# All hands on deck: the sky's the limit for shipboard UAVs

**Rotary and fixed-wing unmanned aerial vehicles are beginning to take roles that have been traditionally reserved for manned maritime patrol aircraft, providing surveillance capabilities and even a limited weapons-delivery capability, reports *Rupert Pengelley***

After several decades of development effort and having become an established feature of land operations, unmanned aerial vehicles (UAVs) are finally beginning to be entrusted with some of the intelligence, surveillance and reconnaissance (ISR) roles traditionally fulfilled by manned maritime patrol aircraft and shipboard helicopters.

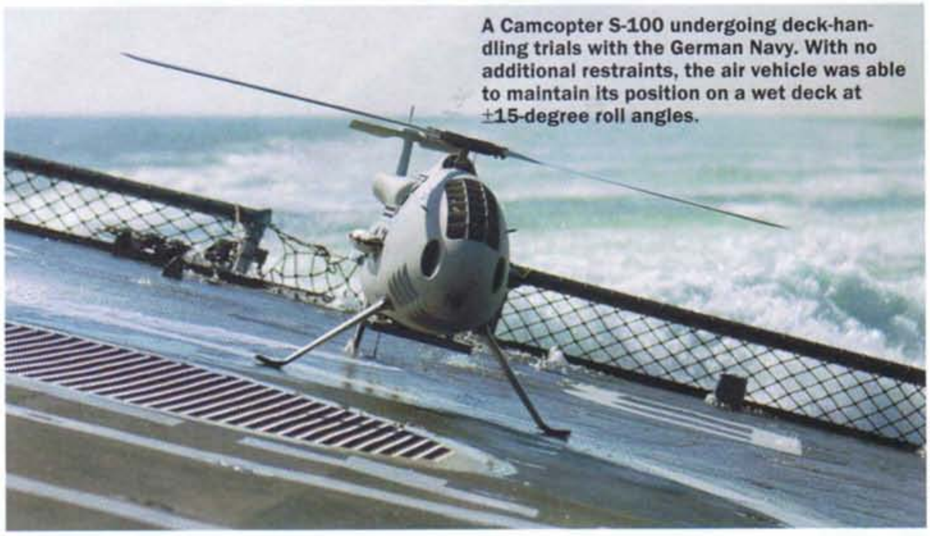
Depending on their size, such UAVs may optimally be based at sea or on land – 'organic' or 'non-organic' respectively. In principle, according to one senior industry figure, the shipboard UAV information exploiter "doesn't actually care where his or her information is coming from, whether delivered as direct streaming video, or imagery and data sent across on a data network". He tells *Jane's*: "From the purely operational point of view such sensor platforms might well be organic, but the main consideration is that the overall system should be fully integrated with the network."

Nonetheless, in practice all such data networks remain dependent on the proper functioning of a multiplicity of communications links and command layers, with their attendant reliability and latency factors. Many naval users will therefore still prefer to 'make their own luck', on the premise that the shorter the communications loop the lower the latency – and the more certain it is that the required information will be available, particularly in tactical situations.

Thus several major navies and coastguard organisations have put shipboard UAV solutions firmly on their acquisition list, both as a complement to conventional manned platforms and as standalone systems.

In the former case, the UAV might typically be used to undertake most of the routine surveillance work while the piloted aircraft is used to fly necessary heavy equipment for search and rescue or surface action. In the latter case they are looking to UAVs to provide a sensing capability (and even a limited weapons-delivery capability) in the third dimension for unsupported vessels regarded as too small to sustain one. The solutions adopted to date have included both rotary and fixed-wing types.

On the face of it, a land-locked mid-European country makes an unlikely source for a maritime UAV. Austria's Schiebel Group has nonetheless succeeded in making inroads into this particular market on the back of its multirole Camcopter S-100 rotary-wing design.

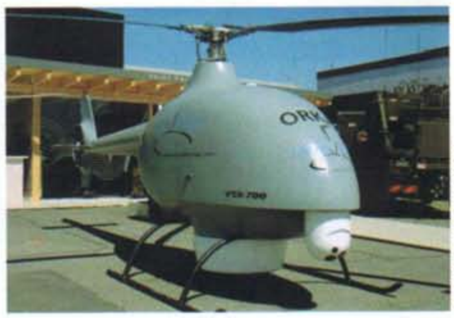


A Camcopter S-100 undergoing deck-handling trials with the German Navy. With no additional restraints, the air vehicle was able to maintain its position on a wet deck at ±15-degree roll angles.

Schiebel: 1377374

Janes/Patrick Allen: 1325463

Mockup of the EADS SHARC with its contra-rotating coaxial twin-rotor system. Its payload was to have included a conformal-array radar.



Janes/Patrick Allen: 1182048

EADS' Orka-1200 proposal has the capacity to carry both an air-surface radar and a gyrostabilised electro-optical/infrared sensor ball.

Altogether the company has sold some 137 S-100 air vehicles, including 60 to the United Arab Emirates. Of the total, roughly 70 have already been delivered and half of these have gone to naval users, according to the company's Chief Executive Officer Hans Georg Schiebel.

"The S-100 is ideal for naval applications, since it takes off and lands completely automatically on ships' decks, without need of the nets and catapults used by its fixed-wing competitors," he says.

Its air vehicle is also readily scaleable, unlike those of its fixed-wing counterparts that rely on an arrester wire – "you could still catch it on a wire, but if you were to make it any bigger it would get damaged."

The Camcopter S-100 currently fills a niche of its own. Powered by a Diamond rotary engine delivering 55 hp at 7,100 rpm, it has a top speed of 240 km/h and a ceiling of 20,000 ft. With a maximum take-off weight of 200 kg, its gross payload (sensors and fuel) is around 100 kg, the maximum sensor payload being 55 kg. Typically, with a 25 kg sensor package its endurance is six hours on internal fuel. For sustained operation at sea it requires a crew of only three, and its ship impact (in terms of manning, accommodation and hangar requirements) is less than that anticipated for larger rotary-wing UAV systems such as those now being developed in the US.

Following trials at sea aboard the hangar-equipped Indian Navy offshore patrol craft

INS *Sujata* (displacement 1,890 tons full load) in October 2007, the Camcopter S-100 also undertook flight trials from a 3,750-ton Type 21 frigate belonging to the Pakistan Navy in March 2008. A month later it was tested off Africa aboard the 605-ton gross weight patrol vessel *Rio Miño* belonging to the Spanish Guardia Civil.

In mid 2008, the German Navy conducted three weeks of trials with the S-100 in the Baltic aboard one of its K130 corvettes. More than 130 takeoffs were completed with maximum takeoff weights in excess of 190 kg. The relative wind speeds over the deck reached as high as 40 kt and the roll angle more than 8 degrees. With no deckhandling aids and a wet deck, the aircraft showed it could withstand flight-deck roll angles exceeding ±15 degrees.

In September-October 2008 the French Navy operated an S-100 for four days from a flat-bottomed barge in the Atlantic off Brest, in seas at times exceeding Sea State 3. Thereafter, the UAV was transferred to the 4,380-ton destroyer *Montcalm* for another three days of trials in the Mediterranean.

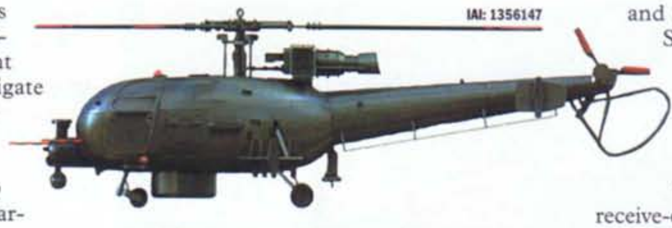
These included the first use of the DCNS-developed SADA (Systeme d'Appontage et de Decollage Automatique) automatic deck landing and take-off system. This has an infrared trajectograph with which to track the UAV while at the same time receiving real-time platform motion data. A computer processes the motion data and generates flight commands for the UAV to adjust its trajectory until it is positioned so that its harpoon deck-lock engages the centre of the landing grid. Tracking is accurate to 300 mm, which DCNS claims is significantly better than that achieved by GPS-only systems.

## Playing it safe

According to DCNS, the operation of unmanned air systems at sea has hitherto been restricted by severe limitations on the safe operating envelope. It claims that "solutions available to date have only worked reliably during daylight and in calm seas; [these are] severe limitations for systems that are required to operate round the clock and in poor weather". SADA has been developed in order to address these limitations, taking less than two minutes to recover a rotary-wing on a moving flight deck up to Sea State 5, according to DCNS.

Schiebel notes that his company has devised a fully automatic deck-lock system of its own, which has been tested by the German Navy. It features an electrically set harpoon device (weighing 1.5 kg), which is spring-actuated rather than pneumatically actuated as in the case of SADA. Since the standard Camcopter S-100 automatic landing and control system can, he asserts, be used in all conditions up to and including Sea State 5, the company does not insist a deck-lock system be installed other than aboard smaller vessels required to operate in the roughest seas.

The standard S-100 airframe has very robust landing gear, able to survive impacts of almost 10G. This is fortuitous, Schiebel observes, as "rather than aiming to achieve a smooth landing as on land, for naval operations you want to be able to achieve positive contact with a down-going deck" and, as has already been shown, the Camcopter S-100 is able to maintain its position on a wet deck with a 15 degree back angle without the aid of a harpoon.



IAI: 1356147

**IAI's NRUAV optionally piloted helicopter concept, initially based on a HAL Chetak helicopter to meet an Indian Navy requirement, carries both a Tamam MOSP EO/IR sensor ball and an Elta EL/M2022 multimode radar.**

Janes/Patrick Allen: 1326916

**Model of the Selex Damselfly vectored-thrust UAV with its wing-tip sensor pods.**

For shipboard operation the standard Camcopter control station and software package are employed, an additional control module being bolted to the ship's deck to record and measure the ship's movement, data which is passed both to the ground station and to the aircraft. The control system gives a landing accuracy of 1.5-3 m, but the company is now testing a higher-precision solution which is intended to be accurate to within a few tens of cms. This will be entirely passive in operation and will be better adapted to salt-spray environments than those relying on infrared emissions, says Schiebel.

The S-100's stand-off surveillance range is a function of the size of the ground antenna, 50 km being achieved with an 18 in/45 cm-diameter dish, rising to 80 km with an 80 cm dish. The on-board sensor and the air vehicle's control data share a common datalink, which is encrypted to an open standard and operates in C band (4.4-4.5 GHz). Schiebel tells *Jane's* that, given that the air vehicle has an on-board data terminal able "to translate any digital language into any other", the system should be adaptable to a range of datalink standards.

The company has developed a portable receive-only remote data terminal (RDT) for downlinking the S-100 imagery directly to a dismounted or vehicle-borne user within a radius of 20 km, but some operators are understood instead to be using standardised full-motion video receivers such as L-3's ROVER III/IV terminal. Otherwise the imagery and data outputs are passed on to remote users via the ground control station, which may be connected to a local area network and act as a network hub.

Camcopter's gross lift capacity for fuel and operational payload is 100 kg, and its endurance is around 6 hours (maximum 8 hours on internal tanks), or 10 hours with add-on blister tanks. Its current payloads, which include a Selex Galileo PicoSAR synthetic aperture radar or an electro-optical sensor ball such as IAI Tamam's POP 200, are in the 15-20 kg weight class. Its full fuel load is 42 kg, and the S-100 thus remains well within its maximum take-off weight limit. Thales is proposing to exploit this spare capacity by arming the S-100, fitting it with launchers for two 13 kg Lightweight Multirole Missiles (LMM). The two companies have already conducted experimental firings using surrogate S15 Starburst laser command-guided missiles (which weigh 15.2 kg in their launch tubes).

## Rotary-wing evolution

Meanwhile, to meet longer endurance and higher payload requirements, Schiebel has been studying a companion S-200 rotary-wing design. Now in its concept stage, this would have a larger airframe than the S-100 but would remain compatible with the existing ground control station. It is expected to weigh between 400-500 kg and have a sensor payload capacity of 100-200 kg.

German industry has had an extended track record in the development of a rotary-wing UAV for shipboard applications, most notably investing in the SEAMOS (Seeaufklärungsmittel und Ortungssystem) vertical take-off and landing (VTOL) UAV demonstrator programme that was begun in the early 1990s. This used the dynamic components, including its coaxial twin-rotor system, of a redundant US QH-50 drone which dated from the 1960s. The definitive SEAMOS had been intended to

Warrior (Aero Marine): 1332421

**The Warrior Gull 36 is claimed to be able to take off and land dependably in Sea State 5.5, thanks to its wave-piercing hull form and sophisticated wave-sensing flight control system.**

AAI: 1332422

**AAI's new Aerosonde Mk 4.7 was unveiled in March 2009. It retains the many of the characteristics of the Mk 4.4, but has tail-boom extensions projecting forward of the wings.**

equip the German Navy's K130 corvettes, but the programme was cancelled in 2001, before the prototype could fly.

Subsequently EADS unveiled its revised SHARC (Scouting and Hunting Autonomous RotorCraft) coaxial rotary-wing UAV demonstrator, which made its first flight on 14 June 2007. SHARC had a gross weight of some 190 kg and a payload capacity of around 60 kg, and was planned to incorporate advanced features such as a conformal antenna array for a synthetic aperture radar.

In parallel EADS had embarked on a study for a larger conventional rotary-wing UAV known as Orka-1200, for which it received a contract from the French armament procurement agency DGA in November 2006. Based on a Guimbal Cabri light helicopter, Orka-1200 was credited with a length of 6.2 m; height 5.4 m; main rotor diameter 7.2 m; payload 180 kg; take-off weight 680 kg; operating ceiling 3,600 m; endurance 8 hours; and maximum speed 195 km/h. Its intended range of sensors included an air-to-surface radar, an electro-optical sensor ball, a laser designator and passive EW equipment.

Both of these projects are currently in abeyance, according to an EADS spokesman. The prospects for a resurrection in the German market would not seem bright in the light of a public assertion in late 2008 by Vice-Admiral Wolfgang Nolting, the Chief of the German Naval Staff, that the German Navy and the German Army had agreed to act in concert to implement service introduction of the Schiebel Camcopter S-100 rotary-wing UAV at an early date. According to Vice-Adm Nolting, the first will be in service aboard the K130 in 2012. Contract negotiations are understood to be in progress, although Schiebel was unable to confirm this.

## Remote possibilities

The MALAT division of Israel Aerospace Industries (IAI) has been promoting a pragmatic scheme for putting remote controls in a standard naval helicopter, which would leave its ship-impact virtually unaltered and minimise certification requirements.

This 'optionally piloted' solution is aimed in the first place at a possible Indian Navy requirement and is therefore based on a HAL Chetak (licence-built Allouette III) helicopter. The so-called naval rotary unmanned air vehicle (NRUAV), which has a maximum take-off weight of 2,200 kg, is designed to operate from combat ships with displacements of 600 tons or greater in support of surface warfare and is intended either as a replacement for, or as a complement to, existing helicopters or land-based maritime patrol UAVs and aircraft.

AAI: 1332423

**The Aerosonde Mk 5 is AAI's contender for the US Navy STUAS/Tier II requirement, which encompasses both land and sea-based operation.**

Shipboard elements of the NRUAV consist of command-and-control stations integrated into the ship's combat information centre and the ship's existing hangar, traversing and securing systems. With a mission equipment payload (MEP) payload of 200 kg at maximum fuel weight (internal fuel only), it is estimated a pilotless Chetak should be able to stay on station 50 n miles from the ship for four hours, or for six hours with a 150 kg payload.

The MEP includes an IAI Elta EL/M2022 multi-mode radar with both surface-search and air-to-air modes (the latter helping to extend platform air-defence capability), plus a synthetic aperture radar mode for overland and littoral operations support. Additionally, according to IAI, NRUAV will be able to accommodate a Tamam MOSP optronics sensor, ELINT and/or SIGINT systems, a COMINT sensor, "and additional equipment as defined by the user".

The ship and MEP segments are common to those already operational aboard IAI's Heron and Searcher fixed-wing UAVs. All three platforms and their payloads can be operated from identical ground stations. The NRUAV's strap-on remote-control systems are designed to be applied aboard ship, ensuring the helicopter can be operated in manned condition if need be.

The prospect of a UK Royal Navy escort-ship VTOL UAV requirement, which has yet to reach tangible form, would appear to have been behind a number of projects spawned within UK industry in recent years.

In July 2007 Selex Sensors & Airborne Systems unveiled its Damselfly project in model form, but a prototype has yet to fly. Its distinguishing design feature was the use a vectored-thrust combined propulsion and lift system, claimed to give "the hover capability of a helicopter but with outstanding wind gust resistance and a small landing and take off footprint. The technology actively resists lateral forces", making it ideal for use on ships or in 'urban canyons', according to Selex.

An electrically powered sub-scale Damselfly demonstrator, with a wing span of about 1 m (3.28 ft), began a successful series of hover trials in early April 2007. The model presented by Selex showed the general configuration of this testbed, which featured wing flaps, all-moving V tail surfaces and wingtip-mounted sensor pods. It was said to have a take-off weight of some 9 kg (19.8 lb) and potential top speed of 150 kt (277 km/h). The intention was to follow this with a scaled-up 80 kg (176 lb) prototype, but according to Selex no construction work is currently being carried out, although discussions are now in progress with another company on further exploitation of Damselfly technologies.

## Unleash the Warrior

Another UK maritime UAV made its flight debut in 2007, in the shape of the Warrior (Aero Marine) Gull floatplane, which started flying in its Gull 24 configuration on 15 May that year. The appeal of a seaplane-type UAV is that in principle its off-board method of operation makes it easier to retrofit aboard ship than those requiring shipboard launcher or arrester gear. The space-claim of its associated handling system is minimised and there is also no requirement for the launch ship to turn to windward for launch and recovery, as would generally be the case when deploying a fixed-wing UAV. Since it floats, the Gull can hold its position on water for sustained periods, facilitating persistent surveillance and detection missions (the latter using either above or below-water sensors).

Between August and November 2008, Warrior completed a programme of work under contract to Flight Refuelling, using two enlarged Gull 36 seaplane UAVs. With a 4 m wing-span, the Gull 36 has a maximum take-off weight of 70 kg, a maximum level speed of 82 kt, an economic cruising speed of 60 kt and a stall speed 28 kt. Its range and endurance are put at 130 nm/2.20 h with a 22 kg sensor payload, rising to 600 nm/12 h with an 8 kg payload.

Using its new-generation wave-piercing hullform, the Gull 36 has demonstrated that it retains a full on-water manoeuvre capability up to Sea State 3, while showing that it can still be operated (launched and recovered) reliably up to Sea State 5.5, according to the company.

Independently, Warrior has been involved in a series of developments for the UK Ministry of Defence's (MoD's) Defence Technology Council, demonstrating what the company describes as "the principles for safe launch and recovery of small vessels, to and from ship while at speed and in significant seastates". Capitalising on these, it has embarked on the development of a launch and recovery sled for the folding-wing Gull, designed to be carried on a conventional davit (or aboard a submarine). This would be streamed over the side or stern, enabling the Gull to be released and to taxi away from the towing platform before flight.

The Gull is a scalable concept and, depending on its size, is envisaged as carrying a range of fixed, deliverable or towed payloads. These include surface radar, EW and SIGINT sensors, EO/IR sensors, UUVs, sonobuoys and towed sonar systems.

A company representative told *Jane's*: "We are hopeful of new ... effects in working surface and airborne payloads together, switching between airborne and surface functions multiple times in any sortie. [This] could aid asymmetric threat detection and monitoring, and possibly even enable triangulation on moving subsurface threats." While work still needs to be done to arrive at a complete multipurpose system, "it only needs integration of established systems and technologies, [and] we are seeking a joint venture and licensees to do so. We are starting work on a larger platform design (750 kg gross weight) meanwhile".

## US flies ahead

The US Navy (USN) remains a key driving force in the maritime application of UAVs, its latest venture being the USN/Marine Corps Small Tactical Unmanned Aircraft System (STUAS)/Tier II programme, for the conduct of over-the-horizon ISR missions from 2010-2011. The requirement embraces both shipboard and land-based operations, which may or may not be successfully fulfilled by a common design. Flight demonstrations of the competing solutions are due to take place in May-June 2009.

The majority of respondents are expected to put up fixed-wing designs. Among them is AAI, which revealed in January 2009 that it had conducted initial flight testing of a new candidate design for STUAS, the Aerosonde Mk 5. In common with the Aerosonde Mk 4.7, developed by AAI's Aerosonde Pty subsidiary in Australia where it was unveiled in March 2009, the Mk 5 is an outgrowth of the Mk 4.4. The latter is credited with an endurance of 14 to 24 h, depending on payload, with a cruise speed of 50 kt and a dash speed of 62 kt, ceiling being 15,000 ft (4,500 m) density altitude. It has a wingspan of 3.45 m, a gross take-off weight of 16.8 kg and is compatible with the launcher and net-type recovery system of AAI's larger Shadow UAV series, as well as the US company's Expeditionary Ground Control Station and One System Remote Video Terminal (OS-RVT) video downlinking system.

The Mk 4.7 version carries a multi-sensor payload combining EO/IR and laser range finder/pointer capabilities, as well as a common data link. It uses the same power plant and avionics as the Aerosonde Mk 4.4, while incorporating a larger fuselage for greater endurance. Its maximum gross take-off weight has been increased to 17.5 kg. The Mk 5 is expected to be somewhat larger – with a gross weight in the region of 54 kg – and to be suitable for land and sea-based operation

AAI has meanwhile secured sales to two undisclosed Far Eastern navies for its Shadow 400 fixed-wing UAV. In September 2000, AAI announced a USD22 million contract from one of them (widely reported as being from the Republic of Korea). This was for a single ship-based Shadow 400 system with multiple air vehicles, a GCS and an hydraulic launcher. Shadow 400 has a maximum speed of 110 kt, a cruise speed of 85 kt and a loiter speed of 65 kt. Maximum range is put at 200 km, ceiling 11,000 ft and endurance at 5 hours. The air vehicle is 3.81 m long with a wingspan of 5.12 m and a maximum payload of 34 kg. Its maximum gross weight is 211 kg.

Since its initial introduction the Shadow 400 has been given a fully automatic take-off and landing capability, using a ramp or rocket assistance for take-off and a net for landing. Its standard payload is a Tamam POP 300 EO/IR sensor ball.

US Navy: 1356144

Having snagged the arrester wire of the SkyHook retrieval system, a ScanEagle UAV is recovered to the flight deck of the assault ship USS *Saipan* during trials in August 2006.

Most recently in the headlines as the provider of video overwatch of the Maersk Alabama piracy incident while operating from the destroyer USS *Bainbridge* off Somalia in April 2009, the Boeing/Insitu ScanEagle fixed-wing UAV is arguably the most successful of the genus to date. Having entered service with US forces operating in Afghanistan and Iraq in 2004 – and subsequently been adopted by Australia and Canada – ScanEagle clocked up its 150,000th hour of operational service in early April. In the meantime it was confirmed as the USN's choice of interim UAS in mid 2008. Trials have also been conducted by the UK Royal Navy and most recently by the Republic of Singapore Navy aboard a Formidable-class frigate.

First entering USN service in July 2005, it was announced in January 2009 that ScanEagle had completed its 1,500th shipboard sortie with that customer, operating from 15 vessels belonging to a number of different classes, including supply ships, a large wave-piercing catamaran, amphibious landing ships and Arleigh Burke-class destroyers. One of the smallest platforms to have been trialled in conjunction with ScanEagle is a Mk V naval special warfare craft, which displaces just 54 tons.

The long-endurance ScanEagle UAS carries either a stabilised EO or IR payload, with which it is capable of flying above 16,000 ft and loitering for some 24 hours. It incorporates a video transmitter compatible with the L3 Communications ROVER III/IV full-motion video ground receiver terminal. It has also been demonstrated with an ImSAR NanoSAR synthetic aperture radar, which operates in the 8-12.5 GHz band and gives a 35 cm resolution at 1 km. Powered by a 1.9 kW (2.5 hp) 3W-28 piston engine and a two-blade pusher propeller, the current ScanEagle Block D has flown in excess of 22 hours using standard fuel and in excess of 28 hours when converted to use JP-5 heavy fuel. It has a wingspan of 3.05 m, a length of 1.22 m and a maximum launch weight of 18.1 kg, including a disposable load of 5.6 kg. Maximum speed is given as 70 kt and loitering speed as 41 kt. It is launched autonomously from a pneumatic SuperWedge catapult launcher and flies either preprogrammed or operator-initiated missions. Insitu's patented SkyHook system is used to retrieve the UAS, capturing it with the aid of a 50 ft mast from which is suspended a rope to snag the air vehicle's wing.

## Sting in the tail

Raytheon, which has entered its KillerBee system in the STUAS competition, says the aircraft's blended-wing body – which was designed by Northrop Grumman-owned Swift Engineering – allows it to carry heavier payloads than a typical tube-and-wing airframe.

According to a Raytheon spokesman at the Sea-Air-Space 2009 Exposition in National Harbor, Maryland, on 4-6 May, KillerBee can fly for 12 hours with a 35 lb (15.8 kg) payload. The company has previously stated that a tube-and-wing airframe will carry about 20 lb for 15 hours. Raytheon also asserts that KillerBee's payload volume of 5,800 cubic inches (0.095 cubic metres) is "more than three times the capacity of competing systems".

KillerBee weighs around 70 lb and has a wingspan of 10 ft. Its two-blade pusher propeller was recently replaced with a five-blade type, giving a maximum speed of 120 kt and a loiter speed of 65 kt.

The aircraft is intended for two-man launch and recovery, using a pneumatic launcher and net. On 5 May, Raytheon announced that KillerBee had been successfully recovered in a net mounted on a truck, simulating an at-sea recovery, at the Yuma proving grounds in Arizona. The company said the test demonstrated the aircraft's ability to return to a platform moving at speeds similar to a naval vessel.

Each KillerBee system includes one ground station that can control four air vehicles. The sensor pack consists of a daytime video/night IR module with laser rangefinder and pointer.

Another UAV from the Boeing stable with naval potential is the rotary-wing A160T Hummingbird, which has an estimated maximum speed of up to 170 kt at ceilings up to 30,000 ft, 10,000 ft higher than conventional rotary-wing designs. It began development under a contract awarded by DARPA in 1998 to Frontier Systems (which Boeing acquired in 2004) and was later espoused as part of the US Army's Future

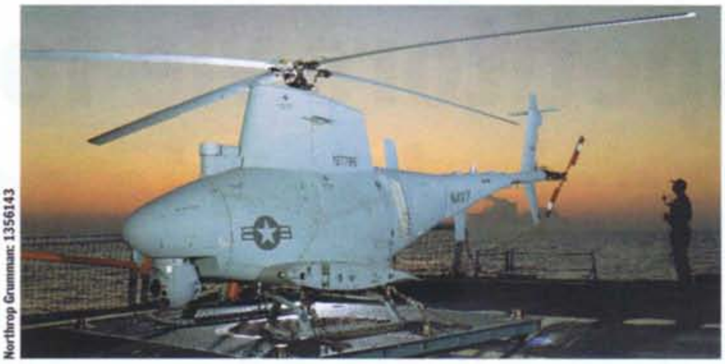
Combat Systems programme. Its principle design novelty is the incorporation of a rigid, optimum-speed rotor with a two-speed transmission. Its rotation speed can thereby be optimised for both high and low-speed flight, cutting fuel consumption and increasing range or payload. Reductions in rotor speed also minimise the Hummingbird's noise signature.

The prototype A160 first flew in January 2002 in piston-engined form, using a three-bladed composite rotor. In its current A160T configuration, powered by a Pratt & Whitney 207D gas turbine engine, the Hummingbird features a four-bladed 11 m-diameter composite rotor and is 10.66 m long. Maximum take-off weight is 2,948 kg, maximum fuel weight 1,179 kg, and empty weight 1,134 kg. It is designed to fly 2,500 n miles with endurance in excess of 24 hours and a payload of more than 136 kg. Flight tests conducted in 2007 showed that it could fly for 8 hours carrying a 453 kg payload, and for 12 h carrying a 226 kg payload, in the latter case using less than 60 per cent of its maximum fuel load. In May 2008 it demonstrated an ability to hover out of ground effect at 20,000 ft and conducted a flight lasting 18.7 hours with fuel remaining for a further 90 minutes.

Among the payloads trialled with the A160T is DARPA's FORESTER foliage-penetrating radar and a 453 kg stores-delivery pod. A six-round Hellfire missile fit has also been evaluated.

The USN's highest-profile shipboard UAV programme is the Northrop Grumman MQ-8B Fire Scout, a rotary-wing design it has adopted for to fulfil its VTUAV (vertical take-off and landing unmanned aerial vehicle) requirement. The US Army has likewise adopted a version of the MQ-8B as the Class IV UAV within its Future Combat Systems (FCS) equipment family.

Fire Scout has a length of 9.15 m, a rotor diameter of 8.4 m, a height of 2.96 m, a gross weight of 1,429 kg and a maximum payload of 272 kg. Powered by a single 420 hp Rolls-Royce 250-C20W turboshaft engine, it has a maximum speed of 125 kt, a ceiling of 20,000 ft, and an endurance of better than 8 h. It can stay aloft at a mission radius of 110 n miles with the maximum payload for 3 h; endurance at 250 n miles with a 45 kg payload is 2 h 12 min; maximum endurance with a baseline payload is greater than 8 h, or 5 h with a 272 kg payload.


Northrop Grumman: 1356143

**Northrop Grumman's MQ-8B Fire Scout is undergoing flight tests from the frigate USS *McInerney* prior to trials with the USN's new Littoral Combat Ships.**

The Fire Scout design, based on a Schweizer Model 333 helicopter, was selected as winner of the VTUAV competition in 1999, the contract for the engineering and manufacturing development models being awarded to Northrop Grumman in February 2000. This was followed in 2001 by a low-rate initial production (LRIP) contract award for the initial RQ-8A version. The USN ultimately elected to proceed instead with the upgraded MQ-8B model, which has a four-bladed rotor, uprated gearbox (320 hp continuous), increased fuel capacity and increased maximum take-off weight of 1,428 kg. This in turn permits increased time-on-station (5 h at 110 nm with a 90 kg sensor/weapons payload) and an increased payload capacity (272 kg).

The first batch of USN MQ-8Bs for system design and development (SDD) was ordered in June 2005, the last two (of nine) SDD aircraft being ordered in February 2007. The first of these flew in December 2006 and VTUAV Milestone C was achieved in May 2007, clearing the MQ-8B for LRIP, under which a further nine aircraft were to be delivered.

The USN authorised the LRIP 1 contract to Northrop Grumman in June 2007, the LRIP 2 contract in September 2008 and the LRIP 3 contract (for the last three air vehicles with their electro-optical payloads, three ground control stations, three light harpoon grids, three UAV common automatic recovery systems [UCARS] and six portable electronic display devices) in February 2009. Work under LRIP 3 is not expected to be completed until March 2011, but in the meantime the USN began VTUAV flight tests aboard the Oliver Hazard Perry-class frigate USS *McInerney* in early 2009. Initial operating capability is expected to be declared in September, full-rate production is due to be authorised in November and follow-on testing aboard the USN's new Littoral Combat Ships is now expected in FY11.

According to Northrop Grumman Business Development Manager (Tactical Unmanned Systems) Michael Fuqua, by the end of February 2009 some 285 fully autonomous flights had been made with the MQ-8B platform, totalling 308 hours. The current expectation is that the company will supply 168 MQ-8Bs to the USN, for anti-submarine, surface and mine warfare applications.

Each Fire Scout system will consist of 1-3 MQ-8B air vehicles with their EO/IR/laser pointer/rangefinder modular mission payloads; a ground control station (integrated in the ship's CIC) incorporating the tactical common data link and tactical control system; a Sierra Nevada AN/UPN-51(V) UCARS; and a NATO-standard talon grid for securing the MQ-8B in high sea states. The choice of sensor payload for the initial service version has yet to be made, but Northrop's MQ-8B demonstrator platform (P6) has latterly been flying with a FLIR Systems Star SAFIRE III EO/IR /laser rangefinder sensor ball and a Telephonics RDR-1700B radar.

An air-surface radar is among the Fire Scout's planned growth capabilities and the USN's 2009 research and development budget also includes provision for an automatic identification system, a communications and data relay package, NBC detection systems, homeland security applications, a satellite communications capability, lightweight sonobuoy delivery and an acoustic data relay capability. ■