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2018 | ISSUE 17

FRONTLINE



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BY
MARK OGDEN

One of the running themes in this issue's feature stories is around the replacement of helicopter fleets. For example, Germany is looking at replacing its aging CH-53 fleet with the CH-53K or a yet again modernized Chinook. The UK is looking at its future requirements as the Lynx is being retired.

In Part 1 of his story on the future of the conventional helicopter Paul Kennard questions how future vertical lift technology may shape the forces of tomorrow. He also looks at UK's Royal Air Force helicopter heritage and where it may be in the near future. All these changes are taking place against a backdrop of an EU that is arguably under stress from Brexit and other political issues and a resurgent Russia, while in the Pacific, an aggressive China is challenging the current world order paradigm. Technology is allowing prior unworkable or impractical concepts to now be viable, whether that is the tilt rotor of the V22 or the development of hybrid airships.

Do I think we will see a significant shift away from the conventional helicopter in the near future? Not likely but ideas, plans and circumstances can change quickly. The fundamental reason is cost. Only the USA seems to have the pockets deep enough and the knowhow to take military vertical lift to the next technological level whether that be tilt rotor, compound (e.g. the S-97 Raider) or whatever. How fast that happens though will depend on the military challenges being faced by the US which is happening on many fronts.

What is being seen though are some interesting contrasts in the way technology is being implemented. Boeing has had the Chinook in production since 1962, that 56 years and counting. Sure, It can lift a bit more, go a bit farther, and it's probably a bit more reliable as it undergoes continual update but it is still essentially a CH-47. Sikorsky and the Marine Corp on the other hand, took the CH-53 and while 'K' looks like a CH-53, it has been substantially redesigned using new materials and technology to provide significant performance and reliability improvements. But the cost is high. The Germans face an interesting choice.

The UK is finding, like other countries such as Australia, that 'bespoke' systems on helicopters comes at a hefty up-front price and ongoing maintenance costs. Militaries really need to weigh up the advantage of a unique system with its associated costs; is it really worth it? For some it may well be but for most, buying unique means that systems will usually quickly become outdated and harder to update, replace, or on-sell.

Mark

First Indian Coast Guard Dhruv ground tested

The first of 16 ALH Dhruv Mk-III earmarked for the Indian Coast Guard has completed its maiden ground run, it has now been handed over to the Rotary Wing R&D Centre for integration and certification of 19 new systems.



CHI supply USTRANSCOM in Afghanistan

CHI Aviation has been selected to provide additional helicopter airlift support for the U.S. Military in Afghanistan. This will include tactical troop transport, internal and external cargo operations.

RNLAF NH90 with MASE Operational

The first Royal Netherlands Air Force NH90 with Terma's Modular Aircraft Survivability Equipment fitted has successfully passed a comprehensive test program. The installation consists of the ALQ-213 EW controller, a modular self-protection pod equipped with MILDS-F Missile Warning System, and the Advanced Countermeasures Dispenser System.





Australian MoD to transmission facility

Leonardo and the Australian Ministry of Defense will establish a helicopter transmission repair and overhaul facility in Melbourne capable of servicing NH90 MRH Taipan and foreign NH90. Operations are expected to start in mid-2020 initially to support Australian MRH Taipan.

Singaporean Chinooks Arrive at Oakey

Five Republic of Singapore Air Force (RSAF) Chinooks have arrived at the Army Aviation Training Centre at Oakey, Queensland, for flying training on the Darling Downs.



Hungary orders 20 H145Ms

The Hungarian Ministry of Defense has ordered 20 H145Ms equipped with the HForce weapon management in the frame of the military modernization program Zrinyi 2026.



Australian Army contract for Rockwell Collins

The Australian Army has signed a contract with Rockwell Collins to provide extended avionics support for its fleet of CH-47F Chinooks through a performance-based logistics contract until 2020.

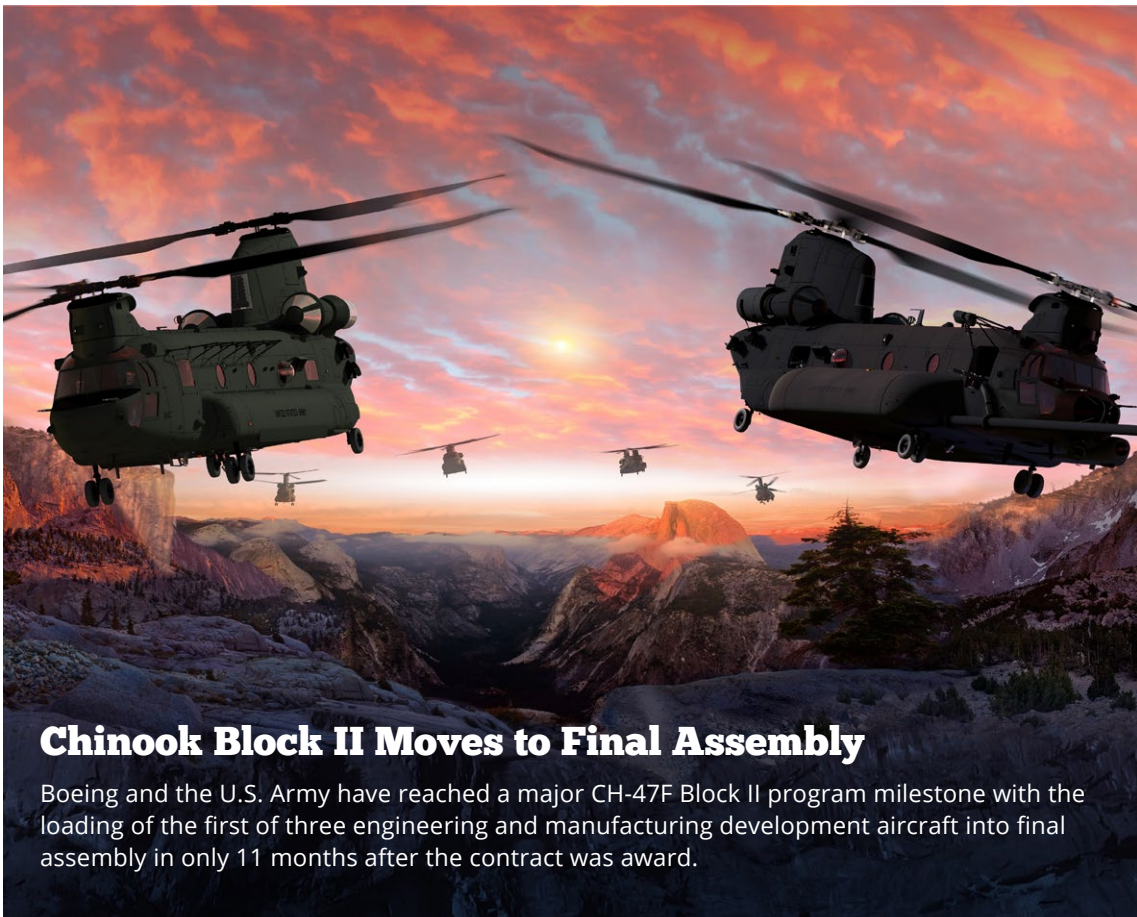


RAF Lakenheath bids farewell to RQS

The 48th Fighter Wing, at RAF Lakenheath, England, has bid farewell to the 56th Rescue Squadron and their HH-60G Pave Hawks signaling the near-completion of the 56th and 57th RQS relocation to Aviano Air Base, Italy.

First Commando Merlin delivered

The UK's Commando Helicopter Force has taken delivery of the first AW101 Commando Merlin Mk4. This one of ten due for delivery by the end of 2018 under Phase 2 of the Merlin Life Sustainment Program.



Chinook Block II Moves to Final Assembly

Boeing and the U.S. Army have reached a major CH-47F Block II program milestone with the loading of the first of three engineering and manufacturing development aircraft into final assembly in only 11 months after the contract was award.



RCAF prepare for Mali deployment

Aircraft and personnel from the RCAF's 450 and 408 Tactical Helicopter Squadrons have completed an exercise to validate the integration of the CH-146 and CH-147F capabilities for a deployment to Mali as part of the United Nations Mission in Mali.

AW159 Demo to Malaysia's Armed Forces

Leonardo, with the support of the UK's 847 Naval Air Squadron, presented its AW159 Wildcat to Malaysia's Armed Forces at Royal Malaysian Navy Base during Exercise Jeanne d'Arc.



Pakistan orders additional AW139s

The Government of Pakistan will introduce into service an undisclosed number of additional AW139 following an order with deliveries set for early 2019 as part of a fleet renewal program.



MV Sycamore supporting HATS

Instructors from HMAS Albatross's 723 Squadron (Joint Helicopter School) have commenced training with the Royal Australian Navy's new Multi-role Aviation Training Vessel MV Sycamore. It was the first time RAN conducted deck landings with the EC135.



H135 for U.S. Navy trainer replacement

Airbus Helicopters will offer the H135 as the solution for the U.S. Navy's planned helicopter trainer replacement program.

Westland Lynx retires at 40

STORY & PHOTOS BY ERIK BRUIJNS





The Westland Lynx entered service with the Army Air Corps (AAC) in 1978. Now, after 40 years of service, the Lynx is retiring and handing over its duties to the Leonardo Helicopters Wildcat. **Erik Bruijns** visits the Lynx retirement.

Since the Lynx entered service it has performed a variety of roles operating for both the Navy and the Army. It was used to kill tanks, perform humanitarian assistance and carry troops into battle during its 40-year service life. This helicopter has been the backbone of the British military, fought in every war since the Falklands and has been piloted by a prince. After a distinguished service career across the world with the British Army and Royal Navy, the Lynx helicopter is finally being retired.

Where it all began

Based at the Royal Air Force's Odiham site in Hampshire, Army Air Corps 657 Squadron is the last UK unit to employ the Lynx. The initial design (then known as the Westland WG.13) was created in the mid-1960s as a replacement for the Westland Scout and Wasp, and a more advanced alternative to the UH-1 Iroquois. As part of the Anglo-French helicopter agreement signed in February 1967, the French company Aérospatiale was given a 30 per cent production work share in the program with Westland performing the remainder. The British Army ordered over 100 helicopters under the designation of Lynx AH.1 (Army Helicopter Mark 1) to perform several different roles, including transport, armed escort, anti-tank warfare (with eight TOW missiles), reconnaissance and evacuation missions. Several land and naval variants of the Lynx have been produced along with some major derivatives. The Westland 30 was produced as a civil utility version of the helicopter, but it did not become a commercial success and only a small number were built

3 of the 4 Lynx helicopters turn left to head to the runway for their final flight leaving 2 additional examples behind - Erik Bruijns.



during the 1980s. An improved Lynx AH.1 with Rolls-Royce Gem 41-1 or Gem 42 engines and an upgraded transmission was referred to as the Lynx AH.5 - only five were built for evaluation. The AH.5 led to the Lynx AH.7, which added a new tail rotor derived from the Westland 30, a reinforced airframe, improved avionics and defensive aids.

The Army's last upgraded and skid-equipped Lynx AH.7s were retired in July 2015, leaving its extensively modernised AH.9As to serve on while its replacement Leonardo Helicopters AW159 Wildcat inventory was increased in size. The AH.9 variant was used as a utility version for the AAC, based on the AH.7, but with wheeled undercarriage and further upgraded gearbox. After its Rolls-Royce Gem-engined Lynx AH.7s performed poorly in the hot and high operating conditions of Afghanistan towards the end of the last decade, the UK Ministry of Defence initiated an urgent operational requirement to re-engine and extensively update the army's wheeled AH.9-variant. A contract worth approximately £130 million (\$175 million) was signed in late 2008, covering an initial 10 airframes. The final version in service, AH.9A was an AH.9 with upgraded Light Helicopter Turbine Engine Company (LHTEC) CTS800-4N 1,015 kW (1,362 shp) engines, which allowed the door-mounted general-purpose machine gun (GPMG) of the AH.7 to be replaced with a .50 calibre Heavy Machine Gun (HMG) as well as flight in hotter conditions. All 22 helicopters have been upgraded and were



AW159 Wildcat AH.1 ZZ403
lands in between trees
testing the pilots abilities and
concentration - Paul Ridgwell



The Army's last upgraded and skid-equipped Lynx AH.7s were retired in July 2015, leaving its extensively modernised AH.9As to serve on while its replacement Leonardo Helicopters AW159 Wildcat inventory was increased in size.

in active use with the AAC, with another four in storage. A small number were also used by the Fleet Air Arm, in support of the Royal Marines. Following the 2017 disbandment of the AAC's 9 Regiment at Dishforth in North Yorkshire, 657 Squadron retained up to 12 AH.9As, from the original complement of 22 upgraded examples.

Operational deployments

The first modernised AH.9A made its flight debut in September 2009, and the Army's lead examples were deployed to Afghanistan aboard an RAF Boeing C-17 strategic transport in May 2010. This was certainly not the first deployment of the Army lynx. During



With perfect winter light Lynx AH.9A ZG917 turns to head for the runway - Erik Bruijns

the Falklands War, the Lynx was equipped with the anti-ship Sea Skua missile. Two Lynx helicopters from HMS Coventry and HMS Glasgow attacked and badly damaged an 800-tonne patrol boat which managed to limp back to port. The Lynx also destroyed an Argentine cargo ship and a patrol boat. They were also used during the conflict in anti-submarine patrols.

During the First Gulf War, the Royal Navy Lynx also used the Sea Skua missile, attacking several fast attack craft and minesweepers. They were also responsible for damaging a landing ship. At the same time, the AAC used their Lynx helicopters in the Gulf as tank killers, equipped with TOW missiles. They were assigned the mission of locating and attacking Iraqi tank concentrations, and to support the advance of coalition ground forces into Kuwait and Southern Iraq during the 100 hours war phase of the conflict. On 26 February 1991, a Lynx of 654 Squadron AAC destroyed two MTLB armoured personnel carriers (APCs) and four T-55 tanks using TOW missiles: the engagement was the first recorded use of the missile by a British helicopter.

On 19 March 1994, during 'The Troubles' in Northern Ireland, the IRA brought down Lynx AH.7 ZD275 of the AAC with an improvised mortar, striking while it was attempting to land at Crossmaglen Army base. The pilot managed to crash land and the aircraft was destroyed, but all crew on board survived. Author Toby Harnden

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Lynx AH.9A ZF537 on
the ramp at RAF Odiham
- Erik Bruijns





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described the incident as the IRA's most successful operation against a helicopter.

Various British Lynxes were used during the NATO intervention in the conflict between Serbia and Kosovo, later known as the Kosovo War. They were frequently employed to supply NATO forces inside the theatre, including those engaged in humanitarian operations. In June 1999, the type was employed to escort British ground forces being air-deployed into Kosovo via Chinooks, during NATO's first phase of deployment. For many years, British Army Lynx and Gazelle helicopters were deployed within Kosovo, performing reconnaissance and transport duties in support of the stationed NATO peacekeeping forces.

In September 2000 two Army Air Corps Lynx helicopters were sent to Sierra Leone as part of a mission to rescue a platoon from the Royal Irish Regiment who had been captured by the West Side Boys in an operation involving the SAS and the Parachute Regiment. The two aircraft were used to strafe a village held by the gang while ground troops rescued the five soldiers who were being held prisoner.

In March 2003, the Lynx formed the bulk of the deployed British





Maj. Peycke, the Commanding Officer of 657 Squadron, poses in the lead aircraft just before the final flight - Erik Bruijns

rotary aviation battle group in the invasion of Iraq. Participating aircraft were quickly outfitted with engine sand filters, armour, heat dissipaters, modern secure radios, and radar warning receivers. In the subsequent multi-national occupation force, a flight of either AAC or Royal Navy's Commando Helicopter Force (CHF) Lynx AH.7s were based at Basra International Airport under command of the Joint Helicopter Force (Iraq) on a rotational basis. In theatre, they would escort infantry patrols, perform aerial reconnaissance, provide fire support and act as airborne communications hubs. Performance issues were encountered in the high temperature environment, often operating with no power reserve and thus no ability to overshoot during landings; these were belatedly resolved by the introduction of the Lynx AH.9A.

In 2006, the first Lynx AH.7 was deployed to the Helmand Province, Afghanistan. This variant would only be subsequently used during winter months due to the performance limitations imposed during the high summer temperatures. The Lynx AH.9A, which deployed first in 2010, was praised as having been a substantial performance improvement. On 26 April 2014, Lynx AH.9A ZF540 of the AAC, crashed near Kandahar Airfield in Afghanistan, killing the 3 crew and 2 passengers on board. This was the first fatal accident in the conflict involving a British military helicopter and the third largest loss of life of British troops in a single incident in Afghanistan since 2001.



Bidding farewell

The final Lynx squadron decommissioned its aircraft at the end of January 2018. To mark this occasion the Army Air Corps flew four of the last remaining Lynx helicopters on 16 January from RAF Odiham in Hampshire on a commemorative tour in a final salute to the aircraft. Speaking before they departed, Major James Peycke, the Commanding Officer of 657 Squadron, was flying the lead Lynx in the formation. He said; “Bidding farewell to the iconic machine’ is a huge moment for everyone who has flown the Lynx over the years. It is hugely emotional saying goodbye to the Lynx after six years of flying, and it carves out a big chunk of your heart”. Describing the aircraft as ‘hugely manoeuvrable’, Maj Peycke mentioned there is ‘never a dull day when you are flying’ one.

The four Lynxes lifted off to thunder around the UK’s skies one last time, taking in sites and locations including Yeovil, Middle Wallop, Upavon, and Shawbury before also flying in formation, along the length of the River Thames in central London. All locations were chosen due to their specific importance to the aircraft and their pilots. Yeovil for the presence of the Westland (nowadays Leonardo Helicopters) factory, where the Lynx was built. Shawbury for the place where all Lynx pilots went through their pilot training. When pressed on how he will feel as the wheels touch down for one of the final times at RAF Odiham, Maj Peycke said it would be an ‘incredibly emotional moment’. “Not only does

it mark the out-of-service date for the Lynx, the 75th anniversary of the squadron (657) which was formed in 1943, but also the closure of the squadron (in May) and the end of my tour as an officer commanding, so it will be an incredibly emotional moment, particularly as we come back in - I'm probably going to have a lump in my throat", he added.

Staff Sergeant Nathan Sharples, joining the formation as the co-pilot in the lead Lynx, when asked if the helicopter being decommissioned is a loss, said; "it is not. Things need to progress, and it is now 'time for the old girl to retire'. "She has served us proud throughout the years", added the 34-year-old, who has only ever flown the Lynx.

Air Trooper Toby Tibbitts, a ground crew specialist, who has been in the military for two-and-a-half years, said; "This is my first and only squadron I have been assigned to so far, and seeing the Lynx go is a 'sad day' but a proud one". Quizzed about his favourite moment involving the helicopter, he said; "fast roping out of a Lynx over a desert was a 'pretty special experience' and one I will not forget any time soon". He said the replacement Wildcat 'seems like a good aircraft', and that, with the positive trials and exercises, plus upgraded avionics and engines, the 'future is looking bright'.

The Ministry of Defence is replacing the Lynx with Apache gunships and the Leonardo Helicopters Wildcats. The Wildcat has been deployed with the Royal Navy on board frigates, where it is used for anti-ship and anti-submarine operations. The Wildcat can also be used to provide air support if the navy has to board another vessel, such as intercepting suspected drug traffickers.

Enter the Wildcat

As far back as 1995, the British Government announced that the Royal Navy's existing Westland Lynx helicopters were to be replaced; at that point, the service was intended to operate an all-Merlin fleet. Westland Helicopters continued to hold talks with the Ministry of Defence (MOD) to find a future role for the type during the late 1990s. In 2002, the Future Lynx project originated in two studies to determine the suitability of a derivative of the Super Lynx 300 to replace the existing Lynx helicopters of the Royal Navy and British Army. These requirements were known as the Surface Combatant Maritime Rotorcraft (SCMR) and Battlefield Light Utility Helicopter (BLUH) programmes.

In July 2002, AgustaWestland received a contract to conduct a formal assessment phase of the Future Lynx. On 22 July 2002, a collaboration agreement was signed between AgustaWestland and Thales Group, under which Thales was assigned development responsibility for the programme's core avionics, including communications, navigation, and flight management electronics. By April 2003, the in-service dates for the BLUH and SCMR programmes were reported as being April 2007 and April 2008 respectively.





The sun rises for the last time after a remarkable career - Erik Bruijns

The new version would adopt a glass cockpit, incorporating electronics upgrades from the AgustaWestland AW101 along with various airframe improvements, such as a redesigned tail rotor and nose, as well as an increased use of machined components over fabricated counterparts. By July 2004, the option of upgrading and remanufacturing the first-generation Lynx had reportedly been judged to be uneconomical, and the BLUH programme of building a new generation airframe was given the preference. Ultimately, the utility transport aspect of the BLUH requirement was de-emphasised and the programme renamed Battlefield Reconnaissance Helicopter (BRH).

By late 2007 a £1 billion contract for 70 Future Lynx helicopters had been signed and the Future Lynx was scheduled to enter service with the British Army (40 aircraft) and Royal Navy (30 aircraft) in 2014 and 2015 respectively. Due to the ever-changing economic situation and budget cuts also in the British government a complete cancellation of the programme was considered. In December 2008 the Ministry of Defence (MoD) announced that the main contract would be proceeding, only incurring a minor cut in numbers set to be procured, for a total of 62 aircraft (34 for the Army and 28 for the Navy). By April 2009 the new helicopter had been designated the AW159 by AgustaWestland and would be known in British military service as the Wildcat. While the AW159 shares broad similarities in appearance to the Lynx, it has significant design differences and is heavily modernised and adapted to gain new attributes and functionality. The AW159 comprises 95% new components. The remaining 5%, consisting

of such items as the fuel system and main rotor gearbox, are interchangeable with the Lynx AH.9 and HMA.8 variants. With the official retirement of the Lynx at the end of January, the last airframes were put in storage, so the useable components could be extracted for future use on the Wildcat. Next to being designed inside an entirely digital environment, the Wildcat also supports a tail rotor that has been redesigned for greater durability and stealth qualities, bringing it completely up to date with the latest technology.

The AW159 is powered by two 1,362 hp (1,016 kW) LHTEC CTS800 turboshaft engines which drives the rotorcraft's BERP IV rotor blades via a new transmission, increasing the maximum take-off weight by more than 1 ton over the legacy Lynx AH.9. Many elements of the AW159's avionics are provided by Thales Group. The type is reported to possess significant ISTAR capabilities and improved situational awareness, achieved through its onboard integrated digital open systems architecture. The Wildcat features an increased payload and range over the legacy Lynx. It can carry either the Future Anti-Surface Guided Weapons Light, like the Lightweight Multirole Missile (Martlet), or the Future Anti-Surface Guided Weapons heavy, like the Sea Venom. A Wildcat can carry four launchers each with five Martlets. The type can perform aerial reconnaissance, anti-submarine warfare (ASW), anti-surface warfare (ASuW), utility, fire control, command and control, and troop transport duties.

On 12 November 2009, the first Lynx Wildcat conducted the type's maiden flight from AgustaWestland's facility in Yeovil, Somerset. The first production Wildcat was received in May 2012 by the Army, while the Royal Navy received their first airframe at the end of 2013. In July 2012, the Wildcat conducted its first public display at the Farnborough Airshow. At the event, Defence Secretary Philip Hammond stated that the "Wildcat represents a considerable advance over the current Lynx helicopters, bringing greatly improved performance and capability". On 29 August 2014, the Wildcat AH.1 formally entered service with the Army Air Corps. On 23 March 2015, the Royal Navy's first Wildcat HMA.2 began its initial operational deployment at sea onboard HMS Lancaster. With the great success of the legacy Lynx, the Wildcat has big shoes to fill. With the new technology that has been integrated in the new aircraft, new possibilities and new mission will arise and existing missions will be more efficient to be executed. Integration with other military platforms is made much easier and will enable the British military to the maximize the capabilities of the new technology. ■





HEAVY-LIFT FACE-OFF

STORY BY ALEX MLADENOV

The heated-up German fast-track/low-risk heavy-lift procurement drive is set to replace the aging license-produced fleet of Sikorsky CH-53 Stallions with a far more capable off-the-shelf helicopter type. The official announcement of the Berlin plan to buy new heavy-lift rotorcraft was made in mid-December 2017 and the expected release of a request for proposals (RfP) is in late 2018 or early 2019. The contract award is now slated for early 2020, with initial deliveries to the Bundeswehr (German Armed Forces) expected to begin in 2023.

The formal procurement process of the Schwerer Transporthubschrauber (STH) program was started with an authorization by the German government of the BAaINBw (the Federal Office of Bundeswehr Equipment, Information Technology and In-Service Support) defense acquisition agency to begin the works related for the preparation of the RfP document.

The STH represents, in fact, the first head-to-head competition between two US-built designs – Boeing’s CH-47F/extended range Chinook and Lockheed’s CH-53K King Stallion, built by its subsidiary Sikorsky Aircraft. Both manufacturers, competing for the lucrative German contract, presented their aircraft to the Bundeswehr at the ILA Airshow in Berlin in the end of this April. They spent a lot of efforts at the show to win

the hearts and minds of the German military, and also select weighty and resourceful local industrial partners to increase the chances to win the hotly contested competition. These local partners would be contracted to provide life-cycle maintenance, support and training, while the OEM, acting as a prime contractor in the deal, will supply the hardware only.

Boeing and Sikorsky were busy at the ILA Airshow touting the benefits of their helicopter offerings to the Germany military in an effort to exercise influence on the decision for a replacement for the existing CH-53G/GA/GS fleet. Boeing has emphasized the availability and success of the 22.4-tonne Chinook, while competitor Sikorsky claimed the weighty advantage of the new technologies inserted into the 33.6-tonne CH-53K such as the fly-by-wire controls, high payload, low maintenance



The German requirement calls for replacing an aged inventory of 72 CH-53G-series heavy-lift with 40 new-generation machines plus an option for 20 more. This is a CH-53GS version upgraded for combat search and rescue operations. (Alex Mladenov)

requirements and the long-time experience with Germany. The Bundeswehr purchased the CH-53D Sea Stallion back in the early 1970s and the type is still in widespread operation which is set to continue until the late 2020s.

The German MoD's STH requirement, which has been articulated in public for the first time in the late 2000s, covers the direct purchase of as many as 60 helicopters and is seen as one of the biggest military helicopter purchases this decade in Europe. The latest plan of the Bundeswehr calls for the purchase of 40 helicopters as replacement of its existing CH-53 fleet, plus options for 20 more.

The estimated price of the new helicopters and their support and training package is between US \$3.7 and 4.9 billion. The new heavy-lift rotorcraft will perform the same set of roles at those currently assigned to the existing CH-53G/

GA/GS fleet, including the tactical air transport of troops and military equipment in addition to Combat SAR (CSAR) and special operations support. There are also some extra requirements to the new type such as in-flight refueling capability from KC-130J Hercules tankers slated to be purchased by Germany and operated jointly with France.

Local partners selected

The two largest US defense companies are competing head-to-head for the STH contract, with Lockheed/Sikorsky offering to sell its brand-new King Stallion model on a Foreign Military Sales (FMS) basis, in a configuration exactly the same as that developed for the US Marine Corps. German company Rheinmetall Defence has agreed to be



Following an upgrade currently undertaken by Airbus Helicopters, 26 CH-53GA/GS produced in the 1970s, are set to continue operation with the Luftwaffe until about 2030. (Alex Mladenov)

the main local partner, involved in the training, support and sustainability of the fleet. The list of the other local partners includes ZFL, Autoflug, Hydro, Rockwell Collins Germany, Jenoptik, Liebherr and Rohde & Schwarz. Another important member of the Lockheed-led team is the German defense electronics company Hensoldt. The German company MTU Aero Engines also joined the CH-53K team, planned to provide maintenance, repair and upgrade services for its engines.

Boeing, in turn, has now in place agreements with a big list of German equipment and training specialist suppliers such as ERO-Bildungs, Aircraft Philipp, CAE Elektronik, COTESA, Diehl Defence, Honeywell, Liebherr-Aerospace, Reiser Simulation and Training, Rockwell Collins, and Rolls-Royce. They will be partnering with Boeing for long-term support and training services of the STH program, including maintenance, aircrew and technical training, research and development efforts, and undertaking supply chain enhancements. According to Michael Hostetter, Boeing's director for vertical lift programs in Germany, speaking at ILA Airshow on 25 April, there is no option of setting up a Chinook production line in Germany because this approach would be incompatible

with the customer's chief requirement to get a low-risk, off-the-shelf STH solution.

CH-53K's performance advantage

Making its international debut at the ILA Airshow in Berlin, the King Stallion has been promoted as a next-generation airlift and the most powerful helicopter US has ever built. Attendees at the show saw how the CH-53K can hover and fly backward with minimal hands-on control from the pilot, thanks to its advanced fly-by-wire system.

Externally similar to the CH-53E, the CH-53K will replace in US Marine Corps service. The mighty King Stallion is, in fact, a completely new aircraft under the skin. No doubt, it boasts a serious advantage in the raw lifting power, while the Chinook is expected to be a cheaper solution in the Bundeswehr's STH competition. The average unit price of the US Marine Corps King Stallions is going to be about \$87 million, according to Col Hank Vanderborght, the US Marine Corps CH-53K program manager. This, however, would be 1.5 to 2 times more than the Chinook, while



The CH-53K King Stallion is a general redesign of the 1970s-vintage CH-53E Super Stallion with a major increase in the overall capability and drastically lowered maintenance requirements. It demonstrated a 36,000lb (16,333kg) payload and has much improved hot-and-high performance. (Alex Mladenov)

operating costs are also likely to be higher due to the CH-53K's three-engine design compared to the twin-engine CH-47. Export orders are expected to help to lower the per-unit cost so the price could drop seriously should Germany, Israel and Japan all decide to buy the three-engine type. Col Vanderborght and Sikorsky's vice president of Marine Corps systems Michael Torok believe that Germany is the nearest term opportunity as the launch international customer, while the next one would be Israel, which currently operates a fleet of 23 highly-upgraded CH-53s.

They maintain that the performance advantage means that the King Stallion is capable of hauling larger loads, up to 15 tons on external sling, without the need for future airframe structural reinforcements. In contrast, as Lockheed/Sikorsky sources claim, the Chinook costs would increase if Boeing has to meet this requirement. Another serious advantage, touted by the Lockheed/Sikorsky sales team, is that the CH-53K boasts near-commercial levels of reliability thanks to the advanced onboard monitoring system; making the aircraft very

competitively pitted against the Chinook despite the initial spike in investment. In addition, Lockheed/Sikorsky sources claimed that the CH-47 carries less, so it would take more flights to accomplish the same mission compared to the CH-53K.

The King Stallion successfully demonstrated lifting of a 20,000lb (9,071kg) load on external sling on 26 May 2018, and the further testing are set to demonstrate lifting of a 27,000lb (12,250kg) payload test while its useful load (fuel and cargo) is 39,103lb (18,100kg). Initial operational capability with the US Marine Corps, defined at four aircraft operational in addition to all the necessary infrastructure and training in place, is expected in 2019.

The CH-53K features triple redundant fly-by-wire flight control system, and advanced corrosion-resistant composites, while the sheer power reserves allow it to fly missions in extreme temperature conditions at an altitude of up to 9,840ft (3,000m). It comes powered by three GE Aviation T408 turboshaft engines, each rated at 7,500shp (5,600kW). In combination

The CH-47F is being promoted by Boeing as a combat-proven and cheaper machine, with a fair future growth capability offered by Block 2 and 3 upgrades considered by the US Army for its existing Chinook fleet to keep it flying until the 1960s. (Alex Mladenov)



Heliops

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AIRBUS OUT OF THE GAME

Europe's aerospace giant, Airbus, which does not have a helicopter big enough to satisfy the Bundeswehr's requirements, has been looking for ways to get involved in one form or another with a significant workshare with both competitors for the STH programme. In doing this, it has challenged the German MoD helicopter procurement plans, arguing that local aerospace companies should get a significant share of the maintenance and management of the STH, a serious business that will run for decades. That is why Airbus planned to get involved and requested splitting the programme into two parts in a bid to secure its fair share in the lucrative deal. While hardware delivery could be by the OEM, the long-term support and sustainment work of the newly-purchased helicopters was to be awarded to Airbus according to the company's suggestion. The German MoD, however, pushed back, saying it would be too unwieldy to proceed with separate production and sustainment contracts for the long-overdue mega-project, which would render it much more complex.

Prior to the launch of the STH in its current form, Airbus Helicopters (then known as Eurocopter) had been contracted to study a potential European solution to the Bundeswehr requirement to replace the existing CH-53 fleet. One of the projects studied at the time in the 2000s called for a tandem helicopter to be design together with Boeing. Offered in 2010, it was to fulfil a joint requirement of Germany and France for a heavy-lift rotorcraft with initial operation capability promised for 2018 and an expected production run of 120 units. The concept offered, in fact, a scaled-up CH-47 Chinook featuring a widened cabin suitable for internal carriage of combat vehicles and equipment instead of their transportation on external sling in a bid to avoid performance limitations and boost battlefield survivability. Using four-bladed tandem rotors, its maximum gross weight was to be increased to around 79,344lb (36,000kg) and the proposed rotorcraft featured a fuselage that was stretched by 16ft (5m) compared to that of the CH-47. The project, however, was shelved, due to the lack of a budget for the rather expensive design, development and testing works associated with it.

with the advanced rotor system, the three-engine powerplant provides a maximum forward speed in excess of 200kt (370km/h), already demonstrated in flight tests. Among the other recent achievements of the CH-53K's flight-test programme are the maximum weight on the single centre point cargo hook of 36,000lbs (16,333kg), 60-degree angle-of-bank turns, 12-degree slope landings and take-offs, external load auto-jettison, and gunfire testing. Lockheed/Sikorsky advertised the three-engine King Stallion as being capable of easily lifting an external load of more than triple the external load-carrying capacity of the Bundeswehr's existing CH-53G/GA/GS twin-engine version.

CH-47's interoperability and costs pros

The list of the advantages of the Boeing's twin-engine tandem-rotor machine is dominated by the fact, that the Chinook is a mature and war-proven helicopter with an up-and-running production line, which delivers new CH-47s for

the US Army and international customers at a rate of three per month. This would minimize the risk and cost for the German military. Boeing's Hostetter also adds that the Chinook is a modern, proven and reliable heavy-lift helicopter with a high availability rate and low maintenance requirements. To date, Boeing has delivered more than 900 H-47 Chinook helicopters worldwide and the type has established a dominance at the heavier end of the military rotorcraft market in the Western world.

In contrast to the still unproven in front-line service CH-53K, so far ordered only by the US Marine Corps and likely to be ordered by the Israeli military, the combat-proven CH-47 is already in widespread operation with no fewer than eight other NATO member states - USA, the Netherlands, Canada, Greece, Italy, Spain, Turkey and the UK. Thus, one of the main advantages, claimed by Boeing is that in case of Chinook selection, the Germany military will get "interoperability that other helicopters cannot".

Boeing's Hostetter touted that the Chinook would provide a proven and reliable, and also extremely affordable platform for the German



BUNDESWEHR'S CH-53 STORY

The German military association with the faithful Sikorsky CH-53 dates back to 1966 when then West Germany undertook evaluation of the type. In a repetition of the current competition, it was pitted against the CH-47A Chinook in a tender to replace both the Piasecki H-21 and Sikorsky H-34G. Two CH-53D Sea Stallions were purchased through US Navy and then 110 more helicopters were built in Germany. 20 of these were Sikorsky-built machines by using kits and 90 more were manufactured by local company VFW-Fokker. The first CH-53s entered Bundeswehr service in 1972. Operated throughout most of its life by the Heeresflieger (German Army Aviation), in 2013 the entire CH-53 fleet was transferred to the Luftwaffe (German Air Force) and by 2015 the number of helicopters in active service was 78. Since 2010 the type has been cycled through an extensive upgrade program which covered 82 aircraft, with main contractor Eurocopter. 48 of these, re-designated as CH-53GA, were outfitted with new digital flight-/navigation avionics, glass cockpit, new automatic flight control system, four-axis autopilot, electro-optical payload, self-defense equipment, obstacle warning system, an additional fuel tank in the cabin and improved communications equipment including satellite communication radio. The structural enhancements and rewiring extended the airframe service life from 6,000 to 10,000 flight hours. The additional internal fuel tank extended the helicopter's range to 647nm (1,200km). The GA upgrade program was completed in 2017.

The Luftwaffe fleet also includes 25 CH-53GS combat search and rescue helicopters, upgraded for operations in Afghanistan. They feature Kevlar armor plating, new and more powerful engines, improved navigation system with GPS receiver, helmet-mounted NVGs, external fuel tanks, night vision fittings, defensive systems (with laser and missile warners and chaff/flare dispensers), optronic system and upgraded wiring/airframes.

Currently, the 72-strong fleet German CH-53G/GA/GS heavy-lift helicopters has been suffering from serious availability issues. On average, 40 helicopters were available at any time in 2017, of which 16, or 40%, were considered to be deployable machines. The material readiness of the CH-53 has become increasingly age-affected, according to the German MoD report, which noted the lack of spare parts for the fleet. Five CH-53s were deployed to Afghanistan during 2017, which were the priority for spares delivery, creating additional shortfalls in pilot training and maintenance personnel back in Germany.

Airbus Helicopters holds a contract to deal with fleet obsolescence issues, covering a limited avionics upgrade of 26 CH-53GA/GS. The prototype with the upgrade avionics package is set to take to the air for the first time in mid-2018 and the whole project is slated for completion by 2022. The implementation of the project should allow to keep the CH-53GA/GS fleet in flightworthy condition until 2030.

In the Bundeswehr's large-scale procurement program, the Sikorsky's CH-53K is pitted against another US-made helicopter, the highly-successful Boeing CH-47F Chinook, seen here in the background. (Alex Mladenov)



military, on time and at a very competitive cost. The company intends to offer either the standard CH-47F model or the extended-range MH-47G version. The offered variant is going to be equipped with an in-flight refueling system, which is in the list of the key Bundeswehr requirements. The specific configuration for the STH competition will be frozen after the release of the final RfP. Hostetter also hinted that Boeing could offer a lead time for delivering aircraft from its Philadelphia Chinook production line of 36-40 months.

Chuck Dabando, Boeing's Chinook program manager, said that the cabin volume offered by his helicopter is almost the same (compared to that of the CH-53K) and the CH-47 is able to lift many of the same payloads. While the Chinook is mature product, he claimed, the CH-53K comes very expensive in comparison. Dabando also highlighted the Chinook's multi-mission capability, 100% power availability and side wind stability with no tail rotor tandem design layout.

Powered by a pair of Honeywell T55-GA-714A turboshafts, each rated at 4,733shp, the CH-47F – the latest derivative of a 1961 tandem-rotor design – has a maximum gross weight of 50,000 lbs (22,680 kg) and useful load of 24,000 lbs (10,886 kg), including 33 to 55 troops,

while its maximum speed is 170kt (302km/h).

According to Boeing officials, if selected, the Germany military could also be an early beneficiary of the CH-47's Block 2 upgrade, featuring new advanced design composite rotor blades, an improved drive train, single sponson fuel tanks and strengthened aft, pylon and nose sections. The upgrade will increase the maximum gross weight from 50,000lb (22,680kg) to 54,000lb (24,500kg) and also foresees design changes to the main rotor blades, cabin floor loading system and fuel tanks plus a larger aft section to accommodate a new engine in the future (to be added during the so-called Block 3 upgrade phase). Additionally, the fuselage's structure is being strengthened in critical areas to allow the aircraft to carry additional payload. US Army plans call for delivering no fewer than 542 Block 2 Chinooks (retrofitted from existing CH-47Fs and special operations MH-47Gs) between 2023 to the 2040s. In May 2017 Boeing announced that it could make CH-47 Block II helicopter renewal available to international customers in 2026, but now it looks set to grant it to the Bundeswehr three years earlier. The US Army plans to continue operating the faithful Chinook fleet – after applying Block 2 and Block 3 upgrades – well into the 2060s. ■



The CH-53K King Stallion is the end result of the advance made by Sikorsky during 50 years of manufacturing and operation of its family of heavy-lift helicopters including CH-53A, CH-53D/G, and CH-53E. (Alex Mladenov)



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How Long has the “Conventional” Helicopter Got?

In this article of two parts,
Paul Kennard ruminates on the
future of the conventional helicopter
in face of the new technologies that
now maturing or under development.



Ahhh, the life of an independent consultant. I write this article sat next to the harborside in Helsinki, Finland, where I have been attending a meeting of the NATO Industrial Advisory Group (NIAG) committee. The sun is warm, and the beer is cold (though expensive!). I've been asked to attend to present a short out-brief to the committee on the results of the recently completed study into what a Next Generation Rotorcraft (NGR) should be able to deliver in terms of capabilities and platform attributes. The timing is prescient; the "traditional" concept of vertical lift is being challenged like never before, and from across the spectrum. The USMC and AFSOC have now fully

adopted the V-22 Osprey, with the USN about to introduce the type as a COD aircraft. Export orders for the V-22 family are finally starting to materialise as confidence in the design increases and the unit price starts to fall. The US Army is eagerly anticipating the full flight envelope demonstrations of the FMR/JVL project contenders, whilst Leonardo Helicopters continue to make progress towards the certification and initial deliveries of the AW609 civil Tilt-Rotor. At the other extreme of the scale in terms of speed, size and payload, there is a resurgence in the interest in lighter than air or hybrid lift vehicles. Finally, the seemingly inexorable "rise of the machines" threatens to undermine the role of the manned helicopter as automated flying systems, mostly vertical lift in nature,







increasingly target some of the core roles currently delivered by conventional rotorcraft. Therefore, with challenges from all quarters, is it time to think the “unthinkable”? Does the conventional helicopter have a long-term future, or will it slowly drift into technical, commercial and societal obsolescence?

What’s a “Conventional Helicopter”?

It’s always best to start with some definitions. For the purposes of this article, a “conventional helicopter” is defined as a manned vertical lift platform using rotor blades that operate “edge-on” to the relative air flow in order to generate lift. This definition makes no distinction between a single rotorcraft with a tail rotor and other, more esoteric, designs such as tandem rotor (Chinook), coaxial rotor (KA-52) or “synchrocopter” (K-Max). These designs all exploit the advantages and suffer the shortcomings of their “edge-on” characteristics. The advantages are best seen in the hover and low speed regime; the rotor area

can be tailored to minimise disc loading or to maximise vertical lift potential. Controllability in the hover can be “dialed in” in a similar manner by a combination of hub and rotor size. The technologies used are, in the main, well understood and now considered “low risk”. Improved material science continues to make incremental gains in performance and efficiency, as do innovative blade designs, such as the UK BERP (British Experimental Rotor Programme) and the US Army’s ACRB (Advanced Chinook Rotor Blade) projects. However, one cannot help but feel that, increasingly, the outright gains being achieved are increasingly smaller, and the costs increasingly high to obtain them. Therefore, in business terms, the return on investment is diminishing.

The single biggest factor that hampers the “edge-on” designs is that of forward speed. There is an absolute limit that an airfoil can achieve in forward flight before it hits the “transonic zone” and starts to suffer the factors associated with “compressibility”. These factors include a sharp increase in drag and, ultimately a change in the location of the centre of pressure of the airfoil section.





The increase in drag requires more power to overcome, remembering that drag increases at the square of speed – i.e. doubling the airspeed will quadruple the drag and, hence, the power required to drive the airfoil at the same speed increases accordingly. If the advancing blade enters the “transonic zone” then the chances of a centre of pressure shift increase. Such a shift could cause imbalance and vibration through the rotor system. Although the measurable effects of compressibility start at a relative airflow of about 300 knots, appreciable impacts of forward flight typically start to manifest themselves at around 450-500kts. As an example, the rotor system on the CH-47 turns at 225 RPM (100%) in normal flight conditions. As the blade is about 30 feet, the tip path is travelling at approximately 400kts, whereas the speed of sound at sea level (Mach 1) is about 670kts. Therefore, if the Chinook is flying at 160 kts, the blade tip is only moving around 100kts less than Mach 1. Clearly, the blade tip

creates little lift, but the effect is still present, albeit diminishing, through the span of the blade (as the angular speed reduces nearer the hub). The point at which the blade section enters the transonic region is known as the Critical Mach Number (M_{Crit}) and is normally around the M0.72 figure for a standard airfoil. BERP/ACRB can increase this figure to M0.75, but as the helicopter continues to accelerate, eventually, the power required to go faster is prohibitive and max forward speed is reached. The other potential danger of high forward speed is retreating blade stall, where the rotor disc cannot balance the lift being generated by the advancing blade with the loss of lift on the retreating blade, which stalls trying to achieve the symmetry of lift required for stable flight. This manifests itself in a, sometimes violent, un-demanded pitch up and roll towards the retreating side – which can cause loss of control or structural damage.

As a consequence of this restriction in



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forward speed and the inefficient thrust direction generated by a “edge-on” rotor, range is often as compromised as speed. These factors limit the missions that can be achieved by a conventional rotorcraft or cause the crew to trade payload for fuel. It was this combination of limitations that gave rise to the concept of the tilt-rotor, or, as the Federation Aeronautique Internationale (FAI) define it, a “convertiplane”, which is an aircraft that uses rotor power for vertical take-off and landing and converts to fixed wing lift for normal flight.

The Tilt-Rotor / Tilt - Wing; Helicopters, the Next Generation?

The conventional helicopter’s forward speed limit has long been recognised as an issue. A number of experimental “convertiplanes” were flown in the 1950s and 1960s, but the lack of computer power to design and control them led to the concept falling into abeyance. The advent of “fly by wire” flight control systems in the last part of the 20th Century permitted the design,

manufacture and production of a number of small tilt wing / tilt rotor demonstrators.

The lessons identified, and knowledge acquired allowed Bell/Boeing to develop the V-22 which, after a lengthy gestation period marred by technical and political difficulties, is now in front line service in considerable numbers. The tilt rotor (where the rotors move separate to the wing) and tilt wing (the whole wing, including engines/rotors tilts) enables the aircraft to attain much higher forward airspeeds as the blade is only “edge on” to the airflow in the hover and low speed regimes – the rotors are rotated forward as the aircraft accelerates, taking advantage of the increasing lift generated by the wing, until they are facing fully forward in the direction of travel, akin to a turboprop. This arrangement enables the aircraft to achieve a far higher forward speed as, in the cruise, the rotor is acting like a conventional (though oversized) “tractor” propeller. The combination of speed, power and wing area enables the convertiplane to achieve and sustain higher operating altitudes – giving the crew the option







to fly over low-level weather/turbulence or to exploit high altitude winds and a favourable IAS/TAS conversion to enable vastly increased range. For example, with a modest increase in fuel capacity, the COD version of the V-22 is capable of delivering a meaningful payload out to 1500 miles offshore, a range outside the reach of a helicopter without in-flight refuelling and, potentially, a punishing 10- to 11-hour transit. Increased height also improves survivability – helping the aircraft stay out of range from Small Arms, RPGs and most MANPADS, and the ability to rotate the wing/nacelles quickly permits rapid acceleration to make optical tracking hard, whilst, in the cruise, the wing/rotor arrangement makes it easier for the aircraft to sustain high “g” forces than a conventional aircraft, permitting more aggressive manoeuvring to counter threats.

However, it’s not all good news for the convertiplane. What it gains at the high end of the speed range, it tends to lose in the hover / low-speed regime. The rotor diameter is a compromise between the need to enable

vertical lift (where disc area is important for “lifting surface”) and the need to minimise the rotor length to provide less aerodynamic resistance in forward flight and, more prosaically, to keep the wingspan to a practical minimum whilst keeping the rotor tips a safe distance from the fuselage when they are in “propeller” mode. The usual outcome of these conflicting requirements is a short rotor disc of somewhat thick chord. This results in a few unwelcome side-effects. Firstly, the rotor downwash can be extremely powerful. Downwash is a function of weight and disc area; the V-22, for example, is a heavy aircraft and is arguably “under-rotored” in the hover. Operations under the aircraft (Underslung Loads and personnel winching for example) are made more difficult by the high downwash, and crews have to be wary of causing physical damage to structures, or of blowing objects and causing harm to third parties on the ground. The small rotors also make “conventional” autorotations problematic – there’s simply not a large amount of blade area nor high rotor inertia to reduce



both the auto-rotative descent, nor cushion at the bottom. The V-22, therefore, uses a hybrid technique using the lift generated by the wing and the rotors at an optimal angle, designing the blades to separate on impact in a safe manner.

The V-22 has also struggled to provide adequate self-protection when decelerating into landing sites. The rotors in the forward position, or whilst transitioning back to hover mode, severely restrict the ability for door gunners to provide coverage and protection in the forward arc. This was recognised at an early stage of the V-22's development, and a co-pilot controlled chin-mounted weapon system was envisaged but discounted on cost/weight grounds. Once in service, this shortfall was partially ameliorated by the introduction of the BAE Systems AWG-35 "Remote Guardian" Defensive Weapon System (DWS), that provided a belly mounted retractable GAU-17 7.62mm mini-gun remote operated by a weapon station in the fuselage and targeted by an EO/IR sensor, also deployed from the belly of the aircraft. Although answering a question, the DWS does not seem to have been widely deployed as it

compromises both payload and troop-carrying capability. More recently, in a further attempt to solve the "front hemisphere" issue, the V-22 has been tested with cheek mounted rocket launchers, capable of firing 2.75" unguided rockets, BAE Systems Advanced Precision Kill Weapon System (APKWS) guided rocket and the new AGM-176 "Griffin" guided missile.

The final hurdle that the V-22 has to overcome is the excess weight and complexity of both the drive mechanism and the need to fold the aircraft for its primary customer, the USMC, to fit aboard their amphibious assault ships. Weight is the mortal enemy of vertical lift, whilst complexity adds cost, technical risk and a maintenance penalty.

Hybrid Air Vehicles; Back to the Future?

At the completely opposite end of the vertical lift spectrum is the apparent resurgence of interest in Hybrid Air Vehicles (HAVs) that exploit the lift potential of





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lighter than air flight, combined with clever computer designed airfoil shapes. The wars in Afghanistan and Iraq, as well as the needs for the Natural Resources industry, have stimulated a renaissance in interest in these gas-filled machines. The fundamental difference between a HAV and a traditional airship is that the former is, technically, not lighter than air. Though much of the lifting performance is provided by buoyancy generated by cells filled with (thankfully inert.....) helium gas, the aircraft are actually heavier than air and require engine thrust and airfoil sections to take off and maintain flight (up to 40% of the lift generated is produced by the airfoil shape). This, in theory, leads to easier ground handling as the HAV should “sit” without the need for a network of mooring masts. Moreover, by eschewing conventional landing gear (wheels/skids) in favour of air cushions, HAVs can land on prepared sites, rough terrain and even on water. In relatively high winds, engine thrust

can be directed to positively “push” the vehicle onto the ground.

There are currently two main players in the HAV development business, Lockheed Martin in the US and Hybrid Air Vehicles in the UK. The former has flown a sub-scale demonstrator and are now in the throes of designing a full-size example. Hybrid Air Vehicles, however, have been flying their development aircraft, the “Airlander 10”, for a number of years. The Airlander 10 is the output from an aborted US Army programme, LEMV (Long Endurance Multi-Intelligence Vehicle), where Northrop Grumman were the Prime contractor tasked with delivering a long-duration sensor carrying capability to support operations in Afghanistan. A combination of technical delays, changing requirements and sequestration, led the US Army to cancelling the program after just one 90-minute flight. Hybrid Air Vehicles bought back the lift vehicle (Northrop Grumman owned the mission kit) and have rebranded it the





Airlander 10. Notionally, the "10" represents the maximum payload – up to 10 000Kg. This figure compares favourably with the CH-47, but the Airlander can also remain airborne for 5 days. A combination of crew, observers, sensors and fuel could see the Airlander 10 conduct a traditional helicopter task such as police surveillance or news broadcasting for longer periods, with more space/mission power and at a cost per flight hour considerably less than a helicopter. The ability to move single, outsize but heavy items also starts to impinge upon the role of the lift helicopter, particularly in the civil world where there are not many CH-47s / CH-53s to compete with.

Where the HAV really scores over the helicopter is in scalability. The next "step" on the Airlander plan is for the "Airlander 50" with a proposed "disposable payload" of 50 000kg. In the realm of helicopters such a leap is highly problematic in terms of engine power, rotor systems and structural weight – not to mention acquisition and operating costs. Airlander 50 would seriously challenge the likes of the Mi-26 for the moving of heavy items of equipment to remote sites – and, although slower than the equivalent helicopter, the range/endurance of

the Airlander will give it a definite advantage past a certain distance. It will also have a cargo bay significantly in excess of the size afforded by even the Mi-26; 30m long with the ability to carry 6 ISO containers at the same time. With a range of 2000miles, the Airlander 50 opens up the possibility of exploiting natural resources in remote areas hitherto considered uneconomical due to the need to build access roads or fly thousands of helicopter sorties to establish sites. The HAV could, of course, fly equipment/ personnel in to such a site, then return with a significant amount of extracted product.

Finally, there are several military roles/ tasks that HAVs could threaten helicopters in. A clear option is Anti-Submarine Warfare, where the HAV can carry significantly more (and bigger) sensors / sonobuoys / weapons than a helicopter and sustain an overwatch position for days rather than hours providing more protection for less cost. The only aspect that the HAV "loses" to the helicopter is in speed to respond to a threat; typically, the HAV will be restricted to 100kts whereas a helicopter will often be a good 40kts faster. The HAV could also replace a rotary wing Airborne Early Warning platform (for example,



as proposed by the Royal Navy to protect the Queen Elizabeth Class carriers) by lifting a far larger radar to a much higher altitude and then loitering for days at a time – returning to low altitude for refuel, resupply and crew change. The ability to lift outsize payloads provides a capability that can only be achieved by the largest of military helicopters or, indeed, tactical airlifters – albeit, the size and (lack of) speed and manoeuvrability of the HAV would place some restrictions on where it could be employed. However, much like the helicopter itself, the HAV may actually be far more battle tolerant than it may appear at prima facie; the pressure differential between the inside and outside of the skin is very small, and the lifting gas is contained within cells, also at relatively low pressure. Therefore, even apparently large amounts of battle damage will not cause a catastrophic failure of the vehicle. History is replete with images of observation balloons, barrage balloons and, of course, airships all catching fire and being consumed quickly. HAVs will use inert Helium under low pressure, mitigating the risk of fire and rapid deflation – giving the aircraft a reasonable amount of battle damage tolerance and, importantly, giving the crew either time to land the aircraft on or abandon via parachute.

HAVs do have some significant disadvantages though. Firstly, they are slow. At best, around 100kts IAS; in any sort of meaningful wind conditions, ground speed into wind could be little faster than a truck.

However, the ability to fly in straight lines for prolonged periods overcomes this issue as far as range is concerned (planning for the HAV to deliver as a “slow ship” rather than “fast truck” might be useful) – but it still means that the HAV cannot respond quickly in terms of time. One concept is for the HAV to carry its own organic UAV capability to “send ahead” at higher speed if required. HAVs also suffer from other wind induced effects, such as ground handling and the need for significant space to operate from. Recently, the Airlander broke free from its mooring mast in the UK and the automatic deflation mechanism activated, causing significant damage to the prototype. At the time of writing the investigation is still underway, but it’s nonetheless a setback which will enable Lockheed Martin to catch up somewhat and will do little to dampen the shrill calls of the detractors. As the muse of our time, Taylor Swift, once opined “Haters gonna hate”; HAVs seem to attract significant criticism and hatred from those who’s prestige, ego and job is threatened by their capabilities. In the short-medium term, this is probably the biggest single factor, certainly in the military, that is holding HAV sales back. Much like the B747 in the 1970s, the commercial world may well wake up to the reality and possibilities afforded by the HAV (5* luxury safaris or a trip to the Grand Canyon with a G&T on the observation deck anyone?) and there could be a rush to ownership. If that happens it will, inevitably, hit the market for conventional rotorcraft. ■







THE RAF AT 100

The RAF turns 100 and
Paul Kennard, ex-RAF,
looks at its helicopters
and what they did.

Photos Courtesy UK MOD



Born out of a recognition that Air Power was a discrete capability, rather than just a subset of traditional military or naval role, the RAF, despite being only half-jokingly dubbed “the hundred-year experiment”, has led the world in technical and tactical innovation for much of its lifespan.

It may have escaped your attention outside of the UK, but the world’s oldest independent air force, the Royal Air Force, is in the throes of celebrating its 100th anniversary this year. Born out of a recognition that Air Power was a discrete capability, rather than just a subset of traditional military or naval role, the RAF, despite being only half-jokingly dubbed “the hundred-year experiment”, has led the world in technical and tactical innovation for much of its lifespan. I confess to a certain bias; I served for 23 of those 100 years, and still have many friends and former colleagues still serving. The RAF was an early adopter of rotorcraft technology; doubtless concerned that the Army or Navy would exploit the versatility of the helicopter to reduce RAF influence (and budgets!) and they opened the first helicopter training unit at RAF Andover in 1945, equipped with Sikorsky R-4 Hoverfly helicopters. There is no small irony that, as of today, the RAF Support Helicopter Force (SHF) is “chopped” at the Operational and Tactical levels to the Joint Helicopter Command, a 2-star HQ within the Army, which has its base in new buildings built on the site of the former RAF Andover.

Growing Capability

After the Second World War, the RAF continued to experiment and exploit the helicopter. Conflicts in Malaya and Suez both proved ideal testing grounds. The former encouraged the development of turbine helicopters and metal rotor blades to counteract the high Density Altitude and humid conditions, whilst the latter saw the RAF join their Royal Navy brethren in the Joint Experimental Helicopter Unit which conducted the first ever opposed amphibious assault by helicopters. A number of colonial policing actions saw RAF helicopters deployed worldwide, whilst the reawakening of “The Troubles” in Northern Ireland in the late 60s / early 70s, saw the start of a prolonged counter-terrorism campaign which saw RAF helicopters play a vital role in supporting the Army with tactical



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FRONTLINE







mobility – helping to minimise travel by road due to the risk of ambush/roadside bombs (in much the same way RAF helicopters were used in Afghanistan years later) and catch elusive terrorist units by the use of air deployed road blocks. The efforts of the single surviving Chinook during the Falklands War of 1982, ZA718/BN, are legion and through both Gulf Wars the RAF helicopter force provided both tactical mobility and assault capability, with the Special Forces element heavily involved in long range missions to interdict Iraqi communications amongst other tasks. Throughout the 1990s the RAF deployed helicopters in the disintegrating state of the Former Yugoslavia, ultimately taking a leading role in securing the population of Kosovo from their Serbian overlords.

The campaign in Afghanistan saw the RAF Chinook become one of the defining images of the UK commitment; news stories invariably featured a Chinook taking off / landing, as did the covers of most of the books written on the war. One role in particular seemed to capture the imagination of the UK public, that of the MERT (Medical Emergency Response Team) which saw a specially modified Chinook with medical team on Very High Readiness 24/7 to collect wounded soldiers (of both sides) and civilians; often in timescales that would be quicker than calling an ambulance in a major Western city. Since Afghanistan, RAF Chinooks have





supported disaster relief in the UK and the Caribbean and are currently deployed in Mali assisting the French.

The RAF has recently seen a reduction in helicopter numbers, despite the acquisition of 14 new-build UK standard CH-47F (known as the Mk6 in UK service). The loss of the Merlin to the Royal Navy, to re-equip the Commando Helicopter Force (CHF) squadrons upon the retirement of their Sea King Mk4s, was planned as part of the “Future Force 20/20”. However, the initial planning assumption was that the 28 Merlins would be replaced by 24 Chinook Mk6s – the reduction of 10 airframes post the 2010 SDSR has, effectively, robbed the RAF of a squadron. A key part of the “2020” plan was the upgrade of the RAF’s Puma Mk1 to Mk2 standard. Funded to “fill the gap” while the Chinooks were all brought up to the Mk4 (“Julius”) standard and the Merlin modified for maritime use, the Puma force actually shrank as well as a result of budgetary pressure and several Mk1 aircraft were not modified to Mk2 standard.

Recent Moves

Perhaps the two most dramatic changes in the RAF’s helicopter inventory over the past two decades have been the removal, in toto, of the Search and Rescue Force (SARF) and the contractorization of flying training at RAF Shawbury, initially through the DHFS (Defence Helicopter Flying School) and now as part of the broader MFTS (Military Flying Training System) contract. The decision to divest the SAR role to HM Coastguard ended decades of proud and dedicated service; although primarily tasked with the recovery of ejectee aircrew, the SARF became far better known as the bright yellow



helicopters that picked up stranded hitchhikers of mountains in poor weather, rescued yachtsman off capsizing boats and helped in the aftermath of natural disasters, such as the Boscastle floods of 2004. The financial reality of a shrinking military meant that, thankfully, overwater (or overland) ejections by Fast Jet aircrew are now increasingly rare, and the vast majority of SAR “shouts” were in support of the civil community. Whilst undoubtedly an important PR tool for the RAF (and, indeed the Royal Navy, who also had SAR squadrons) the sums just didn’t add up – especially looking at the both the running costs of the current fleet and the inevitable recapitalisation expense. The loss of the SARF reduced the RAF’s helicopter fleet by two full Squadrons plus an Operational Conversion Unit.

The outsourcing of rotary wing flying training in 1997 also had an impact upon the RAF’s helicopter and crew numbers; until 1997, rotary wing training was conducted “in house” by the RAF, Royal Navy and Army – DHFS was implemented to save money. These savings were generated by using the same helicopter types and one cadre of instructors, including a large element of ex-military QHIs (Qualified Helicopter Instructors) employed by the contractor.

As a result of these changes, the RAF helicopter fleet today consists of just Chinook and Puma, with some leased AW109s for VVIP/liaison tasks. The shrinking nature of the RAF force, inevitably, brings back into question the “ownership debate”. There are many who advocate passing the RAF SH Force to the Army – providing the Land Army with the means to directly control and task the helicopters. This is an arrangement favoured by several Western militaries – notably the US. Whilst attractive on some levels, the Army have come to realise, since the formation of JHC, just how



expensive the acquisition, upgrade and operation of helicopters is. The current fleet sits at about 85 airframes (60 Chinook and 25 Puma) which will be about the same size as the future Army Air Corps with circa 40 AH64E and 40 Wildcat. Importantly though, the RAF SH force can pull aircrew and engineers from a larger pool. The AAC (Army Air Corp) has to rely on the “big Army” for much of its engineering support and cannot readily increase pilot numbers by diverting trainees from other “streams”. There are some signs that the UK Army is growing tired of starving its own favourite “children”, such as armour and artillery, to fund helicopter projects. Ironically, therefore we may yet see the “ownership debate” play out in reverse, where it is the shrinking AAC that is disbanded, and its assets passed to the RAF (AH64) and Royal Navy (Wildcat). Indeed, the Army’s Manned Aerial Surveillance platforms, Defender and Islander, have already passed into RAF control, and it appears that the replacement for the few remaining Gazelle helicopters in the observation role in Northern Ireland will be provided by a civil contractor.

What’s Next?

Therefore, what next for the helicopter in the RAF? Chinook, it appears, is a secure platform; there is already debate about (another) fleet recapitalisation. The “Julius” standard (Mk5, Mk6 and Mk6a) whilst providing an element of update and standardization,



does not answer some fundamental operating and obsolescence issues. Whilst, at first glance a “glass cockpit” with Primary Flight Displays and moving map, Julius does not enable the higher, coupled, modes of the Digital Automatic Flight Control System (DAFCS) nor alleviate long term supportability of remaining CH-47D standard instrumentation. With militaries waking up to the “Through Life” cost implications of bespoke designs, the pressure (like the AAC’s decision to cohere with AH-64E) to align with the “reference customer”, in this case the US Army, will see the cost of ownership reduce over time as spares and upgrades can benefit from “bulk purchases”. Whilst the CH-47F is a capable platform, and the “Block II” even more so thanks to increased connectivity, better electrical system and the Advanced Chinook Rotor Blade (ACRB), the Chinook remains a “140kt” helicopter in a world moving, via the FMR/JVL initiative and the likes of V-22, to a 240+Kt vertical lift capability. Whilst the sheer payload capacity of the Chinook is not threatened by these medium types (though it is comprehensively outlifted by the CH-53K) the speed, altitude and digital connectivity of the aircraft will become an increasing issue, especially if close allies move to tilt-rotor technology. If the RAF opts to move to a CH-47F Block II, to leverage off the savings negotiated by the US Army, it will need to finally cross the Rubicon and embrace the Rockwell Collins CAAS (Common Avionics Architecture System) cockpit displays that are fitted to US Army, and indeed most export, aircraft.

Hitherto, RAF Chinooks have used “steam” analogue



instruments or, more recently, a partial Thales “Top Deck” cockpit - initially fitted to enable moving map and other capabilities in the aircraft. Crucially, Julius was initially designed to be a “stop gap” for 8-10 aircraft for 8-10 years while a “long term solution” was scoped and selected. CAAS was originally scoped as the replacement cockpit for the hybrid Honeywell cockpit originally delivered with the Mk3 Chinooks, however concerns over software certification (the main reason the Mk3’s hybrid cockpit was never cleared for service) and User Workload saw it lose out to the Thales Top Deck. By adopting CAAS now, the RAF would need to satisfy itself that the software is fully certifiable. It can ill afford another Chinook cockpit fiasco. Additionally, the last time the RAF looked closely at CAAS, in 2009/10 for the CH-47F buy, there were a number of capability shortcomings; noticeably, these included a lack of FLIR capability and “clunky” interface for tactical re-planning whilst airborne (which is a definite strength of the Julius system - even the rear crew have the ability to use and reprogram the mission map/navigation system). When the RCAF purchased their new build CH-147Fs, they made a number of changes to both the airframe and avionics, including CAAS and perhaps this will be the route the RAF elects to pursue.

Perhaps most intriguingly, at the DSEI exhibition in London last year, Commander JHC, Rear Admiral Jon Pentreath, dropped a very large hint that the UK was looking seriously at the acquisition of MH-47G special forces Chinooks, as flown by the US Army’s 160th SOAR. It has been an open secret in the UK that MH-47Gs have been coveted by the UK’s own Special Forces Community for several years; the opportunity with recapitalising the “Green” Chinook fleet with a CAAS-equipped CH-47Fs removes some of the potential obstructions



to a MH-47G purchase on certification and airworthiness grounds. There remain several challenges to a -47G buy including export approval for such a highly sensitive asset (though the UK already operates the very sensitive EC-135 Rivet Joint aircraft.), airworthiness audit trail (the UK uses Boeing for airworthiness assurance, whereas the US Army through TAPO controls -47G airworthiness) and, not least, the steep acquisition cost.

What of the Puma? The life extension program, upgrading the aircraft from Mk1 to Mk2 standard by fitting new engines and cockpit displays, and increasing fuel capacity, was designed to keep the aircraft viable until 2025. At the moment, that 2025 date seems too soon, if force numbers are to be maintained, as there is currently no Project Team established to examine the potential replacements. Recent comments from JHC personnel suggest that they are looking, longer term, into the potential of the US Army's Future Medium Rotorcraft / Joint Vertical Lift project to replace the UK's "medium" fleet of Puma and Merlin HC4 – moving RAF (and Royal Navy) vertical lift capability into the 250kt/25 000ft performance envelope. Whilst at this stage aspirational, it does suggest that the UK is starting to look beyond the "predictable" medium candidates (newer EH101, NH90 and H160) and basing decisions upon doctrinal capability requirements rather than industrial subsidy or skills-base retention. Although Puma has taken on additional responsibility recently, including back-filling the retired Lynx 9A in SF support roles and operating as the "Kabul Taxi" op Operation TORAL in Afghanistan, there still remains a risk that



it is retired early to save near-term cash; the UK is in the throes of another Defence Review only 3 years after the last one, as both a resurgent Russia and currency fluctuations after the Brexit decision, have cast doubts on both the configuration and affordability of the future force postulated in 2015. Decisions made in 2015 to purchase US kit “off the shelf”, including P-8 MPAs and Predator-B RPAS (as well as the ongoing procurement of F-35Bs) have all exposed the UK to a slide in the Pound/Dollar exchange rate. Therefore, “corrections” are required. A relatively simple “sleight of hand” would be to announce the Chinook recapitalisation program (which will save money through life), including perhaps MH-47G in a blaze of publicity which casts into shadow a decision to reduce overall Chinook numbers or retire Puma early.

Ironically, if as postulated earlier in the article, rather than discussing the reduction of the RAF Helicopter fleet, it could be about to start a true renaissance. If JHC were to be scrapped and the AH64 passed to the RAF, then a new Group HQ would need to be established in Air Command. Coupled with new / upgraded Chinooks, a transformational Puma replacement and a cadre of highly experienced and decorated Officers from helicopter backgrounds now permeating the higher echelons, the helicopter force could be secure, capable and influential in the decades ahead.

One final thought; what sort of vehicles will the RAF be operating on the occasion of its’ bi-centennial? Whatever they are, doubtless we cannot conceive of their capabilities and configurations and, on a light-hearted note, perhaps the Chief of Air Staff will no longer be aircrew, but a UAV operator, cyber warrior or, perhaps even, an astronaut... ■



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