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MISSION ANALYSIS AND
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SEPTEMBER 21, 1982

The Honorable Norman D. Dicks
House of Representatives

RELEASED



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Dear Mr. Dicks:

Subject: Information on B-747 and C-5B Aircraft Cost Comparisons (GAO/MASAD-82-48)

Your letter of July 26, 1982, requested that we evaluate the cost of the B-747 and C-5B aircraft competing alternatives for airlift enhancement. Items of particular interest to you were (1) the Department of Defense's (DOD's) rejection of Boeing's offer to provide contractor logistics support, (2) disagreements over the B-747 fuel consumption, (3) the recently reported cost increase on the proposed C-5B program, and (4) the ability of Lockheed to establish the C-5B production line within the cost and schedule they proposed.

This report discusses cost data on the first three of the items of interest and also points out a gap in DOD's documentation supporting a near-term need for more outsize airlift capability (outsize cargo is that which can be airlifted by C-5 aircraft or proposed aircraft such as the C-17). To provide a timely response, this report does not address the issue of Lockheed's ability to produce the C-5B within its proposed cost and schedule. As agreed with your office, we will obtain information on the producibility issue and provide it to you at a later time.

Cost estimates for the B-747 aircraft prepared by Boeing and the Air Force vary widely because of differing cost estimating methods and assumptions. For new B-747s to replace the proposed C-5B acquisition, Boeing has estimated life-cycle cost savings of \$5.7 billion and more. Air Force estimates show that the savings could be as low as \$900 million. Major differences between the Boeing and Air Force cost estimates for the B-747 are in the costs of operating and supporting a fleet of such aircraft. Boeing's estimates are based on a contractor logistics support system while some of the Air Force estimates assume an organic Air Force support system. Other major cost estimating differences occur because Boeing and the Air Force (Comptroller) used different

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estimating methods for computing fuel usage rates and because the Air Force used, in some of its estimates, a larger force of B-747s than proposed by Boeing.

The reported cost increase on the C-5B program consists of \$700 million in underestimated program acquisition costs (with inflation escalation over 8 years) and a \$500 million inflation adjustment due to a slippage in the planned contracting date for the C-5B aircraft. The slippage is due to a lack of funding approval to date by the Congress for the proposed C-5B program. Lockheed's proposed price for the C-5B in base-year dollars has not changed.

The cost of alternative airlift proposals has entered the congressional debate on the administration's airlift enhancement decision. According to DOD, however, two primary factors in its decision to acquire outsize airlift were the urgency and magnitude of an outsize cargo airlift requirement. The study cited by DOD as supporting the near-term need for more outsize airlift capability does recommend, among other enhancements, the addition of 10 million ton miles per day of outsize airlift capability. We have thus far, however, found no quantitative data supporting that recommendation.

SCOPE AND METHODOLOGY

We examined Air Force and Office of the Secretary of Defense (OSD) cost estimates for the C-5B and B-747 alternatives. We discussed the calculations, assumptions, and rationale used in the cost estimates with Air Force and OSD analysts. We also obtained information from Boeing on its cost estimates for the B-747.

As part of our ongoing review of DOD's acquisition of aircraft to satisfy U.S. airlift requirements, we are examining airlift portions of the Congressionally Mandated Mobility Study (CMMS) and documentation used to support DOD's airlift enhancement proposals. Our observations on airlift requirements in this report are based on our ongoing review. We have not attempted to evaluate the validity of the scenarios in the CMMS.

Our review was performed in accordance with our "Standards for Audits of Governmental Organizations, Programs, Activities, and Functions."

COST ESTIMATES FOR THE C-5B AND B-747

DOD documentation shows that it compared the B-747 to the C-5B aircraft in arriving at its January 1982 airlift enhancement decision. DOD rejected the B-747 alternative based on a DOD judgment of the B-747's low military utility and the lack of a near-term capability offered by that option. In March 1982 DOD

stated that the B-747 costs less than the C-5B, but that the lesser cost did not offset the greater military utility of the C-5B. At that time, DOD's life-cycle cost estimates showed, for various quantities of B-747 aircraft, that the B-747 cost was between \$4 and \$6 billion less than the C-5B.

Since the airlift enhancement decision in January 1982 to acquire the C-5B aircraft, the Air Force has prepared a wide array of cost estimates comparing the C-5B and B-747. These estimates, according to DOD officials, were prepared by the Air Force (Comptroller) in coordination with OSD cost analysts.

Boeing made several proposals to DOD in March 1982 for meeting the airlift needs. There has been considerable congressional debate on the relative life-cycle cost differences between the B-747 and C-5B aircraft. DOD's life-cycle cost estimates presented to the Congress for the B-747 are substantially higher than Boeing's estimates, but still less than C-5B costs. Of the various alternatives proposed by Boeing, the proposal to provide 48 new B-747 freighter aircraft as an alternative to the 50 C-5B aircraft allows a direct comparison of new B-747s and C-5Bs. Boeing has estimated that 48 B-747s to replace C-5Bs could save \$5.7 billion or more in life-cycle costs. DOD has estimated that the life-cycle cost difference between the two alternatives could be as little as \$900 million. (See cost estimates for this alternative in enclosure I.)

Comparing the Boeing's cost estimates for the B-747 with those prepared by the Air Force, the major cost differences occur in the 20-year operation and support (O&S) costs. Boeing has estimated 20-year O&S costs to be \$6.0 billion while the Air Force's estimates ranged from \$7.2 billion to \$9.8 billion. (See enc. I.)

Major factors accounting for the Boeing and Air Force cost estimating differences for the B-747 are: (1) contractor versus organic Air Force maintenance and support, (2) fuel consumption, and (3) the number of B-747 aircraft considered to be comparable to the 50 C-5Bs.

Air Force versus contractor maintenance and support costs

A major difference between Boeing and Air Force (Comptroller) cost estimates for the B-747 is the cost for maintaining and supporting a fleet of B-747s over a 20-year period. Boeing's cost estimate is based on the use of a contractor logistics support (CLS) concept while the higher Air Force estimates presume an organic Air Force maintenance and support concept. According to the Air Force data, using CLS for the B-747 reduces maintenance and support costs estimates \$1.5 billion or more over the life cycle.

DOD and the Air Force have cited several reasons why an organic concept was used in some of its cost estimates for the B-747. They said that CLS costs could escalate over the 20-year period due to changes in contracts, making costs difficult to estimate, and that CLS assumes that the airline industry would continue to be able to support the B-747 in the future. The Air Force has stated that it is possible to have CLS for the B-747 but has expressed doubts about whether it would be less costly, over time, than the organic support concept. The Air Force also has questioned whether CLS would be desirable from a military needs standpoint.

In April 1982 the Air Force said that it satisfactorily maintained some of its aircraft by contract, including the initial force of KC-10s. The Air Force said it intended to reevaluate this arrangement on the KC-10 in view of the decision to acquire another 44 such aircraft. A July 1982 cost study by the Air Force's Aeronautical Systems Division (ASD) confirmed a 1979 study which showed a large cost advantage for CLS support for KC-10 aircraft as compared to organic support. The latest study showed a 2 to 1 cost advantage for CLS even with an augmented force of KC-10s.

Cost is a consideration in assessing a CLS or organic support concept but as the Air Force has pointed out, other factors would also have to be considered. We agree that military requirements should be a part of the reevaluation of the support concept for the KC-10. It is noteworthy, however, that the Air Force's 20-year, life-cycle cost estimate for the KC-10 used a CLS concept exclusively, notwithstanding the Air Force concerns with a CLS approach.

Another Air Force rationale in estimating costs for the B-747 using an organic support concept was that this yields an "apples-to-apples" comparison since the C-5B uses organic Air Force support. In our opinion, such comparison is valid where the probable support for B-747s would be organic. However, such comparison is not realistic if the B-747 were to use a CLS support concept, as is presently employed on the KC-10 aircraft. Cost comparisons which use an organic concept for the B-747 take away one of the large cost advantages of this airlift alternative.

Fuel consumption rates

Fuel costs is another major area of difference between Air Force and Boeing cost estimates for the B-747. Boeing and Air Force (Comptroller) calculations of fuel usage per hour for the B-747 aircraft vary widely. Fuel usage is highly dependent on such factors as the type of aircraft, flight distance, payload, and the normal flight pattern of the aircraft (the mission profile).

Boeing based its fuel usage rate on a peacetime mission profile. Twenty-five percent of the flights were short training missions with zero payload, and 75 percent of the flights were long-distance training and logistics missions with a payload of 41 tons. The resulting fuel consumption rate was 2,865 gallons per hour.

Officials at the Air Force's ASD said that they reviewed the mission profile used by Boeing and the methodology and calculations in Boeing's fuel usage estimate. ASD's analysis shows that fuel consumption for the B-747 could range from 2,865 gallons per hour to 3,723 gallons per hour, depending on the mission. ASD considered the Boeing fuel consumption figure representative for the aircraft mission weights in Boeing's proposal. ASD used the Boeing fuel consumption estimate to compute the life-cycle cost for the B-747.

Air Force (Comptroller) estimates of the fuel consumption rates for both the B-747 and C-5B aircraft were derived using engine performance data. This methodology yielded a fuel usage rate of 3,893 gallons per hour for the B-747 and a rate of 3,294 gallons per hour for the C-5B. Using the same flight hours and fuel price for a 20-year period, the B-747 fuel consumption cost would be \$1.1 billion greater than the C-5B in a buy of 55 747s and \$0.5 billion greater than the C-5B in a buy of 48 747s.

Computation of the number
of B-747s comparable to the
proposed C-5B program

Boeing proposed 48 B-747 aircraft as a replacement for the DOD program of 50 C-5Bs. In comparing B-747 and C-5B costs, however, the Air Force calculated that in one scenario a procurement quantity of 55 B-747s would be the correct quantity to compare to the DOD program. DOD and Air Force officials said that they used the same data as Boeing used.

We found that Air Force (Comptroller) computations of the number of Boeing 747 aircraft needed to meet airlift requirements have used data and methodology that is not fully consistent with the stated basis for current requirements--CMMS. Also, the Air Force added 7 aircraft to the Boeing estimate of 48 B-747 total aircraft to equate B-747 and C-5B cargo delivery times in the Air Force analysis. However, the improved delivery time by adding the seven aircraft is extremely small and possibly insignificant.

Key features of CMMS included four representative scenarios and an analysis of overall mobility requirements (airlift, sea-lift, and prepositioning) rather than regarding any one portion, such as airlift, to be a separate and fixed requirement. The Air Force data used to compute the required number of B-747 aircraft,

however, was based on part of one scenario and the methodology assumed a fixed airlift requirement. This fixed requirement was far greater than the cargo moved by airlift in CMMS. As a basis for computing the comparable number of B-747s, for example, the Air Force study (Saber Challenge-Lift) included as airlift requirements items which were moved by sealift in the CMMS.

To equate airlift capability, the Air Force increased Boeing's estimate of total aircraft by seven and delivered cargo about one-half day sooner. Air Force documentation indicates that somewhat over 2 days is within the modeling uncertainty. In our opinion, use of this data to justify significant increases in numbers of aircraft is questionable.

As shown in enclosure I, the Air Force cost estimates using a procurement quantity of 55 B-747s (under CLS and organic support) are \$1.5 billion and \$1.7 billion higher than the Air Force estimates using a procurement quantity of 48.

DOD and Air Force officials stated that it is useful to assume a fixed airlift requirement when comparing the capability of different aircraft. Our criticism is not directed at the use of a fixed requirement to compare aircraft capability, but rather at the fact that the Air Force's fixed airlift requirement far exceeds CMMS airlifted cargo. The Air Force has not demonstrated, in our opinion, that its analysis yields the same result as would an analysis using a lower CMMS requirement.

INCREASE IN C-5B ESTIMATED COST

On August 6, 1982, the news media reported that DOD's proposed acquisition of 50 C-5Bs would cost \$2.1 billion more than the Congress was told. The data referred to in the article was from an Air Force planning document which showed a revised Air Force acquisition cost estimate of \$10.9 billion for the C-5B program.

Of the reported \$2.1 billion increase, \$900 million was for replenishment spares which are not part of acquisition costs. The remaining \$1.2 billion reported increase consisted of underestimated acquisition costs totaling \$700 million (with inflation escalation over 8 years) and a \$500 million inflation adjustment due to a slippage in the planned aircraft deliveries. The proposed C-5B funding and aircraft delivery schedule was based on a planned contract award date in April 1982. Because the Congress has not yet approved funds for this proposal, the planned contracting date has been revised to November 1982 and the funding profile and delivery schedule revised accordingly. An Air Force planning document shows that the November 1982 contracting date may be optimistic.

Lockheed's proposed price for the C-5B, in base-year dollars, has not changed. The underestimated costs for the C-5B program are for such items as engineering change orders, technical data, and support equipment which are needed to arrive at a total program acquisition cost estimate. Inflation adjustments are made periodically to update the projected acquisition costs.

While the costs of various airlift alternatives have entered into the congressional debate on the administration's airlift enhancement proposals, two key factors DOD cited in making its airlift decision were the urgency and magnitude of an outside airlift requirement. DOD has determined that only one source can satisfy the most significant portion of the minimum requirements of airlift capability (i.e., the capability to carry outside cargo without undue technical risk and within the increasingly urgent time requirement to augment existing airlift capability). We believe that there is a gap, however, in DOD documentation supporting a near-term need for more outside capability.

DOD's position is that a critical need exists for near-term outside airlift capability and that CMMS supports such a need. The CMMS report does state that one-half (10 million ton miles per day) of the total recommended airlift enhancement should be outside capable, but the CMMS report does not contain support for the statement. We requested from DOD all data which would support the 10 million ton mile per day outside shortfall, but we have not received any quantitative support for that figure thus far. DOD has stated that the CMMS study conclusion was based, in part, on judgments about the reasonable level of airlift necessary to justify opening an aircraft production line.

We reported in December 1981 ^{1/} our concern that DOD might not obtain adequate competition if an airlifter other than the C-X were selected to meet U.S. airlift requirements. We recommended that the Secretary of Defense avoid unduly restricting competition by directing the Air Force to solicit the maximum competition practicable. Our concerns about competition remain.

As requested by your office, we did not obtain written DOD comments on this report. We discussed the matters in this report with OSD and Air Force officials and have considered their comments in preparing this report.

^{1/}"U.S. Airlift Requirements Should be Satisfied Through Competition" (MASAD-82-11, Dec. 18, 1981).

As arranged with your office, unless the contents are publicly announced earlier, we plan no further distribution of the report until 10 days from the date of this report. At that time we will send copies to interested parties and make copies available to others upon request. We trust that the information and observations are responsive to your needs. We would be pleased to provide further information on these matters if you wish.

Sincerely yours,


W. H. Sheley, Jr.
Director

20-YEAR, LIFE-CYCLE COST COMPARISONS OFNEW B-747s AS ALTERNATIVE TO C-5BsAS OF APRIL 1982(FISCAL YEAR 1981 DOLLARS)

	Air Force				Boeing	
	CLS	ORG	CLS	ORG	CLS	
<u>C-5B</u>	<u>B-747 a/</u>	<u>B-747 b/</u>	<u>B-747</u>	<u>B-747</u>	<u>B-747</u>	
Aircraft quantities:						
Procurement quantity	50	55	55	48	48	48
Primary authorized aircraft	44	48	48	42	42	41
Costs:						
	(billions)					
Total acquisition cost	\$ 5.9	\$ 3.9	\$ 4.0	\$ 3.4	\$ 3.5	\$3.0
Operation and support costs	<u>8.8</u>	<u>8.2</u>	<u>9.8</u>	<u>7.2</u>	<u>8.6</u>	<u>6.0</u>
Total life-cycle costs <u>c/</u>	<u>\$14.7</u>	<u>\$12.1</u>	<u>\$13.8</u>	<u>\$10.6</u>	<u>\$12.1</u>	<u>\$9.0</u>

a/Contractor logistics support concept.

b/Air Force organic support concept.

c/Total life-cycle costs is the sum of total acquisition cost and operation and support costs.