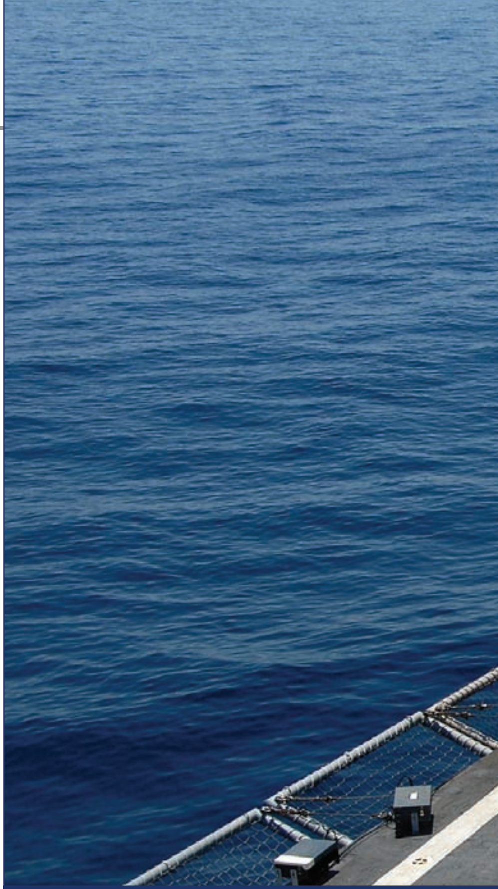

Finding their sea legs at last

After much drawn-out development, the signs are that maritime UAVs are now ready to deliver, **Richard Scott** discovers.

The deployment of the frigate USS *McInerney* (FFG-8) with the US 4th Fleet in early October 2009 saw the US Navy (USN) lay claim to having written the first lines of a new chapter in maritime aviation history. Embarked on board were two Northrop Grumman MQ-8B Fire Scout VTOL maritime UAVs (MUAVs), and this deployment marked the first fleet operation for a large, autonomous rotary-wing UAS.

McInerney and her Fire Scout flight sailed south from Mayport, Florida, to join a counter-narcotics deployment in the Caribbean. Here, the MQ-8B has been tasked to use its ISR capabilities to provide improved situational awareness.

Yet it will not have gone unnoticed by *Unmanned Vehicles* readers that a panoply of land-based UAS have been providing tactical and strategic ISR over land, along coastlines and further out to sea for many years now. And navies themselves have for many years recognised the potential contribution offered by organic unmanned air assets across a range of ISR tasks, plus other missions such as force protection and electronic warfare. So what exactly has held the MUAV back?

UNIQUE CHALLENGES

In turns out that two types of factor have to date conspired to hinder the operation and exploitation of organic UAS in the maritime arena. First, there are technical issues. These include: the challenges of operational and functional integration (airspace de-confliction, integration of communications bearers, bandwidth limitations and sensor data integration into the combat management system); the problems inherent in organic MUAV operation from shipborne platforms (specifically, the issues of robustness and reliability attendant to the harsh maritime environment, plus the complexities and constraints associated with vehicle launch and recovery); and the inability of airframers and integrators to meet the range, endurance and payload demands of the user community with state-of-the-practice VTOL UAVs.

The consensus is that all the above have been addressed, or are well on the road to being overcome. But the second category to consider is what one industry insider – and ex-naval aviator – suggests is a 'cultural resistance' from many in the maritime aviation community. 'There has been a lot of scepticism as to what UAVs can do,' he told *UV*, 'and it has taken time to convince the sceptics. At the same time, many rotary-wing aviators and budget programmers have tended to view the UAV as a threat to the shipborne helicopter, rather than a complement.'

As a result, while VTOL MUAVs have long promised to enable organic operations from the confined footprint of a warship – and capitalise on the helicopter flight deck estate and support facilities equipping virtually

The MQ-8B is based on the Schweizer 333 commercial manned helicopter. *(Photo: US Navy)*


A Northrop Grumman MQ-8B Fire Scout recovers to the deck of the USS *McInerney*. *(Photo: US Navy)*

every vessel of corvette size and above – their maturation has been a long time coming. Indeed, in the nearly 47 years since the USN first landed a prototype Gyrodyne QH-50 DASH (Drone Anti-Submarine Helicopter) aboard the destroyer USS *Hazelwood*, and the over 30 years since DASH was retired, the QH-50 stood out as the only VTOL UAV to have seen operational service at sea.

In the meantime, numerous MUAV programmes have failed to deliver. The list includes the Bell Helicopter Eagle Eye, Bombardier CL-327 Guardian, IAI Hellstar and EADS Dornier Seamos.

FIRE SCOUT BREAKTHROUGH

However, that spell has now been broken by the MQ-8B, selected in 2003 to provide the USN's new Littoral Combat Ship (LCS) with an autonomous VTOL UAV operating capability.

The MQ-8B, like the abortive RQ-8A before it, is based on the COTS Schweizer 333 manned helicopter. Powered by a Rolls-Royce 250-C20W turboshaft (using standard NATO heavy fuel), it features a four-bladed rotor (replacing the twin blades of the RQ-8A), an uprated transmission and drive train, increased fuel capacity and higher MTOW of 1,428 kg. The result is improved time on station (over five hours at 200 km out with a 90 kg payload) and an increased maximum payload capacity (272 kg).

Interoperable through the Tactical Control System, and compliant with STANAG 4586, the USN Fire Scout's baseline modular mission payload comprises a FLIR Systems BRITE Star II EO/IR/laser range finder/designator system and a voice/data communications relay. Northrop Grumman is meanwhile managing a competition for the supply of a multi-mode radar (MMR) to complement the MQ-8B's EO sensor suite and provide multiple modes of operation (including inverse synthetic aperture radar and moving target indication) in support of ISR operations. The company has already self-funded flight demonstrations of an MQ-8B fitted with a Telephonics RDR-1700B radar.

The first batch of MQ-8Bs ordered under system design and development (SDD) was contracted for in June 2005, the last two (of nine) SDD aircraft being ordered in February 2007. The first of these flew in December 2006, and 'Milestone C' approval was achieved in May 2007, clearing the MQ-8B for low-rate initial production (LRIP). A further nine air vehicles have since been ordered in three batches of three (LRIP1-3).

In 2008, the USN announced that Fire Scout would undergo flight testing and operational evaluation (OPEVAL) from the *McInerney* as a risk reduction prior to LCS shipboard integration. An initial embarkation was undertaken in December 2008 for fit checks and integration testing. This was followed by a late April 2009 test which encompassed initial shipboard landings, UAV Common Automatic Recovery System (UCARS) wave-offs, and rotor blade engage/disengage wind limit testing.

This was followed in the first week of May 2009 by test flights designed to explore shipboard deck motion and wind envelope expansion, and landings (including the use of a grid and harpoon system). All flights used UCARS for vehicle position data during shipboard recovery.

During the five days of testing, the ship/aircraft team chalked up 19 flight hours during 12 fights, including 54 landings, 37 of which were into the NATO standard grid. Operations were conducted with ship speeds of up to 26 km/h, ship roll of up to five degrees, and wind over deck of up to 46 km/h.

Two of the three MQ-8Bs from LRIP1 were deployed aboard *McInerney* in October 2009 for use on a scheduled operational deployment to complete a Fire Scout military utility assessment. Continued flight operations and OPEVAL on *McInerney* will prepare the aircraft for operations from both variants of the LCS.

CAMCOPTER AT SEA

In Europe, the Austrian-based Schiebel Group is pressing the merits of its multi-role Camcopter S-100 rotary-wing UAS design to meet emerging MUAV requirements. The S-100 is already in series production for land-based operations, and Schiebel has performed extensive shipborne trials and demonstrations for interested navies.

In fact, the company now has two contracts in place for maritime users. Neither customer can be disclosed for contractual reasons, but Schiebel expects that at least one will achieve a full shipborne operating capability during the course of 2010.

Schiebel's Camcopter S-100 UAV seen performing deck landing trials with the French Navy. *(Photo: Schiebel)*

Compared to Fire Scout, the Camcopter S-100 represents a very different class in terms of both size and weight. Its MTOW is just 200 kg (versus over 1,400 kg) and it has a rotor diameter of just 3.4 m (less than half the 8.4 m of Fire Scout).

Powered by a Diamond rotary engine delivering 50 hp at 7,100 rpm, the S-100 uses a carbon-fibre monocoque airframe, which Schiebel says gives a superior strength/weight ratio, and provides maximum capacity for a wide range of payload/endurance combinations. The air vehicle has a maximum speed of 222 km/h (cruising at 100 km/h for best endurance) and a ceiling of 5,500 m.

With an MTOW of 200 kg, its gross payload (sensors and fuel) is around 100 kg (of which the maximum sensor payload is 55 kg). Typically, with a 25 kg sensor package, endurance exceeds six hours on internal fuel.

Two payload bays are incorporated into the design, together with side hardpoints and an internal auxiliary electronics/avionics bay. The primary payload compartment, located directly beneath the main rotor shaft, is capable of mounting payloads weighing up to 50 kg. Payload options include the Selex Galileo PicoSAR synthetic aperture radar and/or a gimballed EO/IR sensor turret such as the IAI Tamam POP-200, Thales AGILE 2 or FLIR Systems MicroSTAR II (all three falling into the 15-25 kg weight class).

NAVAL TRIALS

Schiebel says that the S-100 is well suited to maritime applications, pointing to its rugged design and robust tripod landing skid arrangement (able to survive impacts of almost 10 g). It is also capable of landing on ship flight decks without recourse to additional landing aids or entrapment equipment.

For shipboard operation, the standard Camcopter GCS and software package are employed, with an additional inertial measuring unit being bolted onto the ship's deck to record and measure the vessel's movement, data which is passed both to the ➤

ScanEagle soars above

The ScanEagle lightweight fixed-wing UAS produced by Boeing's Insitu subsidiary has firmly established itself in the shipborne arena following over four years' service with the USN. Moreover, its success demonstrates that VTOL is by no means the only modus operandi for the MUAV category.

Designed to offer a cost-effective persistent ISR capability, the ScanEagle air vehicle trades on its compactness, simplicity and robustness. Moreover, the combination of a launch catapult and Insitu's proprietary SkyHook system enables launch and recovery capture at sea, making it runway-independent and minimising its impact on shipboard operations.

Capable of flying above 1,500 m and loitering in its area of operations for more than 24 hours at a time, ScanEagle carries inertially-stabilised EO or imaging IR cameras that allow the operator to track both stationary and moving targets. The air vehicle is launched autonomously from the pneumatic SuperWedge catapult and flies either pre-programmed or operator-initiated missions, being recovered using the patented SkyHook (which performs captures by way of a rope suspended from a 15 m high tower).

ScanEagle's diminutive size, coupled with low visual and IR signatures, engender excellent stealth characteristics. Furthermore, an advanced muffler reduces the vehicle's noise footprint.

The USN introduced ScanEagle in July 2005, with the system since having operated from a broad range of platforms. As of late 2009, the service had flown in excess of 1,600 sorties, with the system having in recent times found gainful employment in the Gulf of Yemen as an important asset in anti-piracy operations off the coast of Somalia.

ScanEagle has also been trialled from a Royal Navy Type 23 frigate as part of the Joint UAV Experimentation Programme (JUEP). The first trial, undertaken in March 2005 at QinetiQ's Hebrides range, demonstrated control of the ScanEagle from HMS Sutherland. *Further JUEP trials were conducted in March 2006 under the auspices of Trial* Vigilant Viper. *This activity sought to further extend the capability demonstrated by ScanEagle, and successfully achieved the first UAV launch and recovery from an RN warship.*

Other navies have since trialled ScanEagle. Boeing Defence Australia in early 2009 conducted a trial with the Republic of Singapore Navy, which saw the air vehicle launched and recovered from the flight decks of both a frigate and a landing ship (tank) vessel. The demonstration saw the ScanEagle configured with an EO camera for day missions, switching to an IR imager at night.

A ScanEagle UAV is launched from the flight deck of the amphibious assault ship USS *Saipan*. *(Photo: US Navy)*

In November 2009, Insitu announced a successful flight demonstration of ScanEagle from the Canadian Kingston-class *coastal defence vessel HMCS* Glace Bay. *According to Insitu, the demonstration conducted by the Canadian Forces Maritime Warfare Centre consisted of an in-flight hand-off of the ScanEagle by Canadian Navy personnel aboard* Glace Bay *to a land-based GCS operated by Canadian Army personnel at the Halifax naval base. The mission profile included locating and tracking pre-positioned vessels and suspicious onshore activity, as well as objects and divers in the water.*

controller and the aircraft. The control system gives a landing accuracy commensurate with a NATO-standard 2.75 m diameter deck landing grid.

Low ship impact and reduced costs of ownership are seen by Schiebel as key discriminators. Only three ground crew are required for sustained operation at sea, and its support overheads and ship footprint (in terms of manning, accommodation and hangar requirements) are designed to be somewhat less than that anticipated for larger rotary-wing UAV systems.

Recent years have seen the S-100 put through its paces by a number of navies. Having completed trials aboard the Indian Navy's offshore patrol craft INS *Sujata* in October 2007, the Camcopter also undertook flight trials from a Pakistan Navy Type 21 frigate in March 2008. A month later it was tested off Africa aboard the Spanish Civil Guard patrol vessel *Rio Miño*.

In mid-2008, the German Navy conducted three weeks of trials with the S-100 in the Baltic on board a K130 corvette. More than 130 take-offs were completed with MTOW in excess of 190 kg. The relative wind speeds over the deck reached as high as 74 km/h and the roll angle more than 8 degrees. With no handling aids and a wet deck, the aircraft showed it could withstand roll angles exceeding ±15 degrees.

Following this, 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 conditions reaching slightly above sea state 3. The system was subsequently transferred to the frigate *Montcalm* for another three days of trials in the Mediterranean. These included the first use of the DCNS-developed Système d'appontage et de décollage automatique (automatic deck landing and take-off system).

In 2009, Schiebel and Boeing concluded a tie-up under which the latter is leading marketing activities for the S-100 to potential US customers. While it is acknowledged that there is some market crossover between the S-100 and the Boeing/Insitu ScanEagle (see box), both companies believe that the types are, in the main, complementary to each other within Boeing's wider UAS family.

Saab plans to start deck landing trials of the marinised Skeldar V-200 during 2010. *(Photo: Saab)*

EMERGING COMPETITION

A number of other candidate MUAV designs are waiting in the wings. Saab's Skeldar V-200 rotary-wing UAV – very much aimed at the same niche as the S-100 – for the time being remains in the developmental/pre-production phase, but the company makes no secret of its ambitions in the naval market. Saab has stated its intention to start deck landing trials in the course of 2010.

The last 12 months have witnessed a period of intense activity for Skeldar's development team, with the launch of cooperative engineering development and test activities with Swiss UAV. Extensive flight testing of the V-200 demonstrator has sought to prove new subsystems and expand the flight envelope, and in August Saab performed a first flying demonstration for a potential customer, which it describes as 'very successful'.

A number of marinisation activities are proceeding in parallel, with the first step being the integration of the UAS control station with Saab's 9LV Mk4 combat management system. Saab has also started to adapt the air vehicle to withstand the rigours of the maritime environment, and has additionally begun development of a heavy fuel engine better suited to shipborne operations than the existing gasoline powerplant.

Another MUAV approach, being advanced by the Malat division of IAI, is to install remote controls in a standard shipborne helicopter so as to leave its ship impact essentially unchanged and minimise certification requirements. Based on the company's Helicopter Modification Suite (HeMoS) for existing manned naval VTOL platforms, the Naval Rotary UAV (NRUAV) is designed to combine automatic vertical launch and recovery from dynamic (naval) platforms with an organic multi-sensor and communications payload, offering real-time ISR, over-the-horizon targeting and damage assessment.

Both shipboard equipment elements and the air vehicle mission package leverage technology already proven on IAI's Heron and Searcher fixed-wing UAVs. The NRUAV design shown by IAI Malat is based on the HAL Chetak helicopter, a choice dictated by a near-term Indian Navy requirement. Two prototypes are reported to be supporting development and flight test activities.

Shipboard elements of the NRUAV consist of C2 stations integrated into a ship's combat information centre and its existing hangar, traversing and securing systems. With a mission equipment payload of 200 kg at maximum fuel weight (internal fuel only), it is estimated a pilotless Chetak in NRUAV configuration should be able to stay on station 90 km from its host platform for four hours, or for six hours with a 150 kg payload. Sensor options include an IAI Elta EL/M-2022 MMR, an IAI Tamam MOSP EO sensor turret, and radar and/or communications-band electronic surveillance systems. UV