United States General Accounting Office

GAO

Report to Congressional Requesters

June 2004

MILITARY AIRCRAFT

DOD Needs to Determine Its Aerial Refueling Aircraft Requirements

GAO-04-349

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DOD Needs to Determine Its Aerial Refueling Aircraft Requirements

GAO Accountability • Integrity • Reliability

Highlights

Highlights of GAO-04-349, a report to congressional requesters

Why GAO Did This Study

With the heavy pace of operations in support of the war on terrorism, the Department of Defense (DOD) and the Air Force have become increasingly concerned about their aging aerial refueling aircraft. We last reviewed the aerial refueling fleet in 1996 and found that KC-135 aircraft were aging and becoming increasingly costly to maintain and operate. In December 2001, we began new work on the Air Force's requirements for refueling aircraft. However, we suspended our work several times to provide testimony and other products on the condition of the current fleet and Air Force plans to accelerate replacement. We were asked to review (1) the extent to which the current fleet has met aerial refueling needs, and the cost and effort to operate and sustain the fleet, (2) DOD's current refueling requirements, and (3) options to meet future aerial refueling needs.

What GAO Recommends

We recommend that the Secretary of Defense (1) conduct a study to determine the current and projected aerial refueling requirements, and (2) direct that the planned analysis of alternatives be a comprehensive study of all reasonably available options or options currently being tested, including using contractor-provided aerial refueling services. DOD concurred with each recommendation and had begun the studies at the time of this report.

www.gao.gov/cgi-bin/getrpt?GAO-04-349.

To view the full product, including the scope and methodology, click on the link above. For more information, contact Neal Curtin at (757) 552-8100 or curtinn@gao.gov..

What GAO Found

The current refueling force has successfully supported the needs of U.S. combat and mobility air forces during peacetime and wartime operations but future support costs will continue to rise as the fleet continues to age, according to the Air Force. Congress authorized the Air Force to acquire 100 KC-767A aerial refueling aircraft in November 2003 as the first step in replacing the 538-plane KC-135 fleet but it could take up to 30 years to replace the rest based on the estimated production rate for the first 100 aircraft. Thus, the Air Force will need to continue maintaining and modernizing some of the remaining aircraft for up to 3 decades. Some of those aircraft could be 70 to 80 years old when they are eventually replaced.

DOD does not know how many or what type of aircraft are needed to meet future refueling needs because its requirements study is out of date. The most recent study, *Tanker Requirements Study-05*, was done in 2001 and identified the number of aircraft needed to carry out a two-major-theater-war strategy. However, that strategy has been superceded by a new capabilities-based approach contained in the 2001 Quadrennial Defense Review. In addition, significant changes taking place in operational concepts and force structure could substantially affect future refueling requirements. As a result, the Air Force does not have a clear picture of future needs that could guide its replacement and investment decisions.

GAO outlines three broad options (see table below) to meet the Air Force's long-term aerial refueling requirements. DOD could adopt one or a combination of these approaches. GAO is not taking a position on which option(s) would be most suitable. The Air Force was recently directed by DOD to conduct and complete by August 2005 an analysis of alternatives for replacing the current capability. However, at the time of our audit work, the Air Force did not plan to study the option of using contractor-provided aerial refueling services as part of its analysis of alternatives.

Options for Meeting Aerial Refueling Requirements

Option	Considerations
Acquire new aircraft	This could be a commercial derivative or new development; could consider various types and sizes of aircraft, including potential unmanned aircraft of the future.
Acquire used aircraft and convert to tankers	Numerous types of used commercial aircraft are available, but the condition and age of the planes, along with the cost to convert them to tankers, would need careful study.
Contract for refueling services	The Navy uses contracting on a limited basis. Contracting could meet some portion of refueling needs.

Source: GAO.

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Abbreviation

DOD Department of Defense

GAO
Accountability * Integrity * Reliability

United States General Accounting Office
Washington, DC 20548

June 4, 2004

The Honorable Duncan Hunter
Chairman
Committee on Armed Services
House of Representatives

The Honorable Joel Hefley
Chairman
Subcommittee on Readiness
Committee on Armed Services
House of Representatives

Aerial refueling is critical to U.S. national security strategy, allowing bomber, fighter, and transport aircraft to rapidly deploy and operate globally, stay airborne longer, and carry more weapons, equipment, and supplies. The Air Force has most of the Department of Defense's (DOD) refueling capability in 59 large KC-10 and 538 KC-135 aerial refueling aircraft. The KC-135 aircraft averages about 43 years of age—the oldest aircraft in the military inventory. Following the terrorist attacks of September 11, 2001, and the start of the global war on terrorism, DOD and the Air Force have become increasingly concerned about possible age-related problems that could ground the refueling fleet. The Air Force believes the national security strategy cannot be executed without aerial refueling.

We last reviewed the aerial refueling fleet in 1996[1] and concluded that the KC-135 aircraft were aging and becoming increasingly costly to maintain and operate. We also pointed out that DOD had a need for more mobility aircraft to transport troops and equipment to theaters of operations. Consequently, we recommended that when DOD considers a replacement for the KC-135 aircraft, it develop a multi-role aircraft that could do aerial refueling or airlift operations. DOD responded that it could operate the KC-135 aircraft for another 35 years, to approximately 2030, when they would be 70 to 80 years old. However, since 2001, DOD and the Air Force have accelerated plans to begin replacing the KC-135 aircraft. They will be expensive to replace and will likely require many years of effort given the number of aircraft to be replaced and the high cost of military aircraft. In

[1] U.S. General Accounting Office, *U.S. Combat Air Power: Aging Refueling Aircraft Are Costly to Maintain and Operate*, GAO/NSIAD-96-160 (Washington, D.C.: Aug. 8, 1996).

December 2001, we were requested to review the Air Force's requirements for aerial refueling aircraft and options to meet those requirements. We received the request and began the work before the Air Force announced that it planned to lease Boeing 767 aircraft modified for aerial refueling. We suspended this work several times to provide testimony and other products related to the condition of the current refueling fleet and the specific terms of the proposed lease in 2002 and 2003 (see p. 35 of this report for a list of GAO aerial refueling aircraft-related products, including our testimony statements). We have now completed our work on the original request and this report is the result. As requested, we examined, (1) the extent to which DOD's current aerial refueling force has met refueling needs, and the cost and effort associated with operating and sustaining the current fleet; (2) the most recent aerial refueling requirements; and (3) options to enable DOD to meet future aerial refueling requirements. Subsequent to this request, in 2002, Congress authorized the Secretary of the Air Force to initiate a multi-year pilot program to lease up to 100 Boeing 767 aircraft for use as aerial refueling aircraft. Subsequent to the hearings, Congress amended the authorization to permit the Air Force to lease 20 and purchase 80 aerial refueling aircraft.

To examine the extent to which DOD's current aerial refueling force has met mission requirements, the cost of maintenance, and efforts to sustain the fleet, we interviewed DOD and Air Force officials and reviewed key documents, comparing mission requirements and aerial refueling aircraft availability rates; and obtained a variety of data documenting maintenance costs. We did not independently verify the reliability of the cost and maintenance data, but we discussed cost estimates with certain internal and external organizations knowledgeable about aircraft operating and maintenance costs to determine the reasonableness of the data, and we determined that the estimates were reasonable. To examine current aerial refueling aircraft requirements, we interviewed key DOD and Air Force officials and reviewed key requirements documents, including a joint instruction calling for a requirements determination study and recommending an analysis of alternatives to meeting the requirements, a briefing on Tanker Requirements Study-05, and the complete Mobility Requirements Study-05. To identify options to enable DOD to meet the requirements, we interviewed officials and obtained documents outlining three different approaches to meeting refueling requirements that are generally considered to be reasonably available in the near term. We describe our scope and methodology in appendix I. We conducted this work from December 2001 to April 2004 in accordance with generally accepted government auditing standards.

Results in Brief

The current refueling force has met the needs of U.S. forces in peacetime and wartime; however, future costs and efforts needed to operate and support the existing refueling fleet, especially the KC-135s, will likely continue to rise as these aircraft age. Although Congress has authorized the Air Force to lease 20 and purchase 80 KC-767A aerial refueling aircraft to start replacing the 538-plane KC-135 fleet, the Air Force will likely need another 20 to 30 years to replace the rest based on the planned production rate of the first 100 aircraft and the likely cost of the planes. Consequently, the Air Force will need to maintain and possibly modernize at least some of the remaining aircraft for up to 3 decades. Some of those aircraft could be between 70 to 80 years old when replaced. Operations and support costs for the KC-135 fleet are estimated to grow from about $2.2 billion in fiscal year 2003 to $5.1 billion (fiscal year 2003 dollars) in fiscal year 2017, an increase of $2.9 billion, or over 130 percent, which represents an annual growth rate of about 6.2 percent.

Currently, the Air Force does not know how many aircraft or the type of aircraft needed for the future refueling mission because no up-to-date studies exist to validate the number or type needed. Tanker Requirements Study-05 is the most recent study, but it specifies the number of refueling aircraft needed to support operations contemplated in the outdated two-major-theater-war strategy. The current strategy is the 2001 Quadrennial Defense Review approach to (1) defend the homeland, (2) deter aggression by maintaining regionally tailored forces, (3) swiftly defeat aggression in two overlapping major conflicts, and (4) decisively defeat the adversary in one of two major conflicts. The current strategy, combined with the global war on terrorism, and DOD reassessments of operational concepts and the force structure may lead to still more changes in planned operations and by extension, in refueling support that will be required, although no requirements study was planned to replace Tanker Requirements Study-05 at the time of our audit work. DOD guidance also specifies that an analysis of alternatives is required to identify options for meeting requirements.[2] The Fiscal Year 2004 National Defense Authorization Act required an analysis of alternatives to identify options best suited to meeting current and projected refueling needs by no later than March 1, 2004. To comply with the mandated requirement, DOD has completed an interim report memorandum dated February 24, 2004,

[2] An analysis of alternatives evaluates the operational effectiveness, suitability, and estimated costs of alternative systems to meet a mission capability. It assesses the advantages and disadvantages of the alternatives being considered, including the sensitivity of each alternative to possible changes in key assumptions.

outlining the framework and parameters it proposes for the Air Force to use in an overview study of various options for replacing its aging fleet of KC-135 aircraft. However, DOD and the Air Force recognize that the February 2004 guidance letter is not an analysis of alternatives. DOD plans to issue a separate analysis and report studying the material condition of its fleet of KC-135 aerial refueling aircraft by September 2004, followed by the analysis of alternatives study to be issued in August 2005.

At least three options exist to meet future refueling needs. The Air Force could (1) directly acquire new aircraft to replace the KC-135 fleet, (2) obtain excess commercial aircraft configured for refueling, or (3) augment its fleet with contractor-provided refueling. Except for the option to directly acquire new aircraft, these options or some combination could enable DOD to meet refueling needs without incurring the full cost to acquire, operate, and support a new refueling fleet and develop required associated infrastructure. DOD's planned analysis of alternatives will review options related to buying new or commercially similar aircraft as well as acquiring and modifying used aircraft but was not planned to evaluate the potential for contractor-provided refueling, according to the memorandum from the Office of the Secretary of Defense to the Air Force directing that an analysis of alternatives be done. We are not taking a position on which option(s) would be more suitable.

To provide a current, comprehensive roadmap to guide long-term replacement of the current tanker fleet, we recommend that the Secretary of Defense (1) conduct a new, validated requirements study to determine current and projected aerial refueling requirements and (2) expand the planned analysis of alternatives to include all viable options for providing aerial refueling including the potential for the use of contractors. DOD concurred with each recommendation and had begun the studies at the time of this report.

Background

Aerial refueling is critical to carrying out U.S. national security strategy because it allows other aircraft to fly further, stay airborne longer, and carry more weapons, equipment, and supplies. The Air Force has stated that without aerial refueling, U.S. national security strategy could not be executed. While numerous military aircraft are used for refueling, most of the U.S. refueling capability is in the Air Force's 59 KC-10 and 538 KC-135 aircraft. These large, long-range aircraft are based on commercial aircraft modified for aerial refueling. The KC-10 aircraft is based on the DC-10 commercial aircraft, was built in the 1980s and averages about 20 years in age. Figure 1 displays a KC-10 aircraft refueling an F-16 fighter aircraft.

Figure 1: KC-10 Aerial Refueling Aircraft Preparing to Refuel an F-16 Fighter

Source: Air Force.

In addition to its refueling capability, the KC-10 is a multi-role aircraft and can be used to transport air cargo, known as airlift.

The KC-135 aircraft, similar to the Boeing 707 commercial airliner, was built in the 1950s and 1960s, and aircraft still in the fleet average about 43 years in age. Figure 2 displays a KC-135 refueling aircraft.

Figure 2: KC-135 Aerial Refueling Aircraft

Source: Air Force.

In terms of refueling capacity, the KC-135 aircraft comprise about 90 percent of the refueling fleet and consequently are the mainstay of the U.S. aerial refueling capability.[3] However, their ability to meet current and future refueling mission requirements will depend on continued maintenance, support, and operations for years to come.

[3] There are two basic versions of the KC-135 aircraft today—the KC-135R and the KC-135E—both of which were derived from the original KC-135As produced in the 1950s and 1960s. The Air Force undertook a two-pronged engine replacement program in the mid-1980s to improve the performance of its then 20- to 30-year-old KC-135A refueling fleet. First, over 155 Air National Guard and Air Force Reserve tankers were modified with used commercial airline engines, which improved their fuel offload capability by 20 percent, and their fuel efficiency by 14 percent. These aircraft were redesignated as KC-135Es. During this same period, active duty aircraft received new, more powerful, efficient CFM-56 commercial engines plus about 25 other improvements (such as reinforced floors and wing structures and strengthened landing gear), which enabled the modified aircraft—redesignated as KC-135Rs—to offload 50 percent more fuel, reduce fuel consumption by 25 percent, and operate 96 percent quieter than the KC-135As. Subsequently, some of the KC-135Es were also modified to KC-135Rs, so that as of March 1, 2004, there were 417 KC-135Rs and 121 KC-135Es. All active duty Air Force units only operate the KC-135Rs, as do some Air National Guard and Air Force Reserve units, while all of the KC-135Es are assigned to Air National Guard and Air Force Reserve units. Over half of the total 538-plane KC-135 fleet is assigned to Air National Guard and Air Force Reserve units.

Prior to 2001 neither DOD nor the Air Force Expressed an Urgent Need for a New Refueling Aircraft

Between 1996 and November 2001, DOD and the Air Force expressed little urgency to replace KC-135 aircraft even though the aircraft were experiencing age-related problems. For example, the Air Force was addressing corrosion, increased operating and support costs, and reduced aircraft availability in the mid-1990s, when we last reviewed aerial refueling issues.[4] In our 1996 report, we stated that (1) the KC-135 aircraft was becoming increasingly costly to maintain and operate, (2) procurement of a commercial-derivative aircraft could take 4 to 6 years and development of a new aircraft could take up to 12 years, and (3) the Air Force would need to quickly initiate studies to develop a replacement strategy for mobility aircraft used in aerial refueling and airlift. DOD responded that "while the KC-135 is an average of 35 years old, its airframe hours and cycles are relatively low. With proper maintenance and upgrades, we believe the aircraft may be sustainable for another 35 years." Thus, DOD planned to continue operating the aircraft until about 2030, when they would be about 70 to 80 years old.

At that same time, the Air Mobility Command deferred the start of KC-135 replacement from fiscal year 2007 to fiscal year 2013. Moreover, in November 2001, the commander of the Air Mobility Command stated that the "Air Mobility Command's priority is to continue with C-17 acquisition and C-5 modernization in the near term. As the airlift priority is met, AMC will begin to shift resources to address the next air refueling platform in the mid-to-long-term. Air Mobility Strategic Plan 2000 envisions KC-135 aircraft retirement beginning in 2013 with the concurrent fielding of a replacement air refueling platform."

In January 2002,[5] Congress authorized a pilot program to lease 100 Boeing 767 aircraft modified for aerial refueling, subsequently designated the KC-767A aircraft. At about the time that Congress authorized the proposed lease, the Air Force position on when it wanted to begin retiring KC-135s and introducing replacement aircraft shifted from around 2013 to 2006. The Air Force stated that the urgency was due to growing operating and support costs, declining aircraft availability, and an increasing possibility that a fleetwide grounding event would prevent continued operation of the

[4] U.S. General Accounting Office, *U.S. Combat Air Power: Aging Refueling Aircraft Are Costly to Maintain and Operate*, GAO/NSIAD-96-160 (Washington, D.C.: Aug. 8, 1996).

[5] Department of Defense and Emergency Supplemental Appropriations for Recovery from and Response to Terrorist Attacks on the United States Act, 2002, Pub. L. No. 107-117, § 8159, 115 Stat. 2230, 2284-85 (2002).

KC-135 aircraft and thus cripple refueling support to U.S. combat air forces. In mid-2003, the Air Force introduced a plan to retire 61 KC-135Es, to reduce the support costs while increasing the number of crews, flying hours, and utilization rates for the remaining aircraft.[6] The fiscal year 2004 defense authorization act limited the number of KC-135Es to be retired in that fiscal year to 12 aircraft.

Despite the recently stated urgency of replacing the KC-135 aircraft, the Air Force has not requested funds in the fiscal year 2005 budget to buy or lease new refueling aircraft. In a traditional procurement, the Air Force would need to have programmed any funding to buy the new aircraft. On the other hand, a key claimed advantage of the proposed lease was that the Air Force could immediately order the KC-767A aircraft for delivery beginning in 2006 but would only have to make annual payments to the aircraft owner rather than paying the full purchase price. Conversely, if the Air Force replaced the refueling aircraft through a purchase, it would have had to program sufficient funds to pay the full purchase price by 2006 for delivery beginning in 2009. However, neither DOD nor the Air Force wanted to reprogram funds from other acquisition programs to accelerate refueling aircraft procurement because such action was thought to have the potential to disrupt other programs and affect military capability.

Status of KC-767A Aircraft Acquisition

In 2003, the House and Senate Armed Services Committees held hearings on the condition of the KC-135 fleet and proposed leasing of 100 KC-767A aircraft. Subsequent to the hearings and in the National Defense Authorization Act for Fiscal Year 2004, Congress amended the original lease provision and authorized the Air Force to lease 20 new KC-767A aircraft and purchase 80. A key advantage of this plan is that it offered savings of about $5 billion in current dollars over the plan to lease all 100 aircraft but also requires the Air Force to pay for the 80 aircraft sooner than if they were leased. However, at the time of this report, the combined lease and purchase had not yet been initiated. DOD has placed the final contract signing for the combined lease and purchase on hold until the DOD Inspector General completes a review of the actions of Air Force and Boeing officials during negotiations, and until the Defense Science Board

[6] Seven additional KC-135E aircraft will be moved to back-up aircraft inventory, which allows the Air Force to conduct scheduled and non-scheduled maintenance, modifications, inspections, and repair on these aircraft without a corresponding reduction of aircraft available for operational missions.

completes a review of the condition of the KC-135 fleet, expected in September 2004.

Current Force Has Met Refueling Needs but at Increasing Cost and Effort

DOD's aerial refueling force has met the needs of U.S. combat and mobility air forces since 1991.[7] However, as the fleet ages, the costs and the efforts to keep it operating safely are likely to grow. Although the Air Force has begun the process to replace all 121 KC-135E aircraft with 100 KC-767A aircraft pending final approval, the effort is planned for completion in 2011 or later. Moreover, this plan does not lead to replacement of any of the 417 KC-135R aircraft, a process that could last another 20 to 30 years. As a result, U.S. combat and mobility air forces are likely to continue to rely on some KC-135R aircraft for aerial refueling through at least the 2020 to 2030 time frame.

DOD's Aerial Refueling Force Has Met Refueling Fleet Needs in Combat and Peacetime Operations

Since 1991, U.S. airpower has been used in combat in the Middle East, the Balkans, Afghanistan, and in the United States on homeland defense missions. Aerial refueling has played a vital supporting role in these operations due to the long distances between bases in the United States and elsewhere and the combat theaters, the distances within the theaters between bases and operating areas; the need to keep combat aircraft aloft for extended periods of time or maintain operations around the clock; and the relatively short operating ranges of many combat and support aircraft. Nearly every mission flown by combat and support aircraft during these conflicts required at least one, and often multiple refuelings from U.S. refueling aircraft. Table 1 depicts aerial refueling activity in the last four major conflicts.

[7] We did not review aerial refueling mission accomplishment for missions prior to 1991; however, we are not aware of any shortcomings prior to that date.

Table 1: Air Force Aerial Refueling Statistics for Major Conflicts Since 1991

	Iraq (1991)	Kosovo (1999)	Afghanistan 2001-02	Iraq 2003
Number of refueling aircraft	306	175	80	185
Sorties	16,865	5,215	15,468	6,193
Flight hours	66,238	52,390	115,417	Not available
Average sortie length (hrs)	3.9	10.0	7.5	Not available
Receiver aircraft	51,696	23,095	50,585	28,899
Fuel off-loaded (lbs)	800.7M	253.8M	1,166M	376.4M
Avg. fuel per sortie (lbs)	47.5K	48.7K	75.4K	60.8K

Source: GAO analysis of Air Force data.

According to the Air Force, since the terrorist attacks of September 11, 2001, the refueling fleet has been increasingly stressed due to operational requirements. Table 2 depicts the percentages of the KC-135 fleet that flew within various ranges of flight hours each year from fiscal years 1996 through 2002.

Table 2: Distribution of Flying Hours for the KC-135 Fleet (Fiscal Years 1996-2002)

	Percentage of KC-135 fleet						
Hours per aircraft	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
0	3.1	4.2	4.2	5.8	8.3	7.1	4.2
1-99	3.4	5.3	5.4	9.8	11.6	11.3	7.3
100-199	11.9	8.3	8.3	9.3	11.3	9.6	9.1
200-299	16.3	13.4	16.7	18.1	20.1	18.7	12.4
300-399	28.6	34.2	28.1	21.6	22.0	22.0	15.8
400-499	23.1	20.5	21.6	12.9	13.6	18.5	19.5
500-599	7.6	9.4	10.3	7.4	7.8	8.4	15.5
600-699	4.9	4.2	4.2	6.0	3.6	3.5	8.7
700-799	1.1	0.5	0.9	4.7	0.9	0.5	3.5
800-899	0	0	0	2.0	0.7	0.4	1.5
900-999	0	0	0.2	1.1	0	0	1.5
>1000	0	0	0	1.3	0	0	1.3

Source: GAO analysis.

The cumulative lifetime fleetwide average was about 16,000 hours per KC-135 aircraft at the time of our review, less than half of the projected limit of 36,000-39,000 hours per aircraft, according to Air Force data. In 2001, the Air Force projected that the fatigue life for nearly all of the

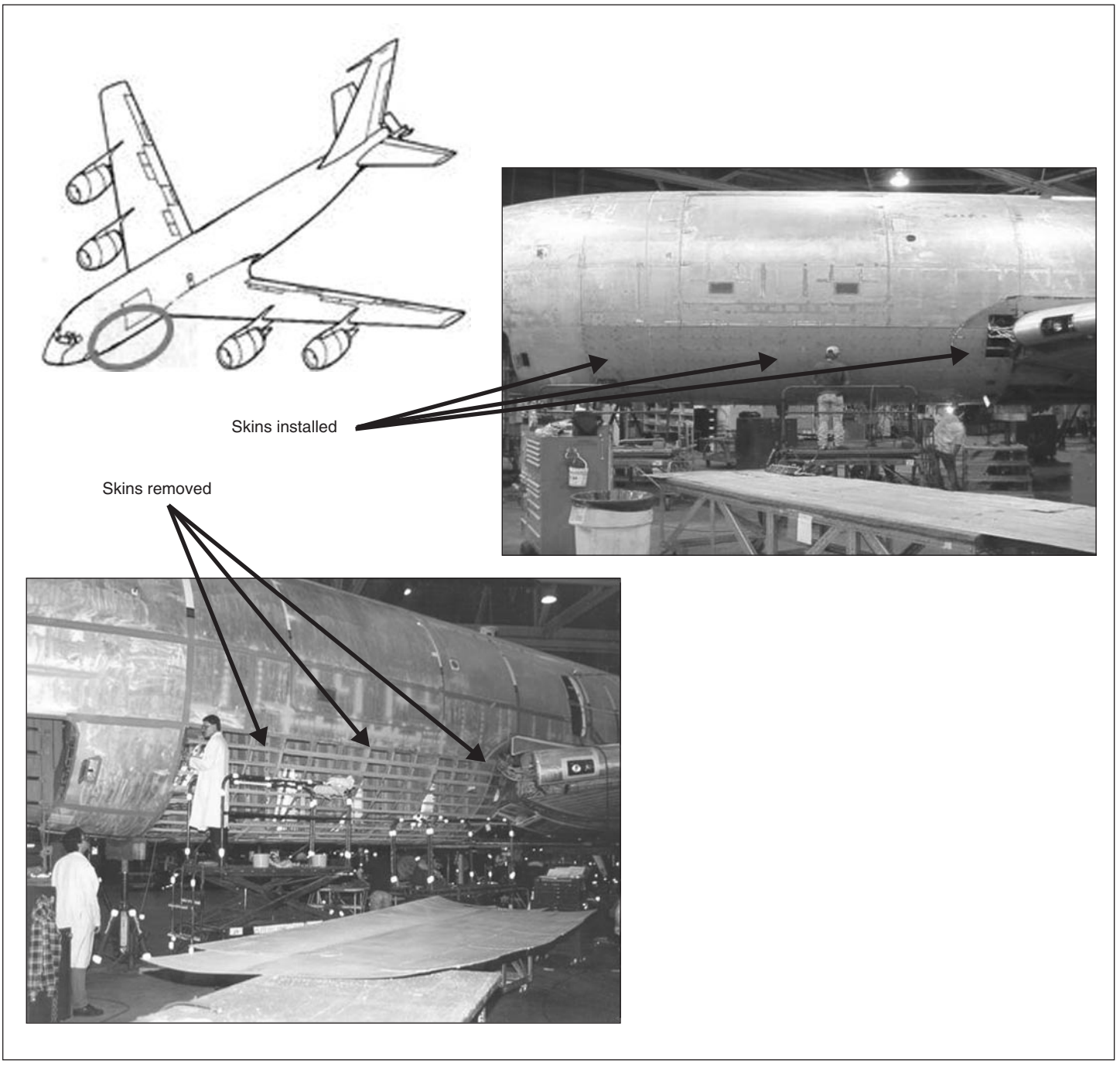
KC-135 aircraft should permit their usage until 2040. However, since 2001, the Air Force has become concerned that unknown future problems could arise and lead to the grounding of the KC-135 fleet, thereby undermining refueling capability.

KC-135 Aircraft Has Undergone Significant Improvements to Remain Combat Ready

While the KC-135 fleet was delivered between 1957 and 1965, significant portions of the aircraft have been upgraded or modified since. Thus, while the aircraft are considered old, significant improvements have been incorporated into the aircraft since, including capability-enhancing modifications and replacement of major structural components. For example, between 1975 and 1988, the Air Force replaced about 1,500 square feet of the aluminum skin on the underside of the wings of most KC-135 aircraft with an improved aluminum alloy that was less susceptible to fatigue. Engine strut fittings were also replaced.

In addition to such specific large-scale, fleetwide upgrade programs, most aircraft have had some other major structural components replaced as necessary, and some major components have been replaced on all aircraft. Examples of some of these major structural repairs include replacement of segments of fuselage skins, floor beams, fuselage bulkheads, and upper wing skins. Figure 3 shows replacement of fuselage skin underway on a KC-135 aircraft.

Figure 3: Removal and Replacement of KC-135 Fuselage Skin



Source: U.S. Air Force.

As components such as these are replaced, the use of new and improved materials, fabrication, and corrosion prevention techniques are being used to prevent corrosion and allow for increased service life of the parts.

KC-135 Operating and Support Costs Have Increased Significantly

KC-135 operations and support costs have risen significantly since 1996. As shown in table 3, the actual average cost per flying hour, adjusted to constant 2002 dollars, increased from $8,476 per hour in 1996 to $10,955 per hour in 2002, an increase of 29 percent.

Table 3: KC-135 Operating and Support Costs (Fiscal Years 1996-2002)

Constant fiscal year 2002 dollars in millions							
Cost category	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Mission personnel	$693.6	$671.3	$641.1	$792.9	$780.2	$793.0	$778.2
Unit level consumption	475.4	473.9	514.8	525.7	388.1	485.0	633.8
Depot maintenance total	292.0	306.5	417.8	460.8	390.2	423.9	647.3
Contractor support total	6.0	4.6	8.3	10.8	5.8	13.3	4.2
Sustaining support total	30.1	18.8	23.1	22.9	24.5	24.5	38.4
Indirect support total	111.6	134.7	130.9	220.2	211.9	211.6	298.7
Total	**1,608.7**	**1,609.8**	**1,736.0**	**2,033.3**	**1,800.7**	**1,951.3**	**2,400.6**
Annual flying hours[a]	189,827	188,579	189,236	195,851	157,786	165,574	219,136
Cost per flying hour	8,476	8,536	9,173	10,382	11,412	11,785	10,955

Source: GAO analysis of Air Force data.

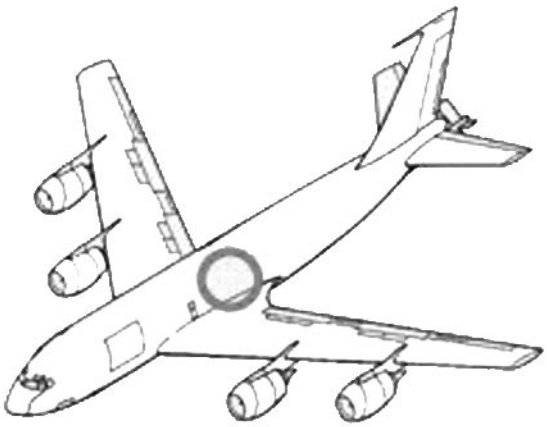
[a]Excludes hours for four KC-135D aircraft that are scheduled for retirement in fiscal year 2005.

The Air Force's 15-year cost estimates project further significant growth through fiscal year 2017. For example, operations and support costs for the KC-135 fleet are estimated to grow from about $2.2 billion in fiscal year 2003 to $5.1 billion (2003 dollars) in fiscal year 2017, an increase of $2.9 billion, or over 130 percent, which represents an annual growth rate of about 6.2 percent.

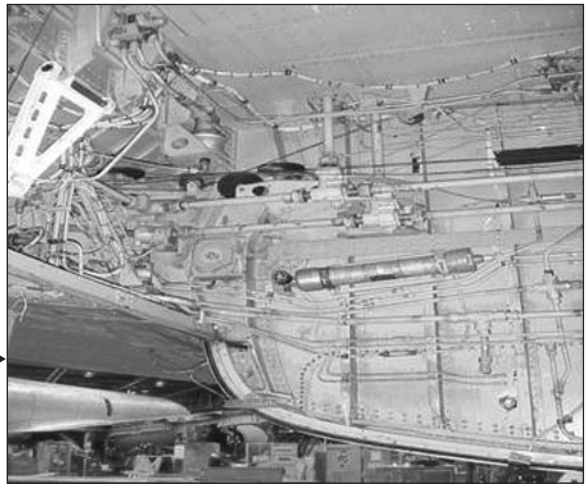
KC-135 Depot Maintenance Trends Change

To maintain serviceability, each KC-135 aircraft periodically undergoes programmed depot maintenance. During this maintenance, crews inspect the aircraft, repair or replace structural components and systems, make modifications, and strip and reapply paint. Figure 4 shows the location and damage to a component of a refueling aircraft's frame that was discovered during program depot maintenance. The part was replaced.

Figure 4: Example of a Cracked Frame Component That Was Replaced During Programmed Depot Maintenance

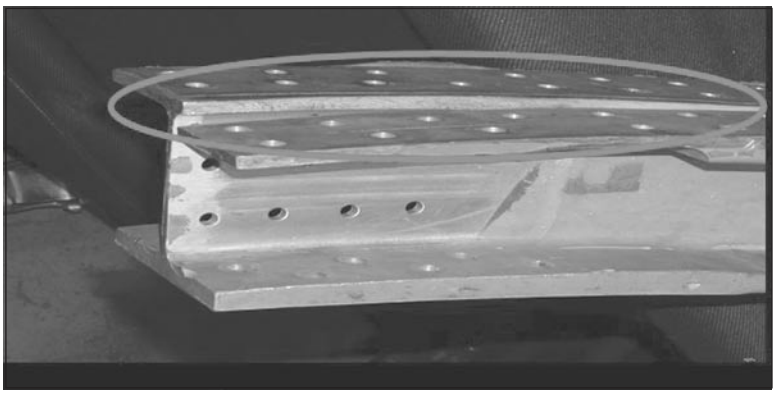


Installed frame
(As seen from wheel well)



Frame removed

Cracked flange



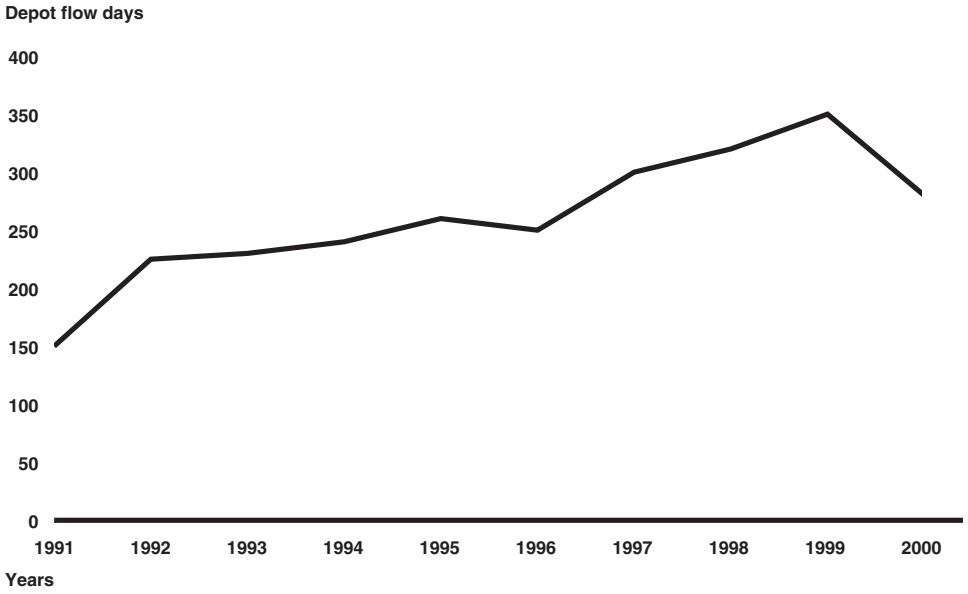
Source: U.S. Air Force.

Most KC-135 aircraft are scheduled for depot maintenance every 5 years, although aircraft based in locations subject to humid air and/or a salt air environment are generally scheduled every 4 years.[8]

Between mid-1994 and mid-1998, an average of about 100 KC-135 aircraft were at a depot at any given time. However, by mid-2000, that number had risen to 166 aircraft, about 30 percent of the fleet, due in part to modernization programs and the need for more extensive maintenance attributed to the aircraft aging. As shown in figure 5, the average number of days that each KC-135 spent in depot maintenance, known as "depot flow days," rose sharply during the 1990s but declined significantly in fiscal year 2000, due to a variety of short-term initiatives.

[8] KC-135 depot maintenance is performed at the Oklahoma City Air Logistics Center at Tinker Air Force Base, Oklahoma; the Boeing Aircraft Support Center in San Antonio, Texas; and at PEMCO Inc. in Birmingham, Alabama.

Figure 5: Trend in the Number of Depot Flow Days for Programmed Depot Maintenance Per KC-135 Aircraft (Fiscal Years 1991-2000)



Source: Air Force.

Between 1991 and 2000, the Air Force doubled the basic depot maintenance package, accounting for a significant portion of the increased depot flow days. The change increased maintenance time from 16,000 hours to 32,000 hours[9] on average per aircraft. Moreover, other factors also increased maintenance time including:

- the removal and replacement of major portions of wiring systems (5,200 hours per plane);
- one-time structural changes to prevent corrosion (2,100 hours per plane); and
- unplanned major structural repairs, including replacement of floor beams, fuselage bulkheads, and fuselage skins (increased by 6,000 hours per plane).

Depot flow days began to decline in fiscal year 1999 but recognizing the need to try to further reduce depot flow days and despite the doubling of

[9] These hours are calculated by tallying the total number of hours that each maintainer worked on an aircraft.

the maintenance package, in 2001, the Air Force made improvements to depot operations. These changes included:

- deferring maintenance if warranted based on an inspection of the aircraft;
- increasing the number of maintenance personnel;
- moving engineers to production to shorten decision-making time on whether to remove, repair, or replace a damaged or worn aircraft component;
- and increasing second shift operations.

As a result, the number of aircraft in the depot decreased from 176 to 89 between September 2000 and September 2002 with no known degradation in aircraft safety and readiness. The Air Force expects the number of KC-135s in depot maintenance to continue to decline to 73 aircraft in fiscal year 2005, followed by a gradual increase to 89 aircraft in fiscal year 2020.

Air Force's Aerial Refueling Requirements Are Outdated

The Air Force plans to embark on a program to replace the KC-135 fleet without a current study to identify the number or type of aircraft needed for the future refueling mission. The most recent study is Tanker Requirements Study-05. However, it specifies the number of refueling aircraft needed for the outdated two-major-theater-war strategy, which was replaced by the 2001 Quadrennial Defense Review. Moreover, refueling requirements could change still more due to force transformation initiatives, projected changes in operational concepts, the advent of new technologies such as unmanned aerial vehicles, and force structure changes. Finally, the Air Force also has not conducted a recommended analysis of alternatives to identify the approach best suited to meeting refueling mission requirements prior to committing to a specific approach. Consequently, the Air Force may embark on an expensive program to invest in new aircraft without knowing how many it needs and may miss an opportunity to meet its needs using the most cost-effective approach.

Current Refueling Force Is a Cold War Legacy

The KC-135 aircraft design and fleet size has evolved from post-World War II requirements to that needed to carry out the U.S. strategy of containment of the former Soviet Union. The Air Force acquired more than 700 KC-135 aircraft between 1957 and 1965, principally to refuel bombers that would have carried out the strategic nuclear war plan. Thus, the KC-135 aircraft was equipped with a boom to provide high refueling rates that strategic bombers needed. In that role, the refueling aircraft spent 30 percent of their time on nuclear alert ready for takeoff

but were not actually flown much. In the post-Cold War era, the aerial refueling aircraft mission has changed to the support of global operations of all strike and cargo aircraft, but the KC-135 fleet was reduced to 538 aircraft from over 700.

Most Recent Study Reflects Now Outdated Two-Major-Theater-War Strategy

The most recent study effort addressing Air Force aerial refueling requirements is Tanker Requirements Study-05, which was issued in February 2001. According to Air Force officials, the purpose of the study was to determine the number of tanker aircraft and aircrews needed to support the National Military Strategy of conducting two nearly simultaneous major theater wars in Korea and in Southwest Asia. The study also included the refueling requirements to support the strategic nuclear plan, certain special operations, and smaller-scale contingencies. The study identified shortages of both aircrews and aircraft in certain scenarios.

Tanker Requirements Study-05 concluded that up to 1,033 aircrews were needed, depending on the scenario. When we applied the KC-10 and KC-135 crew ratios to the number of aircraft in the inventory, we derived a total of over 840 aircrews, a shortage of about 190 crews. The KC-10 crew ratio is 2.0 crews per active duty aircraft and 1.5 crews per reserve component aircraft while the KC-135 crew ratio is 1.36 crews per active duty aircraft and 1.27 crews per reserve component aircraft. However, even this level was insufficient in Operation Desert Storm when the Air Force needed 1.5 crews per KC-135 aircraft, and in Operation Allied Force when it needed 1.8 crews per KC-135 aircraft. To meet the immediate mission requirements of these operations, the Air Force deployed more crews from their home bases without their aircraft. While this permitted the Air Force to meet the immediate needs of the specific operation, it also significantly undermined the refueling capability that would normally be available for other concurrent contingencies.

Tanker Requirements Study-05[10] also concluded that, depending on the scenario, the Air Force needed up to 607 KC-135R-equivalent[11] aircraft to

[10] We did not evaluate the validity of the study's analysis.

meet aerial refueling requirements in 2005 and uses such equivalencies to evaluate its refueling capacity. When we applied the equivalencies to the fleet in March 2004, acknowledging that some aircraft will not be available due to aircraft needed for training (24) and aircraft in depot maintenance (98), the Air Force had the equivalent of 507 KC-135R available aircraft, as shown in table 4.

Table 4: Number of Air Force Aerial Refueling Aircraft in the Fleet Expressed as KC-135R Aircraft Equivalents

Aircraft	Number in the fleet in March 2004	Used in training[a]	In depot maintenance[a]	Number in the fleet available	Equivalency factor	Number in fleet in 2004 as an equivalency of the KC-135R
KC-135E	121		20	101	0.84	85
KC-135R	417	24	70	323	1.00	323
KC-10	59		8	51	1.95	99
Total	**597**	**24**	**98**	**475**	**na**	**507**

Source: Air Force.

[a]Estimated number of aircraft expected to be unavailable for operations in 2004. As we pointed out previously in this report, the Air Force expects the number of KC-135 aircraft in depot to decrease to 73 by fiscal year 2005 and gradually increase to 89 in fiscal year 2020. Thus between 335 and 351 KC-135 aircraft could be available for operations between 2005 and 2020.

New Strategies and Changing Operational Concepts Could Affect Aerial Refueling Requirements

Major changes in U.S. national security strategy and changes in operational concepts could have a significant effect on the type and number of aerial refueling aircraft needed.

2001 Quadrennial Defense Review Promulgated New Defense Strategy

Prior to 2001, U.S. national security strategy was based on the long-standing two major theater war threat-based model, which focused on specific adversaries and geographic locations. Tanker Requirements Study-05 is based on this approach. In 2001, the Quadrennial Defense Review shifted defense planning to a "capabilities-based" construct based

[11]"Tanker equivalents" reduces the differing capabilities of various refueling aircraft to a common standard. *Tanker Requirements Study-05* established the range and offload capability of the KC-135R as the standard, thus its equivalency is one. A KC-135E can offload less fuel than can a KC-135R because the E model carries less fuel and its engines are not as fuel-efficient. Therefore, its equivalency to a KC-135R is 0.84 to 1.00. The KC-10, on the other hand, has a greater fuel capacity than the KC-135R. Thus, its equivalency is 1.95 to 1.00.

on the assumption that the United States cannot know which specific nation or group may pose a future threat, although defense planners can anticipate the range of capabilities an adversary might employ.

Under the strategy articulated in the Quadrennial Defense Review, U.S. forces must:

- defend the U.S. domestic population, territory, and critical defense-related infrastructure against attacks from outside U.S. borders;
- deter aggression and coercion by maintaining regionally tailored forces forward stationed and deployed in Europe, Northeast Asia, the East Asian littoral, and the Middle East/Southwest Asia;
- swiftly defeat aggression against U.S. allies and friends in two overlapping major conflicts; and
- decisively defeat the adversary in one of two major conflicts by imposing U.S. will and removing any future threat from that adversary.

The revised strategy significantly broadens the scope of potential theaters of operations. Moreover, Air Force officials believe that the Quadrennial Defense Review approach represents a significant increase in potential mission requirements and carries with it a concomitant increase in refueling requirements. At the same time, increasing domestic operations in defense of the U.S. homeland may also impose substantial aerial refueling requirements not previously contemplated. As shown in table 5, in addition to changes in U.S. national security strategy, changes in (1) overseas basing rights, (2) operational concepts, (3) the extent of use of precision-guided munitions, (4) joint operations, and (5) technology could also change refueling requirements.

Table 5: Changes to National Strategies and Operational Concepts That Could Lead to Changed Aerial Refueling Requirements

Change	Discussion
Changes in strategy	If changes to U.S. national security strategies occur, including the 2005 Quadrennial Defense Review, refueling requirements could also change. For example, "anti-access environments" may exist whereby both the tanker and receiver aircraft would be required to fly longer distances, causing the tanker to have less fuel to offload and the receiver aircraft to require more fuel.
Overseas basing	The potential loss of overseas basing rights without a concomitant increase in basing rights elsewhere or contemplated overseas force realignments could force U.S. combat and support aircraft to operate from bases at greater distances from theaters of operations and consequently require additional aerial refueling to meet combat and support mission requirements.
Operational concepts	Refueling requirements could change if individual aircraft in the new refueling fleet can remain longer at aerial refueling rendezvous points and themselves be aerially refueled.
Precision-guided munitions	Increased reliance on precision-guided munitions could change refueling requirements if standoff distances increase for combat aircraft, thereby decreasing distances from the operational base to the munitions' launch location, and if precision munitions' success rate increases sufficiently to reduce the number of sorties needed to bring the same effects on target.
Mixed receivers on joint operations	The Air Force uses one type of refueling system known as a "boom and receptacle," while Navy, Marine Corps, and many allied aircraft use another system, known as "hose and drogue." Consequently, increasing reliance on joint operations leads to increased requirements for both boom and receptacle, and hose and drogue off load capabilities. If the refueling fleet can operate either type of offload mechanism on a single mission, refueling requirements could be still different.
Emerging technologies	Some emerging technologies such as unmanned aerial vehicles have much longer ranges than manned systems and may lead to changed refueling requirements.

Source: GAO analysis.

Other Factors Could Impact Requirements

Other aircraft acquisition and modification programs may also affect future aerial refueling requirements. For example, Air Force officials believe that newer aircraft will be increasingly fuel efficient, possibly increasing their ranges and potentially reducing the number of refueling aircraft needed. In its 2003 report on re-engining the B-52 bomber fleet, the Defense Science Board examined the effect of more fuel-efficient engines on missions flown from Diego Garcia during Operation Enduring Freedom. Assuming that more efficient engines would increase the B-52s range by at least 25 percent, the Board found that the Air Force could reduce the size of the refueling fleet on Diego Garcia by one-third.[12]

[12] Department of Defense, Office of the Under Secretary of Defense for Acquisition, Technology and Logistics; *Defense Science Board Task Force on B-52H Re-Engining* (Washington, D.C.: Dec. 2002).

In addition, the Air Force may be expected to refuel fewer aircraft in the future potentially leading to a reduction in refueling aircraft requirements. For example, in its fiscal year 2004 budget submission, the Navy proposed a new Navy-Marine Corps Tactical Air Integration plan that is to more fully integrate the Navy and Marine Corps strike fighter forces between fiscal years 2003 and 2012. If implemented, Navy and Marine Corps strike fighter forces would be reduced from 872 to 562 aircraft, significantly reducing the number of aircraft needing aerial refueling.

Greater Efficiencies of a Modern Refueling Aircraft Could Lead to Reduced Requirements

Initially, the Air Force plans to begin replacing its KC-135E aircraft, about 130 planes, with 100 new KC-767A aircraft. The KC-767A, like most modern aircraft, will have advantages and capabilities not found on the KC-135s. In theory, these capabilities permit recapitalization of the refueling fleet with fewer but more efficient aircraft without degrading refueling capability. These capabilities could be added to new aircraft during construction or during refurbishment and conversion of used aircraft.

- New aircraft can be equipped with engines that are considerably more powerful, yet more fuel efficient, maintainable, and less costly than those powering the KC-135Es. This enables larger aircraft to operate from shorter runways and to carry a greater payload (fuel, cargo, and/or passengers) longer distances than the KC-135R aircraft. This would allow new aircraft with characteristics similar to the KC-767A, to operate from four times as many runways and offload up to 20 percent more fuel than the KC-135E aircraft.

- Refueling aircraft that are equipped to refuel both hose and drogue and boom and receptacle-type receiver aircraft on the same flight would enhance joint operations because a single refueling aircraft could refuel both Air Force and Navy aircraft without first landing and changing equipment or requiring two differently equipped aircraft to operate simultaneously. All of the KC-10 and 20 of the KC-135 refueling aircraft currently have this capability.

- Refueling aircraft that can be aerially refueled themselves serve as force multipliers in the sense that they can remain airborne for much longer missions than the KC-135s and potentially support many more receiver aircraft.

- Refueling aircraft that are equipped with wing-mounted refueling pods could refuel two Navy-allied receiver aircraft simultaneously.

- Refueling aircraft derived from commercial aircraft designs can be maintained according to commercial maintenance practices, which generally results in the aircraft spending less time in maintenance at any given time and consequently, being available for missions more often than the KC-135 aircraft.

Updated requirements study and analysis of alternatives were not planned at the time of our work

The national security strategy and defense planning guidance have changed considerably since Tanker Requirements Study 05 was completed. In addition, DOD Instruction 5000.2,[13] which governs defense acquisition programs, identifies the basic process acquisition programs should follow, beginning with and based upon the overarching national security strategy, any existing national military strategies, and joint concepts of operations. Generally, a series of analyses should be conducted to identify: what is needed to achieve military objectives; current capabilities; gaps or shortcomings; and potential solutions. However, at the time of our work, DOD did not plan to conduct a new requirements study or replace Tanker Requirements Study 05. The guidance also recommends that DOD conduct an analysis of alternatives to evaluate the operational effectiveness, operational suitability, and estimated costs of alternative approaches to meet a mission capability. The analysis assesses the advantages and disadvantages of alternatives being considered to satisfy capabilities, including the sensitivity of each alternative to possible changes in key assumptions or variables.

The Air Force did not comprehensively reassess aerial refueling requirements following the most recent Quadrennial Defense Review, nor did it conduct a comprehensive analysis of alternatives before it proposed to lease 100 KC-767A aerial refueling aircraft in 2003. Consequently, as a result of congressional concerns about this matter, the National Defense Authorization Act for Fiscal Year 2004 required that DOD complete an analysis of alternatives by March 2004. DOD issued a memorandum dated February 24, 2004, containing a preliminary report and outlining the framework and parameters for the Air Force overview study of various options for replacing its aging fleet of KC-135 refueling aircraft. In addition, DOD has contracted for a study of the material condition of its

[13] DOD Instruction 5000.2, *"Operation of the Defense Acquisition System,"* May 12, 2003, implements DOD Directive 5000.1, "The Defense Acquisition System," dated May 12, 2003. One of the stated purposes of 5000.2 is to "establish a simplified and flexible management framework for translating…approved mission needs and requirements, into stable, affordable, and well-managed acquisition programs that include weapon systems."

fleet of KC-135 aerial refueling aircraft with a report due by September 2004. Finally, to fully comply with the congressional reporting requirement and the DOD February 2004 memorandum, the Air Force plans to issue an analysis of alternatives in August 2005.

Three Options Exist to Meeting the Air Force's Future Aerial Refueling Requirements

Replacing over 500 KC-135s will likely cost tens of billions of dollars, and the time period over which this will be done could last several decades, a period in which aircraft technology and aerial refueling needs, as well as U.S. national security and military strategies and operational concepts could change significantly. Just as conditions in the first decade of the 21st century are dramatically different than they were in the mid-1950s when the KC-135s were introduced, so too will conditions be far different 30 to 40 years from now. As the Air Force begins to modernize its aerial refueling fleet, it has three alternatives available that have either been used previously or were being tested at the time of our report. The most obvious alternative is to acquire one or more variants of new commercial aircraft and convert them to refueling aircraft. A second option is to acquire used commercial aircraft and convert them into refueling aircraft. Thirdly, the Air Force could contract for a portion of its aerial refueling needs as a service. The most cost-effective solution may be a combination of these or other options that would be closely examined in a comprehensive analysis of alternatives, although the Air Force's analysis of alternatives was not planned to review the option of contractor-provided aerial refueling.

Acquiring New Aircraft

The Air Force could acquire one or more variants of new production aircraft and convert them to refueling aircraft either through purchase, lease, or a combination of the two.[14] These new aircraft could consist of a mixed force comprised of small, medium, and large aircraft suitable for supporting a wide range of refueling operations. For example, in some instances, U.S. airpower may be needed in parts of the world where there are few suitable overseas airfields from which to operate large refueling aircraft. In such cases, smaller tactical refueling aircraft capable of operating from short, unimproved airfields close to the battlefield may be desirable. In other instances, U.S. aircraft may be denied access to airfields close to the battlefield, requiring combat aircraft to fly extremely long distances with multiple aerial refuelings and large amounts of fuel. In these instances, large strategic refueling aircraft capable of offloading large amounts of fuel may be desirable. Regardless of the ultimate aircraft mix, the overall cost to procure these planes could be extremely expensive. If the Air Force could buy new refueling aircraft at the $131 million price negotiated with the Boeing Company in 2003, it would spend about $71 billion (in 2003 dollars), excluding support and other costs, to replace all of the KC-135 fleet on a one-for-one aircraft basis. On the other hand, if the Air Force leased some of these aircraft over a long period of time—10 years for example—its cost per aircraft could be about $80 million to $125 million.[15] While purchasing costs less than leasing if the aircraft is retained for its full service life of 20 to 30 years, leasing could have merit in some instances—for example to temporarily fill a known capability gap before a significantly improved technologically-advanced new aircraft can be produced.

Currently, the aircraft most discussed as the initial replacement for some of the KC-135 fleet is the Boeing KC-767A. Section 8159 of the Department of Defense Appropriations Act for Fiscal Year 2002[16] authorized the Air

[14] In 1996, we recommended that the Air Force consider a multi-role aircraft that could conduct either aerial refueling or airlift operations as a replacement for the KC-135. See U.S. General Accounting Office, *U.S. Combat Air Power: Aging Refueling Aircraft Are Costly to Maintain and Operate*, GAO/NSIAD-96-160 (Washington, D.C.: Aug. 8, 1996).

[15] Based on a lease rate for wide-body aircraft of one-half to eight-tenths of 1 percent per month of the estimated purchase price, multiplied by duration of the lease. This formula was presented by an expert in commercial leasing at a July 23, 2003, hearing held by the Committee on Armed Services, House of Representatives.

[16] Department of Defense and Emergency Supplemental Appropriations for Recovery from and Response to Terrorist Attacks on the United States Act, 2002, Pub. L. No. 107-117, § 8159, 115 Stat. 2230, 2284-85 (2002).

Force to lease up to 100 aerial refueling aircraft, which the Air Force tried to do in 2003 when it sought congressional approval of its leasing plan. Subsequent to the hearings and in the National Defense Authorization Act for Fiscal Year 2004, Congress amended the original lease provision and authorized the Air Force to lease 20 new KC-767A aircraft and purchase 80.[17] The KC-767A has about the same fuel capacity as the KC-135R and is larger and heavier, but more fuel-efficient. Another current aerial refueling aircraft candidate is the Airbus A330 aircraft. The A330 is considerably larger than the KC-767A and has about 20 percent greater fuel capacity. It was being considered as the replacement refueling aircraft in the United Kingdom at the time of this report. Another Airbus model, the A310 is being operated with five international air forces, with the first aerial refueling version expected to be operational with the German Air Force in the first half of this year. In addition, two other aircraft are being developed that could potentially serve as future refuelers. Airbus is developing the A380, which is somewhat larger than the Boeing 747 and is expected to enter passenger service in 2006. Airbus claims the A380 will burn 13 percent less fuel but carry about 35 percent more passengers. Boeing has begun developing the 7E7, which will be closer in size to the A330. Boeing claims the 7E7 will be 20 percent more efficient than current aircraft.

Also, future unmanned aerial refueling vehicles may be another acquisition option to be considered by the Air Force and is denoted as a possible option to study in DOD's February 2004 guidance to the Air Force. The Unmanned Aerial Vehicles Roadmap released by DOD in March 2003 suggests the possibility of such unmanned aerial refueling vehicles being in the Air Force's inventory in the 2015-2020 time period.[18] The development and deployment of such vehicles would permit their remaining at an aerial refueling rendezvous point for long durations without entering a combat zone. In addition, such a collection of unmanned aerial refueling vehicles may be smaller in size than the aerial refueling aircraft now being considered and may better meet the needs of the Air Force in certain unique operations.

[17] National Defense Authorization Act for Fiscal Year 2004, Pub.L. No. 108-136, § 135, 117 Stat. 1392, 1413-14 (2003).

[18] U.S. Department of Defense, *Unmanned Aerial Vehicles Roadmap, 2002-2027* (Washington, D.C.: December 2002).

Acquire Used Aircraft

The Air Force could augment its refueling fleet by acquiring some used aircraft from among the over 1,500 commercial airliners in storage at the time of our report.[19] Under this approach, the Air Force would convert them to aerial refueling aircraft. Some of these aircraft are relatively new or have not been used extensively, while others are older and have been used extensively. However, with extensive refurbishment and conversion into a refueling and cargo-capable aircraft, these aircraft could be suitable, given the relatively few hours refueling aircraft fly each year when compared to commercial aircraft. Possible limitations are that it is not known whether the owners would sell the aircraft, the cost to convert them could be high, and introduction of differing aircraft types into the fleet could complicate maintenance and logistics because different spare parts would need to be stockpiled and maintenance crews would need different types of training.

Obtain Refueling Services from a Contractor

Under this concept the Air Force would maintain a core aerial refueling capability and augment it with contractor-provided refueling services that could be activated on short notice—an aerial refueling Civil Reserve Air Fleet—to meet additional anticipated aerial refueling demands that may exceed its own capacity. We envision that this approach could be similar to the Civil Reserve Air Fleet program in which commercial airlines agree in advance to make some of their aircraft and crews available to DOD when needed to transport troops to a theater of operations in wartime. In addition, contractor refuelers could be used to meet some of the non-combat aerial refueling demands such as proficiency training for receiver aircraft aircrews, supporting the deployment of aircraft during periodic Air Force Air Expeditionary Force rotations, and other planned aircraft movements. Currently, these types of support missions can add a considerable amount of additional time that active duty and reserve component refueling aircrews must spend away from their home bases.

Before joining the program's pool of eligible aircraft, the aircraft would be structurally modified, and basic aerial refueling equipment including additional fuel tanks, lines, and pumps, would be installed, most likely at government expense. Some of this equipment, such as external refueling booms and pods, and militarily-unique avionics could be designed so that

[19] Speednews.com, a commercial aviation Web site, reported that there were 475 wide-body jets in storage in December 2003 and 1,147 narrow-body jets. Of the wide-body aircraft, there were 119 B-747s, 71 B-767s, 81 DC-10s, and 26 MD-11s.

it can be quickly added or removed depending on whether the aircraft is to be operated in a military or civilian capacity. The aircraft owners would most likely operate these aircraft for commercial airfreight business when not needed for aerial refueling.

Contractor-owned aircraft would not necessarily have to be used in the combat theater, but could nevertheless provide significant refueling support, and free up military refueling aircraft to be used in combat areas. For example, these aircraft could be used to provide the "air bridge" refueling to support the movement of fighters, bombers, and transport aircraft from home bases in the United States or elsewhere to the combat theater of operations but never enter the theater.[20] DOD and the Air Force did not plan to include the option of contractor-provided aerial refueling in its analysis of alternatives, at the time of our review.

The Navy is conducting a pilot program to examine the feasibility of using contractor-provided aerial refueling services to meet some of its aerial refueling needs. The Navy refueling aircraft is a Boeing 707, the same aircraft on which the Air Force's current workhorse KC-135 is based. At times, Air Force refueling aircraft have not been available to support Navy training due to the lower priority placed on Navy training by the Air Force, and sometimes training plans changed on relatively short-notice; hence, the Navy sought alternatives and developed the pilot program. According to a Center for Naval Analyses study, the Navy's contractor has enhanced aircraft carrier training. The study reported that having an aerial refueling aircraft controlled by and dedicated to the Navy provided flexibility during periods of high-operational tempo, and saved time and fuel as Navy aircraft flew coast to coast to conduct training. Moreover, Navy officials have stated that at least in the early stages of its pilot program, mission availability rates have been excellent for operations performed in the continental United States and in supporting training exercises in Puerto Rico. The presence of a large dedicated refueling aircraft during training has also enabled Navy aircraft to rely less on their own refueling-capability, currently S-3B and F/A-18F fighter aircraft that can refuel other fighters, and allow those aircraft, especially the F/A-18D/Es to focus on their primary combat missions. While Navy officials expressed positive views about their experience to date with contractor-provided aerial refueling, they also said that landing privileges at military bases, peacetime

[20] The Air Force used 100 refueling aircraft during Operations Desert Shield and Desert Storm to support the Atlantic and Pacific "air bridges."

and wartime communication requirements, reliability, and other issues would need to be worked out if this approach were used on a large scale.

Conclusions

The Air Force is embarking on a program that could cost billions of dollars to replace the existing KC-135 fleet without knowing how many or what types of replacement aircraft it needs, because it does not have a current requirements study. Consequently, the Air Force could miss opportunities to meet its refueling needs in the most cost-effective manner; it does not have a roadmap to guide it as it makes investment decisions about tanker replacement. The Air Force could begin its tanker replacement program along the lines of the lease-buy program approved by Congress last year without such a roadmap, but we believe that long-term replacement decisions for the remainder of the tanker fleet should be based on a sound, comprehensive requirements study reflecting the most up-to-date analysis possible of the future environment.

Also, at least three options exist for meeting DOD's aerial refueling needs, but without a comprehensive analysis of alternatives, the Air Force would not know what option or combination of options are best suited to meeting the requirements. As a result, the Air Force would not have a sufficient basis on which to make its investment decision. Thus, we agree with the February 2004 DOD initiative for the Air Force to conduct an analysis of alternatives study for meeting the aerial refueling requirements. We believe, however, that the planned analysis of alternatives would be more effective and useful if it included all potential options, especially the possibility of meeting at least a portion of tanker needs through the use of contractor-provided refueling.

Recommendations for Executive Action

To provide a current, comprehensive roadmap to guide long-term replacement of the current tanker fleet, we recommend that the Secretary of Defense conduct a new, validated requirements study to determine the current and projected aerial refueling requirements.

We also recommend that the Secretary of Defense direct that the Air Force's planned analysis of alternatives be a comprehensive study of all reasonable options, including using contractor-provided aerial refueling services to meet some portion of its aerial refueling needs.

Agency Comments and Our Evaluation

We received written comments on a draft of this report from the Director of Defense Systems in the Office of the Undersecretary of Defense for Acquisition, Technology, and Logistics. In its comments, DOD concurred with each of our recommendations. First, DOD indicated that a Mobility Capabilities Study was underway at the time of our report to determine aerial refueling requirements. Second, DOD indicated that the analysis of alternatives would include consideration of contractor-provided aerial refueling as a potential alternative. DOD's comments are printed in their entirety in appendix II.

In addition, DOD provided technical comments which we incorporated in our report where appropriate.

We are sending copies of this report to other appropriate congressional committees, the Secretary of Defense, the Secretary of the Air Force, and the Director, Office of Management and Budget, and it will be available at no charge on GAO's Web site at http://www.gao.gov. If you or your staff have any questions about this report, please contact me at (202) 512-4914. Key contributors to this report are listed in appendix III.

Neal P. Curtin
Director, Defense Capabilities
and Management

Appendix I: Scope and Methodology

Our objectives were to examine (1) the extent to which DOD's current aerial refueling force has met aerial refueling needs, and the cost and effort associated with operating and sustaining the current aircraft fleet; (2) the most recent aerial refueling requirements; and (3) options to enable DOD to meet future aerial refueling requirements.

To examine the extent to which DOD's current aerial refueling force has met refueling needs, we conducted interviews with DOD and Air Force officials and obtained documents showing the services' refueling needs in recent operations and the mission capable rates achieved of the current refueling fleet. In addition, to examine the cost and effort to operate and maintain the existing aerial refueling fleet, we interviewed officials and obtained documents from the Office of the Chief of Air Force Acquisition, Global Reach Program. We also visited the Air Force's Air Mobility Command at Scott Air Force Base, Illinois, and the Air Force's Oklahoma Air Logistics Center at Tinker Air Force Base and interviewed key aerial refueling aircraft operations, maintenance, and program analysis officials. At both locations, we reviewed cost and maintenance documents. We did not independently verify the reliability of the cost and maintenance data provided to us however, we discussed cost estimates with certain external organizations, including the Institute of Defense Analyses, the American Transport Association, and other organizations and determined the data that we had obtained was reasonable. We also reviewed testimony by DOD, Air Force, and other officials before a variety of congressional committees considering the proposed lease of 100 KC-767A aerial refueling aircraft.

To examine the most recent aerial refueling requirements, we met with officials from the Office of the Secretary of the Air Force, and U.S. Transportation Command officials responsible for determining refueling requirements and operating costs and obtained key requirements documents including DOD Instruction 5000.2, "Operation of the Defense Acquisition System," Chairman of the Joint Chiefs of Staff Instruction 3170.01C, "Joint Capabilities Integration and Development System," June 24, 2003, and other documents showing the characteristics, missions, requirements, employment concepts, and costs of operation of the refueling aircraft. We also reviewed a briefing on Tanker Requirements Study-05 and the complete Mobility Requirements Study-05, and other Air Force briefings, and related documents. To gain a better perspective of air refueling operations and requirements, we discussed with appropriate Air Force and DOD officials the services' policies, priorities, and procedures for using, modernizing, and maintaining their refueling aircraft inventory. Moreover, we obtained information documenting required KC-135

maintenance and planned modifications to the aircraft. We also reviewed several studies and reports addressing various aerial refueling fleet topics, including those developed in recent major combat operations. We also reviewed a report from the Congressional Budget Office that estimates refueling aircraft maintenance and replacement costs. In addition, we discussed aerial refueling issues with representatives of several research organizations including the Institute of Defense Analyses and The Rand Corporation, and major military aircraft manufacturers including The Boeing Company and Lockheed-Martin. When analyzing the problems of maintaining aging aircraft, we concentrated on the Air Force's KC-135 aircraft because it makes up the bulk of the DOD's aerial refueling inventory.

Finally, to examine options to enable DOD to meet its aerial refueling requirements, we met with officials from the Office of the Secretary of Defense (Comptroller); Office of Air Force Acquisition, Global Reach Programs; the Air Force's Air Logistics Center at Tinker Air Force Base; a contractor who was providing refueling services to the Navy at the time of our review; the Office of Management and Budget; the Air Transport Association; several major U.S. commercial airlines; and the United Kingdom's Ministry of Defense, which was preparing to lease aerial refueling aircraft at the time of our review. We used our 1996 report on aging refueling aircraft and related accelerating operation and maintenance cost problems to suggest ways for DOD to consider recapitalizing its aerial refueling fleet. Moreover, we reviewed documents and briefings from many of these same organizations to identify options available to the Air Force and DOD to meet current and projected aerial refueling requirements.

We performed our work from December 2001 through April 2004 in accordance with generally accepted government auditing standards.

Appendix II: Comments from the Department of Defense

OFFICE OF THE UNDER SECRETARY OF DEFENSE
3000 DEFENSE PENTAGON
WASHINGTON, DC 20301-3000

ACQUISITION,
TECHNOLOGY
AND LOGISTICS

MAY 21 2004

Mr. Neal P. Curtin
Director, Defense Capabilities and Management
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Curtin:

This is the Department of Defense (DOD) response to the GAO draft report GAO-04-349, (GAO Code) - "MILITARY AIRCRAFT: DOD Needs to Determine Its Aerial Refueling Aircraft Requirements," dated May 2004 (GAO Code 350229).

The DOD concurs with both of the draft report's recommendations. The rationale for the DOD's position is provided in enclosure 1. Enclosure 2 provides additional comments and suggested changes to the report.

The Department appreciates the opportunity to comment on the draft report.

Sincerely,

Glenn F. Lamartin
Director
Defense Systems

Enclosures:
1. DOD Comments to the GAO Recommendations
2. DOD Technical Comments to the Draft Report

GAO CODE 350229/GAO-04-349

"MILITARY AIRCRAFT: DOD NEEDS TO DETERMINE ITS AERIAL REFUELING AIRCRAFT REQUIREMENTS"

DEPARTMENT OF DEFENSE COMMENTS TO THE RECOMMENDATIONS

RECOMMENDATION 1: The GAO recommended that the Secretary of Defense conduct a new, validated requirements study to determine the current and projected aerial refueling requirements. (Page 29/Draft Report)

DoD RESPONSE: Concur. Two efforts are underway to determine tanker requirements and recapitalization needs: the Mobility Capabilities Study, directed by the Strategic Planning Guidance; and the KC-135 Tanker Recapitalization Analysis of Alternatives (AoA), directed by the Under Secretary of Defense (Acquisition, Technology and Logistics).

RECOMMENDATION 2: The GAO recommended that the Secretary of Defense direct that the Air Force's planned analysis of alternatives be a comprehensive study of all reasonable options, including using contractor-provided aerial refueling services to meet some portion of its aerial refueling needs. (Page 29/Draft Report)

DoD RESPONSE: Concur. The AoA guidance outlines a comprehensive study. We agree with the recommendation regarding consideration of contractor-provided aerial refueling, and we will work through the AoA Senior Steering Group to incorporate this option into the AoA Study Plan.

enclosure (1)

Appendix III: GAO Contact and Staff Acknowledgments

Contact

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Acknowledgments

In addition to the person named above, William C. Meredith; Kenneth W. Newell; Joseph J. Faley; Tim F. Stone; Fred S. Harrison; Norman L. Jessup, Jr.; James K. Mahaffey; Ann M. Dubois; Charles Perdue; and Kenneth E. Patton also made major contributions to this report.

Related GAO Products

Military Aircraft: Observations on DOD's Aerial Refueling Aircraft Acquisition Options. GAO-04-169R. Washington, D.C.: October 14, 2003.

Military Aircraft: Institute for Defense Analysis Purchase Price Estimate for the Air Force's Aerial Refueling Aircraft Leasing Proposal. GAO-04-164R. Washington, D.C.: October 14, 2003.

Military Aircraft: Observations on the Proposed Lease of Aerial Refueling Aircraft by the Air Force. GAO-03-923T. Washington, D.C.: September 4, 2003.

Military Aircraft: Observations on the Air Force Plan to Lease Aerial Refueling Aircraft. GAO-03-1143T. Washington, D.C.: September 3, 2003.

Military Aircraft: Considerations in Reviewing the Air Force Proposal to Lease Aerial Refueling Aircraft. GAO-03-1048T. Washington, D.C.: July 23, 2003.

Military Aircraft: Information on Air Force Aerial Refueling Tankers. GAO-03-938T. Washington, D.C.: June 24, 2003.

Air Force Aircraft: Preliminary Information on Air Force Tanker Leasing. GAO-02-724R. Washington, D.C.: May 15, 2002.

U.S. Combat Air Power: Aging Refueling Aircraft Are Costly to Maintain and Operate. GAO/NSIAD-96-160. Washington, D.C.: August 8, 1996.

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