



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

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PROCUREMENT LOGISTICS  
AND READINESS DIVISION  
B-210298

JANUARY 27, 1983

The Honorable Verne Orr  
The Secretary of the Air Force



120439

Dear Mr. Secretary

Subject Reengining of the KC-135 Aircraft With Used  
Commercial Engines (GAO/PLRD-83-34)

We have reviewed Air Force plans for replacing engines in a portion of its fleet of KC-135 aircraft. The plans, which the Oklahoma City Air Logistics Center in Oklahoma is administering, call for purchasing 46 used 707 aircraft and 35 spare engines from commercial airlines. The JT3D-3B engines and horizontal stabilizers from the 707 aircraft are to replace the horizontal stabilizers and J-57 engines of a like number of KC-135 airplanes. The JT3D-3B engines have more thrust, greater fuel economy, and less pollution emission than the J-57 engines. The JT3D-3B engines' additional thrust accounts for the need to replace the horizontal stabilizers.

Although the Air Force normally does not refurbish its airplane engines before the end of their estimated useful lives, the Center is having the JT3D-3B engines refurbished without first determining what useful life remain. It is spending about \$200,000 for refurbishing each JT3D-3B engine even though the life-limiting components of many still have years of useful life. The Center contracted for replacing life-limiting components as necessary to provide an expected engine life of 6,000 flying hours and 4,000 cycles (or takeoffs and landings). This is about 17 years of life at the expected Air Force use rate. Such components in many of the engines had a replacement value of \$8,000 to \$18,000 each and from 8 to 16 years of useful life when the contractors replaced them.

In view of the above circumstances, we suggest the Air Force reevaluate its program for the used JT3D-3B engines being purchased to reengine the KC-135 and adjust its refurbishment criteria accordingly.

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OBJECTIVES, SCOPE, AND METHODOLOGY

We reviewed the Air Force's practice of refurbishing used engines in the KC-135 reengining program. We wanted to evaluate the criteria the Air Force used in determining the need for overhaul. We conducted our review primarily at the Oklahoma City Air Logistics Center and the following activities

- Boeing Military Airplane Company, Wichita, Kansas.
- American Airlines Maintenance and Engineering Center, Tulsa, Oklahoma.
- Trans World Airlines Overhaul Center, Kansas City, Missouri.

At these locations, we interviewed officials, reviewed Air Force contracts for procuring used 707 aircraft and refurbishing JT3D-3B engines, and reviewed contract and program records. We made this review in accordance with generally accepted government audit standards.

BACKGROUND

In September 1981, the Air Logistics Center awarded Boeing Military Airplane Company a firm-fixed-price contract of about \$70 million for purchase of 18 used 707 aircraft and 21 spare engines; refurbishing the engines, and modifying the KC-135 aircraft, including the engine replacement. Boeing subcontracted with Trans World Airlines to refurbish the 72 engines removed from the used 707 aircraft. In April 1982, the Center awarded Boeing a letter contract for 28 additional 707s and 14 spare engines. If the Air Force receives adequate funds, it could reengine another 90 or so aircraft with the commercial engines. If the Air Force purchased additional spares, the number of engines requiring overhaul could total 400 to 500. Based on the overhaul cost of \$196,000 per engine on the first contract, the cost to refurbish these engines would range from \$78 million to \$98 million.

REASONS FOR REBUILD

Center officials said that they wanted the engines rebuilt to assure the command using the aircraft of reliable service and to preclude the engines from being returned to the depot before the center had developed the in-house capability to overhaul them.

Center officials also said that the stated rebuild level was necessary because the commercial engines had been operated under the "on-condition maintenance" concept and those engines would be transferred to the 'hard time maintenance' concept used by the Air Force. 'On-condition maintenance' is defined generally as repairing and replacing parts and components as required to keep the engine running properly and safely without any scheduled major overhauls. 'Hard time maintenance' generally refers to operating the engine for a certain number of hours before sending it to a depot for complete teardown and major overhaul of all or most of the components.

REMAINING USEFULNESS OF ENGINES  
AND PARTS NOT RECOGNIZED

The engines purchased under the contracts had various economic lives remaining before requiring major overhaul. Therefore, varying degrees of refurbishment were required at an average cost of about \$196,000 per engine. At a minimum, however, all life-limiting parts which did not meet the 6,000-hour criterion or the 4,000-cycle criterion had to be replaced. These parts are usually very expensive to buy and install. The cost alone for the life-limiting part ranges from \$7,900 to \$18,200, and engines have 21 such parts.

Before awarding the refurbishment contracts, the Center did not make any economic studies to determine whether a lower rebuild level would be more cost effective. Analysis of the 72 engines purchased with the first 18 aircraft showed that

- 55 (76 percent) had 6,000 hours or more remaining on the life-limiting parts and
- 20 (28 percent) had 4,000 cycles or more remaining.

Even though a large number of engines had life-limiting parts which did not meet the 4,000-cycle criterion, 27 engines (38 percent) had 2,000 to 3,999 cycles remaining. Had the Air Force adopted a lower criterion, fewer life-limiting parts would have to be replaced and the cost to refurbish the engines would be lower.

Historically, each KC-135 aircraft has been flown about 360 hours per year. As the Air Force did not record cyclical data for KC-135 aircraft, we had to estimate the expected cycles for the aircraft based upon a flying hour to cycle ratio of 1.5. We estimated the Air Force would fly about 240 cycles per year per

aircraft. Therefore, those life-limiting parts having 2,000 cycles remaining would have had an expected service life of about 8 years.

#### AIR FORCE ENGINE OVERHAUL POLICY

Aircraft engines, according to Air Force policy, are normally overhauled only when the useful life is expended. Although the Air Force establishes maximum operating times for engines, it encourages the maximum use of an engine's economic life--even to the extent of authorizing "over flying" the engine limits by as much as 10 percent. The Air Force has issued instructions for use by its in-house overhaul activities to insure that engines are overhauled only to the degree necessary.

Officials of the Propulsion Division at the Oklahoma City Air Logistics Center discussed our concerns that engine rebuild alternatives had not been considered initially and that such alternatives should now be considered. Center officials directed that an analysis be made to identify the most cost-effective criteria for overhauling the commercial engines. Officials were reevaluating the 6,000-hour/4,000-cycle engine overhaul criteria and had asked the contractor to provide cost estimates for various alternatives.

A Center official said that his division had not completed its studies as of June 22, 1982, but would make whatever change in acquisition that was found necessary on the basis of the study results.

#### CONCLUSION

The Air Force had not recognized the economic life remaining in selected commercial engines or taken full advantage of life-limiting parts before extensive refurbishment. Such refurbishment levels should be predetermined on a cost-effective basis in view of the Air Force's expected maintenance and overhaul capability, fleet size, flying hour programs, and any other relevant data.

#### RECOMMENDATION

To insure that the Air Force obtains full economic benefits from used commercial engines, we recommend that you evaluate alternative rebuild levels which consider the remaining useful life of the engines.

AGENCY COMMENTS

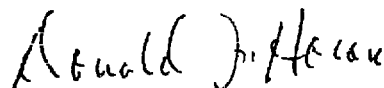
We discussed a draft of this report with DOD officials. They agreed with the conclusions and indicated that the Air Force would implement the recommendation and would advise us when the cost-benefit analysis is completed.

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As you know, 31 U.S.C. § 720 requires the head of a Federal agency to submit a written statement on actions taken on our recommendations to the House Committee on Government Operations and the Senate Committee on Governmental Affairs not later than 60 days after the date of the report. A written statement must also be submitted to the House and Senate Committees on Appropriations with the agency's first request for appropriations made more than 60 days after the date of the report.

We are sending copies of this report to the Secretary of Defense, the Director, Office of Management and Budget; the Chairmen of the above committees, and the Chairmer, House and Senate Committees on Armed Services.

Sincerely yours,



Donald J. Horan  
Director