Efficient Construction and Survey Operations Using the ACV Intervention System

Technology for remotely operated vehicles (ROVs) has evolved rapidly over the last 20 years, driven mainly by the requirement to support development of deepwater oil and gas fields. As most intervention operations are now beyond diver depths and therefore require ROV intervention, the performance of the ROV system is a vital factor in the success of the offshore operation.

BY CALUM MACKINNON AND JASON STANLEY

As part of Acergy's new ROV fleet, the Acergy Core Vehicle (ACV™) system, was designed to improve the system's operational efficiency to optimise the commercial performance of the offshore operation. This involved implementing improvements to all system equipment, from the launch and recovery system to the tether management system (TMS), the ROV, and even the control console. The design process required careful review of the work involved in deck operations, deployment to the worksite, subsea navigation and positioning and intervention tasks.

Jointly developed by engineers in the Acergy group and at Schilling Robotics, LLC, the ACV system delivers two major step changes in how intervention operations are performed. Firstly, the vehicle can handle a high level of tooling, either within the vehicle centre-deck area or mounted externally. Secondly, the StationKeep™ control and positioning provides system provides a very accurate subsea dynamic positioning capability. These two features combine to enable the vehicle to provide a very flexible approach to tooling allowing it to be operated more efficiently.

***Acergy Core Vehicle** (photo: Acergy)*

Launch and Recovery System (LARS)

To improve the operational efficiency of the ACV system, Acergy required very high speed and precise control of the LARS for several operational reasons:

- Rapid deployment/recovery through the splash zone to increase the operating weather window.
- High-speed transit through the water column to and from the worksite to reduce deployment and recovery time.
- Active heave compensation during the docking operation between the ROV and TMS to avoid tether damage/parting.

Acergy required a winch system with a very compact footprint and low noise characteristics to suit the vessel locations. An electrically driven winch design was selected as an alternative to the traditional hydraulic system. Increasing the level of articulation of the horizontal A-frame position enabled the ROV/TMS assembly to be released at a much lower level, reducing the risk of impact damage against the vessel sides due to the pendulum effect. This was required for a number of vessel installations where the launch position was very high above the water line.

The implementation of electric winches and enhanced A-frame systems also increases weather capability and the efficiency of the offshore operation during launch/recovery and transit to the worksite.

Centredeck Intervention

ROV systems used in construction projects are typically required to operate a large variety of intervention tooling systems. On most vehicles, there is not enough space within the vehicle frame to accommodate these components, so traditionally they have been on an externally mounted toolskid under the vehicle or on the rear face, which have several operational disadvantages:

- Structural mounting onto the ROV frame can be complicated and time consuming.
- Manoeuvring the skids into position on the vehicle offshore may require a crane and can also be limited by weather.
- The component configuration in the tool-skid may affect the wash from the vertical or horizontal thrusters.
- The size or position of the tool-skid may affect vehicle dynamics and manoeuvrability.
- The manufacturing cost of tool-skids is typically doubled due to the structural framework and associated buoyancy.
- Packing and transportation can also be expensive, and require a dedicated storage space on the vessel.

***Electric AHC Winch** (photo: Acergy)*

To address the problems associated with externally mounted toolskids, the ACV system design incorporates a centredeck space in the middle of the vehicle for onboard tooling, including a tooling slide on both the port and starboard sides. Ballast lead of 75 kg is provided in each slide area to provide 150 kilograms total of tooling payload.

Installing centredeck tooling on the vehicle is as simple as removing a corresponding weight of lead ballast, installing and securing the centredeck module slide, and then hooking up to the vehicle's plug-and-play services. The slides can accommodate a large variety of tooling components within their operating envelopes, and each vessel is provided with a number of spare slides for ad hoc tooling.

The centredeck modules provide a step change in how intervention

High-Articulation A-Frame *(photo: Acergy)*

tooling is performed, as they provide, for the first time, a dedicated envelope within the vehicle for tooling and have the following advantages over externally mounted toolskids:

- Dedicated tooling envelope within the vehicle framework with a standard slide interface.
- Easy on-deck handling, installation, and hook-up of the slide modules.
- Centredeck modules are positioned so that they do not affect the vehicle thruster wash or vehicle manoeuvrability.
- Easy module storage on workshop shelves.
- Easy packing and shipping.
- Low-cost construction, with no buoyancy or frame required.
- Minimised on-deck turnaround time for tooling.

Rear-Mounted IHPU toolskid *(photo: Acergy)*

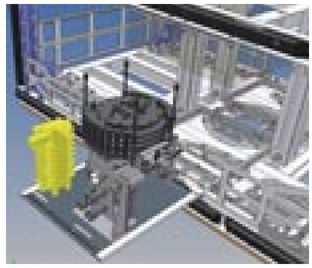
A number of centredeck isolated hydraulic power units (IHPU) have been developed for the ACV and are very compact and easy to transport both to the vessel location and between vessels at the worksite. They can be used on any ACV system and on a number of other vehicles when combined within a rear deck frame. This has the same slide interface as the centredeck tooling module and is designed to mount on the rear face of existing Acergy SCV ROVs and most third-party vehicle systems, again reducing project cost and operational logistics.

External Toolskid Interfaces

The ACV vehicle is designed to handle a large number of externally mounted toolskids or equipment items. The vehicle is fitted with the following structural docking interfaces on its framework to facilitate mounting of external components while greatly increasing the operational flexibility of the vehicle:

- The underside of the vehicle is fitted with a traditional four-pin vertical docking interface that is rated for a 3000-kg vertical load.
- The front, rear, and sides of the vehicle are fitted with a bespoke four-point docking interface that uses the structural integrity of the vehicle's top and bottom decks. These are each rated to handle a 1000-kg vertical load.
- The crash bar at the vehicle's front top can also be rated to handle a 250-kg vertical load.

This capacity is useful for mounting survey sensors and instruments.



Centredeck Slide Installation *(illustration: Acergy)*

Workbasket Skid

The vehicle can also be fitted with an underslung hydraulically actuated workbasket for general tooling support that is used to store utility tooling such as cutters, grinders, torque tools, and hot stabs for easy access by the manipulator for ad hoc operations. These tools are permanently plumbed into the vehicle for ease of operation and greatly increases the vehicle's operational flexibility.

Centredeck IHPU Module *(photo: Acergy)*

Suction Pump Module

As part of the ACV tooling development program, a large-capacity suction pump system has been developed for pile installation operations. Designed to interface to a standard structural interface frame on the suction pile, this system includes a landing deck, bull's-eye and water stab receptacle. The suction pump, control pod, and data logger pod components are configured to fit on a centredeck slide for ease of handling and installation.

The pipework from the pump is routed down through the workbasket and then out the vehicle front to a 4-inch water stab. A flowmeter is fitted in the pipework to accu-

Rear Deck Interface Frame *(illustration: Acergy)*

rately measure the pumping rate. The docking frame on the vehicle's underside is equipped with two-off docking probes and a tailhook arrangement at the rear and is mounted on the underside of the ACV workbasket. It could also be mounted directly to the ACV or any other work class vehicle.

Subsea Positioning

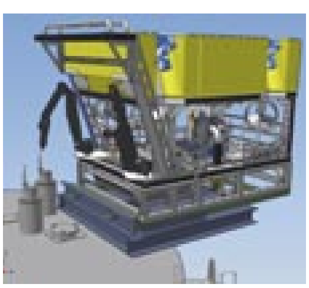
In addition to the high level of intervention tooling capability built into the vehicle, the ACV system offers StationKeep control and positioning capability. This provides the operator with the subsea equivalent of vessel dynamic positioning which enables the control system to take command of the vehicle and automatically maintains position relative to the seafloor. The ACV's instrumented hydraulic motors further enhance direction and speed.

The main sensor used in this process is a Doppler velocity log (DVL) which uses seabed tracking, altitude information systems and data provided by the onboard motion reference unit and gyro to provide the vehicle with automatic flight control and the ability to maintain position in the X, Y, and Z axes.

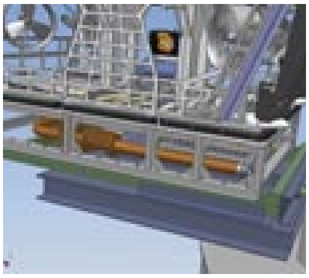
The main operational benefit provided by the StationKeep is the ability to "park" the vehicle in any location with the confidence that the vehicle will stay in exactly that position until instructed to move. This negates any problems associated with the pitch and roll of the platform, and allows the operators to accurately focus a camera on a specific target, perform a delicate manipulator task or carry out training. Heading, altitude, position and external forces, such as visibility and strong currents, are all maintained automatically, providing the operator with an exceptionally stable platform and is used extensively to relieve the pilot from continuously having to fly the vehicle.

The system also enables the ACV pilots to change the methods of not only operating the vehicle but also performing intervention operations. By ensuring the vehicle's position is maintained to suit the manipulator operations, less exertion is put on the five-function grabber arm, which often acts as a pivot point while the rest of the vehicle responds to forces exerted by the other manipulator or currents. The viewing angle is also opened and restrictions to the operating envelope of the seven-function manipulator are lifted.

While it aids in many intervention tasks, survey operations may not



***Suction Pump Mounted in Centredeck** (illustration: Acergy)*



***Flowmeter Arrangement** (illustration: Acergy)*

fully realise the benefits of enhanced control and automatic position capability. AutoTrack™, a utility that allows surveyors to direct the ROV to move forward across the seabed along a designated survey line, is one of the ACV's main survey applications to improve the quality and speed of seabed survey operations. The control system keeps the vehicle on the designated survey line, closing the control loop with feedback from the survey system and reporting any vehicle variances from the survey line. Other survey applications, such as riser inspection and pipeline inspection, will also benefit from this enhanced positioning and control capability.

Development

Engineers from the Acergy Group and Schilling Robotics are continuing to develop enhancements to the ACV system and associated technologies, which, following full field testing, will be retrofitted on the rest of the Acergy ROV fleet:

- The layout control console is currently being reviewed to improve operator ergonomics. This development involves a "cyberchair" that features ROV controls and control monitors located on the pilot seat.
- Applications for the StationKeep will be further developed to provide the ROV with even more options for positioning and manoeuvring subsea.
- High-definition digital video technology will be developed and implemented onto the ACV system to dramatically improve the quality of video capture, handling, presentation, and storage.

***StationKeep System** (illustration: Acergy)*

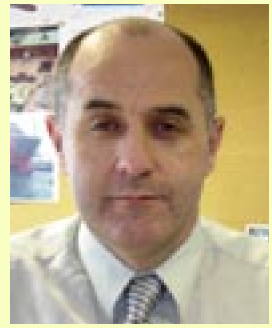
Efficient and Flexible

The ACV system was designed from the outset to provide a high level of operational efficiency. While the configuration and specification of the launch and recovery system increases the weather window for operations, it also reduces the deployment and recovery times for deepwater operations.

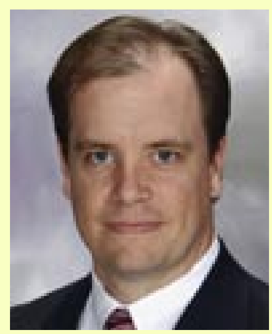
The integration of a high level of intervention interfaces and services into the vehicle design results in a very efficient and flexible suite of tooling. The StationKeep positioning and control system is a major step change in how ROV systems are operated and has proven to provide many operational benefits. These capabilities and technologies will be further developed on the ACV system as part of an ongoing development programme between the Acergy group and Schilling Robotics. ■

***Cyberchair Development** (illustration: Acergy)*

The Authors:



Calum MacKinnon – Chief Engineer, Remote Intervention, Acergy – is a degree qualified Mechanical Engineer with 23 years' experience in subsea construction and remote intervention systems design. He is the Chief Engineer within the Acergy Remote Operations (ARO) division and is responsible for remote intervention engineering on Projects worldwide. Mr. McKinnon was been instrumental in the development of the ACV system and is actively involve in various R&D programs within the Acergy group.



Jason Stanley – Regional Manager, Gulf of Mexico, Schilling Robotics LLC – has 19 years of experience in offshore operational engineering and management. At Schilling Robotics, he oversees sales and marketing activities for standard and engineered-to-order systems, including electrical and hydraulic ROVs. Mr. Stanley is also regional manager of the company's GOM office. He holds a BS degree in ocean engineering from Texas A&M University.