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**AIR-TO-AIR REFUELLING IN THE AUSTRALIAN
DEFENCE FORCE**

By

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About the Author

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INTRODUCTION

In the near future, the ADF will take delivery of an air asset that has the potential to greatly enhance the mobility of its air and land forces. That asset is the Hercules C-130J. Procured to replace the ageing C-130Es currently in service and perhaps also, in time, the C-130Hs, the J model will have substantially improved performance over both earlier models at significantly less operating cost. More importantly for the ADF, the aircraft is built to a baseline configuration designed specifically for pre-delivery modification in line with its intended role, be that tactical transport, maritime patrol, airborne early warning or whatever.

One role for which the J model Hercules is well suited is that of tactical air-to-air refuelling tanker. Air-to-air refuelling (AAR) can extend the range, payload and time-on-task of aircraft and thus provide increased flexibility. AAR can be used to support all three air campaigns¹ and, moreover, can enhance the capabilities of virtually all types of aircraft, fixed and rotary wing, in almost all air power roles.

However, some policy documents seem to indicate that the importance and relevance of air-to-air refuelling to the ADF is not fully appreciated. The Department of Defence Force Structure Review of 1991 included a number of specific proposals for developing the Army and made specific mention of the proposed C-130 replacement. From an air refuelling perspective, however, the language used was not encouraging: 'Replace the twelve C-130Es, and consider fitting some of the new aircraft for, *but not with*, an air-to-air refuelling capability'.²

The ADF recognised the need for an AAR capability over twenty years ago. However, it was not until the Defence White Paper of 1987, which stressed the need for self-reliance and reduced dependence on foreign forward operating bases, that some priority was given to procuring an AAR capability. The policy of self-reliance was reiterated in the 1994 Defence White Paper (DA94).³

Australia believes that at present no country has either the motive or intention to attack it. The Government considers that capabilities to mount a major conventional attack on Australia do not exist in the region and, moreover, could not be developed in secret. Furthermore, adequate warning time would be available to adapt and expand the ADF to meet a major attack.⁴ DA94 does recognise, however, that should political circumstances change, an increasingly demanding range of conflict could emerge with little warning and Australia must be prepared to meet it. The types of encounters that could be sustained by current national capabilities within the region are described as short-warning conflicts.

In short-warning conflict, an adversary may seek to exploit the vast distances and dispersed population of northern Australia to mount small attacks at isolated locations. The ADF has only a limited number of assets, and providing close

¹ The three air campaigns comprise Control of the Air, Air Strike, and Air Support.

² Department of Defence, *Force Structure Review 1991*, AGPS, May 1991, p 27. Emphasis added.

³ *Defending Australia, Defence White Paper 1994*, AGPS, Canberra, 1994, p 21.

⁴ *ibid.*, pp 22-23.

protection for all potential targets would be impossible. Thus, surveillance and mobility are the keys to effective defence.⁵

This paper argues that the ADF currently lacks the necessary mobility to effectively meet the tasks that may be placed upon it in the event of short-warning conflict. That shortfall could, however, be redressed to some extent by employing the C-130J in a secondary AAR tanker role.

Firstly, the paper examines the three air campaigns and the means by which strategic and tactical AAR can enhance their successful prosecution. Secondly, the AAR capabilities and deficiencies of ADF fixed-wing and rotary-wing assets are discussed. The paper recognises that in the current financial climate, purchase of additional AAR tankers is extremely unlikely. Nonetheless, a number of options that could address the deficiencies are considered. Finally, the potential of the C-130J as an AAR tanker for the ADF is examined and the implications of its potential employment considered.

Within budgetary constraints, every opportunity should be taken to exploit the versatility of a newly acquired air asset. Merely possessing potential does not reflect operational capability. By definition, short-warning conflict comes with little notice. The significance of the old adage 'you fight like you train' cannot be over-emphasised.

DEFINITIONS

For the purpose of clarity, the following definitions have been adopted:

- a. **Strategic AAR.** Strategic AAR is an activity conducted in support of the deployment of a combat force and its ancillary elements to a forward operating base or into an Area of Operations (AO). Generally, strategic operations are planned and co-ordinated by a dedicated, centralised planning and control staff.
- b. **Tactical AAR.** Tactical AAR is the airborne refuelling of combat or support aircraft conducting operations within a defined AO, and carried out under autonomous or local control.

AAR AND THE AIR CAMPAIGNS

According to AAP1000, *The Air Power Manual*, air power is projected through the conduct of three distinct air campaigns - control of the air, air strike and air support. These campaigns include a range of possible aircraft roles. In the event of aggression, Australia may opt to use defensive or offensive action, or a combination of both. Providing the necessary options requires a force structure with a degree of inherent flexibility to facilitate the conduct of all three air campaigns concurrently.

⁵ *ibid.*, p 21.

Control of the Air

Control of the air encompasses the establishment of a dependable integrated air defence system (defensive counter-air), and the destruction of enemy aircraft, airfields, air defences and C³ (offensive counter-air).

Defensive Counter Air (DCA)

DCA involves a combination of passive and active measures to nullify or reduce the effectiveness of an enemy air attack. Throughout all phases of tension or conflict, DCA operations would be foremost in securing sovereign airspace. Active DCA measures involve the use of forces maintained at high levels of readiness.

The limited number of ADF air assets available for DCA missions together with the vastness of the continent mean that DCA operations must focus on achieving high degrees of control over specific volumes of airspace for specific periods of time. The reactionary nature of such operations emphasises the need for all elements of the DCA system to be well developed and practised.

DCA missions can be resource-intensive, especially if conducted continually over many hours. In the summer of 1993, the assets assigned to Operation Deny Flight, responsible for enforcing UN Resolution 816 over Bosnia-Herzegovina, included 71 fighters, eight AEW aircraft and eight tankers.⁶ Bosnia-Herzegovina represents an area similar in size to Tasmania. To meet the national commitment of three hours of combat air patrol the RAF required a minimum of six Tornado fighters and one K-1 Tristar tanker.⁷ Significantly, the RAF's fighter area of responsibility was on most occasions less than 250 nautical miles from the fighters' operating base.

In any such operation, if the fighter aircraft are to be effective they must at all times have sufficient fuel to carry out an engagement and return to base without further refuelling. Moreover, the fighters must retain a minimum diversion fuel should an AAR transfer be unsuccessful. In determining the number of assets required for continuous operations, factors such as the number of operating areas, transit time, receiver requirements, tanker unserviceabilities and crew fatigue must all be taken into account.

Offensive Counter Air (OCA)

Offensive counter-air operations are mounted to destroy, disrupt or limit enemy air power as close to its source as practicable. Australia must have the military capacity to prevent an enemy from successfully attacking its air and sea approaches, gaining a foothold on its soil, or extracting political concessions through the use, or threatened use, of military force.⁸

The conduct of OCA operations is one means by which control of the air over the air/sea gap could be established. Such operations may require an attack package, comprising bomber and supporting fighter aircraft, to operate beyond the range of

⁶ Lambert A., 'Operation Deny Flight', *Air Clues*, DDTP(RAF), London, December 1993, p 445.

⁷ *ibid.*, pp 446-447.

⁸ *Defending Australia*, p 14.

their unrefuelled radius of action. Restriction to a known range and predictable operating profile could limit the number of targets available, simplify enemy defence requirements, and thus increase the risk of attrition. The use of AAR could remove these constraints and enhance flexibility and unpredictability - the fundamentals of sound air power employment doctrine.

Air Strike

A strategic air offensive campaign involves the use of air power to strike directly at an enemy's centres of gravity which are often located deep in the enemy heartland. A purely defensive response to any form of armed aggression could be very demanding on the ADF and could result in high costs for Australia against a modest investment by the protagonist.⁹ On the other hand, a strategy of proportionate offensive response may deter further aggression.

In Australia's unique geographical environment, strike aircraft, even when located at forward bases, could be required to operate over considerable ranges. To maximise the number of available targets and improve survivability, the attacking aircraft must be capable of long-range, low-level, all-weather, day and night operations. Conduct of such operations would require considerable amounts of fuel and thus, as stated in AAP 1000¹⁰, it is a doctrinal imperative for all strike aircraft to be AAR capable.

Air Support

Air support comprises those activities which complement the combat power of land, sea and air power assets. With regard to surface operations, air support is not a subsidiary but an integral component. In addition, in many situations, control of the air remains a pre-requisite for the successful conduct of surface operations.

Maritime Operations

Air power provides support to sea power through the roles of maritime surveillance, anti-submarine warfare (ASW), anti-surface warfare (ASuW) and maritime strike.¹¹ The F-111s of Strike Reconnaissance Group (SRG), the F/A-18s of Tactical Fighter Group (TFG) and the P3-Cs of Maritime Patrol Group (MPG) could all be used to support maritime operations. Maritime strike and ASuW could be considered Australia's first lines of defence with their purpose being to keep the battle away from Australia's shores by exploiting the natural advantage provided by the air/sea gap.

Maritime patrol aircraft (MPA) are capable of operating at long range with considerable loiter time; however, they carry no self-defence armament. To improve their chance of survival in a hostile environment, such aircraft would need the support of fighter combat air patrols (CAPs). Fighter aircraft typically have considerably less range and endurance than MPAs and, thus, the provision of fighter CAPs could be limited without the support of AAR. In addition, the employment of F-111s and F/A-18s in the maritime strike or ASuW roles would be determined by the unrefuelled

⁹ *ibid.*, p 29.

¹⁰ AAP 1000, *The Air Power Manual*, 2nd Edition, AGPS, Canberra, p 97.

¹¹ Maritime strike for Australia is the application of air power against enemy naval targets not in contact, but posing an indirect or longer term threat. The term should not be confused with ASuW.

radius of action of the aircraft. The availability of AAR would greatly enhance the flexibility of these combat assets.

Land Operations

The immediate contribution of air power to the land battle comes most obviously from the provision of close air support (CAIRS) or battlefield Air Interdiction (BAI). Under normal circumstances, CAIRS and BAI missions would be flown by fixed-wing RAAF assets operating from forward operating bases (FOB). The ability to operate from a secure FOB would generally reduce mission flight time and thus obviate any requirement for AAR.

Despite the protection and support offered by aircraft operating in anti-surface roles, the Army still requires mobility to successfully prosecute the land battle. Manoeuvre is a fundamental principle of land warfare and involves the destruction or disruption of the enemy rather than the taking or holding of ground for its own sake.¹² The capacity to manoeuvre effectively depends on the mobility available to the force from ground vehicles, aircraft and ships together with the fitness of troops to march.¹³

The vast geographical area over which the ADF has responsibility for defence, together with the inclement nature of the tropical wet season places additional emphasis on the importance of mobility. DA94 is quite specific in its requirement for the Army to be highly mobile, so as to allow rapid deployment into areas of contention and the conduct of dispersed operations over wide areas. Air refuelling of its helicopters could significantly enhance Army's mobility and give its commanders a level of flexibility and rapidity of response that could greatly simplify logistic support requirements.

AAR CAPABILITIES OF THE ADF

The \$60 million contract to convert four of the RAAF's 707s into dual role tanker/transport aircraft in 1991 went some way towards satisfying the ADF requirement for an AAR tanker force capable of refuelling both fixed-wing and rotary-wing aircraft during strategic and tactical operations. Before addressing the issue of deficiencies, however, we must first examine the present capability of the relevant ADF assets to conduct air-refuelling operations.

AAR Tankers

Boeing 707-338C

The Boeing 707 AAR force comprises four aircraft and two AAR qualified crews. On average, three of the aircraft are available on a daily basis. The aircraft and crews provide a core force for operational training that could be expanded in time of tension or conflict to offer a limited operational capability.

¹² *The Fundamentals of Land Warfare*, Doctrine Branch, Headquarters Army Training Command, Sydney, 1993, p 41.

¹³ *ibid.*, p 41.

Presently, for AAR, the aircraft are employed solely in a training role; however, No. 33 Squadron could quite feasibly be upgraded to operational status. AAR training currently accounts for 25 per cent of the Squadron flying effort. Much of the AAR training is in support of F/A-18 squadron deployments and these operations highlight the versatility of the B707. For example, one B707 can transport 80 personnel and 10,000 lbs of cargo from Darwin to Singapore whilst simultaneously providing AAR support for up to six F/A-18s. Typically, for support of a routine air defence training mission, the aircraft has a nominal 100,000 lbs of fuel available for AAR.

Air refuelling is conducted using a 'probe and drogue' system from two wing hoses. Although the 'flying boom' system is not fitted, the aircraft fuselages were plumbed during the modification program to allow relatively cheap and short notice retrofitment of a boom.¹⁴ Despite the demonstrated versatility of the B707, its flight envelope is such that it is unable to refuel helicopters. Purchased second-hand in the early 1980s, the B707 is expected to remain in service until at least 2010.¹⁵

AAR Receivers

The ADF presently has two aircraft types in operational service that are AAR receiver capable. In addition, the Black Hawk and the Chinook both have the potential to receive fuel in flight but would require modification. The P3C maritime patrol aircraft (MPA) in RAAF service presently has no capability for AAR.

F/A-18

The F/A-18 is fully operational as an AAR receiver and squadron pilots retain AAR currency within normal training hours. The aircraft receives fuel via a retractable probe.

F/RF-111C/G

All models of the F-111 are operationally capable of AAR; however, the aircraft can only be refuelled using the 'flying boom' method. As the B707s have no boom fitted, operational crews retain currency through a memorandum of understanding (MOU) with the USA that allows regular refuelling practice with USAF KC-135s.

Black Hawk

The Australian Army operates the S-70A-9 Black Hawk which is a derivative of the UH-60A Black Hawk operated originally by the US Army. Those in Australian service have no AAR capability; however, such a capability has been developed.

In 1982, to satisfy its requirement for a helicopter capable of unescorted, nap-of-the-earth, night, all-weather combat rescue operations, the USAF took delivery of the Black Hawk. Two of the nine aircraft acquired underwent a modification program that included the capability for in-flight refuelling. A 443 litre auxiliary fuel tank in the

¹⁴ The 'flying boom' system is the only means by which to air refuel the F-111.

¹⁵ *Aircraft Acquisition and Fleet Management of New and Ageing Aircraft*, A key issue paper presented by AOCLC at the CAS Strategic Planning Conference, 2-5 November 1994, Annex B.

fuselage was complemented by two 871 litre external tanks. A telescopic flight refuelling probe, of composite construction, was mounted on the starboard side. Extensive evaluation was carried out in 1984 and, subsequently, the USAF began to upgrade the remainder of its Black Hawks to a similar standard. ADF Black Hawks would require the USAF modification before AAR operations could be contemplated.

Chinook

The ADF is in the process of accepting four D-model Chinook helicopters.¹⁶ In 1988, to demonstrate the aircraft's AAR capability, the US Army conducted air refuelling exercises between an HC-130 Hercules and a CH-47D Chinook.¹⁷ ADF Chinooks would require modification to allow an AAR capability.

P-3C

The P3C fleet is about to undergo a major upgrade; however, there appears to be no intention to make the aircraft AAR capable. At first, an AAR capability for the P3C might appear superfluous. Nevertheless, as the RAF discovered during the Falklands Campaign of 1982, AAR of MPA can enhance, or indeed be essential to the conduct of maritime operations over extreme distances. Certainly, the case for a P3C AAR capability should not be dismissed out of hand.¹⁸

DEFICIENCIES

Strategic Refuelling

Australia's defence policy emphasises a capacity for the ADF to operate independently across Australia, its offshore territories and proximate ocean areas. The Government seeks forces that are capable of denying the air and sea approaches to an adversary as well as defeating incursions onto Australian territory. These forces should provide a range of cost-effective options which Government could employ to bring about a cessation of hostilities as rapidly and decisively as possible.

Australia's area of strategic interest comprises an area some 7,000 kilometres by 5,000 kilometres, representing over ten per cent of the earth's surface. The location of mainland aircraft operating bases means that much of this area falls outside the unrefuelled radius of action of the ADF's combat aircraft, particularly the F/A-18.

The B707 tanker currently in service is an effective strategic tanker. However, the number of aircraft presently available could severely limit the ability of the ADF to

¹⁶ *Defending Australia*, p 50.

¹⁷ The exercises, which covered air refuelling by day and night, showed the Chinook was capable of receiving up to 3,780 litres of fuel in about six minutes.

¹⁸ AAP 1000 states that MPA, which are one of the elements of the surveillance system, possess the long range and endurance necessary for surveillance missions. However, the manual considers the ASW role asset-intensive, requiring many fully serviceable MP aircraft capable of maintaining 24-hour coverage of a particular area of ocean. The benefit that force multiplication through AAR could impart to the MPA fleet is worthy of consideration; that topic, however, is outside the scope of this paper. AAP 1000, *The Air Power Manual*, 2nd Edition, pp 106, 123-124.

meet the strategic tanker tasks likely to occur in times of conflict. Nevertheless, given adequate warning time of any significant conflict, the ADF could procure and modify additional B707s, or other suitable tankers, which could then be integrated into operational service.

Realising this additional operational capability would, of course, also depend on the availability of an adequate number of trained crews. A strategy based on early warning which obviates the need for a large force structure is economically sensible; nonetheless, there is another side to the coin that must also be considered.

Government policy recognises that hostile motives and intentions can develop much more quickly than a build-up of military capabilities and could manifest themselves as short-warning conflict.¹⁹ The ADF, therefore, must be adequately equipped and trained to meet such contingencies.

In recognising the trend of increasing military capability within the region, Australia must ensure it remains able to defeat any forces which could credibly be brought to bear against it. Maintaining this ability demands appropriate equipment and adequate training. For RAAF F/A-18 pilots the frequency of AAR training is somewhat sporadic, revolving around detachments and specific pre-deployment work-up periods. Due to a variety of reasons, but primarily those of tanker serviceability, weather and priority tasking, routine AAR training is often unavailable and very little is conducted at night.

Realistically, the current B707 force could probably offer a limited degree of strategic support at short notice to a single AO. However, if there were two or more AOs, the available number of tanker aircraft, and more specifically tanker crews, would severely limit the RAAF's ability to meet its strategic task. This shortfall could be further compounded if AAR assets were required to support tactical operations within one or more of the AOs.

Tactical Refuelling

Although well suited to the strategic role, the B707 airframe has some limitations in the tactical role. The airframe is not optimised for low level operation, is not particularly manoeuvrable, is extremely vulnerable in a hostile environment and, when fulfilling its primary air transport (AT) role, requires considerable special support. Moreover, the B707 has no capability to refuel rotary-wing aircraft.

For tactical AAR, the minimum tanker capability required should be the maximum sought. This proposal is advanced for two reasons. Firstly, the more modest the requirement, the simpler and cheaper it is to meet. Whilst economy in itself is always desirable, low unit cost also allows the acquisition of a greater number of aircraft. Greater numbers provide redundancy, increase flexibility, and thus enhance operational effectiveness.

Secondly, although one tanker may be able to support operations in one geographical region, there may be a requirement to refuel other aircraft in a different area within a

¹⁹ *Defending Australia*, p 23.

short space of time. Transit between refuelling areas would incur time penalties that may prevent the tanker from meeting the requirements of all its receivers. A larger number of smaller tankers with less, but still adequate, transferable fuel could satisfy the operational requirement.

Helicopter Refuelling

The Kangaroo series of exercises are designed to simulate short-warning conflict and to test the ADF in joint operations in a demanding environment. The lessons from K89 and K92 both recognised the significant improvement in mobility provided by the Black Hawks of No. 5 Aviation Regiment. However, the helicopter's high fuel consumption has, in the past, prejudiced the success of long range missions and restricted flexibility.²⁰

The basic Black Hawk aircraft with a speed of 150 knots and a 30 minute reserve of fuel has a flying time of 2 hours (375nm). The fitment of four external fuel tanks can extend transit range to around 1,000nm; however, there is a significant penalty on load carrying capability.²¹ More importantly, a considerable number of the 27 troop-carrying Black Hawks have at times been grounded due to structural problems. A contributory factor may be the high usage of long-range fuel tanks.²²

Presently, for additional fuel, the Black Hawk relies on refuelling facilities at FOBs, the pre-positioning of fuel at pre-determined refuelling points, or a fuel resupply carried by a supporting Black Hawk. Each of these options has limitations.

- a. Firstly, FOBs may be located too far from the area of operations to provide support services.
- b. Secondly, the selection of suitable refuelling points requires pre-planning; location of these pre-determined points could affect desired routing, thereby reducing flexibility. Furthermore, in the wet season, the ability of support aircraft to land and deliver fuel to the refuelling points could be very limited.
- c. Thirdly, ground refuelling from fuel bladders or drums is a relatively slow process and requires specialist pumping equipment. During the refuelling operation, the helicopter and its crew are particularly vulnerable to attack. Moreover, whenever the refuelling site is provisioned with fuel, it is a target and must therefore be afforded the necessary protection against the risk of attack.
- d. Finally, the Black Hawk, when configured as a refueller, can only adequately support one other Black Hawk and this represents poor economy of effort. Consideration has been given to the newly acquired D-model Chinooks providing a capacity for the tactical transport of fuel. However, the Chinook is a multi-purpose utility helicopter capable of a number of roles. To commit one

²⁰ O'Donell, Lt Gen L., 'K89 Highlighted Equipment Deficiencies', *The Australian*, 27 November 1989, p 8; Hawkins, M., 'K92 Lessons Much the Same as Earlier', *Australian Aviation*, July 1992, p 77.

²¹ Lambert M. (ed.), *Jane's All the World's Aircraft 1993-1994*, Surrey, England, 1993, p 565.

²² *Australian Defence Report*, 16 February 1995, p 5.

or two aircraft out of a total of four to fuel delivery duties would appear to be under-utilisation of a versatile platform.

Availability of additional AAR tanker assets capable of both strategic and tactical AAR could overcome the Black Hawk's range limitations.

OPTIONS FOR ADDITIONAL AAR CAPABILITY

There are a number of options available to any nation wishing to enhance its AAR tanker capability. These options include:

- a. production of a new purpose-built tanker,
- b. purchase of an existing tanker,
- c. modification of combat aircraft for 'buddy-buddy' AAR,
- d. modification of in-service civilian aircraft, and finally,
- e. modification of in-service or future military aircraft.

Tanker aircraft have never been designed specifically for their task and have generally been a compromise between the ideal and the affordable. Versatility of the airframe is essential. The utility of a tanker aircraft is greatly enhanced if it is capable of providing an airlift capability for cargo and personnel in addition to AAR. In times of financial restraint this additional capability could be seen as essential rather than desirable. Nevertheless, design and production of a new, purpose-built, tanker/transport is feasible. However, Australia has no indigenous aircraft design and manufacturing capability. To produce a purpose-built tanker would involve major research and development costs and, therefore, this option would be prohibitively expensive.

There are many existing aircraft that could be considered for an 'off-the-shelf' purchase and include types such as the KC-135, KC-10, Tristar and KC-130. However, second-hand aircraft represent yesterday's technology and may offer only a compromise solution to the identified requirement. With the emphasis on versatility and multi-role capability, the selected aircraft must offer the greatest value for money in an operating environment that is unquestionably unique. Significantly, of the types mentioned above, only the KC-130 is suitable for helicopter refuelling operations.

The 'buddy-buddy' system of refuelling was designed primarily for the support of naval air operations. As aircraft carriers were unable to support very large aircraft operations, a system of 'probe and drogue' AAR evolved, whereby 'podded' refuelling equipment was fitted to combat aircraft. The 'buddy-buddy' system is still widely used, notably by A-4 aircraft of the RNZAF and by Tornados of the RAF and Italian Air Force.

The 'buddy-buddy' option could be feasible for the ADF; however, incompatibilities between the F/A-18, F-111, and helicopter refuelling equipment and flight envelopes

make the proposal impractical. Furthermore, this option would lack versatility as it would effectively reduce the available number of combat aircraft/helicopters whilst providing nothing more than an AAR platform for one specific type.

The B707, KC-135, KC-10, VC10 and Tristar are all illustrations of successful civilian aircraft modification. Some of these aircraft have limitations in the tactical AAR role and none can refuel helicopters. Other civilian types could be identified as suitable for the tactical role; nonetheless, research, development and procurement costs could preclude their consideration as a viable option. Presently, there are no modified civilian aircraft capable of conducting helicopter refuelling.

Realistically, the only ADF asset that could be re-configured for the AAR role is the C-130 Hercules. Presently, the RAAF possesses twelve C-130Es and twelve C-130Hs. As the E models are due for replacement in 1996/97, and a possibility exists of replacing the H models by the turn of the century,²³ it is unlikely the Government will invest in modifications to either of these types. The optimum solution lies with the soon to be acquired C-130J which, if modified, has considerable potential to fulfil a secondary AAR tanker role.

QUALITIES OF THE HERCULES C-130J

The J model of the C-130, whilst looking externally similar to the H model, can take-off in 32 per cent less distance, climb 24 per cent more rapidly, cruise 16 per cent higher and 5 per cent faster, carry the same payload 46 per cent further and land in 6 per cent less distance.²⁴ In recognition of the potential world market, tanker, special operations, gunship, maritime patrol and airborne early warning versions are all planned.

The Hercules airframe is well suited to AAR operations and earlier models have proved themselves as effective tactical tankers in many air forces including the USAF, the RAF and the RSAF. The aircraft is an extremely stable refuelling platform that can operate at low and medium altitude and at a speed compatible with fast-jet and rotary wing refuelling operations. Furthermore, the aircraft can be fitted with a centreline hose, two wing-refuelling pods, or both. Modification to include a 'flying boom' system is not anticipated.

In earlier models of the Hercules, if the quantity of normal internal fuel was insufficient for specific refuelling operations, additional cargo bay fuel tanks could be fitted thereby increasing the aircraft's total fuel capacity to approximately 100,000 lbs. The fitment of tanks, however, would compromise airlift capability.

The improved capabilities of the J model greatly enhance its potential as an AAR tanker. For example, the basic aircraft is more fuel efficient than its predecessors and has a simplified and more reliable fuel distribution system. Plumbing for the optional AAR probe, which allows the aircraft to receive fuel in flight, is fitted as standard. Post-production modification to tanker configuration is easily achieved through the

²³ Project Air 5216.

²⁴ Warwick, G., 'Hercules Renewed', *Flight International*, 31 August - 6 September 1994.

fitment of underwing hose and drogue pods and a cockpit control panel. Fuel capacity can be increased by the use of a roll-on/roll-off cargo-bay fuel tank.

THE IMPLICATIONS

The acquisition of an additional AAR capability for the ADF could have many benefits. However, the advantages must be put in perspective against the costs associated with the acquisition and maintenance of an AAR capability.²⁵

Support Facilities

AAR tankers require considerable investment in support facilities. Where an aircraft is brought into service to fulfil two roles, such as AT and AAR, the home base must be suitably provisioned with personnel and equipment to support both roles. Furthermore, over and above the normal aircraft engineering requirements, airborne refuelling equipment requires special support. Of course, receiver aircraft must be similarly supported, albeit to a lesser degree. As circumstances may dictate the requirement for AAR support in any part of Australia's area of interest, the tanker aircraft should, ideally, be fully capable of unsupported, dispersed operations.

As the RAAF currently has an AAR tanker capability in the B707 and AAR capable combat aircraft, many of the problems so far discussed have already been addressed. The C-130J more than meets the equipment requirements of a tactical tanker. Moreover, home base maintenance support facilities for Hercules aircraft operating in the AT role are already in place at RAAF Base Richmond. Furthermore, as the home of the B707 fleet, RAAF Base Richmond also has the necessary facilities to support AAR operations. Logically, therefore, a mixed force comprising B707s and C-130Js offers the best solution when determining the composition of the AAR tanker force necessary to meet the strategic and tactical needs of the ADF.

Communications and Navigation

The primary task of an AAR tanker is to be in the right place at the right time with sufficient fuel to meet the task. Furthermore, it must be compatible with the receiver aircraft's AAR equipment and refuelling flight envelope. Making an effective rendezvous requires specialist communications and navigation equipment in both tanker and receiver.

Standard Operating Procedures

For effective and safe AAR operations standard operating procedures (SOPs) must be developed. Production of SOPs is normally an onerous task as each tanker and receiver type requires separate consideration. However, the limited number of ADF aircraft types that can perform AAR reduces the required workload. Nevertheless, AAR of helicopters would be a new experience for the ADF.

²⁵ This section draws heavily on the RAF's experience of maintaining an AAR capability. For more details on the multitude of potential problems, see: 'Air-to-Air Refuelling - Panacea or Placebo?', *Air Clues*, January 1990, pp 32-37.

Training

Ultimately, it is people who fight wars. How well they are trained could have a powerful effect on their performance in combat. If possession of a capability is to be truly effective then air and ground crews must receive regular training in the role during peacetime. Operation Desert Storm provided numerous examples of situations where a lack of preparation and training, for reasons beyond the control of the operators, resulted in confusion, unnecessary aborts and, in extreme cases, accidents.²⁶

Once SOPs have been developed, crews must be trained in their use. Not only must this training be monitored and standardised, but sufficient flying hours must be allocated to ensure proficiency in the role. The C-130J has potential as both AAR tanker and receiver. Moreover, it has a primary role of AT to fulfil. To train all crews in all roles is probably unnecessary. Thus, to avoid nugatory training effort, the required numbers of trained crews to meet each role must be determined.

Tasking

If the training requirement is to be met and currency is to be achieved, then tanker and receiver crews require co-ordinated tasking. A lack of co-ordination could result in unproductive flying hours which represent a waste of both time and money. A number of AAR planning and control staff already exist in the RAAF; however, the tactical training environment could be further complicated by the inter-service relationship, military/civil airspace divisions and international issues.

For major exercises and during actual AAR operations, ‘a highly capable tactical control agency, supported by long and short-range radars and secure communications, is essential if the basic “same time, same place” criteria for AAR are to be achieved consistently and safely’.²⁷

CONCLUSION

DA94 recognises that in planning Australia’s defence capabilities over the next 15 years, the most important challenge will be the need to adapt to the greater demands possible in short-warning conflict as capabilities in the region increase.²⁸ The procurement of at least 12 C-130Js will go some way towards meeting this requirement.

By 1990, the RAAF’s specific requirement for an AAR capability had been recognised for over 20 years but had been repeatedly pre-empted by other acquisition programs deemed to have higher priority.²⁹ In 1991, the B707 modification programme met the requirement; however employment of the aircraft as an AAR platform was confined solely to a training role. If the ADF is to address some of the

²⁶ Meilinger, P., ‘Airwar and the Future’, *Army Quarterly and Defence Journal*, Vol. 122, No. 2, April 1992, p 173.

²⁷ ‘Air-to-Air Refuelling - Panacea or Placebo?’, p 36.

²⁸ *Defending Australia*, p 23.

²⁹ Kopp, C., ‘RAAF Accepts First 707 Tanker’, *Australian Aviation*, May 1990, p 54.

mobility deficiencies identified in recent Kangaroo exercises then it must ensure that the inherent versatility of any newly acquired air asset is fully exploited.

Australian defence strategy emphasises the importance of defending the air-sea gap and the need for flexible, mobile forces to operate over great distances. In this respect, air power is fundamental to that defence strategy. Any aggression against Australia could be directed along several axes involving air, sea or land forces. The fact that Australian forces could be involved in either defensive or offensive action demands a force structure sufficiently flexible to permit the concurrent conduct of all three air campaigns. The need for operational AAR to support these campaigns is compelling and must feature in all planning.³⁰

Presently, the ADF has only a limited AAR tanker capability. The resulting restriction in flexibility brought about by this limited capability could prove a critical factor in the successful prosecution of certain missions. Yet numerous options are available to enhance the AAR capability of the ADF. These options include the purchase of a new or existing AAR-capable airframe, modification of an in-service civilian aircraft, and modification of an in-service or future RAAF aircraft.

Of the available options, the purchase of a new airframe would be prohibitive on grounds of cost, whilst purchase of an existing tanker, as well as being expensive, may offer only a compromise solution to the requirement. Modification of an in-service civilian aircraft has proved successful in the past. However, presently, there is no modified civilian aircraft type ideally suited to the tactical environment nor, indeed, to helicopter refuelling operations. The modification of in-service C-130s would appear a viable option but, with replacement due in the near future, the cost-effectiveness of such a modification programme is questionable.

The new C-130J could meet the tactical refuelling requirements of the ADF, including the ability to refuel helicopters. The B707, although not fully suited to the tactical role, could meet the ADF's strategic AAR needs.

The use of large capacity tankers for strategic tasks is attractive as it represents good cost-effectiveness. However, in the tactical environment, the converse could be true. The vast fuel capacity of a strategic tanker may not be fully utilised before other factors such as weapon expenditure or aircrew fatigue become relevant.³¹ Moreover, strategic tankers invariably have operating base requirements that reduce their flexibility of operation. A limited number of tankers reduces the number of possible AAR operations. Ideally, a tanker fleet comprises sufficient airframes of appropriate type to meet all coincident tasks no matter where they arise. In the case of the ADF, the optimum choice would be a mixed force of B707s and C-130Js.

An acquisition philosophy of 'fitted for but not with' may be appropriate if the ADF is fortunate enough to receive seven years notice of conflict. However, such a philosophy does not reflect true capability in the environment of short warning conflict and any argument to convince people otherwise is seriously flawed.

³⁰ *AAP 1000, The Air Power Manual*, 2nd Edition, p 79.

³¹ 'Air-to-Air Refuelling - Panacea or Placebo?', p 37.

This paper has proposed a solution to some of the air mobility problems within the ADF. Introducing the C-130J into service with a full capability to conduct AAR is an attractive option that would appear to come at relatively little cost. Modification of the J model has the potential to enhance the capability of air power for both the RAAF and the Army. Realisation of this potential however, is dependant on the Army supporting an AAR capability for the Black Hawk. If the land forces are to capitalise on the true versatility of air power then, in concert with the Air Force, they must fight for its procurement and enhancement at the highest levels. All arms of the Defence Force should understand that AAR is a force-multiplier for all suitably equipped ADF air assets and is not the sole prerogative of the RAAF.

The airplane can be used for many military purposes, and it has a mobility that surpasses any other man-carrying weapon. To tie this versatile instrument of war down to a few specific tasks and thus deny it other objectives which at times might be far more productive toward eventual victory would seem to be a profligate waste of force. If a (military) force is organized to take advantage of the great material versatility inherent in the airplane, the commander can be in a position to skilfully apply all the Principles of War.³²

³² Baker, Maj Gen J.D. and Smith, Col D., 'Air Power Indivisible', *Air University Quarterly Review* 4, Number 2, Fall 1950, p 7.