SkyHook – a revolution in vertical lift?

Boeing's Integrated Defense Systems division is working with Calgary-based SkyHook International to produce a revolutionary new air vehicle optimised for lifting and moving heavy loads, especially in remote areas and harsh environments like the Canadian Arctic and Alaska, where conventional surface transport is often inadequate, unreliable and costly.

This brand-new aircraft, designated the JHL-40 SkyHook, is a hybrid combining aerostatic lift and rotorcraft technology – essentially a lighter-than-air balloon 'envelope' providing 'neutral buoyancy', married to helicopter-type rotors. In this concept, the helium-filled envelope is sized to support the weight of the airframe and its fuel, leaving the four rotors exclusively dedicated to lifting the payload. This allows SkyHook to safely carry payloads 'unmatched by any rotorcraft in existence today', according to its creators.

Lessons from the past

Boeing and SkyHook's new JHL-40 model bears some resemblance to the earlier, ill-fated Piasecki PA-97 Heli-Stat Heavy Vertical Airlifter, which married a helium-filled envelope (actually a surplus ZPG-2W blimp) to four cut-down Sikorsky H-34J fuselages retaining their engines and rotors. These were arranged around the blimp's centre of lift, with the pilot controlling the entire machine from the cockpit of the port aft H-34J (although crew members were stationed in each cockpit).

This earlier Heli-Stat was built under a 1980 US Navy contract, but was intended for use by the US Forest Service to demonstrate the economic and ecological potential of heavy vertical airlifters in harvesting timber and other natural resources in inaccessible terrain. At 343 ft long (and with a 1 million cu ft envelope), the Heli-Stat was claimed to be the world's biggest aircraft.

The prototype made its maiden flight from the Naval Air Engineering Station at Lakehurst, NJ (long the home of US airships, and scene of the Hindenburg disaster), on 26 April 1986. Unfortunately, just over two months later, on 1 July, the aircraft was lost when it broke up after landing due to ground resonance. Some suggested that structural analysis had been inadequate, others that positioning the pilot so far from the centre of the vehicle made it very difficult to control. Unfortunately, one of the pilots, Gary Oleshfski, was killed, and the others were injured.

Could a fresh approach to the combined aerostat/rotorcraft concept be the answer to outsize payload transport requirements in remote areas?

Neutral buoyancy allows the JHL-40 to lift very heavy loads and then move them at near-helicopter speed.

This was a major setback for Piasecki, and to the Heli-Stat concept, which has only really re-emerged this year. NASA studies into quad-rotor heavy lift airships and buoyant aircraft ground to a halt, and Aérospatiale's twin-rotor Hélicostat and Goodyear Aerospace's ambitious quad-rotor heavy lift airship concepts came to nothing.

SkyHook secured the patent for this type of aircraft in 2007 (although the vehicle depicted in the documentation looked markedly different to today's JHL-40) and the Canadian company approached Boeing with the proposal that the US aerospace giant should develop and build the system. 'We conducted a feasibility study and decided this opportunity is a perfect fit for Advanced Systems' technical capabilities,' Pat Donnelly, director of advanced rotorcraft systems for Boeing, told *ROTOR**HUB***.

Behind the scenes, Boeing had not been a complete newcomer to the world of airships, having signed a July 2002 contract with Germany's CargoLifter AG to explore stratospheric airship concepts, before the latter company got into financial problems which forced it to abandon its planned CL160 airship (intended to carry 160-tonne loads). A sub-scale CL75 AirCrane prototype was completed, but this was destroyed in a storm in July 2002.

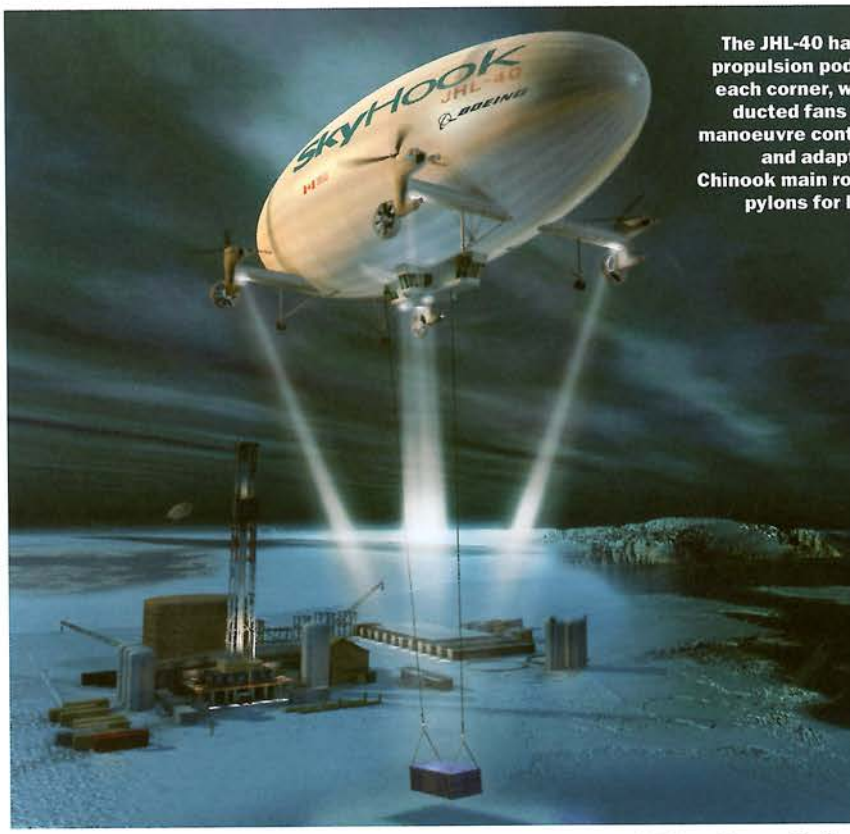
On 8 July 2008, Boeing and SkyHook International formally announced their teaming agreement to develop the JHL-40.

Boeing has received the first instalment of a multiyear contract from SkyHook to develop the new aircraft, and will build the first two production prototypes at its Ridley Park, PA, factory. Rapid development of the aircraft will be facilitated by using proven components, avoiding the need for proof-of-concept prototyping. SkyHook will own, maintain, operate and service all aircraft for customers worldwide from its main base in Alberta, Canada. The new aircraft will enter commercial service once FAA and Transport Canada certification is received.

Pete Jess, SkyHook president and COO, is enthusiastic about the market potential for the new aircraft. 'There is a definite need for this technology. The list of customers waiting for SkyHook's services is extensive, and they enthusiastically support the development of the JHL-40.'

Integrated engineering

Although superficially similar to the Piasecki Heli-Stat in concept, any comparisons are really unfair to the JHL-40. The Piasecki aircraft was unashamedly a cheap and cheerful demonstrator, while the SkyHook will be a properly engineered solution, optimised for full commercial service. Thus, while the Heli-Stat reportedly used



The JHL-40 ha propulsion poc each corner, w ducted fans manoeuvre con and adap Chinook main ro pylons for

aluminium sewer pipes as the basis of the clumsy and unwieldy framework by which the surplus H-34s were lashed to the retired blimp, the SkyHook will be engineered to modern standards, using modern materials, and with a much more streamlined and integrated design.

Instead of using surplus helicopter fuselages, the SkyHook has four engine/rotor pods adapted from those of the Boeing 234 Chinook helicopter. But whereas the Piasecki relied on using the cyclic pitch of the individual H-34s (and differential use of collective on individual rotors) for control, the Skyhook also incorporates separate, vectoring ducted propellers to provide forward propulsion, and for manoeuvring, positioning and station-keeping.

Because the elliptically shaped, semi-rigid envelope is sized to support the weight of the aircraft and its fuel, the SkyHook is neutrally buoyant without payload, and unlike traditional airships, does not need to transfer ballast when the payload is lifted or deposited.

The SkyHook is designed specifically to economically transport equipment and materials in remote regions where there may be no airport infrastructure, where building new access roads might be impractical or environmentally unacceptable, and where existing land and water transportation methods are inadequate.

The SkyHook can lift under-slung loads of up to 80,000 lb (40 t) and transport them up to 200 miles, at speeds of 70 kt, without refuelling represents double the capacity of what is cu the world's largest helicopter, the Mil Mi-26 The aircraft is capable of precision load s and picking, and can be integrated with ex rail, ship, and truck infrastructure.

'This Boeing-SkyHook technology repre an environmentally acceptable solution for companies' heavy lift short-haul challenge it's the only way many projects will be a progress economically,' Jess said. The J is claimed to be environmentally respo because it can avoid the need to buil roads to support construction in remote and has been described as the key enab some projects previously thought to be 20 years away. Boeing therefore expec SkyHook to reduce the carbon footprint industrial projects it supports, making green aircraft of choice.

But all of that lies some way in the f and the JHL-40's creators face real chall in getting the aircraft into service. A experts warn that neutrally buoyant aircr extremely susceptible to turbulenc extreme weather, while the placement of and thrusters close to the envelope will things difficult for those studying the mechanics of the new aircraft. Finally, th of helium is 'ballooning' – potentially thi ing to dramatically increase running cos