

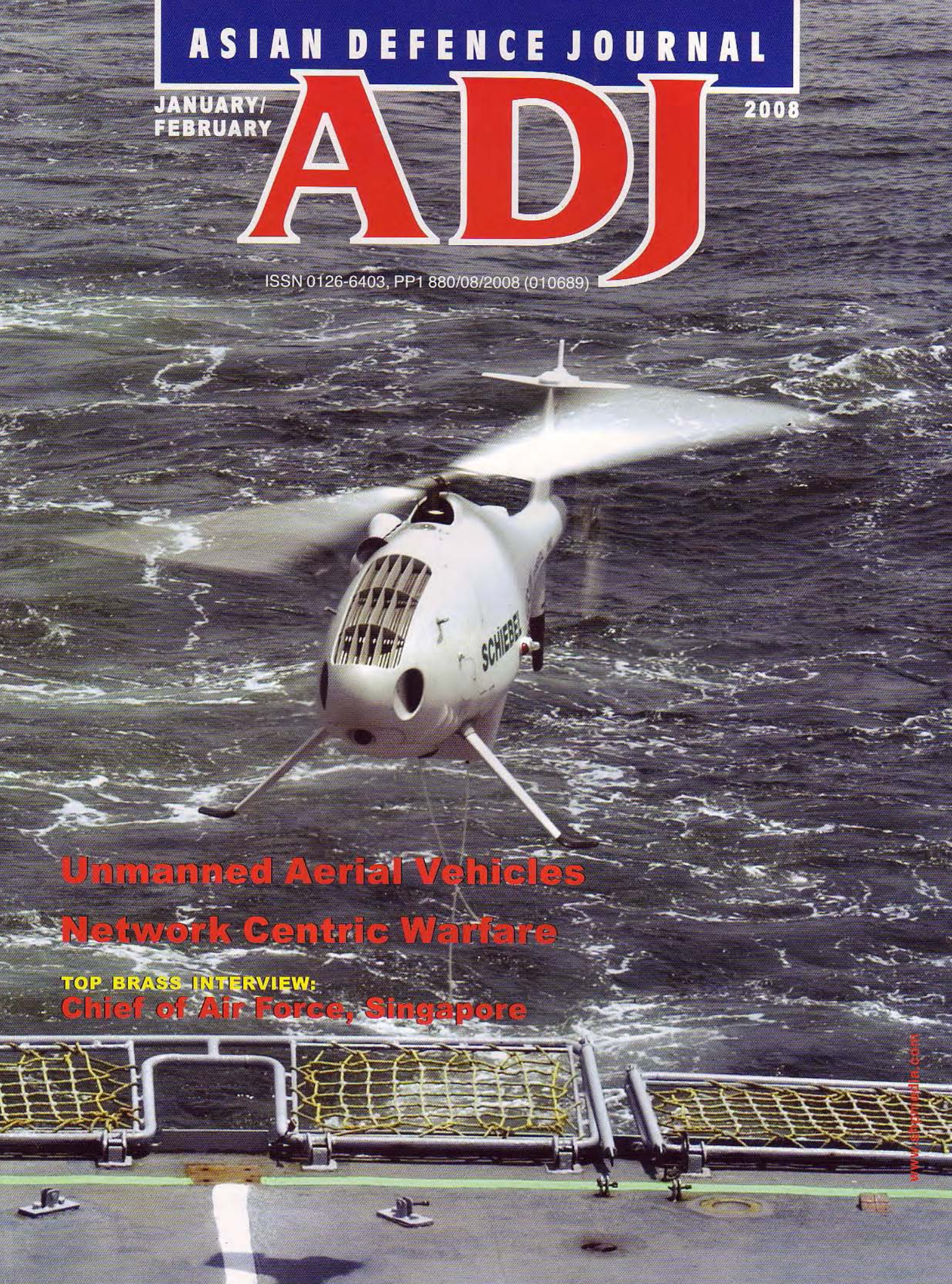
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**Unmanned Aerial Vehicles  
Network Centric Warfare**

**TOP BRASS INTERVIEW:  
Chief of Air Force, Singapore**

# Further Development of the **Camcopter**



**Now** that it has delivered more than 40 of its Camcopter S-100 Vertical Takeoff and Landing (VTOL) UAV systems to its launch customer in the United Arab Emirates, Schiebel Industries AG of Austria is increasing its activities in the rest of the Asian continent, the highlight being a shipboard trial with the Indian Navy in October.

The S-100, which will be on display at the Singapore Airshow 2008, is a helicopter-type unmanned aerial vehicle system designed for both civil and military uses. Designed from the start to match or exceed the performance of similar-sized fixed wing UAVs, the S-100 features a 120kts dash speed, 50-plus kg payload capacity, and an effective datalink range to 180km (97nm).

In October, the Indian Navy became the first potential customer to witness the S-100's shipboard capabilities, conducting flight operations from one of its 103-metre long, helicopter-deck equipped *Sukanya*-class offshore patrol vessels in the Arabian Sea. Equipped with both fixed and gimballed cameras, the S-100 provided real-time video surveillance from an altitude of 12,000 feet and 25nm (46km) from the ship.

The S-100's capabilities have obvious applications for Asian customers, such as in the fight against piracy and prevention of terrorism in the Straits of Malacca. The Camcopter system's range and endurance (up to 6 hours in its standard configuration) make it an ideal tactical surveillance tool for policing

the Straits as part of the cooperative efforts now underway by the Indonesian, Malaysian and Singaporean governments. Indeed, all three of these governments have expressed serious interest and have attended demonstrations of the S-100 system.

The system's network-based concept allows individual Aerial Vehicles to be handed-off between control stations, meaning that the S-100 could fly considerably farther than its datalink range would normally allow, allowing, for example, a ship-launched S-100 to follow a suspect vessel, and even be handed-off to a ground-based control station to pursue the crew on land.

On the purely civilian side, the S-100's precision navigation system and advanced sensors, such as infrared and multi-spectral, makes it ideal for performing land surveys for agricultural, environmental or infrastructure monitoring, replacing the costly manned aircraft that are currently used for such purposes.



## Underway in the Arabian Sea

While the Camcopter S-100 has now been in active land-based service since early 2006, the demonstration for the Indian Navy gave Schiebel the opportunity to show off its shipboard capability. Maritime operation has always been a priority for the system, which is constructed entirely from non-corroding materials and whose VTOL capability makes it a natural fit for shipboard use.

Though the shipboard trial was limited, due to the Indian Navy's ongoing operational commitments, to one day for installation in port and one day at sea, this gave an opportunity to showcase the logistical flexibility of the S-100. After arriving at the Indian Navy's base in Cochin, Kerala, the S-100 flew a land-based demonstration for VIPs from the Indian military. The demonstration also served as an evaluation of the technical and safety aspects of the system, for example by conducting an impressive test of the S-100's loss-of-link automatic return and automatic landing capabilities.

Following the land-based demonstration, the complete system was loaded and installed aboard the ship within just a few hours. During the course of the demonstration, Schiebel also showed that the entire system, consisting of two aerial vehicles and ground equipment, could be transported in one of the Indian Navy's Sea King helicopters. This further proves the value of a VTOL system such as the S-100, which, unlike fixed-wing UAVs, requires no special launch or recovery equipment that can add significant logistical difficulties. The Camcopter can conceivably be used for maritime patrols on sea one day, and be quickly transported to support land-based operations.

The actual shipboard flight trials were preceded by static tests to demonstrate to Schiebel and the Indian Navy's satisfaction that no electromagnetic interference (EMI) would occur between the ship's radar and communications systems and the S-100's data links, and vice-versa. No conflicts being found, a series of engine runs with rotor blades turning at various sea conditions and ship speeds were conducted to validate the aerial vehicle's onboard navigation system's ability to cope with the relatively large accelerations while on the ship's deck and to assure that it remained firmly on the helicopter deck.

The first flights were simple takeoffs and landings with the ship underway at a speed of 8kts. The system's fly-by-wire flight control system demonstrated its ability to maintain a relative position to the ship's deck, receiving precise position and orientation information from a GPS and inertial measurement unit placed on the ship's deck. After commanding the takeoff climb, the operator then let go of the joystick used for manual control and the S-100 maintained its position and orientation relative to the ship's deck.

Schiebel's operators performed takeoffs and landings at progressively faster ship speeds, until the ship was cruising at 16kts with up to 33kts wind over the deck. Manoeuvres were conducted at close range from the ship, demonstrating to the impressed audience the aerial vehicle's ability to maintain a fixed relative position to the ship while the ship executed various heading changes. During the flight, the system was switched between relative and absolute navigation, alternately following the ship and then proceeding to fixed coordinates input with a point-and-click on the laptop control stations' 3D map interface.

The capstone of the demonstration was a flight to demonstrate the S-100's ability to provide beyond-the-horizon surveillance capabilities. The aircraft flew via waypoints to a distance of 25km (46nm) from the ship, and to an altitude of 12,000ft (3,660m) above sea level.

## Interest from all Seven Seas

In addition to the interest from the Indian Navy, the S-100 system has also been selected by the German Marine (Navy) and is under evaluation by the UK Royal Navy for maritime use. In the UK, the S-100 is competing in response to an urgent operational requirement for its ongoing operations in the Northern Arabian Gulf.

Both the Spanish Guardia Civil and Navy have expressed interest, and are discussing potential demonstrations with Schiebel. The Pakistani Navy, which has long been interested in a shipboard UAV capability, is now in detailed discussions with Schiebel for a demonstration in the near future and possible acquisition of multiple S-100 systems.

In France, the shipbuilder DCNS is in discussions with Schiebel with the goal of integrating the Camcopter system with the advanced frigates that it is providing the French and other navies, as well as ships still on the drawing board. Schiebel sees this as a great opportunity to further refine the S-100's shipboard capabilities by working with a shipbuilder to integrate the system directly, rather than the more cumbersome (but as evidenced by the Indian demonstration, still fully practical) task of "bolting on" to an existing system.

- The German Marine has selected the S-100 along with General Atomics' Predator B medium altitude, long endurance (MALE) UAV for purchase as part of the initial phase of its Imaging Surveillance System for the Depth of the Employment Area (SAATEG) programme. Though the final details have yet to be settled, the Marine plans to integrate the S-100 with its new *K-130*-class corvettes to provide close-range surveillance capabilities. The Predator B would maintain a broader overwatch of the employment area, providing position and initial imagery of potential targets that the corvette/S-100 team could then investigate in detail. The first trials of the S-100 system are scheduled to begin in early 2008.

Schiebel has already begun deliveries to multiple unnamed customers, for whom shipboard and operation over the open seas is a top priority. During the acceptance trials for one of these customers, the S-100 demonstrated its maximum range capabilities over open ocean.

**Future Improvements**

As shown to the Indian Navy, the standard S-100 system that has proven itself for land-based use can quickly be installed on a ship and operated effectively without modification. However, Schiebel is continuing to work on further improvements to make the system more attractive to the world's navies. For example, Schiebel is developing a UAV-scale hook-and-winch system for use with NATO-standard helicopter flight-deck grids. The hook-and-winch system will provide further safety during landings in extremely high seas.

During the flights for the Indian Navy, the system demonstrated its "semi-autonomous" recovery capability, flying autonomously to a pre-designated initial approach point a fixed distance relative to the ship, with the aerial vehicle's onboard fly-by-wire flight controls assisting the pilot by matching the ship's forward speed and flight deck movements during the final approach and touchdown on the ship's helipad.

While this method has been proven with the S-100's predecessor aircraft (the Camcopter 5.1) in conditions up to Sea State 6, Schiebel is currently developing a fully autonomous shipboard landing system for future use. A number of potential solutions are being investigated, with a goal of having the winning solution integrated by the end of 2008.

Perhaps the most important step towards an ideal maritime UAV system will be the implementation of a heavy-fuel variant of the S-100's existing rotary engine. The aerial vehicle is currently fuelled by aviation gasoline (AVGas). Schiebel began testing the new variant of the engine, designated the S-1X, in January 2008.

The key feature of this engine is a modular direct-injector that will allow the use of heavy fuels when preferred (the US Army has also opted for heavy fuel in order to simplify logistics), but also allow the engine to run on AVGas with the standard fuel injectors installed. Not only will this improvement allow the use of heavy fuels, but other design optimisations will increase the engine's power to 60hp, thus increasing the S-100's performance. The S-1X, which will be available as a form, fit, function replacement for the existing engine, will be available by the middle of 2009.

Schiebel is also continuously integrating the latest payloads to meet customer's requirements. New high-performance, low-weight synthetic aperture radars, such as the Selex PicoSAR and Thales Ocean Master, will soon allow the S-100 to carry a radar in addition to a stabilised EO/IR gimbals system such as the Agile 2 offered by Thales.

**Back on Solid Ground...**

Interest from Asian customers is not only limited to maritime usage, nor to military/police applications. Numerous companies whose livelihoods depend on infrastructure, such as pipelines and power transmission lines, have shown interest in the S-100. Various solutions for pipeline and drilling platform monitoring, to perform preventive maintenance and detect leaks and illegal taps, have been proposed to petroleum companies all over the world.

Indeed, one system has recently purchased by one of the world's top petroleum companies with the aim of exploring the different ways in which it will aid them in securing their infrastructure. Though confidentiality agreements prevent Schiebel from disclosing the name of the customer at this time, it is expected that once results are made public, it will place Schiebel in an ideal position to capture a large share of that potentially lucrative market.

A Korean company, UAS Centre, has acquired a Camcopter system for quite a different application. After delivery in the second quarter of 2008, their S-100 will be fitted with spraying equipment to be used as a crop duster. Once initial trials are completed, the programme is designed to be expanded in the region.

Not content with the wide variety of earthly opportunities, Schiebel is also participating in the European Space Agency's (ESA) "Mars Lander" programme. Though there are no plans for a Martian version of the S-100, the aircraft will be used by the ESA to test various payloads and Mars Lander sub-components in flight trajectories

similar to those the Lander will encounter when it reaches Mars in the next decade.

**Airworthiness Certification**

To facilitate operation in civilian airspace, the S-100 has been designed from the ground up to meet the applicable manned aviation standards. In June 2007, the Camcopter S-100 became one of the first UAVs, and the first helicopter-type UAV, to receive a "Permit to Fly" from the European Aviation Safety Authority (EASA). This permit allows the S-100 to fly under EASA-approved conditions until such time as a type certificate is issued. Schiebel has already had preliminary discussions with several Asian aviation authorities, including the Civil Aviation Safety Authority (CASA) in Australia and Department of Civil Aviation (DCA) in Malaysia.

**Full Speed Ahead**

The Singapore Airshow 2008 will be an important venue for the Camcopter S-100 and it is no accident that Schiebel has made it a priority to appear in Southeast Asia. The technical sophistication of the market and unique challenges facing it make it one of the most attractive UAV markets in the world. Though some of the region's domestic UAV programmes will certainly compete with the S-100, Schiebel also sees enormous opportunities to work together with domestic industry to create solutions tailored to each individual customer.

Schiebel is looking forward to giving the public its first look at this unique UAV system, not to mention a second look for many of the VIPs from around the region that have previously been introduced to the system. ■

