[Key Facts]

- Subsea 7 has joined forces with SeeByte to develop a prototype autonomous inspection vehicle (PAIV).
- The PAIV can be used as a de-risking platform for 3D tracking of structures.
- Its new capabilities can be easily interfaced as new payload modules or be made to replace existing core modules.

Subsea 7 and SeeByte have collaborated on the development of a prototype autonomous inspection vehicle with a unique potential to revolutionise life-of-field projects. Subsea 7 global technology manager John Mair tells *World Expro* how the innovation can reduce costs and make lighter work of increasingly tough conditions.

On closer inspection

As offshore oil and gas exploration and production has evolved over the last decades more and more infrastructure is being installed on the seabed, of increasing complexity, in deeper water and of increased criticality to successful operations. Installation, support and maintenance of this equipment is currently carried out using specialised vessel based Remotely Operated Vehicle's (ROV's) and/or diving operations. To meet this challenge, new concepts of operations and novel solutions are required.

Subsea 7, one of the world's leading subsea engineering and construction companies servicing the oil and gas industry, in collaboration with SeeByte, a leading provider of smart software solutions for unmanned underwater vehicles, is developing a Prototype Autonomous Inspection Vehicle (PAIV), which has the unique potential to revolutionise Life of Field projects.

The concept aims to provide operators with a capability deployed from a host facility to provide a low-risk inspection and light intervention system to aid field integrity management. This will significantly change the way in which offshore inspection and intervention activities are carried out and has the potential to significantly reduce costs by removing the need for a dedicated support vessel.

John Mair, global technology manager, Subsea 7 comments: 'The vision is to use know-how developed from many years experience of conducting offshore operations with the development of autonomous technology to provide support and maintenance of subsea equipment using a hover-capable Autonomous Inspection Vehicle (AIV) operating from a host facility such as a fixed platform or FPSO.

'The unique ability to operate directly from the host facility as opposed to an infield support vessel provides significant advantages where routine or unplanned inspections can be easily and frequently carried out without the need for a dedicated support vessel.'

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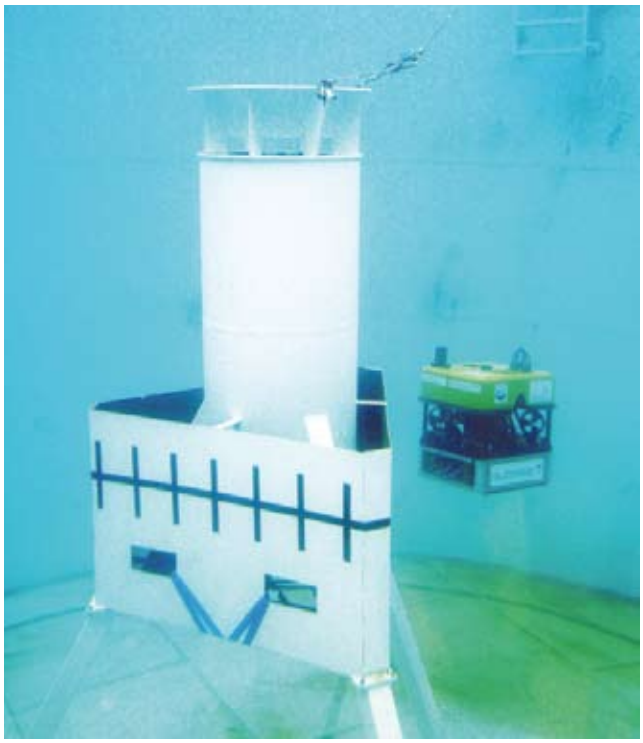
The continuous and efficient operation of oil and gas assets over many years is crucial to maximise the return on initial investments. The success of such operation must be supported by a full life-cycle suite of services to support, not only the initial development of subsea oil and gas fields, but also the maintenance and integrity management of these assets throughout their producing life. This smart AIV technology will provide operators with a cost effective, low risk inspection system to aid field integrity management.

To enable truly autonomous operation, the AIV will



The prototype autonomous inspection vehicle (PAIV) at work.

have no tether, enhancing the vehicles manoeuvrability and capability to access confined spaces with no potential for tether entanglement.

The PAIV is based on a converted inspection class ROV and does not have the hydrodynamic form that might be expected for a self powered vehicle. It is a prototype and as such its primary function is to provide a stable and robust platform to carry the smart sensors and systems required by the software during the de-risking phase of the development. The production vehicle, which will eventually be deployed for life of field support duty, will take the smart technology from PAIV and have a form factor that is tailored to the project specific seabed infrastructure.

The PAIV is being used as a de-risking platform for new modules and capabilities, for example 3D tracking of structures and navigating in the mid-water column without Doppler lock. These new capabilities can be easily interfaced as new payload modules or be made to replace existing core modules.

Outwardly, PAIV may appear unsophisticated but at its centre is some of the most sophisticated autonomous vehicle intelligence currently under development, anywhere. Its effectiveness has only been made possible by applying the best aspects of existing mechanical ROV design towards this new concept.

The deep ocean operation of ROVs has depended on the long term development of solutions to many complex engineering problems. These are easily comparable to those faced in other highly complex technology driven industries such as aviation. Progression from remote to autonomous technology has relied on the advancement of many of the accepted concepts found in ROV technology.

Evolution of remotely operated vehicles

The advances in ROV technology since its introduction to the oil and gas sector, some 30 years ago, have been meteoric. They have evolved from devices able to carry out a variety of simple inspection and maintenance tasks in relatively shallow water, to being the enabling technology for deepwater subsea oil and gas production worldwide.

Subsea 7 has played a leading role in developing this ROV and intervention capability, the company is now on a similar path with the PAIV programme which it believes to be the next technological step to meet these industry challenges.

For Subsea 7 this journey started in the late 1970s when the potential of ROVs was recognised, but their implementation was floundering due to a lack of reliability. However, the step change arrived when oil companies declared their desire to commit to the use of ROVs for drill rig support as opposed to divers, thereby providing the incentive for companies such as Subsea 7 to respond.

By the mid-'80s Subsea 7 had developed its purpose built drill rig support ROV 'Pioneer', the success of which led to a further 30 similar type units being deployed.

The success of these original systems encouraged the development of a range of vehicles improved and fashioned to meet increasingly complex requirements and environmental conditions, not only for drill rig support but also survey and construction.

In parallel with ROV development, add on tools and sensors were developed to be integrated with the vehicles making it now possible to maintain and operate subsea wells in much deeper water, automating many difficult tasks previously performed manually by the pilot.

As many of these tasks and associated tooling interfaces became routine, Subsea 7 played a key role in the industry with the formation of the ISO interface standards for ROV tooling and intervention.

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Subsea oil and gas production however continues to become increasingly complex, in deeper waters and more remote parts of the world placing a greater emphasis not only on equipment installation but its integrity and reliability.

Looking ahead

The vision of Subsea 7 and its partner SeeByte is for the introduction of hover-capable AIVs that will follow a similar evolutionary path to that of the ROV, culminating in the ability to provide an enhanced service.

Unlike the early ROV systems where the vehicle was under direct control of the pilot the latest generation of ROVs are controlled by computer with the position adjustments provided by the pilot, commonly referred to as DP (dynamic positioning). This brings some significant advantages in

Engineers monitor the PAIV's performance.

the safe operation of the equipment by designing into the control software behavioural characteristics that will not allow potentially unrealistic or dangerous demands to be carried out. For instance, when working close to a seabed asset and sudden bad visibility is encountered the pilot can fix the vehicle position mid water until the visibility improves.

The PAIV programme will develop this intelligence a significant step further. The vehicle will have intelligent goal based mission control systems that use information from the onboard sensors to adjust the intended mission plan to accommodate unforeseen interference.

Mair concludes: 'Our involvement in this programme results from Subsea 7's ambition to be the Subsea partner of choice in the subsea engineering, construction and technology sector and is underpinned by our reputation as a pioneer of ROV and remote intervention technology.

'In order to meet our customers' evolving needs, Subsea 7 is committed to developing new cost-effective solutions to meet the challenges of subsea oil and gas field development and maintenance activities in increasingly deep water and remote locations. We believe that our new generation of AIV, being developed with SeeByte, will be a key component of this strategy.' ●

[John Mair]

John Mair is a mechanical engineer with 30 years' experience in the subsea sector of the oil and gas industry. He manages all the technology and R&D initiatives within Subsea 7. He is also a board member of Subsea UK and a member of the industry steering group for the recently formed National Subsea Research Initiative.