



Photo: Châteauroux Air Centre

End-of-life solutions: Retirement is not what it used to be

As increasing numbers of aircraft are retired from service, *Joanne Perry* speaks to OEMs, dismantlers, parts redistributors, materials recyclers, researchers and the Aircraft Fleet Recycling Association (AFRA) to discover how aircraft can be born again.

“Green is a very popular colour these days,” notes Marcel Landry, Thales Canada’s VP of business development, commenting on the launch last year of a C\$150m (£94m), public-private “green aircraft” programme in Quebec. Like the majority of projects designed to lessen the negative impact of aviation on the environment, Quebec’s new scheme will focus on testing technological concepts for next-generation aircraft.

Taken together with the continual drive by OEMs to increase engine efficiency, it seems fair to suggest that the glamour of cutting-edge technological genesis means that efforts to reduce environmental impact during develop-

mental, production and operational phases overshadow another important element of the aircraft lifecycle: what to do with aircraft when they reach the end of their service.

The Aircraft Fleet Recycling Association (AFRA), an international collection of corporations and research groups, estimates that more than 12,000 aircraft will be retired in the next two decades. In times past, such aircraft would simply be parked in a desert “graveyard” and left to gradually disintegrate. However, the last few years have witnessed a growing realisation that applying recycling techniques to aircraft disposal can bring both environmental and business benefits. The potential ranges

across a number of different processes: dismantlement, parting out, material redistribution and repurposing.

When a retired aircraft arrives at a recycling facility such as the Air Center at Châteauroux Airport, the airframe is dissected using a large circular saw. Activities at Châteauroux are handled by AFRA member Bartin Aero Recycling, the only dismantling entity in Europe with ISO 14000 certification. Bartin dismantles between three and ten aircraft per year on site, but also sends teams out to other air centres and airports to handle a further four or five. At Châteauroux, the process takes place in a specially designed area consisting of a concrete



The A380 is 35 per cent composite by weight. Composite materials require special recycling strategies.

slab on impermeable geo-membranes — synthetic liners. Dissection begins with the wings to obviate balance issues, progressing to the tail and finally the front or rear landing gears in order to collapse the airframe. With recertifiable and resaleable parts already removed, the leftover metal is cut up into manageable pieces for transportation to a recycling plant.

Bartin GM Yves Basset says that typically 60 per cent of recovered material is aluminium from the airframe and the seats. For a 747 this can be up to 100 tonnes, compared with 75 tonnes for a DC-10. Around 15 per cent of recovered material is steel from the landing gear, while 10 per cent consists of copper cables, titanium and precious metals. Interiors are more difficult to handle, with foams, floor coverings and side panels at present largely irrecoverable.

Basset points out that demand for recycling services is linked to the market prices of scrap aluminium: "If they [owners] know the price gained from the scrapped materials covers their costs or offers a degree of profit they are much more likely to seek out our services." This is a clear demonstration of the importance of research to improve recycling efficiencies.

Major research schemes

The first major study on aircraft recycling was initiated by Airbus in 2005. The manufac-

turer's Process for Advanced Management of End-of-Life of Aircraft (PAMELA) dismantling demonstration project was carried out with support from four partners and the European Commission. The two-year programme involved the dismantlement of an A300B4, during which the effectiveness of a range of techniques was assessed. PAMELA led to the introduction of an Airbus environmental standard for the disposal of an A300.

Airbus followed up the original PAMELA project with the establishment of the Tarbes Advanced Recycling and Maintenance Aircraft Company (Tarmac Aerosave) with partners including Snecma Services and Aeroconseil. Tarmac's first dismantling facility was opened at Tarbes airport in 2009 and has since used refined PAMELA processes to dismantle nine Airbus and non-Airbus aircraft. Techniques practised there enable valorisation of 85 per cent of an aircraft's material weight, compared with a conventional rate of around 60 per cent. Olivier Malavallon, PAMELA project director, environmental affairs, describes Tarmac as "the centre of reference for recycling aircraft for Airbus and also within EADS".

Airbus has also initiated a PAMELA project for the A380 in a bid to address recycling issues surrounding larger aircraft. Malavallon says that an A380 static test structural cell has

allowed Airbus to assess the recovery potential for new alloys, including welded alloys, via the testing of specially developed processes. The result has been a 98 per cent recovery rate for metallic components. Malavallon says the success of the PAMELA programmes lies in selective dismantling techniques which make use of technical documentation and portable measuring devices to map materials in aircraft structures and systems components. This generates controlled batches of aluminium alloys and other metallic materials such as copper, titanium and stainless steel which command a much better price than contaminated batches. Or, as Malavallon puts it, "smart disassembly addresses both the technical and business aspects of recycling". Malavallon says that mechanisation of dismantling, which Tarmac aims to achieve by next year, will help to reduce processing time and further enhance profit margins.

Because Airbus fleets are relatively young, less than four per cent of Airbus aircraft are currently at the end-of-life stage. A greater proportion of retiring aircraft bear the Boeing stamp, and have structural compositions originating several decades ago.

Boeing launched its own foray into aircraft recycling in 2006 as one of the eleven founding members of AFRA. The association currently has 54 members across North

America, Europe, South Africa and Turkey and continues to grow, most recently welcoming SOS Metals in May this year. Corporate members range from aircraft manufacturers like Boeing and engine OEMs such as Rolls-Royce and Pratt & Whitney, through to dismantlers/parts redistributors such as AELS and Magellan Group, dismantlers/metals reclamation companies such as Bartin Recycling Group and finally materials recyclers such as ELG Metals and Milled Carbon. Members from the world of academia include the Universities of Oxford and Nottingham. AFRA's mission is to pursue and promote "environmental best practice, regulatory excellence and sustainable developments in aircraft disassembly, as well as the salvaging and recycling of aircraft parts and materials". As the only such organisation with a global scope, AFRA is working towards significantly increasing recycling rates worldwide.

Boeing regards AFRA as a key catalyst for environmental management. At last year's AFRA annual meeting, Jeanne Yu, commercial airplanes' director for airplane environmental performance, commented: "Partnerships such as AFRA create innovative models which

accelerate technology development and allow the industry to set challenging recycling goals to enhance environmental performance."

Guiding best management practice

A mainstay of AFRA's approach is the consolidation of its members' collective experience in a series of Best Management Practice (BMP) Guides. According to Denis Oliver, ELG Metal's manager aerospace business development, AFRA acts as vital means of information exchange. "AFRA membership not only keeps ELG abreast of trends in that area but allows it to participate in improving recycling techniques and standards for the industry," he says. ELG handles steel and alloy recycling across a number of industries, with 40 locations worldwide. On the aerospace side, several of its units are among a limited number of plants approved to supply recycled superalloys for remelting to produce rotating parts for jet aircraft engines, supplying material direct to melters.

AFRA's BMP Guides outline the standards, processes and procedures which enable businesses involved in aircraft recycling to implement best practice in their day-to-day activities,



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—Jeanne Yu, commercial airplanes' director for airplane environmental performance, Boeing



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Bombardier's CSeries aircraft, currently in production, will be 40 per cent composite.

as assessed by the association's accreditation programme. They cover: facility management; training; documentation and records; tooling; parts management; and recycling and environment. Executive director Martin Fraissignes, also GM at Châteauroux, is keen to emphasise the potential for a happy marriage between environmental and commercial interests: "We insist that the recovery and recycling be done in the most environmentally friendly manner possible but also in a way that makes sustainable business sense". The organisation is currently developing the third BMP Guide, due for publication in the second half of 2011. This will focus on interiors recycling, in contrast to versions one and two which concentrated on airframes and engines respectively.

The importance of formalising ground-level experience in the shape of the BMP guides is suggested by the fact that one third of the 400 or 450 aircraft which are scrapped around the world each year are disassembled and parted out by AFRA members. Standardising and improving such procedures can thus make a significant impact on aviation recycling culture and ultimately the industry's environmental profile.

Organisations which are audited to the BMP standard receive AFRA accreditation, which benefits both the member and its clients. "It's a guarantee for our customers that they will get the quality that one should

expect; quality from an aviation point of view, an environmental point of view, but also labour safety," explains Derk-Jan van Heerden from Aircraft End-of-Life Solutions (AELS). The Dutch company has three main strands to its business: end-of-life decision-making support; disassembly and dismantling; and component management. AELS is currently processing an A310-300 on behalf of EADS EFW. It will dismantle the airframe and recycle materials such as the aluminium, as well as recertifying, marketing and selling components for use on other aircraft.

Other AFRA members handling aircraft dismantlement processes include Evergreen Trade, which locates its services in the dry Arizona climate which is ideal for preserving resaleable aircraft components, and Southern California Aviation (SCA), operator of the world's largest transitional facility.

van Heerden feels confident that dismantlers can look forward to an increasing volume of business in the short- to mid-term, owing to a combination of factors: a time lag effect from higher aircraft manufacture rates 15-25 years ago; a modern tendency toward retiring older aircraft in favour of more fuel efficient and cost-effective models; and steady production from both Boeing and Airbus during the recent economic crisis. Basset confirms that Bartin has seen a corresponding demand for

dismantlement and recycling services, stretching into 2012 and beyond. Oliver adds that legislation to reduce carbon emissions places an extra pressure on operators which should favour companies involved in aircraft recycling, even in the unlikely event of a drop in fuel prices that would make engine efficiency less crucial.

In the near term, AELS is conducting research into improving the aluminium recycling process in partnership with Delft University of Technology, from which AELS originated. This could well be a fruitful enterprise; while Oliver says there are well-established practices to handle aluminium recycling, he admits that it "presents difficulties". Since Fraissignes estimates that the aluminium from an airliner is worth €70-100,000, improvements to the process could generate both financial and environmental benefits.

New frontiers for research

It is composite materials which present the biggest challenge — in Oliver's words "both technically and economically". "Composite recycling is in its infancy and there are limited (if any) outlets," he says. Since there is a trend among aircraft manufacturers to move toward composite airframes, recycling of such material will become an issue of growing concern. A

number of research projects across the world are bringing together corporate and academic resources in order to identify solutions ahead of time.

Boeing's efforts at present and in the coming years are naturally focused on the new 787, which is constructed from 50 per cent carbon fibre as measured by weight. The first retirements of this aircraft type are 30-40 years in the future. However, 777s which are now being retired also have a significant composite element — 20 per cent by weight. Boeing has thus worked on collaborations with Huron Valley Fritz West and Adherent Technologies in the US and Milled Carbon in the UK, as well as the Universities of Nottingham and North Carolina. In 2008, Milled Carbon set up Recycled Carbon Fibre, the world's first commercial scale continuous recycled carbon fibre operation. The company currently processes more than 2,000 tonnes of carbon-composite material each year and will be adding another overseas facility in 2011. Boeing continues to investigate methods of composite recycling, alongside opportunities to repurpose interior components – as noted earlier, the other bugbear of aircraft recycling.

For its part, Airbus is supporting a materials recovery research project involving Bordeaux University, France's National Centre for Scientific Research (CNRS), EADS Astrium and Snecma. The aim is, firstly, to test the chemical process of solvolysis as a means of separating carbon fibre from resin and, secondly, to establish ways of aligning the fibres for reuse. This work may generate important applications for the A350 (50 per cent composite by weight) and A380 (35 per cent by weight).

Meanwhile, in January this year Bombardier launched a composites recycling project with Canada's National Research Council and the Université du Québec à Montréal (UQAM), which Bruce Parry, corporate social responsibility manager, says will enable the company "to understand these materials when today's aircraft come out of service". This knowledge will eventually apply to the new CSeries aircraft, composed of 40 per cent composites and due to enter service in 2013.

In addition to the composites programme, Bombardier is undertaking a metals recycling project in partnership with the Consortium for Research and Innovation in Aerospace in Quebec (CRIAQ), other industry players and

academic institutions. The project will involve the dismantlement of a CRJ100/200 aircraft at the Centre Technologique en Aérospatiale (CTA) in Quebec, which CTA GM Pascal Désilets says "will determine which parts are truly recyclable". The three-year programme will begin at the end of summer 2011.

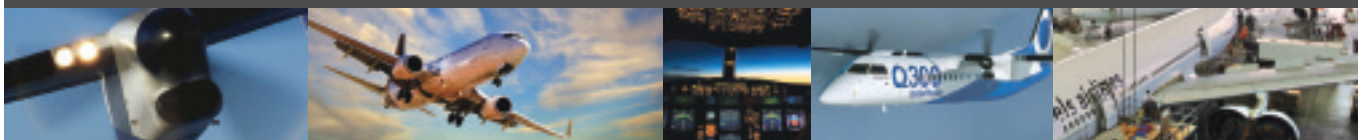
Bombardier's recycling efforts have already been recognised by AFRA, which accredited the company's joint dismantling operations with Magellan Aircraft Services in February 2010.

It is fortunate that the aviation industry, in conjunction with the world of academia, is pushing ahead with research into aircraft recycling. Amidst a curious dearth of specific legislation, OEMs, dismantlers, parts redistributors and materials recyclers, associations such as AFRA and academic institutions need to pull together to ensure that the end of an aircraft's working life continues the commitments made to green aviation during its development, production and operation. To borrow Malavallon's phrasing, this could well mean a shift from a "cradle-to-grave" process to a "cradle-to-cradle" cycle. ■



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