The unique Caribou

Why then is the Caribou so valuable to the ADF as a tactical airlifter and why is finding and funding a replacement such a dilemma?

What makes the Caribou unique is its short and soft field landing and takeoff (STOL) performance, which has not been matched by any design of a comparable aircraft since the aircraft came into service in the 1960s. The only realistic equivalent today is the vastly more expensive Bell/Boeing MV-22 Osprey tilt rotor, an aircraft that remains bedeviled by immaturity and ongoing political arguments over funding for the US armed forces.

All other alternatives, even if exceeding the modest payload/range performance of the Caribou, fall short in that all-important Caribou role – operations from short, unprepared runways.

Losing this capability is not desirable. US forces learned the hard way in Afghanistan and Iraq that using heavy/medium lift helicopters for this niche airlift role is expensive – so expensive that last year a debate emerged in Washington on whether alternatives existed to ‘burning out’ helicopter fleets. Suffice to say – with the Caribou and its offspring, the Buffalo, both out of production for decades – the US will continue burning hours on its CH-46, CH-47 and CH-53s.

In addition to its tactical military importance, a key role for Caribou continues to be ‘support in our region of interest’ and national support tasking such as natural disaster relief.

A less obvious but important role for the Caribou is its value as a training platform, used by Army's paratroopers, and air despatch operators – and for RAAF tactical lift qualified commanders, later to progress to the C-130, and for qualified flight instructors (QFIs) and test pilots. The high workload and demand for cockpit coordination inherent in a small airlifter provides valuable experience for developing pilots (Caribou pilots achieve Captain status well before other type operators) and the RAAF experience in these competencies bears this out.

The strategic ‘big picture’ is sobering. Australia will continue to be engaged in peace enforcement, peace keeping and likely counter-insurgency campaigns globally, with the ongoing turmoil in the Islamic world and ‘arc of instability’ in the Pacific Rim, all demanding precisely the type of capability the Caribou provides. Yet the RAAF also faces its biggest challenge for decades with the need to recapitalise its fighter, tanker and maritime patrol fleets, and introduce the Wedgetail AEW&C platform over the coming decade.

A low cost option to extend the service life of the Caribou therefore has much to offer, both in terms of retaining a valuable capability and in not adding significantly to budgetary pressures.
The Caribou is a design that predates the era of computer-aided design and modern fabrication techniques. Its structural design and construction compare best to the ubiquitous C-47/R-4D/DC-3 and it is, in the simplest of terms, rugged, simple and durable – maintainable using the same techniques as general aviation types.

A RAAF sponsored study of the structural life of the Caribou assessed that the airframe is capable of being operated to 2020 and beyond, or more, providing some investment is made in corrosion control and structural refitting of key but simple components.

The principal obstacle to extending the service life of the Caribou is the age and sustainability of the Pratt & Whitney R2000 powerplant, a technological artifact of the 1940s. While the R2000 was a robust design, it has been out of production for decades and is now maintained using mostly refurbished components. An Avgas-burning radial piston, the R2000 is the only piston engine remaining in ADF service and requires retention of a unique and costly fuel distribution and replenishment infrastructure. The Caribou was not deployed in support of the Ash Tsunami relief effort (Operation Sumatra Assist) because Avgas was not available on site.

Much of the downtime and most of the maintenance bill on the Caribou fleet is a result of problems with the R2000 and related power plant system. These include failures in the antiquated electrical system, engine components, oil leaks, overboosts, over heating, damage from thermal shock – with many resulting in in-flight loss of power and shut downs (the aggregate being known as the IFSD rate and power plant shutdowns on the ground during maintenance and ground handling. In the civil aviation community, the number of engine problems on the ground are also considered when determining the IFSD rate.

Remedial measures to deal with the obsolescence of the R2000 have been quite expensive and not particularly successful. In 2001, Air Project 5190 Phase 1A, termed “the recovery program for the Caribou” had a stated budget of between $100m to $150m “in addition to the existing operating budget to help arrest declining aircraft availability levels”. Surprisingly, this phase (and funding level) did “not include any provisions for revised engine solutions”.

This year, the Caribou fleet will fall well short of its planned flying rate of 5,080. Independent analyses in 2001/02 predicted a shortfall of some 15% to 20% but the achieved flying rate could be lower (around the 3,600 hour mark, or only 70% of ROE). Operating cost, aircraft availability and reliability problems aside, flight safety is now emerging as a major issue. With the unreliable condition of the R2000s, full payload and fuel, there is the potential for an engine-out scenario arising where the remaining R2000 cannot sustain the required power rating, resulting in the potential for loss of the aircraft. An independent analysis last year predicted an IFSD rate generally considered to be above the maximum acceptable for civil aviation operations.

To re-engine the Caribou is not a new idea, and follows the rationale of the S-2T and other successful piston-to-turboprop conversions. Several proposals were put to the Department, with the most detailed and credible submitted by Hawker de Havilland (circa 1988). None of these mainlined mainly because there was no existing design or flying prototype.

In 1999, Australian Flight Test Services, an Adelaide based flight test and design contractor, proposed a recovery program, jointly with Pen Turbo Aviation in New Jersey, and an Australian Industry team, under an unsolicited industry proposal called ‘Project Tango Charlie’. Tango Charlie is an adaptation of Pen Turbo’s DHC-4T ‘Turbo Caribou’ upgrade with the Pratt & Whitney, Canada, PT6A-67T turboprop, first flown in 1996. Since then the prototype N600NC has accrued more than 500 flight hours.

The Tango Charlie proposal is unique as it was based on an existing, proven, flight-tested and certificated conversion design, and would not incur risks associated with a new design. It also included other improvements resulting in the Caribou’s utility and value increasing markedly.

Pen Turbo’s design focused on reliability, maintainability, affordability and mitigation of risk. Unlike many re-engine programs, the Turbo Caribou maintained the power rating of the R2000 engines, with the PT6A-67T an exact fit to the existing nominal power ratings. In practice, however, the operational R2000s no longer deliver the ratings of new engines, so the Turbo Caribou would deliver slightly better performance than newly manufactured R2000s.

The PT6A is a mature engine, with more than 215 million operational hours on 34,000 units produced since 1963. Choosing an engine with an identical power plant shut down on the ground during maintenance and ground handling. In the civil aviation community, the number of engine problems on the ground are also considered when determining the IFSD rate.

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Implementing the Turbo Caribou Conversion

The Turbo Caribou is a mature project, with hundreds of hours of accrued time on the prototype, and impressive reliability and availability statistics to date. This success is due to merging a mature and robust airframe with a mature and modern engine and propeller. With nine years elapsed since the prototype first flew, and Transport Canada and FAA Supplemental Type Certifications achieved on the design since then, implementing the Turbo Caribou upgrade would be a very low risk proposition.

The implementation model originally proposed is still applicable today: an Integrated Product Team, comprising a group of Australian contractors and Pen Turbo in the United States along with an IV&V/T&E capability assuring the Commonwealth’s needs. A Private Finance Initiative (PFI) or ‘power by the hour’ model comprised a group of Australian contractors and Pen Turbo in the United States along with an IV&V/T&E capability assuring the Commonwealth’s needs. A Private Finance Initiative (PFI) or ‘power by the hour’ model.

Much of the conversion kits would, subject to agreement with Pen Turbo, be manufactured in Australia, with engines, propellers and some other major items more economically produced and sourced from the US. The Caribou fleet would then be progressively cycled through a nominated depot where the retrofit and associated engineering tasks would be performed. The expected time in depot for each aircraft would be three months, subject to production economics. The fleet of 14 aircraft could be retrofitted over a 30-month period.

With a fleet of Turbo Caribou the effective strength of No 38 Squadron would be increased by over 25% as the achievable 96% availability would permit a significantly higher flying rate and rate of sortie completion against that currently being achieved by the legacy R2000-powered fleet. Should more Caribous be sought, refurbished aircraft modified to the Turbo Caribou configuration would be a credible option. With several refurbished Caribous used for the initial in-country conversions, there would be no loss of aircraft availability at the outset of any conversion program.

Summary

The reality for Defence over the next decade seems destined to be constrained budgets resulting from large scale recapitalisation of much of the RAAF fleet along with sustained pressures to provide airlift support of Coalition operations, regional stabilisation and relief operations. These are unavoidable facts of life Australia must confront.

The Turbo Caribou proposal offers an opportunity to retain and enhance a vital existing capability through this difficult period, with revenue-neutral expenditures, taking into account existing Caribou fleet operating costs.