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STUDENT REPORT

LOW ALTITUDE--A NEW DIMENSION IN AIR REFUELING

MAJOR CARY M. WALGAMOTT 88-2690

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Enemy air defenses have increased their sophistication due to technological advancements. Response to these advancements requires new tactics and procedures to increase the B-52's chances of penetrating such air defenses. One such possible tactic is low altitude air refueling or LAAR. This article examines the need for LAAR and assesses the US Air Force's ability to satisfy that need. Capabilities of the US military's air refueling aircraft are analyzed. The effects of low altitude flight on the KC-135's airframe, autopilot, navigation systems, and aircraft performance are examined. Finally the article discusses the degree to which LAAR missions impact on operational and maintenance organizations so tasked.

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PREFACE

This paper assesses the need for low altitude air refueling and whether the US Air Force has the ability to meet that need. This is not intended to be a technical report but is geared toward a general reading audience. The author is a former KC-135 instructor pilot. Therefore, some of the information in the article is based on his experience and knowledge in KC-135 operations. The author wishes to acknowledge Lt Col Tim Krull, ACSC/3821 STUS, for his insight and guidance. Special thanks to Col (sel) Richard L. Smith, 305 AREFW/DO, and Lt Col Larry A. Timmerman, HQ USAF/XOOTS, for their technical assistance, and to the author's wife, Linda A. Walgamott, for her invaluable assistance in typing and proofreading this article. Subject to clearance, this article will be submitted to the Air Power Journal for publication.

ABOUT THE AUTHOR

Major Cary M. Walgamott is a senior pilot with over 2,000 flying hours, primarily in the KC-135A. He received his commission through the Reserve Officers Training Corps in 1973. Following Undergraduate Pilot Training at Craig Air Force Base, Alabama, he was assigned as a KC-135A copilot in the 97th Air Refueling Squadron at Blytheville Air Force Base, Arkansas. While at Blytheville he held positions as standardization evaluation copilot, aide to the 42d Air Division Commander, and aircraft commander. In 1981, he was assigned to Griffiss Air Force Base, New York, where he served as a KC-135A aircraft commander and training flight instructor pilot. During the latter part of his tour he served as the executive officer for the 416th Bombardment Wing. In 1984 he was assigned to Headquarters, US Air Force at the Pentagon, Washington DC. He served as an action officer in the Airspace and Air Traffic Services Division and later as a Chief of Staff operations briefer. Major Walgamott earned his Bachelor of Landscape Architecture Degree from the University of Idaho in 1973 and his Master's Degree in Operational Management from the University of Arkansas in 1980. Major Walgamott has completed Squadron Officer School in residence, Air Command and Staff College and National Security Management by correspondence. His is married to the former Linda Ann Young and has three children: Brian, John, and Melissa.

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GLOSSARY

ACRONYMS

ANG - Air National Guard

BMW - Bombardment Wing

DNS - Doppler Navigation System

INS - Inertial Navigation System

LAAR - Low Altitude Air Refueling

MOA - Military Operating Area

MSL - Mean Sea Level

NAM - Nautical Air Miles

NM - Nautical Mile

SAC - Strategic Air Command

TACAN - Tactical Navigation System

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REPORT NUMBER 88-2690

AUTHOR(S) **MAJOR CARY M. WALGAMOTT, USAF**

TITLE **LOW ALTITUDE--A NEW DIMENSION IN AIR REFUELING**

I. **Purpose:** To examine the need for low altitude air refueling below 10,000 feet mean sea level and to establish the Air Force's capability to meet that need.

II. **Problem:** Enemy air defenses have become more sophisticated with advancements in technology. New procedures and techniques need to be developed to provide our forces a higher probability of penetrating those defenses and striking their target. One possible solution is low altitude air refueling or LAAR. To evaluate this new tactic, the article first identifies the need for LAAR. Then, it addresses several areas that may impact this country's ability to fly LAAR missions. These areas are: the capability of present Department of Defense air refueling aircraft, the effect low altitude operations have on the KC-135 airframe, the reliability of its autopilot and navigation systems, its performance characteristics at low altitude, and the effect LAAR operations have on the individual flying unit.

III. **Data:** General John T. Chain, Jr., Commander-in-Chief of Strategic Air Command, expressed a need for LAAR to enhance SAC's flexibility in conventional warfare. With this in mind, current Department of Defense air refueling platforms were analyzed with reference to air refueling capabilities. Then, the effect of low

altitude operations on the KC-135 airframe was reviewed. The majority of this information was extracted from research completed in 1985 by Majors Timothy R. Krull and Donald C. Siegel. Next, the autopilot and navigation systems were evaluated using information from the KC-135A Flight Manual, a USAF Inspection and Safety Center autopilot report, and actual LAAR missions flown by four KC-135 units. Results from these same LAAR missions, as well as technical data from the KC-135A Performance Manual, were used to evaluate aircraft responsiveness and performance in low altitude operations. Finally, discussions with KC-135 operations and maintenance personnel were used to assess the impact LAAR operations would have on individual flying units.

IV. **Findings:** In a large scale conventional war, the KC-135 is the most logical aircraft to use in LAAR missions. However, certain precautions are necessary. Severe turbulence at low altitudes can cause structural damage to the airframe. Flying over selected terrain, reducing aircraft gross weights and airspeeds, and flying LAAR missions with structurally modified aircraft will reduce possible structural damage. Even though an operative autopilot is not required to fly LAAR missions, the system dampens dutch roll, reduces pilot fatigue, and provides a much smoother platform for refueling. Both the TACAN and radar are limited at low altitude because of line-of-sight limitations. However, the INS/DNS performs normally in all phases of low level flight. Aircraft responsiveness is enhanced at lower altitudes, but fuel consumption is increased. This reduces the range and offload capability of the KC-135. Low altitude air refueling operations add additional requirements to the operational and maintenance organizations within a flying unit. Operational organizations can absorb the additional taskings; however, additional manning may be necessary before maintenance organizations can reasonably meet the new requirements.

V. **Conclusions:** The US needs LAAR to improve the B-52's ability to penetrate sophisticated enemy air defense systems in a conventional war. During such a scenario, the air refueling capabilities of the KC-135 provide a logical means of implementing LAAR. Flying the KC-135 at low altitudes does risk structural damage to the airframe. However, this risk can be significantly reduced by following specific parameters. Examination of the KC-135 autopilot and navigation systems reveals nothing to prevent aircrews from proceeding with LAAR missions. Aircraft responsiveness does improve at lower altitudes although fuel consumption is adversely effected. Some adjustments will have to be made in the operational and

CONTINUED

maintenance organizations as units transition into LAAR operations. Assessment of these different areas indicates the US Air Force is capable of successfully conducting LAAR operations.

INTRODUCTION

Since the first in-flight transfer of fuel between two biplanes, the demand and the tactics developed for in-flight refueling have served to expand the warfighting capabilities of the Armed Forces. Today, aerial refueling is "performed by aerospace forces to support strategic, tactical, and mobility operations by extending the range, payload, and flexibility of these operations" (7:3-6). But, meeting the air refueling needs of tomorrow may necessitate utilization of the newest venture into tactical air refueling--Low Altitude Air Refueling (LAAR). Defined by Strategic Air Command (SAC) as air refueling conducted below 10,000 mean sea level (MSL) (8:6-7), LAAR rests on the frontier of air refueling as a potent tactic for enhancing the effective use and survivability of US conventional forces. As with any new tactic involving commitment of valuable Air Force manpower and resources, careful review must precede implementation of LAAR. First, the need for such a tactic must be examined. Second, the Air Force's capability to meet that need must be clearly established.

This article begins by addressing the projected need for LAAR. Air-refueling resources within the Armed Forces are then analyzed to determine which aircraft could best satisfy that need. Next, aircraft structural considerations, systems capabilities and limitations, as well as aircraft performance at low altitude are reviewed. Finally, the impact LAAR has on individual flying units is discussed.

NEED/REQUIREMENT

Technological advances in enemy air offensive systems have evolved to the point that they now have impact upon US conventional warfighting tactics. For General John T. Chain Jr., Commander-in-Chief of Strategic Air Command, these radar and missile advancements can be countered by employing LAAR (4:6A). "If I refuel at 25,000 or 30,000 feet, enemy radar can see me 200 miles out. If I refuel down at 3,000 feet, it may be 50 miles because of the curvature of the earth. If I drop down to 300 feet, I'm a lot closer" (4:6A). Strategic Air Command's B-52 force will continue to have a primarily nuclear deterrence mission for years to come, but even today B-52s on Guam have a non-nuclear primary mission. As the B-1 and Stealth bombers assume the B-52's nuclear role in the future, the B-52's conventional role will increase. Pairing LAAR with this role will improve the B-52 conventional warfighting capability (4:6A).

The use of LAAR in a conventional conflict provides several advantages, regardless of the type of receiver. The tactic keeps both tankers and receivers below enemy radar coverage. Therefore, tankers can top-off their receivers much closer to the target, enabling the receivers to hit deeper inside enemy territory with heavier payloads. Delay in radar detection improves the element of surprise and enhances the survivability of the strike force (18:1). This tactic would be esp3cially effective when targets are great distances from safe haven, such as targets well inside Warsaw Pact countries, the Far East, or in the Persian Gulf/Middle East sector. An added advantage is that enhanced conventional capability serves to raise the nuclear threshold by providing North Atlantic Treaty Organization commanders with other options to nuclear weapons (4:6A).

The flexibility which LAAR contributes is important to commanders. General Chain has stated, " 'We need the flexibility to be able to refuel high and to be able to do it at low altitudes,' day or night, with or without radio communication between bombers and tanker aircraft" (4:6A). To meet this specific challenge, as well as any LAAR requirements of other key commanders, careful analyses must determine the choice of refueling aircraft to best fulfill LAAR taskings.

AIR REFUELING PLATFORM

Several Air Force, Marine, and Naval aircraft provide air-refueling support for US aerospace forces. Table 1 depicts these aircraft and their refueling capabilities. The mainstays of the Air Force's air-refueling resources are SAC's KC-135 and KC-10. The KC-135 Stratotanker is a four-engine, high-speed, long-range aircraft with refueling capability between a wide range of airspeeds (11:1; 14:--). This allows the KC-135 to refuel a variety of aircraft. The Stratotanker can fly 2,000 nautical miles (NMs), offload 45,000 pounds of fuel, and return to its departure point (31:--). The KC-10 Extender was designed as an advanced tanker/cargo aircraft with the ability to deploy combat aircraft, personnel, and supplies on a global basis (3:458). The primary mission of the Extender is mobility with a dual role of strategic airlift and in-flight refueling support (31:--). Like the KC-135, the Extender refuels a variety of aircraft and has excellent range and offload capability.

In addition, the Air Force uses two models of the C-130 for air-refueling support. The HC-130P was modified with a low-speed drogue to refuel helicopters in an airspeed envelope near 200 knots (21:--). The MC-130H, which was designed for special operations, provides air-refueling support for HH-53, HH-3, and H-60 helicopters (21:--). The range and offload characteristics of both aircraft are similar.

The Marine Corps' KC-130R is a probe-drogue tanker version of the C-130H with pylon-mounted fuel tanks and a removable fuel tank in the cargo compartment. The US Marine Corps Reserves, however, use an updated version of the KC-130R, the KC-130T. These two aircraft are capable of offloading fuel to both helicopters and low speed fighters (1:376; 3:441).

The Navy has modified A-6As to use as fleet air-refueling tankers. Designated the KA-6D, these aircraft use a hose and reel system, but the range and offload capacity are limited. The aircraft can transfer 15,000 pounds at a radius of 250 NMs and return to its carrier (2:349).

AIR REFUELING AIRCRAFT CAPABILITIES			
TYPE AIRCRAFT	AIR REFUELING AIRSPEEDS (KIAS)	RANGE	OFFLOAD CAPABILITY
KC-135	200 - 320 K	2,000 NM	45,000 lbs
KC-10	225 - 320 K	2,000 NM	120,000 lbs
HC-130P	200 K	500 NM	48,500 lbs
MC-130H	200 K	500 NM	48,500 lbs
KC-130R	200 K	1,000 NM	52,000 lbs
KC-130T	200 K	1,000 NM	52,000 lbs
KA-6D	240 - 260 K	250 NM	15,000 lbs

TABLE 1
Sources: (1:376; 2:349; 12:--; 23:--; 24:--; 31:--)

An analysis of this data reveals only the KC-135, KC-10, and KA-6D possess the required airspeed necessary to refuel the B-52 at its charted air-refueling speed of 255 knots (12:2A-11). The KA-6D, however, is extremely limited in range and offload capability and cannot support a long-range air strike. During a preplanned contingency/wartime situation, SAC and Military Airlift Command jointly determine the role of the KC-10 (9:2-1).

In a large-scale conventional war scenario, all 59 KC-10s in the Air Force inventory will likely be needed in the dual role of deploying fighter squadrons along with support personnel and equipment to the war front (31:--). Due to this mobility requirement, the KC-135 is the logical choice to perform LAAR if no overriding structural limitations to its use exist.

STRUCTURAL CONSIDERATIONS

An aircraft experiences greater load stress during low-altitude operation than at high altitude. This is due to the more severe and frequent turbulence present at lower altitudes (5:10). The common cause of low-altitude turbulence is convective currents. Heated air, rising unevenly from various differences in the earth's surface, creates these currents. For example, plowed fields and rocky wastelands become hotter than open water. Therefore, the severity of such turbulence varies with the type of surface over which the aircraft flies as well as with altitude (6:10-1). With this in mind, Boeing conducted a computer test to evaluate the effect extended low-level flying had on the KC-135's primary structure (14:14).

This test analyzed numerous mission scenarios under the following parameters: aircraft gross weights between 190,000 - 260,000 pounds, altitudes between 1,000 - 25,000 feet, airspeeds from 210 - 315 knots indicated airspeed, and fuel offloads from 30,000 - 50,000 pounds (14:15). Based on the results, "Boeing engineers would not authorize or recommend flying the KC-135 at low level with a usage of the magnitude in this test, until the aircraft received the Outboard Wing Lower Surface Life Extension Modification" (14:17). At the time of this article, 233 KC-135s had received this modification. The entire KC-135 fleet is scheduled to have the modification completed by the second quarter of 1991 (31:--). In addition, Boeing engineers stated the Lower Wing Surface Reskin Program must be accomplished before an extensive low-level training program is implemented (14:18). This fleet modification is scheduled for completion in August 1988 (31:--). In addition to these modifications recommended by Boeing, there are additional means of reducing structural damage to the KC-135.

Excessive turbulence may cause structural damage to the airframe during low-altitude flight. However, this damage can be substantially reduced by flying less frequently at low altitudes, reducing aircraft gross weights and airspeeds, flying missions over selected surfaces such as water, and flying low-level missions with aircraft modified as mentioned above. In summary, structurally the KC-135 can be flown at low altitude as long as certain parameters are maintained. Now, the reliability of the KC-135 systems under LAAR conditions must be evaluated.

SYSTEMS EVALUATION

The effectiveness of two aircraft systems could limit the

KC-135's ability during low-level operations. These are the autopilot and navigation systems. Since an autopilot malfunction at low altitude could have grave ramifications, it will be addressed first.

AUTOPILOT

Although LAAR missions can be flown manually, an autopilot effectively dampens dutch roll in turbulent air, reduces pilot fatigue, and provides a much smoother platform for refueling. The present KC-135 autopilot is a 1955 vintage MC-1 system designed with tube technology (10:3). This system experienced an increased trend in malfunctions and SAC decided to replace the MC-1 autopilot with a new, state-of-the-art system. This new system, called the Flight Control Set, will increase the reliability and capability of the KC-135 autopilot. The conversion begins in May 1988 and will be completed on all aircraft in 1990 (25:--). The autopilot is not a prerequisite to fly LAAR missions, but use of the new autopliot will enhance mission effectiveness and safety.

NAVIGATION SYSTEMS

Accurate navigation is essential in conducting LAAR missions. The aircraft must be at the correct location at the right time to successfully rendezvous with the receivers and provide the needed fuel. The KC-135 was designed to perform high-altitude refueling missions. It is equipped with three primary navigation systems: Tactical Air Navigation (TACAN), Inertial/Doppler Navigation System (INS/DNS), and radar. The navigator plays the lead role in integrating these systems and, in reality, is the key to a seccessful rendezvous. The adequacy of each navigation system used to assist the navigator in a low-altitude environment needs reviewing.

TACAN

The TACAN system provides the aircrew with range and bearing data from selected surface navigation beacons. With the desired navigation beacon frequency set in the TACAN radio, continuous information is displayed in the cockpit provided the aircraft is within line-of-sight distance of the surface beacon (11:4-408). The operating range of the TACAN varies depending on the altitude of the aircraft. As the aircraft altitude decreases, so does the effective range of the TACAN. For example, the operating range of the TACAN at an altitude of 30,000 feet is 213 NMs; at 1,000 feet the range is only 39 NMs (11:4-408). Also, when flying at lower altitudes, there is a greater possibility that mountainous terrain, ridges, and other obstacles would block the line-of-sight signal to the aircraft. Thus, flying low level adversely effects the use of the TACAN for navigation purposes.

Emissions control is one additional aspect which needs to be addressed when discussing TACAN use during operational LAAR missions. Emissions control is a technique which may be employed to avoid detection by the enemy. The KC-135 TACAN gives off a signal that can be picked up by the sophisticated equipment the enemy now possesses. When close to enemy territory, the TACAN should be selectively turned on and off to prevent detection (22:--). In addition, crews should cross-check the TACAN against other aircraft navigation systems to insure the data is reliable. Because enemy ground stations can send false TACAN information over the frequency being used by the crew, they must use this precaution to avoid being drawn off course. Thus, emissions control should be utilized when using the TACAN for navigation or air-refueling rendezvous during contingency operations.

INS/DNS

The Inertial/Doppler Navigation System was not affected in actual low-level missions flown by the 93rd Bombardment Wing (BMW) at Castle AFB, California, and the 305th Air Refueling Wing at Grissom AFB, Indiana (16:--; 27:--). Results from these flights did show that the INS/DNS needed frequent updating to insure accuracy (16:--). The INS can be updated by TACAN range and bearing signals, radar, or by manual updates (11:4-90A). The doppler of the DNS emits a signal that can be detected by the enemy. Therefore, it should be operated using emissions-control techniques similar to those used with the TACAN (11:4-90B).

Radar

The effective use of the radar depends on altitude; the lower the aircraft is flown, the smaller the range coverage of the radar due to line-of-sight limitations (11:4-48A). Even though these line-of-sight limitations are similar to that of the TACAN, the radar is not dependent on a ground beacon. Therefore, any radar target such as a tower, concrete or metal building, or permanent terrain feature can be used for radar navigation. The Phoenix Air National Guard (ANG) found turbulance made radar impractical on missions flown at 1,000 feet over the desert (19:--). Navigation was accomplished through map reading with the INS/DNS used to verify position (19:--). However, crews from Grissom picked up good radar returns while flying over the flat terrain of Indiana at 2,000 feet above ground level. The crews used radar updates, map reading, and the INS/DNS for course guidance (15:3). Like the TACAN, the radar must also be used in a discrete manner to prevent the enemy from detecting aircraft location.

A review of the navigation systems reveals the capability of the TACAN and radar declines as altitude decreases. But, both can be used in various phases of the rendezvous and air-refueling mission. The INS/DNS performs normally in all phases of low-level flight. It can be surmised from this discussion that navigation systems on the KC-135 are adequate for low-level navigation. However, for LAAR flights involving emissions-out navigation, the keys to navigation are map reading and visual reference outside the cockpit validated by frequent INS readings. The final critical element in the KC-135's qualification for LAAR missions is aircraft performance at low altitude.

AIRCRAFT PERFORMANCE

Aircraft performance at low altitude is an important consideration in analyzing the KC-135's capability to fly LAAR missions. Two areas in particular, aircraft responsiveness and fuel considerations, need examination. Since the first concern of a pilot is the aircraft's flight characteristics, the manner in which the KC-135 responds at low level will be discussed first.

AIRCRAFT RESPONSIVENESS

Aircraft thrust and handling characteristics improve at lower altitudes due to the density of the air. This was verified by four KC-135 units that flew LAAR missions on a test basis. The 93 BMW found that the aircraft performance improved at lower altitudes. Maneuvering up to 30 degrees of bank was easily accomplished and only small power corrections were required by the pilots (16:--). The Phoenix ANG flew against both F-16s and A-6s and stated, "The aircraft responded well to control inputs and throttle response was excellent" (19:--). Aircrews from Kadena AFB, Okinawa, refueling over water, found the aircraft to be very stable and responsive to power/airspeed changes (20:2). Pilots at Grissom noted faster-than-normal acceleration of the KC-135 after a practice emergency separation (17:--). These results clearly show that KC-135 responsiveness is enhanced at lower altitudes.

FUEL CONSIDERATIONS

The distance the tanker can fly and the offload it can provide to a receiver is vitally important to operational planners. Figure 1 depicts how range is effected by altitude.

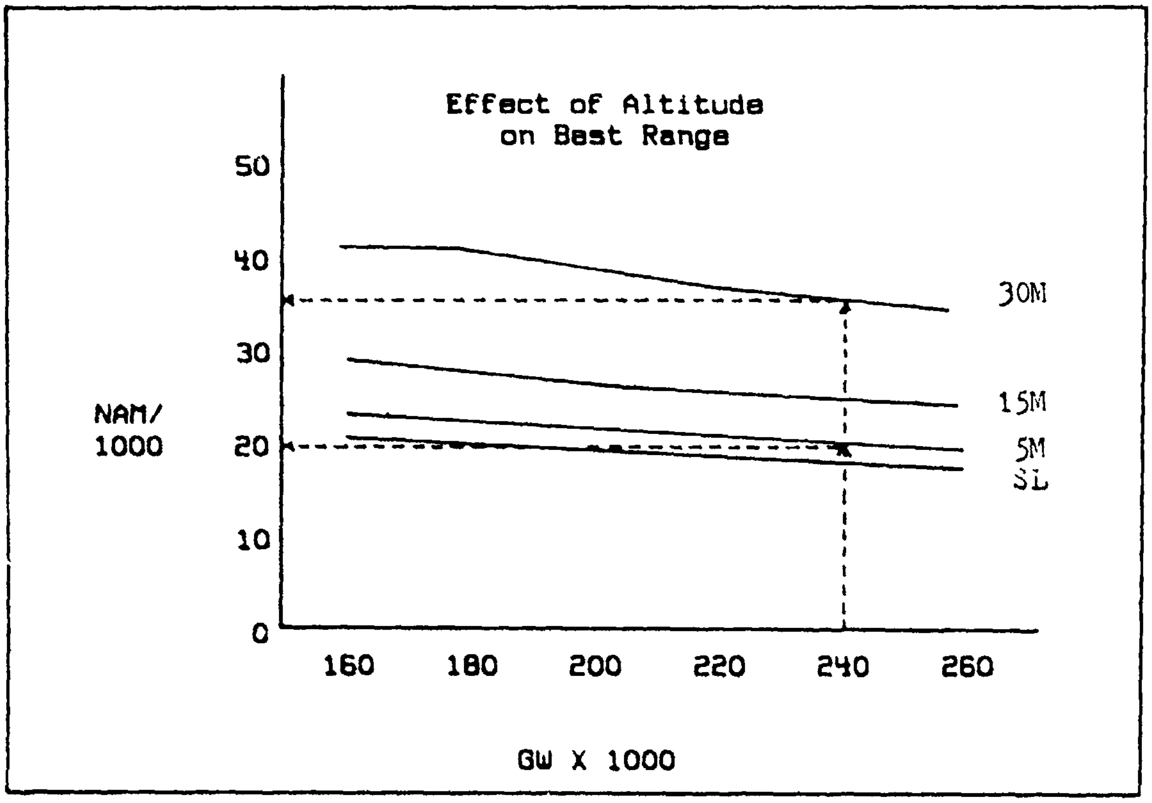

FIGURE 1
Source: KC-135A Performance Manual

The nautical air miles (NAM) per 1,000 pounds of fuel at 5,000 and 30,000 feet can be compared. A 240,000 pound gross weight aircraft flown at 5,000 feet covers 19.7 NAM per 1,000 pounds of fuel. At 30,000 feet the number of air miles flown per 1,000 pounds of fuel increases to 35.5. The trade off for flying at 5,000 feet versus 30,000 feet is 15.8 NAM per 1,000 pounds of fuel (13:Part 5). Thus, flying at low altitude to avoid detection will reduce the tanker offload capability. This loss can be minimized by flying at higher altitudes as long as feasible before descending to the lower altitude structure. Additionally, use of the newly reengined, more fuel-efficient KC-135R can further minimize loss of range and offload capability. Any loss of capability must be weighed carefully against the advantages of a close in, undetected air refueling.

The KC-135 is clearly capable of performing LAAR missions. A final step in considering the Air Force's ability to support LAAR missions requires a review of the effects on ground operations.

RAMIFICATIONS ON FLYING UNITS

The Strategic Air Command needs to consider the impact LAAR missions would have on the daily operations of a tasked unit. Both the operations and maintenance organizations within that unit will be directly affected. For the operational organizations the effect is mostly positive.

Many aircrew members find the new LAAR missions both exciting and challenging (30:--). Low-level air refueling breaks up the routine of flying at high altitudes, promotes airmanship, and boosts morale (27:--). Because LAAR is more challenging than high-altitude air refueling, mission planning is more comprehensive and time-consuming. Such items as step-down procedures, station keeping, routing, timing, and crew coordination items are discussed in detail (30:--). A full day of mission planning may be required to completely cover all mission details.

Squadron Training Flights and Wing Standardization/Evaluation Divisions will acquire additional responsibilities. Training Flights will need to build LAAR ground- and flight-training syllabi. They will be responsible for initial training and qualification of all squadron crewmembers. However, once additional instructors in the squadron become qualified, they can assist in the training process and reduce the workload on Training Flight (30:--). After all squadron crews receive initial qualification training, the main emphasis will be to maintain proficiency and train newly arriving crewmembers. Once LAAR is declared a proficiency item, Standardization/Evaluation Division will evaluate LAAR on annual checkrides.

The scheduler will be tasked with locating a track or anchor area to conduct LAAR missions. This could be a problem depending on the location of the scheduler's base. Units near Military Operating Areas (MOAs) should have little problem scheduling airspace for LAAR training. However, units may lose valuable training time if they have to fly long distances to reach MOAs.

The scheduler is also tasked with providing receiver aircraft for the refueling. There has not been an across-the-board requirement for fighter units to be proficient in LAAR. This reduces the availability of receiver aircraft and could make the scheduler's job more difficult. Both factors must be weighed before tanker units are tasked to maintain proficiency in LAAR. Overall, LAAR will have a moderate effect on the daily routine of the operational organization.

From a maintenance point of view, the only flying unit with a mission comparable to LAAR is the 93 BMW. Most KC-135 crewmembers, whether receiving initial qualification or upgrade training to aircraft commander or instructor pilot, train at Castle. A large portion of each mission is spent in the traffic pattern practicing instrument approaches, visual flight rule patterns, and landings. When computing wear and tear on the airframe, aerospace engineers at Oklahoma City Air Logistics Center state that one hour of flying at Castle is equivalent to two hours at other bases (28:--). Due to this, KC-135s are rotated in and out of Castle on a regular basis. This rotation does effect the maintenance organizations within the wing.

The thirty-nine KC-135s maintained at Castle are rotated to other SAC bases after 24 months (28:--). This process causes Castle maintenance personnel to perform an abnormally high number of rotation and acceptance inspections. These inspections are comprehensive and take up to three days to complete (26:--). If selected SAC units were tasked with LAAR missions, similar aircraft inspection problems would occur. One way to blunt the impact of the additional workload would be to increase maintenance personnel to handle the inspections. Other than the additional inspection requirement, the daily maintenance routine at Castle is like that at other KC-135 bases.

CONCLUSION

Due to the more sophisticated enemy air defense systems in existence today, the US needs a new tactic to strengthen the B-52's conventional war-fighting role. Low-altitude air refueling can provide that needed edge. An analysis of available air-refueling platforms reveals the KC-135 as the logical choice to fulfill this tasking. However, flying the KC-135 at low altitudes can result in structural damage to the airframe. The risk of such damage occurring can be significantly reduced by following specific parameters of use and safety. An examination of the impact of LAAR on KC-135 flight systems reveals nothing to prevent aircrews from carrying out the mission. It has been found that aircraft responsiveness actually improves at lower altitudes although the rate of fuel consumption is adversely effected. Increased fuel consumption results in a decreased offload capacity for the receiver. In addition to the impact that LAAR may have on the KC-135, there are also considerations that must be examined for the operational and maintenance organizations. Increased training and proficiency requirements will substantially affect operational organizations. Maintenance organizations will be affected even more substantially due to the increased number of aircraft inspections. However, when all of these aspects are considered and weighed against the flexibility that LAAR adds to the US war-fighting capability, the scale surely falls on the side of adding LAAR to the US arsenal. As General Chain stated, "I want to be able to refuel low because that gives me one more arrow in my quiver" (4:6A).

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