AUSTRALIAN AVIATION

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TO THE ICE

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Antarctic express

Flying Australia's Antarctic airlink A319 to the ice

story and photos by Dan Colborne

Eighty-one years ago a ski-equipped black Lockheed Vega took off from the sea ice on the Antarctic Peninsula on the first flight over the frozen continent. Its pilot, the then famous Australian adventurer Sir Hubert Wilkins, could never have imagined that one day a passenger jet would run a weekly service to a runway bearing his name carved out of solid blue ice on a large glacier.

These weekly flights of an Airbus A319 have transformed the logistics of the Australian Antarctic Division (AAD). The journey to its largest Antarctic research base, Casey Station, was once an infrequent two week voyage across the wildest ocean in the world. Now, the weekly 4.5 hour flights from Hobart enable personnel to swap in and out faster, effectively increasing the number and productivity of Antarctic scientists and also reducing the environmental footprint of ship transport.

The need for an airlink to access the Australian Antarctic Territory – an area of just under six million square kilometres or 43 per cent of the icy continent – had been identified for several decades. However, the challenges of overcoming a combination of the long distance from Australia to Antarctica, no alternate landing sites near Casey, strong headwinds, frequent poor weather and environmental concerns over runway construction delayed the implementation of the Australian airlink until recently.

In 1999, the AAD began a tender process for an airlink to a proposed ice runway on a glacier about 70km from Casey Station. In a bold move outside the traditional Antarctic aviation paradigm of C-130s and Twin Otters, Sydney based company Skytraders won the tender offering ski equipped CASA C-212-400 turboprops for long distance intracontinental work and a Falcon 900EX for the intercontinental link.

The long range Falcon 900EX business jet had the ability to fly from Hobart to Casey, conduct two approaches and return to Hobart with fuel reserves intact. This capability overcame the three primary hurdles in establishing the airlink – it removed the safety concerns associated with weather deteriorating past points of no return associated with C-130 type aircraft; it removed the environmental concerns about transporting and storing large amounts of fuel within the pristine Antarctic environment; and it saved the large expense of establishing an alternate aerodrome and facilities at Bunger Hills, 250nm away.

In time, the opportunities that an intercontinental aircraft could offer both the AAD and other nations' research programs became more widely understood throughout the scientific community, and a larger aircraft was required. After careful consideration the Airbus A319-115 was selected as best suited to the role.

VH-VHD was born as Airbus Corporate Jet (ACJ) MSN1999, but is configured internally in either a standard all-business class configuration (48-seats) or a business and economy mix (28/54-seats) depending on the work. Unlike its competitor the BBJ – a hybrid of different Boeing 737 models

– the ACJ is a standard A319 aircraft that could be placed alongside any A319 in any airline fleet in the world.

As there are no maintenance facilities on the ice, the continued serviceability of the aircraft is paramount. The modern airframe and technology provide excellent reliability both in Antarctica and worldwide on charter work in the winter off-season. An engineer is carried on all flights to the Antarctic, both as further insurance against technical problems on the ground and also to sign off prior to Extended Diversion Time Operations (EDTO – formerly known as ETOPS).

FLYING SOUTH

Using its ICAO callsign of *Snowbird 1*, VH-VHD flies from Hobart to Wilkins and return most Tuesdays from November to February. Other flights are also operated during the summer for a variety of national Antarctic research programs from Christchurch to the American Antarctic research station of McMurdo, nestled in the foothills of Mt Erebus.

For today's representative flight, at 0500 local, *Snowbird 1* is cleared for takeoff and rolls down Hobart's runway 12 through V1 and rotating at 131kt, and climbs out onto a track of 188° initially to FL360. With no steps in the control zone to the south, contact is soon established with Melbourne on VHF who in turn gives the oceanic HF frequencies to establish contact and conduct a SELCAL check. Although fitted with an Iridium satellite telephone in the overhead panel, all primary communications are still done via HF radio, which generally works well in the Antarctic, with recent upgrades to the HF radio transmitters in Australia improving signal strength over the Southern Ocean.

Up to 38 passengers could be carried with today's fuel load, but the flight has 23 expeditioners seated in the front cabin, with the rear cabin loaded with a variety of cargo contained in seat packs. There is also more cargo carried underfloor in the rear cargo hold. The takeoff weight is 73,417kg – limited by the landing weight at Wilkins of 62,500kg.

A fuel load of 23,590kg is onboard in the wings and the four containerised fuel tanks (known as ACTs) in the cargo hold. Up to six ACTs can be fitted to the Airbus in a matter of hours to reconfigure the aircraft easily for different client demands, extending the standard A319 range to well over 6000nm with reserves.

Normally Skytraders operates the aircraft with four ACTs fitted, and in such a configuration the ACJ can comfortably fly for around 11 hours with reserves. This allows the aircraft to fly from Hobart to Antarctica, conduct two instrument approaches, land and return to Hobart without refuelling. This also meets all 180 minute EDTO fuel planning requirements, including depressurisation and engine failure scenarios.

ICE RUNWAY An aerial view of Wilkins's 09/27 True orientated runway.

Once in the cruise, the cabin crew serve a large hot breakfast to the passengers and crew. Being well fed is one of the primary defences against the cold to which all will be subjected in the hours to come.

There is little to see across the Southern Ocean. It is frequently cloud-covered and the crew busy themselves completing the EDTO checklist prior to the EDTO entry point 609nm from Hobart. A short satellite phone conversation confirms the weather and NOTAMs for the nominated EDTO alternate airports – Hobart and Wilkins – are still suitable. If required, Launceston, Melbourne, Adelaide and Pegasus can also be used as EDTO alternates.

Antarctic weather can be very difficult to predict and the meteorological forecasters keep a close eye on the weather observations from Wilkins. An excellent rapport and mutual understanding has developed between the aircrew, the runway meteorological observers and the Bureau of Meteorology forecasters, allowing a better appreciation and communication of the forecast and actual conditions.

At a cruise level of FL360 reached at 135nm south of Hobart, a cost index of 25 gives a TAS of 455kt. For the next 1000nm, the wind is forecast to average 300° at over 100kt. Over the next couple of hours the temperature will steadily decrease to stabilise at -56°C (at around latitude 65°S) where the lowering tropopause intercepts the cruise level.

At 59°30'S the polar navigation system in *Snowbird 1* is activated via a simple push button on the centre panel. This references all heading and navigational information to degrees True in order to cope with the huge magnetic variations (Wilkins is 120°W). Further south, below 65°S the navigation display also displays grid heading. Preliminary contact is made on HF 5400 with Casey Station who relay updated

LANDING A319 VH-VHD 'Snowbird 1' pictured landing at Wilkins – at midnight!

AT WILKINS On the ground at Wilkins as the loading process begins for the return flight to Hobart.

weather observations and the latest runway condition report. Primary communication, however, still remains with Airservices Australia until 65°S.

The latest METAR indicates a wind of 085°T at 20kt. The sky is clear, temperature -12°C, and the surface and horizon definitions are both good. Advance knowledge of surface and horizon definitions are essential when operating in potential whiteout areas and are routinely appended to Antarctic meteorology reports. The QNH is 980hpa – quite normal for the coastline close to the Polar Trough in the Southern Ocean.

Appended to the weather forecast is a runway friction reading taken every 500m along the runway length measured with a friction meter attached to a four-wheel drive ute. Today's cold temperatures give friction coefficients of the ice surface readings similar to a wet tarmac runway.

One hour before landing, the captain instructs all passengers and crew to get dressed in their Antarctic clothing. At the same time, the cabin temperature is lowered to make the rest of the flight more comfortable.

Just before descent (200nm from Wilkins) the pre-landing briefing is undertaken for the RNAV GNSS approach to runway 09T. Autobrake medium is armed and the APU started (the APU is not required to be running during EDTO flights on the A319). The APU will be used for heating and engine starting during the turnaround.

Shortly after leaving FL380, contact is established on 129.7 VHF with Wilkins. They advise that the runway surface and personnel are in readiness and that the horizon definition to the southeast is now fair. Such events are common in Antarctica – even on clear days – and can be caused by local wind effects whipping up snow obscuring the surface and horizon.

Approaching the coast the cloud clears as the dry katabatic winds from the interior of the highest, coldest and driest continent on earth keep the moist sea air offshore in a low stratus deck. The expanse of the empty white continent becomes apparent and the clarity of the air is extraordinary – with no pollutants, smoke or humidity, the horizon is razor sharp.

The Hobart-Casey great circle track is now 236°T – a change of 33° since departure. The broad, flat summit of the 6000ft high Law Dome lies clearly ahead. To the left lies the distinct Totten Glacier pushing out into the ocean – one of the fastest moving glaciers in Antarctica and it is accelerating. Some of the passengers peer through the windows intently as they will soon be travelling to the Totten Glacier by C212 aircraft to conduct ice core drilling to determine what is causing its acceleration – research crucial to current climate change science.

The ragged coastline of the Vincennes Bay lies to the right of track. The brightly coloured buildings of Casey Station are just visible wedged on a thin peninsula of rock between the brilliant white snow and the dark blue ocean. In the bay, a mesoscale low pressure system has swirled broken up squares of pack ice into a 30 mile wide clockwise spiral. These systems can be triggered during stable weather when katabatic flows that start life high up in the interior,

IN COMFORT Some of the 23 passengers onboard the 2x2 configured A319 dressed in their Antarctic clothing.

one thousand miles to the south, flow down the Petersen Glacier and out into the bay. The tight clockwise flow then causes a local onshore breeze around Casey station that often forms a daytime sea fog – sometimes as far inland as the Wilkins runway.

Nearing the initial approach fix Charlie of the RNAV GNSS 09T approach, *Snowbird 1* levels out at 5700ft on QNH. Crossing the aircraft track is a single faint line drawn across the emptiness – vehicle tracks along the 70km route between Casey and Wilkins. The black specks of two concrete filled 44 gallon drums marking the route are visible every five kilometres.

Wilkins, at an elevation of 2533ft, is carefully located in a neutral ablation zone – the precipitation and ablation of the snow and ice are equal. The Upper Petersen Glacier moves approximately 12m per year westwards – roughly along the length of the runway. If the runway was located any lower, summer temperatures would cause melting under the ice surface, undermining the strength of the runway. Furthermore, melted puddles of water absorb more heat than the surrounding ice, accelerating the melting. This would then freeze overnight, expanding and causing 'blistering' of the ice surface – hard ice bumps that are difficult to remove.

Approaching the Petersen Glacier, the endless white snow cover starts to become broken, revealing the deep blue ice hundreds of metres thick. Snow compressed over several millennia has squeezed out all the air bubbles to form ice that has taken on a rich deep blue colour. Then in areas of high wind, the surface snow gets stripped off, exposing the hard blue ice underneath.

Shortly after turning left onto the final inbound track of 095°T, a fully managed standard three degree glidepath is established and the missed approach altitude is set to 5700ft – which is also the 25nm minimum safe altitude.

After passing the final approach fix the runway becomes clearer – a 4000m long rectangle in an otherwise random patchwork of snow formations. The runway camp – a series of heavily modified shipping containers – appears as a line of black dots running 100m perpendicular to the runway across the prevailing wind. The radar altimeter then comes alive at 2500ft above ground level. Radar altimeters can be erratic over snow and ice surfaces, but the density of the snow and ice in the Wilkins environment causes no problems to the readings.

The two per cent upslope of the runway is quite noticeable, and the illusion furthered by the continuously rising ground in the distance. This, combined with lack of any terrestrial features around the runway's swath of blue ice, can cause quite significant illusions when established on the standard three degree approach.

With a couple of miles to run the red and white lights of the PAPI become discernable against the bright background. Black PVC markers 55 by 77cm on polycarbonate poles line the sides of the runway every 100m. The yellow windsock is clearly visible at the threshold indicating the wind is straight down the runway.

The touchdown is gentle and the surface is smoother than at many airports around the world. With a combination of reverse thrust and autobrake, *Snowbird 1* is slowed to taxi speed in little over 1000m. There is excellent ground clearance for the CFM56 engines, which significantly reduces the chances of snow ingestion.

NOTHING BUT ICE On the ground at McMurdo. Note the extended built-in stairs.

ON THE GROUND *Snowbird 1* on the large empty apron with its APU running and the nosewheel chocked by the ground crew.

Airbus test pilots and engineers worked closely with Skytraders throughout 2006 and 2007 in developing procedures for landing the A319 on ice runways. Furthermore, all aspects of the flight and touchdown are continuously reviewed through a flight operations quality assurance program that allows analysis of both flight events and the aircraft's interaction with the runway surface to ensure that any imperfections in the ice surface are within the stringent limitations specified by Airbus.

Turning and taxiing on the ice is done slowly and carefully – especially in high winds. A practical safe wind limit of 40kt is adhered to during the flightplanning. While this is well below the aircraft's limit, high winds and slippery surfaces become a hazard to machinery and personnel operating around the aircraft.

After landing, the slats and flaps are retracted to takeoff configuration (Flap 1) in case they freeze in place and also to prevent any damage from ice accumulation in the shrouds. Landings are never made during periods of forecast precipitation, as there is no de-icing fluid available in Antarctica due to environmental restrictions.

Once *Snowbird 1* is parked on the large empty apron, the APU is left running and the nosewheel chocked by the ground crew. *Snowbird 1* does have a built-in extendable air-stair system that removes any requirement for ground based equipment at remote ports, but today the Captain determines that the conditions are safe to use external stairs to the back door. These are carefully positioned in place by the ground crew and anchored by using ice screws into the ice apron. At the top of the stairs the passengers disembark into the bright icy wilderness.

A variety of tracked vehicles approach the aircraft slowly. A scissor lift is positioned carefully by the rear cargo door on the right hard side to assist in loading and unloading heavy cargo in the hold. Loads are transferred to Haggalund vehicles and tracked trucks for the journey onwards to Casey station.

During the post flight inspection, the tyres show minor ice burn where on touchdown they skidded momentarily on the ice before rolling. Four parallel black skid marks about a metre long are visible on the runway surface from the main tyres. After departure, the ground crew will scrape them off to preserve the surface, as the dark rubber marks would absorb heat and cause melting.

Fresh from preparing the runway for the flight, the multitasking runway personnel unload the cargo of fresh food, mail, spare parts, personal baggage and scientific apparatus from the hold. Some passengers are earmarked to stay and help to form a human chain to help to unload the 16 cargo seat packs in the rear cabin that contain a variety of lightweight cargo.

The stop also sees one flight crew member changeover. Most Skytraders Airbus pilots are cross qualified on the C212 skiplanes and will rotate during the summer to spend a couple of months continuously on the ice. Not only do the crew enjoy flying the different aircraft types, but more importantly it keeps experienced ski-plane pilots returning to the ice year in year out, which is essential for efficiency and safety in such a unique environment.

Five of today's passengers are from the French and Italian Antarctic programs and they are driven over to a waiting C212 for their onward flight south to the high altitude research station at Dome C – 582nm inland and at 10,600ft above sea level. The other C212 will depart soon after with passengers and cargo to Davis Station, the second largest Australian research station 750nm to the west.

A laden tracked tray truck pulls alongside and the cargo is loaded into *Snowbird 1*'s hold for the return to Australia. This cargo also includes several tubes containing ice cores thousands of years old that were extracted from a glacier 36 hours ago. The Antarctic Airlink has allowed more detailed research on these ice cores that are crucial to current climate science, as they can be in university laboratories in Hobart and around the world before critical isotopes begin to decay.

There are hugs all around as the 25 returning expeditioners, who have been in Antarctica anywhere from one week to 14 months, say goodbye to their colleagues. Contrasting emotions of sadness and excitement are written in their faces as they walk carefully across the icy apron to board.

With a roar of the engines and a rooster tail of fresh dry snow arcing into the air behind, *Snowbird 1* lifts off to Hobart – after a 1hr 20min turnaround. In two hours the runway crew will begin to take down the runway markers to prevent them from melting into the ice before the next flight the following week.

Mid February heralds the last flight of the summer, when the Wilkins markers, buildings, waste and rubbish are towed back to Casey by the 18 expeditioners spending the winter there. Soon the snow, blown by relentless fierce winter storms, reclaims the runway and the pristine Antarctic environment is restored.

Dan Colborne is an A319 and C212 captain with Skytraders.

ROOSTER TAIL Roaring engines and a rooster tail of fresh dry snow arcing into the air behind, *Snowbird 1* lifts off to Hobart after its 1hr 20min turnaround.