

When the Saab Group acquired Seaeeye Marine in 2007, one of its strategic objectives was to investigate the potential of broadening and adapting its military-based subsea technology for use in the civil offshore/marine market. There were clear synergies between the autonomous vehicle portfolio of Saab Subsea Systems and the electrical remotely operated vehicle (ROV) systems developed by the Hampshire-based manufacturer. What this also gave Saab, was access to Seaeeye's wealth offshore market expertise that could enable the expanded group to collaborate in pursuing alternative market opportunities.

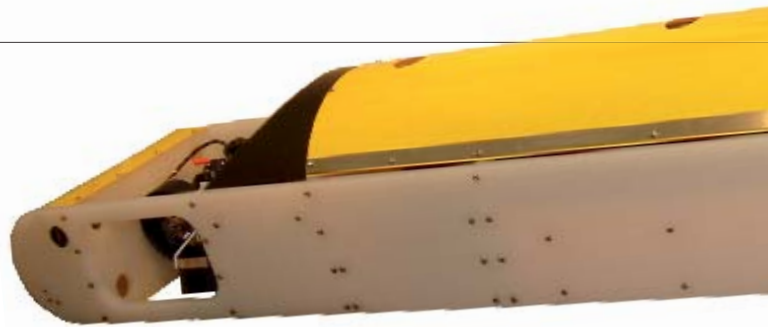
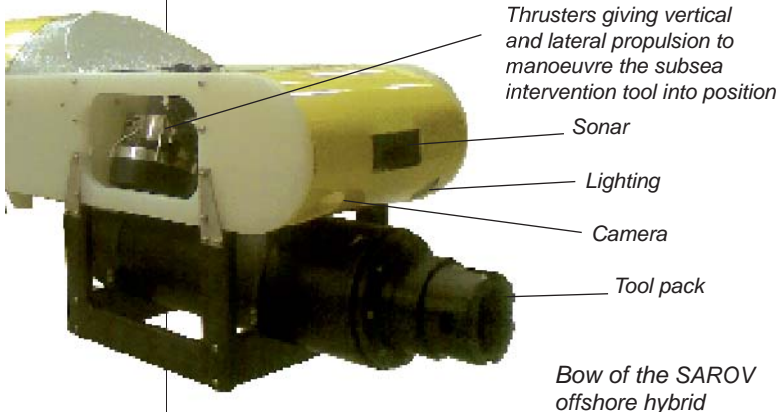
Now, two years later, Saab Underwater Systems has unveiled its first civil product – the SAROV Offshore Hybrid. This concept could realistically have significant practical ramifications on how future deepwater observation and intervention activities are conducted, and Saab is working closely with Aker Solutions on ways to practically develop the technology. An introductory system was unveiled at Offshore Europe in Aberdeen, inviting industry comments before the complete system is formally launched next year.

“Saab Underwater Systems has a strong background in developing unmanned underwater vehicles, traditionally for mine countermeasure operations and search/recovery and potentially for maritime security and artificial targets,” said Sven-Inge Svensson, vice president of unmanned systems. “We have a good record, selling over 70 systems across the world. While the SAROV Offshore Hybrid is new, its components and systems have been tested over many years in parallel, but equally demanding, theatres of operation.”

One of Saab's most advanced military designs is the Double Eagle, a hybrid vehicle that combines the speed and cost-effectiveness of an untethered autonomous underwater vehicle (AUV) with power efficiency and flexibility of a tethered ROV (*UT² August/September 2008, p44–45*). Many of its features have now found their way into the new offshore Saab autonomous remotely operated vehicle (SAROV).

“The Double Eagle had to be large enough to afford it a high endurance while being able to carry a disposal charge for mine detonation. The SAROV Offshore Hybrid is designed more for observation and light intervention on distributed offshore infrastructure, thus necessitating a different design shape and specifications,” said Svensson.

While the SAROV Offshore Hybrid has a similar length to its military counterpart, it is available in two configurations:



Offshore

The double-hull SAROV Offshore Hybrid

single and double hull rated to 3000m water depth. Both are 3m in length and 450mm in height, however, the double hull increases the Offshore Hybrid's width from 400mm to 900mm and the launch weight from 250kg to 650kg.

The double hull increases the forward speed from 4kts to 5kts and the forward thrust from 30kgf to 100kgf (although the lateral thrust is marginally increased from 25kgf to 30kgf and the vertical thrust remains the same at 50kgf). This thrust may be a bit low for certain applications, but since the control system allows alternate thruster configurations, tool packs can include additional thrusters if needed without having to sacrifice size, weight and endurance for other missions. It also doubles the payload from 40kg to 80kg and increases the battery capacity from 8kWh to 14kWh which manifests as an increase from 2–4 hours to 3–10 hours.

ROV Mode

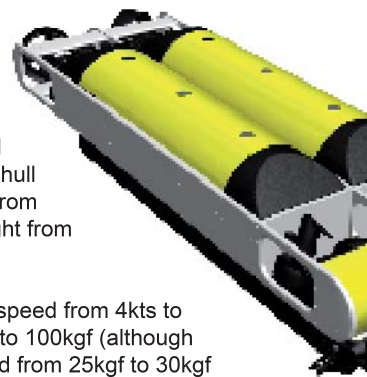
“When in ROV mode, the vehicle is connected to the surface facilities by an umbilical,” said Jan Siesjo, chief engineer at Saab Underwater Systems. “In the military versions, with their characteristic shallower water depths and shorter ranges the umbilical commonly provides both control and power.

“The SAROV Offshore Hybrid, however, contains its own power supply in the form of a bank of batteries located within the vehicle. This means that the umbilical can be reduced to a simple fibre optic line for communication (for control/data) only. This fibre optic tether is so light, that it obviates any clashing problems when looking at risers and mooring systems in FPSOs that might be expected in more traditional vehicles.”

AUV Mode

Various autonomous vehicles are commonly used in the offshore sector to carry out pipeline or grid pattern surveys. For these, being able to ‘fly’ at speed is an advantage, and they consequently feature a smooth hydrodynamic morphology with thrusters positioned at the stern.

The SAROV Offshore Hybrid departs from this classic AUV shape because its intended function requires manoeuvrability rather than speed. It would need to fly near or within a subsea

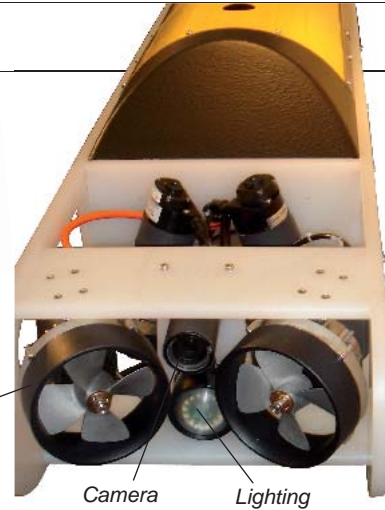




The SAROV Offshore Hybrid

Hybrid

Four DC brushless thrusters for propulsion and manoeuvring



Camera Lighting

Stern of the SAROV Offshore Hybrid

The solution envisaged by Saab is a number of toolboxes located at the base of the docking port where the vehicle would select the appropriate device to interface with subsea structure componentry.

“The advantage of locating the AUV subsea is that it reduces the requirement and therefore, costs, for ROV or AUV support vessels,” said Svensson. “Availability of surface vessels and equipment depends heavily on weather as well as market demand. Time spent waiting on weather goes up from 8.5% in summer to 28% in winter on the Norwegian continental shelf.

“The SAROV Offshore Hybrid design is a good example of the benefits of combining the teams in Sweden and Hampshire,” said Svensson. “The lightweight polycarbonate vehicle frame is redolent of those across the entire Saab Seaeeye ROV range, while the tried and tested DC brushless thrusters are also similar to those found in the ROVs.”

“Conversely, the navigation software is borrowed from Saab Underwater Systems’ AUV suite, which allows the vehicle to digitally recognise position from inbuilt maps. Thus a virtual template structure can be assembled within the Sarov’s memory obstacle avoidance software within the navigational circuitry.”

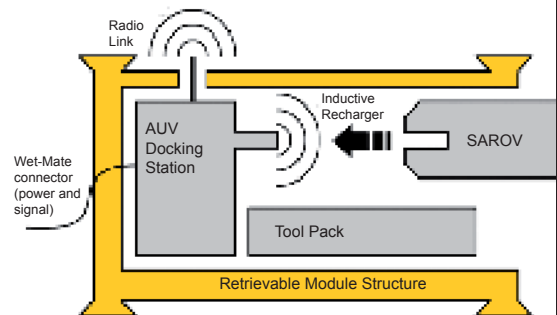
production system’s protection frame in order to examine or interface with individual components. This instead favours a structure that is thin enough to pass through smaller gaps under a protective covering, with thrusters at either end that allow 360deg movement in three dimensions. Another application might be to inspect risers in a floating production, storage and offloading (FPSO)vessel. In free flying mode AUV, it can swim within the pipes or mooring lines to perform automatic inspection.

It is not so much the vehicle shape, however, but how it will be deployed that could realistically open up a new horizon in inspection vehicle methodology.

The idea envisages the SAROV Offshore Hybrid being semi-permanently installed on the seabed within a retrievable modular structure located near a template or manifold, with habitation times of up to six months. The AUV itself would be connected to a docking station from which it would receive power from an inductive port, while instructional commands would be relayed wirelessly from a radio link via the template’s communication umbilicals. Steering and docking could be carried out manually, automatically or semi-automatically. Once the operation has concluded, it could send the survey information back to the docking station. The data stream would then be wired back to the template/manifold and eventually routed to the surface control facility.

While this general idea is not new, Saab Underwater Systems are actively cooperating on the concept development of the SAROV system with subsea equipment manufacturer Aker Solutions of integration and adaptation of the subsea installation for AUV inspection, maintenance and repair (IMR) operations. A full-scale integration on selected subsea production systems will contribute to Aker Solutions life-cycle service philosophy.

This mission could be simple observation task or a more complex maintenance operation which might require semi-specialist equipment, such as a torque tool. It is likely that a number of tools might be required to carry out an operation. Carrying a number of tools on one vehicle would add weight and possibly impair its manoeuvrability.



Stern of the SAROV Offshore Hybrid. The connection between the docking station and the SAROV is non-mechanical in order to avoid wear and tear of the connectors. The SAROV is recharged by induction which may deliver up to approximately 2kW with current technology (7 hours to full recharge of the battery). Communication may go through a wireless radio modem implemented on the docking station.