 would actually perform, it eliminates any margins for weight growth or reduced engine performance that are included in the more stringent traditional methodology. Using the operational methodology, the C-17 would deliver a 123,330 pound payload a distance of 3,200 nautical miles. In other words, it would achieve the threshold requirement, but it would still fall short of the current contract specification of 130,000 pounds.

In agreeing to these reduced standards, DOD directed the contractor to implement the following initiatives.

- Use the Pratt & Whitney 94 commercial engine that includes commercial improvements to increase specific fuel consumption by 0.4 percent.
- Implement low risk weight reduction initiatives to reduce aircraft weight by 1,500 pounds.
- Reduce total aircraft drag by one percent.
- Increase maximum takeoff gross weight by 5,000 pounds, to 585,000 pounds, to allow for additional fuel.

The DSB found that successful implementation of these initiatives was necessary for the aircraft to meet even the revised payload and range specifications, including the key heavy logistics mission. According to a contractor official, while McDonnell Douglas has been pursuing weight reduction initiatives, it has been unsuccessful at reducing the net aircraft weight and believes many of the proposed initiatives would be too expensive to implement. Program and contractor officials stated that flight testing has demonstrated that drag can be reduced at least 2 percent. These officials believe that the increased payload achieved by the additional drag reduction would offset any lost

payload capacity should the weight reduction measures be unsuccessful.

Planned IOC May Slip

The current program plan calls for the commander of the Air Mobility Command to declare IOC in January 1995. This requires 12 similarly configured aircraft to support the RM&A evaluation which follows. In preparation for IOC, the aircraft delivered during 1993 will undergo modifications to configure them to an as yet unspecified design. Five aircraft (P5 through P9) will spend up to 3 months being retrofitted with new flaps and slats and will undergo major wing and fuel system modifications. The retrofits are scheduled to be completed in December 1994.

The DSB, however, concluded that there was insufficient time to retrofit all of the design changes in the aircraft, evaluate them in flight test, and incorporate them into the production aircraft to provide 12 similarly configured aircraft for IOC and the RM&A evaluation. It, therefore, recommended slipping the start of IOC 5 months, from January to June 1995. However, Air Force officials, while agreeing that the contractor's retrofit plan is high risk, believe that it is achievable. They, therefore, plan to keep the January 1995 date as a target for starting IOC.

C-17 Reliability and Maintainability

RM&A is critical to peacetime availability, wartime utilization, and the ability to keep operations and support costs near budgeted levels. The Air Force plans to conduct an RM&A evaluation after the start of IOC between February and July 1995. The RM&A evaluation is a 30 day evaluation requiring about 1,750 flying hours. However, we believe that if C-17 reliability does not improve sufficiently in the next few months, the Air Force should consider delaying the RM&A evaluation until reliability improves.

Aircraft testing has revealed that C-17 reliability is less than expected based on contractual growth curves, although maintainability is substantially better than expected. The DSB concluded that based on current reliability values, the likelihood of the C-17 successfully completing a mission does not meet requirements.

Table 3 shows that actual aircraft reliability at 1,202 flight test hours and 25 hours of initial squadron operations is substantially below the expected reliability.

Table 3: Actual C-17 Reliability and Expected Reliability

Reliability measure	FLIGHT HOURS					
	Flight test (1202 hours)			Initial squadron (25 hours)		
	<u>Expected</u> (hrs)	<u>Actual</u> (hrs)	Percent of <u>Expected</u>	<u>Expected</u> (hrs)	<u>Actual</u> (hrs)	Percent of <u>Expected</u>
MTBM(I), Inherent ^a	0.99	0.43	43	0.95	0.46	48
MTBM(C), Corrective ^b	0.48	0.24	50	0.46	0.15	33
Mean Time Between Removal	1.70	1.53	90	1.62	1.70	105

^aInherent maintenance is unscheduled maintenance required on a component due to its own internal failure.

^bCorrective maintenance is the sum of inherent, induced and no defect maintenance actions. Induced maintenance is unscheduled maintenance on a component due to some induced condition rather than an inherent failure. No defect maintenance results from a false indicator or isolation reading.

C-17 reliability data show that a large variety of different failures have occurred with no one particular item driving the low reliability numbers. This means the contractor will have to find corrective solutions for a substantial number of failures to improve reliability. In other words, there is no simple fix. In addition, there is insufficient data to track trends for some components because they are seldom used, failed but not fixed, not yet installed, or operating with restrictions.

While reliability performance is less than expected, aircraft maintainability appears to be substantially better than expected. However, some Air Force flight test officials believe that the higher than expected maintainability numbers are partially due to the maintenance support that contractor employees provide both at flight test and at the initial squadron operations at Charleston Air Force Base. These officials are concerned that given the immaturity of the aircraft BIT system and the incomplete maintenance manuals, repairs by Air Force personnel will take longer.

Other Technical Issues

As we reported last year, technical problems continue to occur in the C-17 program. These problems may result in decreased aircraft performance, increased program cost, and/or extended program schedules.

Built-in-Test

The C-17 has been experiencing excessively high BIT false alarm rates. BIT provides for electronic fault isolation to individual line-replaceable units. The C-17 air vehicle specification requires a BIT false alarm rate of not more than 5 percent. However, the Air Force has experienced BIT false alarm rates as

high as 97.9 percent for production aircraft operating at Charleston Air Force Base.

Current problems with BIT provide extremely limited capability to maintenance personnel troubleshooting the aircraft. In addition, immaturity of BIT software has limited the ability to fully test the BIT system itself, and additional problems may exist within the system that have yet to be identified. It also impacts critical maintenance training to be accomplished as part of initial squadron operations. This problem, if not corrected, will have a significant impact on the ability of the aircraft to pass operational testing and RM&A evaluations.

The contractor agreed to take responsibility for developing and managing a corrective action plan to reduce the number of BIT false alarms by January 1994. However, BIT data, as of the end of January 1994, show the number of false alarms is still very high, with the number occurring at Charleston Air Force Base increasing to its highest level.

Wing Failure

In October 1992, both wings on the static test article failed at approximately 128 percent during a 150-percent load test. After retrofitting the static article's wings, the contractor resumed static testing in July 1993. In September 1993, the left static

wing failed again at 144 percent. The initial damage occurred on the outer part of the wing where the upper spar cap did not meet specifications. However, based on an engineering analysis, McDonnell Douglas and an Executive Independent Review Team, which was appointed by Secretary of the Air Force to review the test results, concluded that the wing had passed the 150 percent load test. The team's final report has not been issued.

Due to the 1992 static wing failure, the contractor is retrofitting the production wings. Basically, this retrofit involves reinforcing the wing by adding stainless steel straps to the wing stringers and stiffeners to various ribs and spars on the wing. Some Air Force and DOD officials, however, were not entirely satisfied with this approach. Therefore, as a part of the proposed settlement, the contractor, at its own expense, agreed to redesign the wing to eliminate the need for supplemental straps and stiffeners by using stronger components to build the wing. The new wing is to be incorporated as soon as possible, but not later than aircraft P29.

If 120 C-17 aircraft are purchased, approximately one-fourth of the fleet will have wings using the supplemental straps and stiffeners. DOD officials warn of possible corrosion problems with the currently implemented solution because of attaching dissimilar materials--stainless steel straps and aluminum stringers. They

stated that potential corrosion problems could limit the service life of these wings.

Flap and Slat Redesign

In March 1993, we testified that C-17 flaps and slats were susceptible to heat damage from engine exhaust, which can ripple the skin and weaken the structure. Since then, the contractor has redesigned the slats by changing the material to titanium in the slat ribs and skins, and the flaps by changing the trailing edge to titanium. The hinge fairings on the flap are being changed to high temperature composite materials. Redesigned flaps and slats with titanium skins and substructures have been installed on test aircraft P2 and are currently undergoing flight testing.

The redesigned flaps and slats will add approximately 1,100 pounds to the weight of the aircraft. P11 will be the first in-production aircraft to receive both the new flaps and slats. The contractor will retrofit existing production aircraft with the new flaps and slats.

Main Landing Gear and Tires

The C-17 continues to experience problems with the main landing gear. These problems include (1) retraction, (2) post interference, and (3) tire wear. Testing has shown that, on

occasion, the main landing gear has not retracted satisfactorily in level flight and while banking. In addition, during heavy-loaded ground maneuvering and braking, the large shock strut compression allows interference between the post and axle beam of the main landing gear. The Air Force has also found that the tire service life does not meet specification even after adjusting the actual test data to reflect a more normal operational mission profile than experienced during tests.

EVOLUTION OF C-17
SETTLEMENT AGREEMENT

Concern over continuing C-17 cost, schedule, and performance problems resulted in the Congress restricting the release of procurement funds and imposing various reporting requirements. The Fiscal Years 1993 and 1994 Defense Authorization Acts required DOD to conduct a special Defense Acquisition Board (DAB) review and report on the adequacy of the C-17's requirements, cost and operational effectiveness, and affordability. Subsequently, the Under Secretary of Defense for Acquisition tasked the DSB to evaluate the program and report back on what had to be done to put the C-17 program back on track. The DAB conducted an extensive review of the program between August and December 1993. The results of the DAB have not yet been officially reported.

In December 1993, the Secretary of Defense and Under Secretary of Defense for Acquisition announced a decision to stop the C-17

program at 40 aircraft unless the contractor made significant management and productivity improvements. They also outlined a proposal to resolve C-17 issues between the government and the contractor. On January 6, 1994, McDonnell Douglas agreed to DOD's proposed settlement.

The settlement, which according to its terms requires enactment of specific authorizing legislation and appropriations approval, provides for:

- a provisional 2 year program during which McDonnell Douglas must (a) introduce major management and manufacturing process changes, (b) demonstrate an ability to deliver aircraft on schedule and at cost, (c) successfully complete the flight test program, and (d) satisfy all other contract specifications including RM&A requirements and
- a settlement between the government and McDonnell Douglas resolving all outstanding C-17 business and management issues as of the date of the agreement.

The estimated cost to implement the proposed settlement is \$802 million. The government's share is \$348 million, \$237 million of which is to settle claims. A breakout of proposed settlement costs is shown in table 4.

Table 4: Estimated Settlement Costs (Dollars in millions)

Item	Government	Douglas
Flight test extension	\$61.5	\$61.5
Redesign wing	0	32.0
Computer Aided Design/Computer Aided Manufacturing	20.0	20.0
Management Information System	15.0	15.0
Advanced Quality System	2.5	2.5
Product improvement projects	0	100.0
Other	12.0	52.0
Nonrecurring engineering	0	171.0
Claims	237.0	0
Total	\$348.0	\$454.0

GAO'S ASSESSMENT OF THE SETTLEMENT

The proposed settlement recommends changes designed to ensure completion of a viable 120-aircraft program. We believe the settlement only makes sense in the context of a 120-aircraft program and not a 40-aircraft program. On the basis of our analysis of the proposed settlement, we have several concerns.

First, DOD has not established specific cost, schedule, and performance objectives that must be met by McDonnell Douglas if the program is to continue beyond 40 aircraft. Second, in an effort to improve the management environment and continue the program, the government reduced payload/range specifications and agreed to waive potential claims against the contractor without an in-depth analysis of the value of the claims. Also, DOD agreed to pay McDonnell Douglas an additional \$237 million to settle all outstanding claims, filed and unfiled, without attempting to evaluate the validity of such claims or to establish realistic estimates of the government's exposure. Third, the impact of productivity improvements cannot be realized unless the program continues beyond 40 aircraft.

DOD Has Not Established Cost Or Schedule Criteria

The settlement letter states that McDonnell Douglas must demonstrate an ability to deliver aircraft on schedule and at cost,

as well as successfully complete the flight test program and all other contract specifications, including RM&A requirements. However, DOD has not established any specific cost or schedule criteria it intends to use to decide whether to continue beyond 40 aircraft. For example, DOD does not define targets or goals for delivering aircraft "at cost." The DSB recommended that specific target unit costs be established for C-17 production lots.

The settlement states that the delivery schedule under contract for aircraft beginning with P7 shall remain the same. However, as I discussed earlier, in order to meet delivery schedule, the Air Force is accepting aircraft with unfinished work or uncorrected deficiencies. In addition, the next seven aircraft--P10 through P16--are at risk of being delivered at least 1 month late. DOD officials told us that consideration was being given to slipping the delivery schedule several months. Thus, even before the proposed settlement can be implemented, it appears the delivery schedule may slip. If this happens, DOD may have to seek relief from a fiscal year 1994 congressional requirement restricting the obligation of funds for C-17 production aircraft referred to earlier.

DOD officials told us a decision on whether the C-17 program proceeds beyond 40 aircraft would not be based upon any single set of criteria or key parameters. It will be a judgement based on an evaluation of all pertinent data. We believe this situation

provides DOD too much latitude in determining program performance and undermines accountability. The DSB reported that to create a new program environment there was a need for accountability. As such, we believe DOD should clearly spell out specific criteria that will be used to recommend to the Congress whether the C-17 program should proceed beyond 40 aircraft.

Claims Resolution Was
Key to Settlement

A major objective of the settlement was to resolve contractor claims. Prior to the settlement agreement, McDonnell Douglas had filed 12 claims against the government, totaling \$472 million. When the settlement agreement was signed, none of these claims had been resolved; they were either under consideration by the contracting officer or in litigation at the Armed Service Board of Contract Appeals.

The settlement states that McDonnell Douglas was planning to submit an additional \$1.25 billion in claims against the government. According to the DSB, these claims were based on delay and disruption to the program caused by the government. I want to emphasize that the \$1.25 billion in claims was never filed or reviewed by any government entity. In testimony before the House Committee on Appropriations, Subcommittee on Defense, in March 1993, the Air Force Principal Deputy Assistant Secretary for Contracting said that he knew of no basis for these claims.

In the DSB's opinion, the government was liable for \$237 million of the \$472 million in claims filed by the contractor. The settlement provides that DOD will make this payment through contract modifications, increasing the target and ceiling prices of the full-scale development contract. In return for the \$237 million, McDonnell Douglas agrees to release the government from all C-17 claims it may have as of January 6, 1994, the date of the settlement, whether filed or not. Of the \$237 million settlement, \$234 million was based on McDonnell Douglas' assertion that the government requested the company to subcontract a package of wing components. The DSB concluded that the government should pay 100 percent of this claim. We question the decision to pay this claim without DOD performing a legal or price analysis of the claim.

As part of the settlement, the government also agreed to revise various specifications and the delivery schedule for P6 and prior aircraft. The government also agreed to waive all claims against the contractor for failure to meet the original contract specifications and delivery schedule. The consideration due the government for agreeing to these waivers and contract modifications is difficult to estimate. We were told that members of a DSB team estimated the value based on several different assumptions. Members' estimates ranged from \$750 million to \$3 billion. No further effort was made to establish the magnitude of the specific government claims against the contractor. DOD officials told us

that avoiding protracted litigation with the contractor was a primary factor in the claims settlement.

Officers and employees of the government may not waive contract rights of the government or modify existing contracts to the detriment of the government without obtaining valid legal consideration. Clearly, considering the settlement in its entirety, both McDonnell Douglas and the government have agreed to make concessions. DOD has been unable, however, to identify the specific consideration the Air Force will receive in return for agreeing to waive its existing contractual rights and to modify this contract.

We believe that, in an overriding effort to eliminate the contentious relationship between the government and the contractor and to continue the C-17 program to 120 aircraft, the government has made concessions without establishing the value of potential claims both parties have against each other. Without any effort to establish the realistic value of the claims of both parties, the true cost of this settlement is not known. In addition, we believe that the contract specification revisions and the change to an operational methodology for calculating payload and range were driven by the C-17's current performance capabilities in an effort to maintain the 120 aircraft program.

Benefits From Productivity
Improvements Are Uncertain

According to the DSB, McDonnell Douglas' corporate infrastructure is antiquated and lacks an effective quality system. These problems limit the efficiency of the C-17 program. As such, the DSB recommended that McDonnell implement Computer Aided Design/Computer Aided Manufacturing (CAD/CAM), a Management Information System, and an Advanced Quality System along with other productivity improvements to modernize business practices so as to improve the efficiency of the C-17 program. The estimated costs of these improvements is \$175 million. The settlement proposes that the government pay \$37.5 million of this cost. The DSB estimated that these improvements could decrease total program cost by \$1.4 billion or, under a worst-case scenario, limit program cost growth to about \$800 million for the 120-aircraft program.

It could take several years before benefits resulting from productivity improvements and management process changes will be realized. The first installment of specific product improvement projects to be proposed by McDonnell Douglas is not scheduled to be completed until December 31, 1995, and the second package will not be completed until a year later. Given these time frames, little if any benefit from these programs will occur prior to 1996 when the Congress will be faced with the decision on proceeding with production beyond a 40 aircraft program.

Similarly, actions intended to modernize McDonnell Douglas' manufacturing and management structure will have only limited impact during the first two years. While the CAD/CAM system for engineering changes may be fully functional by 1996, full implementation of the system is not proposed to start until 1997. Finally, the Advanced Quality System will be a phased change in quality control that will take several years to implement.

ALTERNATIVES TO THE C-17

DOD's settlement letter to McDonnell Douglas also discusses the need to consider commercial wide-body aircraft or new C-5B production as part of a successful strategic airlift program. Based on congressional direction, DOD directed that a COEA be conducted to determine alternatives to the C-17. As announced by the Secretary of Defense, the analysis showed that a combination of C-17s and C-5Bs, or C-17s and commercial wide-body aircraft can get the job done. In general, the most cost-effective alternative was a combination of 40 C-17s and 47 commercial wide-body aircraft. This total represents primary authorized aircraft.³ For the total aircraft inventory, 47 C-17s and 49 commercial wide-body aircraft are needed.⁴ Based on this combination of C-17s and commercial

³Primary authorized aircraft do not include backup and training aircraft.

⁴Total aircraft inventory is the entire fleet, including backup and training aircraft.

wide-body aircraft, life-cycle cost savings were estimated at about \$7 billion when compared to a fleet of 120 C-17s.

In connection with the settlement, DOD announced that the C-17 program would not proceed beyond 40 aircraft unless McDonnell Douglas made significant program improvements. Because DOD's announcement is based on total aircraft inventory, there is a disconnect with the COEA, since the alternatives examined were based on primary authorized aircraft. As such, DOD needs to update the analysis to include an alternative based on a total aircraft inventory of 40 C-17s, or 34 C-17 primary authorized aircraft. We believe this information is needed to assist the Congress in assessing the proposed settlement and determining whether the C-17 program should proceed beyond a total aircraft inventory of 40 aircraft.

Although DOD has acknowledged that there are significantly cheaper alternatives that can get the job done, it has decided to execute a settlement with the contractor and to launch a new study to determine the optimum strategy for a mixed force of C-17s and nondevelopmental aircraft. By doing so, DOD will effectively delay making a decision on the most cost-effective mix of aircraft for meeting its airlift requirement until November 1995. At that time, DOD will have obligated about \$21.3 billion, including the settlement costs, or about 50 percent of the total estimated program cost for only 40 of the 120 planned C-17s.

In 1987, we reported that the C-17 was the most cost-effective alternative to meet our airlift requirements if the program came close to meeting its cost and performance objectives, especially the cost advantages achievable through its planned reliability and maintainability capability, and was used for routine direct delivery in wartime. The changed world environment, as well as rising costs, less than anticipated performance, and lengthy delays in this concurrent acquisition program, raise serious doubts about the C-17's cost-effectiveness. Even though the C-17 is 9 years into full-scale engineering development, significant uncertainties about its cost, schedule, and performance continue, and in our opinion, undermine the program's credibility.

You also asked that we provide an update on DOD's plans to acquire commercial aircraft. The Fiscal Year 1994 Defense Authorization Act made available to DOD up to \$400 million to initiate procurement of a nondevelopmental wide body military or commercial cargo variant aircraft as a complement to the C-17. Instead, according to an Air Force official, DOD has determined that the procurement of two additional C-17 aircraft would contribute more to intertheater lift than the procurement of additional complementary wide body aircraft. They told us that DOD plans to request Congress to transfer \$300 million of undesignated funds to the C-17 program.

The Air Force has developed a preliminary acquisition strategy that calls for spending up to \$100 million to procure a nondevelopmental military or commercial wide body aircraft. The strategy, which has been presented to the Under Secretary, seems to be closely related to the C-17 milestone decision that is scheduled for November 1995. In our opinion, it appears that a decision on the number of nondevelopmental airlift aircraft will depend on the outcome of that decision. In the interim, DOD will assess the operational utility and cost-effectiveness of wide body aircraft in moving military bulk and oversize cargo. An Air Force official estimated that these efforts will cost around \$5 million, or a small fraction of the \$100 million available. DOD's preliminary acquisition plan suggests that it is preparing to compete the C-17 against nondevelopmental military and/or commercial wide-body aircraft.

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Mr. Chairman, that concludes my statement. I will be happy to answer any questions you or members of the Subcommittee may have.

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