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ROVS

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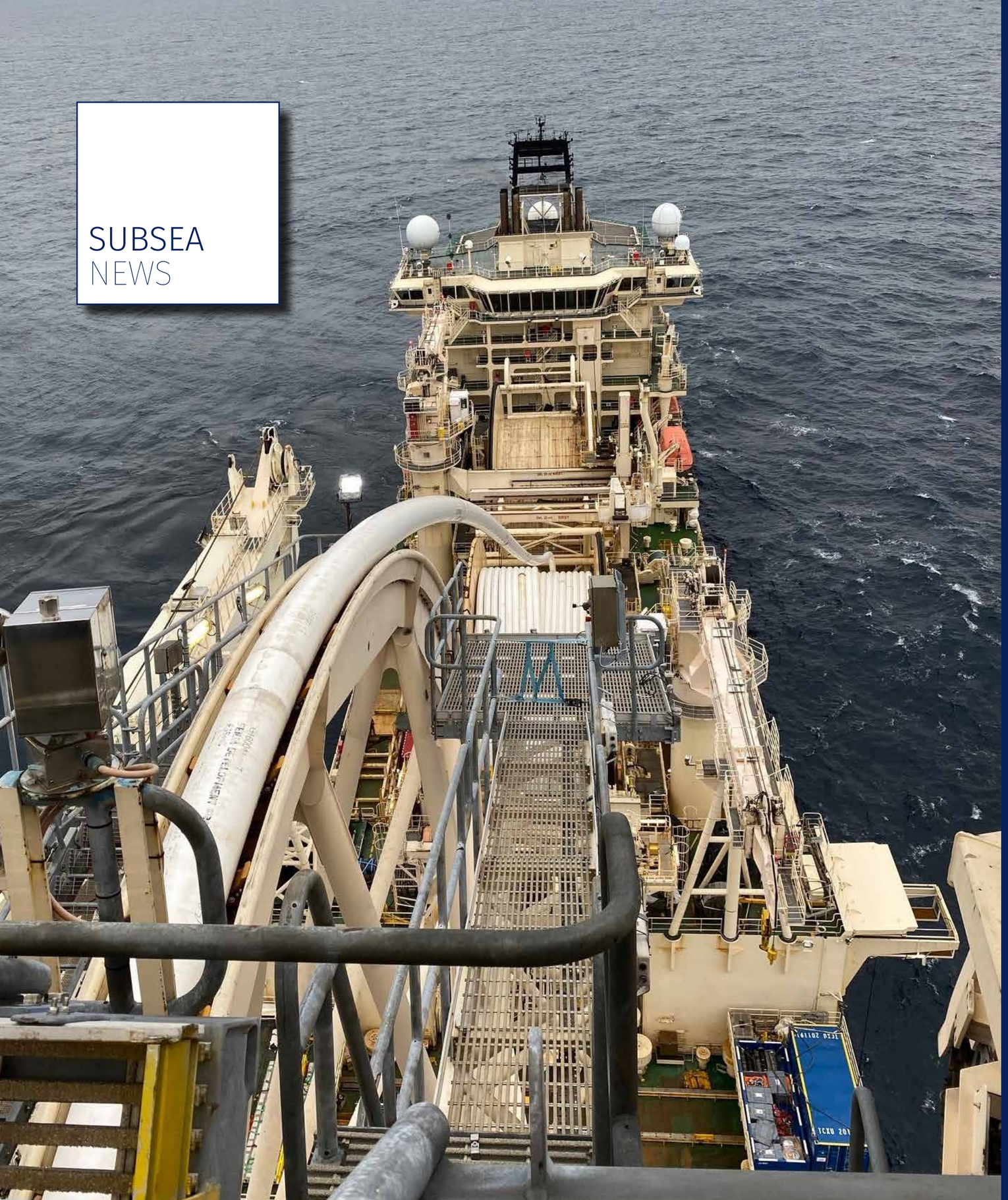
TechnipFMC's new ROV Gemini

SUBSEA NEWS



WORLD'S LONGEST HEATED PRODUCTION PIPELINE

Neptune Energy is currently installing the world's longest heated subsea production pipeline in the Norwegian sector of the North Sea.

Once completed, the 36 kilometre electrically trace-heated (ETH) pipe-in-pipe solution will transport oil from the Neptune Energy-operated Fenja field to the Njord A platform, operated by Equinor.

The first phase of the installation saw a 9km section safely installed and successfully tested.

Neptune Energy's Director of Projects and Engineering in Norway, Erik Oppedal, said: "The installation and testing of the ETH pipe is a great technical achievement, as well as a milestone in the development of the Fenja field.

"The heated pipe-in-pipe solution permits us to tie the field back to existing infrastructure, keeping costs low."

The length of the ETH pipeline is a significant technological achievement and was developed and qualified through a collaborative approach with TechnipFMC. Due to the high wax content of the Fenja field's oil, the contents of the pipeline must be warmed up to a temperature above 28-degree Celsius before starting the flow after a shut down.

During normal production, the temperature in the pipeline is well above this temperature.

Ståle Ryggvik, TechnipFMC's Project Director, added: "TechnipFMC is delighted that the extensive qualification program for the ETH Pipe-in-Pipe for Fenja has been successfully completed, and that the first section of the pipe has been installed on the seabed.

The offshore installation was carried out by TechnipFMC's vessel, ***Deep Energy***, approximately 120km north of Kristiansund, Norway, at a water depth of about 320m.

THERE'S NO FACE LIKE STROHM

Airbourne Oil and Gas has changed its name to Strohm. The launch of the new brand reflects the company's strategy to reposition away from Oil and Gas and into other areas.

C-INNOVATION ACQUIRES CALTEX OIL TOOLS

C-Innovation has acquired the controlling interest in Caltex Oil Tools, a solution-focused company providing equipment rentals, services and customized engineering capabilities to the offshore industry.

This acquisition underscores C-innovation's core mission to serve as the single source solution for the subsea and offshore industries.

AKER TOMMELITEN FEED

Aker Solutions was awarded a front-end engineering and design (FEED) contract from ConocoPhillips for modifications on the Ekofisk installations to integrate the Tommeliten Alpha discovery, offshore Norway.

The FEED starts immediately and is expected to be completed in the second quarter of 2021 with an estimated value of about NOK 130 million.

The contract includes an option for the engineering, procurement, construction, and installation (EPCI) work following the completion of the FEED. The option is subject to Norwegian authorities' approval of the plan for development and operation (PDO) and a new award decision by the Tommeliten Alpha partnership.

TECHNIPFMC FOR PAYARA

TechnipFMC has been awarded a contract by Exxon for the subsea system for the proposed Payara project. TechnipFMC will manufacture and deliver the subsea production system, including 41 enhanced vertical deep water trees and associated tooling, six flexible risers and ten manifolds along with associated controls and tie-in equipment.

SUBSEA NEWS

SUBSEA NEWS

Equinor has submitted the plan for development and operation of the Breidablikk field to the Minister of Petroleum and Energy while awarding contracts for subsea facilities.

The expected production from the field is about 200 million barrels, investments totalling about NOK 18.6 billion.

The development concept chosen for the Breidablikk field is subsea development with 23 oil producing wells from four subsea templates that are controlled from Grane. Breidablikk will be tied in to the Grane platform for oil processing prior to being brought ashore at the Sture terminal.

The production from Grane will be monitored with advanced digital tools from Equinor's integrated operations centre (IOC) at Sandsli to ensure optimal production and value creation from the wells.

The Breidablikk development will include a control cable system for electricity and communication (DC/FO). This is a relatively new technology that can reduce the costs associated with further development of the field, in addition to facilitating the use of docking stations for subsea drones on the seabed.

PLATFORM SAILAWAY

The jacket and topsides for the Tolmount field in the Southern North Sea has left Rosetti's yard in Italy and is heading towards the field where met the ***Sleipnir*** heavy lift vessel for its installation.

The 500 Bcf development is on track to deliver first gas in the second quarter of 2021.

The project was postponed due to the coronavirus pandemic, following the yard entering lockdown in March.

The project development consists of a platform and associated gas export pipeline comprising the Humber Gathering System, owned by Humber Gathering System Limited (HGSL) and Dana Petroleum. It will initially deliver gas from the Tolmount field to the Easington onshore gas terminal.

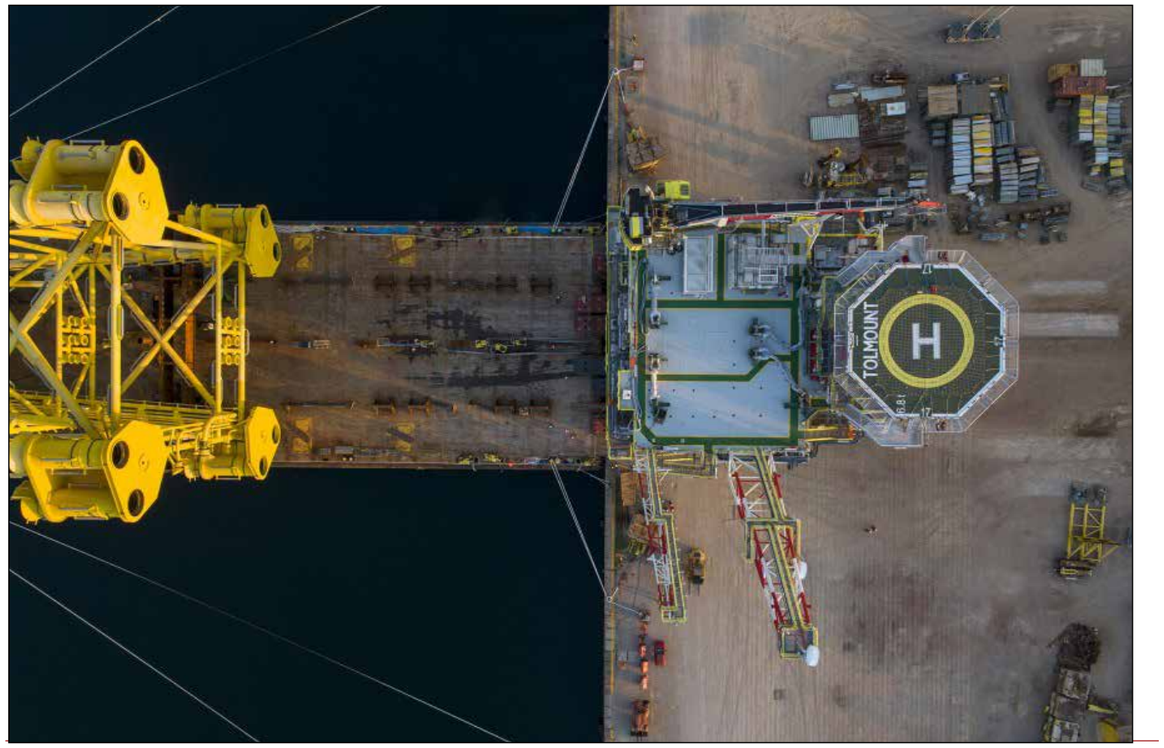
The pipe lay is progressing with the shoreline and inshore pipeline crossings successfully completed.

After the platform installation, the drilling rig will mobilise to drill the initial four development wells. The Tolmount field should add 20-25 kboepd once on plateau in 2021.

After The Sleipnir installed the 4850t Tolmount platform, it sailed to Hornsea 2 to complete the second wind platform of the season. Most recently, it has been used to installed the 395t P-11 Unity platform from Dana Petroleum.

Installing the 395t P-11 Unity platform

Loading Tolmount on a barge at the Rosetti yard



ASSEMBLING THE ARMADA

Grovfjord Mek. Verksted (GMV) will build Ocean Infinity subsidiary Armada's fleet of large, ultra low emission robotic ships.

It has plans to build up to 13 vessels capable of wholly robotic operations. Each ship can be equipped with ROVs and AUVs, as well as a variety of other sensors or equipment, and will be remotely controlled from one of 3 global control centres in Austin, Texas, Southampton in England and a location in Asia still to be determined.

The ships are designed to be transported worldwide by airplanes. They have been specifically designed to include highly efficient propellers, engines, and batteries, to reduce the CO2 emissions during the operation.

GMV has already started the construction of Ocean Infinity's first 4 21m autonomous vessels. They will be built according to DNV GL class and British flag. The first delivery is planned late this year, and the rest in the period 2021-2023.

GMV is Norway's largest manufacturer of aluminum work boats.

- Ocean Infinity have selected the Saab Seaeye the Leopard work-class underwater vehicles will be deployed from Ocean Infinity's initial 13 unmanned vessels.

The 3000m Seaeye Leopard was chosen not only because it is well suited to USV applications but more specifically because of its comparable capabilities to a conventional hydraulic work class vehicle, but with considerably less input power, meaning materially reduced carbon emissions.

FALLING OIL COSTS

Rystad Energy has analysed of oil production costs and revealed that the average break-even price for all unsanctioned projects has dropped to around $50 per barrel, down around 10% over the last two years, and 35% since 2014. This means that oil is much cheaper to produce now compared to six years ago, with the clear cost savings winner being new offshore deepwater developments.

The cost of supply curve for liquids now reveals that the required oil price for producing 100 million barrels per day (bpd) in 2025 has been in continuous decline in recent years, with Rystad's updated projection showing that an oil price of only $50 per barrel is needed to keep oil production at this level.

Previously, in 2014, the company had estimated that the required oil price for producing 100 million barrels per day in 2025 was close to $90 per barrel, an estimate which they then revised in 2018 to around $55 per barrel.

The updated curve also shows another key trend. From 2014 to 2018, the cost of supply curve 'moved to the right'. In 2014, the company estimated that the total 2025 liquids potential was only 105 million bpd. In 2018, this number had increased considerably to around 115 million bpd. However, since 2018, Rystad has revised down the potential to about 108 million bpd, moving the cost curve to the left.

"The implication of falling breakeven prices is that the upstream industry, over the last two years, has become more competitive than ever and is able to supply more volumes at a lower price. However, the average breakeven prices for most of the sources remain higher than the current oil price. This is a clear indication that for upstream investments to rebound, oil prices must recover from their current values," says Espen Erlingsen, Head of Upstream Research at Rystad Energy.

PIPELINE MARKET

The global oil and gas market demand for large-diameter offshore pipeline is set for an annual drop of 26% this year, with the size of total installations forecast to reach 2150km, according to an analysis by Rystad Energy. Recovery, however, is likely to be swift, led by projects in the Middle East.

Although it is set for a significant drop from last year's 2,913 km, offshore trunkline demand is holding up much better now than during the previous downturn, when demand plummeted to just 938 km in 2016 from 2488km the year before.

Rystad Energy estimates the market's recovery to be swift this time, as Middle Eastern projects are likely to propel demand to almost pre-Covid-19 levels already from 2022 and push it even higher from 2023, when offshore trunkline installations are projected to exceed 3,000 km.

Transport infrastructure accounts for a significantly larger portion of the value chain for gas developments than for oil, where operators can opt for export via buoy loading onto oil tankers. In project count terms, more than 90% of the nearly 100 offshore trunklines expected to be developed in the 2020–2024 period are gas export pipes.

Transmission lines make up around half of the new trunklines forecasted up till 2024 measured by length, but in project count they amount to less than one third.

As a result, alterations in the timing of a few of these can throw the market around considerably.

SEAGULL TO ETAPS

Neptune Energy has begun the subsea construction phase of the Seagull tie-back project.

TechnipFMC, working under the Neptune Energy Alliance Agreement, has deployed the ***Apache II*** pipelay vessel to start the pipe-in-pipe installation, laying approximately 5km of pipe connecting the Egret manifold to the Seagull development.

Seagull is a high pressure, high temperature (HPHT) development located in the Central North Sea on UK licence P1622 Block 22/29C, 17km south of the BP Operated ETAP Central Processing Facility (CPF). Proved plus probable gross reserves are estimated at 50 million boe.

The development will be tied back to the ETAP Central Processing Facility, partially utilising existing subsea infrastructure. Gas from the development will come onshore at the CATS processing terminal at Teesside, while oil will come onshore through the Forties Pipeline System to the Kinneil Terminal, Grangemouth.

Seagull is expected to produce 50,000 boe per day (gross) and supports UK security of supply.

TechnipFMC's ***Normand Mermaid*** was mobilised in late August to provide pre-lay activities, including surveying and boulder removal. Following the pipe installation, its ***Normand Ranger*** will undertake trenching activities for the development.

Apache II pipelay vessel

SUBSEA EQUIPMENT

WAYFINDER DVL FOR MICRO VEHICLES

Teledyne RD Instruments has launched its new Wayfinder Doppler Velocity Log (DVL). The Wayfinder has been designed to provide Doppler navigation capability for micro vehicles, which are often constrained by stringent size, weight and budget limitations.

Measuring just 10 x 10 x 7 cm and weighing in at.51 kg, Teledyne RDI's new Wayfinder is ideally suited to address the needs of our industry's proliferation of increasingly smaller subsea vehicles.

From the outset, the Wayfinder DVL has been designed with micro vehicle manufacturers, universities, and hobbyists in mind, delivering a 200 m depth rating, ease of integration and operation, as well as self-serve online support documentation and online purchasing.

Wayfinder DVL

NEW VALEPORT SENSORS

Valeport has further expanded its portfolio's capability with the launch of two new sensors for ROVs/AUVs and subsea survey. The new miniIPS2 and uvSVX both offer operationally specific interchangeable pressure transducers that deliver enhanced accuracy for specific depth ranges.

These field-swappable sensor heads make it easy for users to select the correct pressure range for their work and offer increased accuracy at any depth, alongside streamlining benefits to users who previously required different instruments for shallow and deep water.

The smart miniIPS2 underwater pressure sensor with accuracy to 0.01%, offers a cost-effective solution to vehicle pilots who

miniIPS2

uvSVX

require highly accurate depth information in real time.

Key to the design is the unique interchangeable pressure module that allows users to change pressure transducers for maximising operational specific depth requirements. This innovative pressure module, with integral calibration, can be easily changed in a couple of minutes without opening the instrument and is available in 10, 20, 30, 50, 100, 200, 300, 400 and 600bar variants.

The pressure sensor module fitted to the miniIPS is a temperature compensated piezo-resistive sensor which delivers the performance previously only available from resonant quartz sensor at a more cost-effective price. It also brings the added advantages of long-term stability, allowing longer intervals between calibration, and a smaller and more robust construction; complex and vulnerable arrangements of diaphragms and oil filled capillaries and reservoirs are therefore no longer necessary.

The miniIPS2 is compatible with Valeport's MIDAS BathyPack and BathyLog software, allowing the depth data to be continually updated for Density variations in the water column.

Designed for underwater vehicles where space is at a premium, the compact uvSVX features Valeport's Time of Flight technology and delivers salinity, conductivity and density data, along with SVP as standard. High accuracy data is assured with the addition of Valeport's unique interchangeable pressure module that allows users to maximise operational specific depth requirements.

This advanced pressure module, with integral calibration, is quickly and easily changed whilst in the field, with no tools required and without opening the instrument. Delivering 0.01% accuracy, the interchangeable pressure transducer is also available in 10, 20,30, 50, 100, 200, 300, 400 and 600bar variants.

Using the latest developments in digital sensor technology the new uvSVX is lightweight and housed in a titanium with a depth rating of 6000m and delivers a reliably accurate performance under all conditions.

PYXIS NAUTICA

Applied Acoustic Engineering (AAE) has announced the launch of their next generation USBL system, Pyxis USBL. Taking its name from the constellation Pyxis Nautica- the mariner's compass- Pyxis USBL takes the best of AAE's subsea acoustic tracking technology with a highly advanced inertial navigation system (INS) from one of the most respected names in the industry, to create a state of the art, inertially aided Ultra Short Baseline system capable of accurate subsea tracking with survey grade performance.

The combination of AAE's Sigma 2 acoustic protocols and SBG Systems high precision Navsight Apogee Marine INS brings together two leading names in the field of marine technology, resulting in AAE's most accurate and long range positioning system to date, and in the process providing many time, cost and performance benefits to global survey operators.

As a tightly coupled, factory fitted package, Pyxis USBL is a portable, calibration free system able to immediately operate from any vessel as soon as the work site has been reached. The MEMS based INS does not fall under ITAR regulations, and the range restricted option means the whole system can be shipped unhindered and without export control to almost anywhere in the world. A feature of the Pyxis system is the ability for the operator to deactivate the range restriction in the field under an export- controlled regime.

Available with short range omni-directional or long range directional transceiver options, the versatility of Pyxis USBL makes it ideal for very shallow operations such as diver monitoring, for deeper applications where ROV's and AUV's might be deployed, and for tracking short or long range towed sensors such as magnetometers and side scan sonars.

C-KORE DEPLOYS WITH AUSTRALIAN OPERATOR TO TEST DOWNHOLE GAUGES

C-Kore Systems has finished a series of deployments with an Australian operator to perform detailed measurements of downhole gauges. The C-Kore Subsea TDR unit verified the down- hole connections and cables, providing quick and accurate information on the location of anom- alies. The information gained would be difficult or impossible to measure using traditional test- ing methods and allows the operator to learn lessons for future well installation campaigns.

C-Kore Systems has a range of subsea testing tools used globally by operators and contractors on both fault-finding operations and new installation campaigns.

The tools perform rapid subsea measurement, saving customers money by reducing the vessel time needed to perform subsea testing. The autonomous units also require no extra personnel offshore.

A Subsea Engineer from the Australian operator commented, “We were very pleased how the Subsea TDR units worked. After initial testing of equipment in our workshop, we deployed on multiple offshore mobilizations to test several subsea wells.

The detail in the results was better than we anticipated, giving very accurate information. For future drilling campaigns we would like to use the Subsea TDR units to get baseline readings on all our wells.”

Greg Smith, General Manager of C-Kore commented further, “As downhole testing is a new application for our technology, we were delighted with the high-quality results our customer obtained.

BLUE LOGIC SUBSEA DOCKING STATION ONS INNOVATION AWARD

Blue Logic has been awarded an Innovation Award 2020 from ONS, for its development of an open-standard subsea docking station for underwater vehicles.

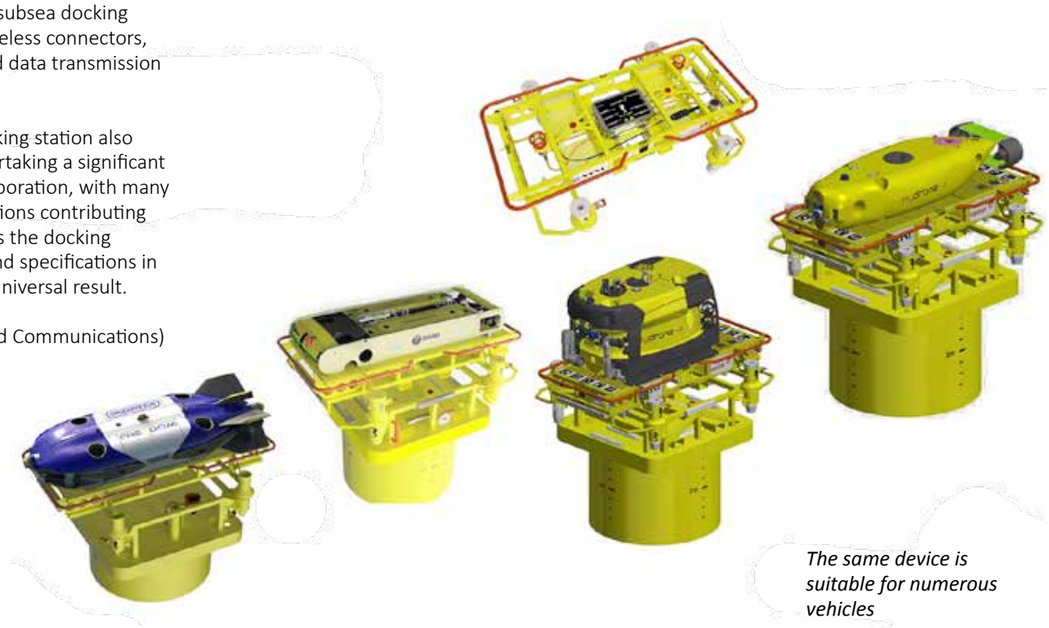
Blue Logic’s seabed installed docking station enables underwater vehicles or drones to be permanently deployed subsea by providing access to power for charging and communications for upload/ download of inspection and assignment data.

The ability to long-term or permanently deploy underwater drones is seen as a benefit for several underwater applications, enabling a reduction in risk to personnel, who can operate the vehicles from shore, a reduction in reduce the carbon footprint of subsea operations, by no longer requiring a support vessel on site.

A key component of the subsea docking station is Blue Logic's wireless connectors, which provide power and data transmission underwater.

Development of the docking station also involved Blue Logic undertaking a significant amount of industry collaboration, with many companies and organisations contributing and participating towards the docking station’s requirements and specifications in order to achieve a truly universal result.

WPC (Wireless Power and Communications) is behind the technology and solutions used in the inductive connectors and is also central in the work of creating a universal standard for the international market.



The same device is suitable for numerous vehicles

Designed and built close to Blue Logic’s headquarters in Sandnes near Stavanger, multiple docking stations have already been tested, including at the Norwegian University of Science and Technology (NTNU) underwater test facility in Trondheimsfjorden, near Trondheim, as well as by SAAB in Sweden, Oceaneering at the Tau Autonomy Center near Stavanger. One is also due to go to Italy where Saipem will verify its functionality with its underwater vehicles.

The first underwater inductive product was introduced in 2005. Blue Logic has since developed several more products that can use and support the docking station, including inductive torque tools for valves, inductive fibre optic cable couplers, inductive couplers for drone tools and inductive subsea batteries.

ROVs

ACSM's PANTHER

For pipeline inspection in the Gulf of Mexico, global maritime, survey and ROV services operator, ACSM, chose an electric Saab Seaeye Panther XT robotic vehicle over other ROV vehicle alternatives.

The Panther inspected 261 pipelines totalling 2,340 km in four fields in the Gulf of Mexico (GOM), at depths ranging from 15 to 130 metres, in a less than 10 month project duration.

ACSM chose the electric Saab Seaeye Panther because it can perform the full scope of work needed yet is far smaller than hydraulic equivalents.

Considerable savings come from deploying the 700 kg Panther system, rather than the much heavier hydraulic alternatives.

The 1000 m rated Panther's proven success comes from a design architecture that can accommodate a wide range of tooling with a 'plug and go' simplicity that makes it easy to change, maintain and repair systems – and easy to operate.

The potent thruster power can handle the large array of equipment needed for full survey work- and provide the steadiness and agility needed to continue working even in strong currents when other vehicles are withdrawn from active service.

Acoustically quieter than hydraulic vehicles, means electric vehicles provide more accurate multi-beam sonar data.

The ACSM Panther XT is fitted with a Kongsberg HDTV camera, Norbit Dual Head MBES, ROVINS INS, Tritech Super SeaKing sonar, Blueview multibeam sonar, Teledyne Navigator DVL, TSS 440 pipe tracking system, CTD, Laser Line, CP and five-function manipulators and booms.

ACSM's new Saab Seaeye Panther ROV

GORILLA

A few years ago, Copenhagen subsea developed a novel rimless thruster for use on third-party electric ROVs. This immediately brought number of inherent advantages, particularly in the area of heat management as well as operational benefits due to reeds or ropes being unable to wrap themselves around the thrusters hub.

There are a very wide range of ROV designs on the market, however, and often, the various customer's power demands and physical sizes are not always the same. This means that in such cases, the advantages of the novel thruster are not always optimally transferred to the vehicle in the way that the designers had anticipated.
This prompted the Danish manufacturer to design its own ROV, the new Gorilla.

"By designing entire package from thruster to control electronics, we can better translate the thruster properties into increased power and manoeuvrability," said Christian Tyrol, business development manager at Copenhagen Subsea.

"We started thinking about the design a few years ago, and came up with a minimal base design. Throughout this year has been spent carrying out a wide range of tests to a point, that we are have now reached the stage for the device to be fully commercial.

The vehicle has eight powerful thrusters which gives it the ability to keep position in strong currents and thus able to operate in harsh and demanding environments.

GORILLA
The gorilla ROV is about 1.5m in length and about a metre wide. It is rated to 600m water depth.

It has a maximum forward and lateral thrust of 128kg at 10kW and a vertical trust of 118 kg also at 10 W. There are eight thrusters in total, four horizontal and four vertical. The control system allows auto depth, auto altitude and auto pitch and roll and station keeping
.
A fibre optic link connects the surface control system to the ROV and provides a conduit for sensor data. A total of 10 kW is available to be shared between the propulsion and payload.

The open system architecture is fully maintainable by the customer and there is a lock and latch system for high altitude launch and recovery.

"We are looking at a wide variety of applications driven by demands from universities, commercial companies and the defence sectors," said Tyrol

RIM DRIVEN THRUSTERS

"When high-power thrusters rotate in the water, they can generate heat. In conventional systems this builds up on the hub and main drive shaft.

The Copenhagen Subsea thrusters, however, are driven through the rim. The seawater acts as a cooling agent and this is spread over a greater surface area. This means that more power can be introduced into it when it compared to more conventional thruster.

Because the design, there is neither oil nor mechanical parts touching. the rotors. Instead, the thruster ring is lubricated by a very thin film of seawater. This makes it extremely silent.

VISUAL MARKERS

Vallourec, FORSSEA Robotics and iXblue have joined forces to facilitate the inspection of subsea pipelines using drones and digital technology

Traditionally, the inspection of subsea pipelines and structures requires the use of a surface vessel (manned or unmanned) with acoustic positioning used to monitor the deployment of Autonomous Underwater Vehicles (AUVs) or Remotely Operated Vehicles (ROVs). These subsea vehicles then collect the required information – such as a pipeline's general aspect and route, anode consumption, free span, burial and crossing areas – using observation sensors.

In order to reduce pipeline inspection operational costs, Vallourec, iXblue and FORSSEA decided to develop a solution using visual markers directly integrated on subsea pipelines that enables vessel-free subsea navigation.

The project relies on barcodes placed on installed pipes, resulting in many passive positioning references logged with their own coordinates during the laying operation which will remain accessible throughout the life of the field.

These markers would be used as navigation aids for subsea drones equipped with FORSEEA cameras and iXblue's inertial navigation systems that easily relay the pipelines' locations to the operators thus removing the need for acoustic positioning systems and costly mother vessels.

GEMINI

TechnipFMC has launched its new Gemini Workclass ROV. This incorporates a number of innovative features including a tooling carousel designed to be accessed by a pair of newly-developed manipulators.

Over the past few years, a number of major ROV manufacturers have brought out new models. Forum has launched its new XLe Spirit with the intention of extending this new technology across its entire product range, IKM, Oceaneering and Saipem have been busy developing progressing with their electric ROVs for use as seabed- resident systems, SMD brought out its Quantum E, while Saab Seaeye's Leopard has been increasingly predatory in carrying out work previously the domain of hydraulic systems.

Elsewhere, companies have also taken their electric ROVs in another direction blurring the margins between AUVs and ROVs.

And all the time, TechnipFMC-owned Schilling Robotics has been disturbingly quiet. Its last vehicle model, the UHD-III was launched in 2014 but since then, the company has been keeping under the sonar, busy perfecting its latest model.

Watching the progressive march towards electric systems from its Northern Californian headquarters, Schilling made the executive decision to travel quite the opposite direction.

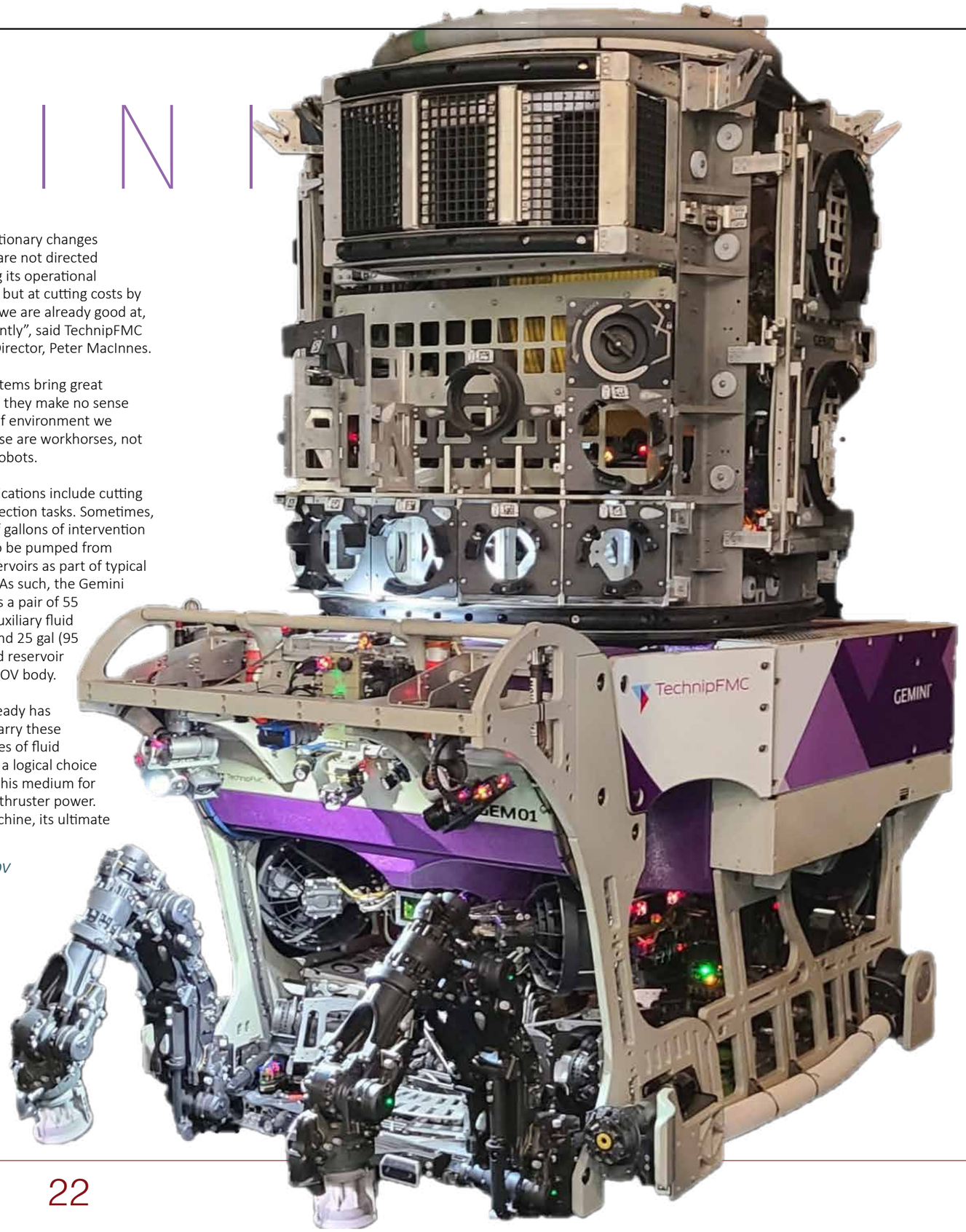
It has been unapologetically developing technology to make its hydraulic systems even more effective in conducting intervention operations, further augmenting its position within the heavy duty deepwater harsh environment workspace.

"The revolutionary changes on Gemini, are not directed at extending its operational boundaries, but at cutting costs by doing what we are already good at, more efficiently", said TechnipFMC Marketing Director, Peter MacInnes.

"Electric systems bring great benefits but they make no sense in the sort of environment we inhabit. These are workhorses, not inspection robots.

Typical applications include cutting and fluid injection tasks. Sometimes, hundreds of gallons of intervention fluid have to be pumped from internal reservoirs as part of typical operations. As such, the Gemini incorporates a pair of 55 gal (208 l) auxiliary fluid reservoirs and 25 gal (95 l) waste fluid reservoir within the ROV body.

"Since it already has be able to carry these large volumes of fluid around, it is a logical choice to also use this medium for vehicle and thruster power. Like any machine, its ultimate



The Gemini ROV

success, especially in carrying out nonroutine technical procedures, depends on the ability of the operator.

ROV pilots embody a wide variety of skill levels. While there are a many very useful training simulators on the market, these cannot always capture the nuances of carrying out live subsea operations, often on unfamiliar equipment.

There is no substitute for hands-on experience , however, in reality, the operators get surprisingly little time in the real world to practice how to execute these tasks.

"A pilot has to have electronic, electrical, hydraulic skills, mechanical engineering knowledge, spatial reasoning, good communication and even some software skills," said MacInnes. "This is why the pool of excellent pilots is relatively limited.

"There are some pilots that have the ability to consistently carry out highly accurate operations and others less so. The penalties of under-performing can be severe.

"In order to improve overall performance, therefore, a fundamental tenet in the Gemini ROV's design is to find ways of removing or minimising the human factor from underwater operations, enabling the crew to focus on project operations and client interfacing.

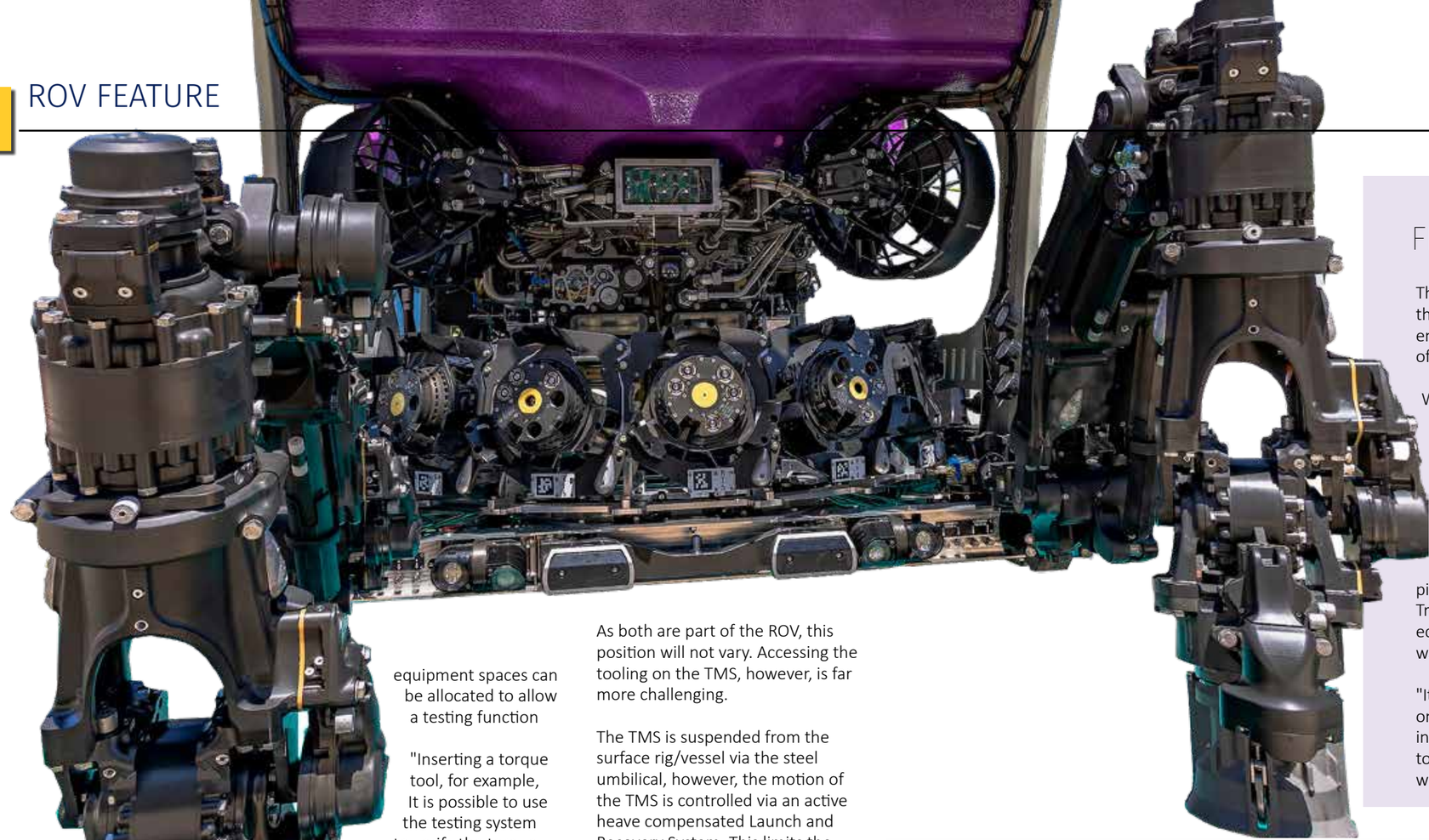
In some industries, this could translate as fully automating operations, but the potential dangers in the deepwater offshore industry, where accidents could have disastrous consequences, are unacceptably high.

Gemini addresses this through pilot assistance features, where the operator executes the commands, while being assisted by the automation system. Additionally, a human pilot or operator assisted by using various pieces of semi-autonomous tooling offers significant safety and efficiency benefits.

TIME IS MONEY

Working at extreme depths, the journey between the surface and the work site can take hours. When at the work site, the vehicle may also require a large number of different tools.

Predictably, commuting to the surface rig/vessel and back to interchange tooling is not an option and the



equipment spaces can be allocated to allow a testing function

"Inserting a torque tool, for example, It is possible to use the testing system to verify the torque output. Other slots can be assigned to the pressure calibration for hot stabs. These allow the operator to verify that the tool can exert say, 5000 psi of pressure before it is actually inserted in a live system ."

"It may be, however, that a greater number of tools are required to carry out a specific operation. Schilling Robotics engineers, therefore, have designed the top hat Tether Management System to be able to accommodate an additional 15 tools around the exterior of the structure."

traditional solution is to carry items in a storage receptacle somewhere within the vehicle, typically in between the manipulator and the grabber.

A key feature of the new Gemini ROV, is its novel tooling carousel. This has capacity for up to 15 tools however some of the

On the Gemini ROV the manipulators are located either side of the revolving carousel. This means that the manipulator control software always knows the exact location of the designated slot from which to select the correct tool.

As both are part of the ROV, this position will not vary. Accessing the tooling on the TMS, however, is far more challenging.

The TMS is suspended from the surface rig/vessel via the steel umbilical, however, the motion of the TMS is controlled via an active heave compensated Launch and Recovery System. This limits the motion of the TMS to a point where Gemini's machine vision cameras can lock on to the target tool and automatically acquire it.

In addition to the machine vision technology, Gemini's positional control and stability are enabled by a range of third party navigational tools including its Valeport miniIPS Depth Sensor, the IXBLUE OCTANS NANO motion reference unit and the Teledyne RDI Pioneer 600 kHz Doppler Velocity log.

STATIONKEEP

Maintaining position in the water column requires a variety of sensors feeding to a software-driven control centre called StationKeep. The latest version – StationKeepV2 – incorporates additional ROV sensor inputs and a state estimator, enhancing the overall accuracy.

"This new Stationkeep V2 system

FIDUCIALS

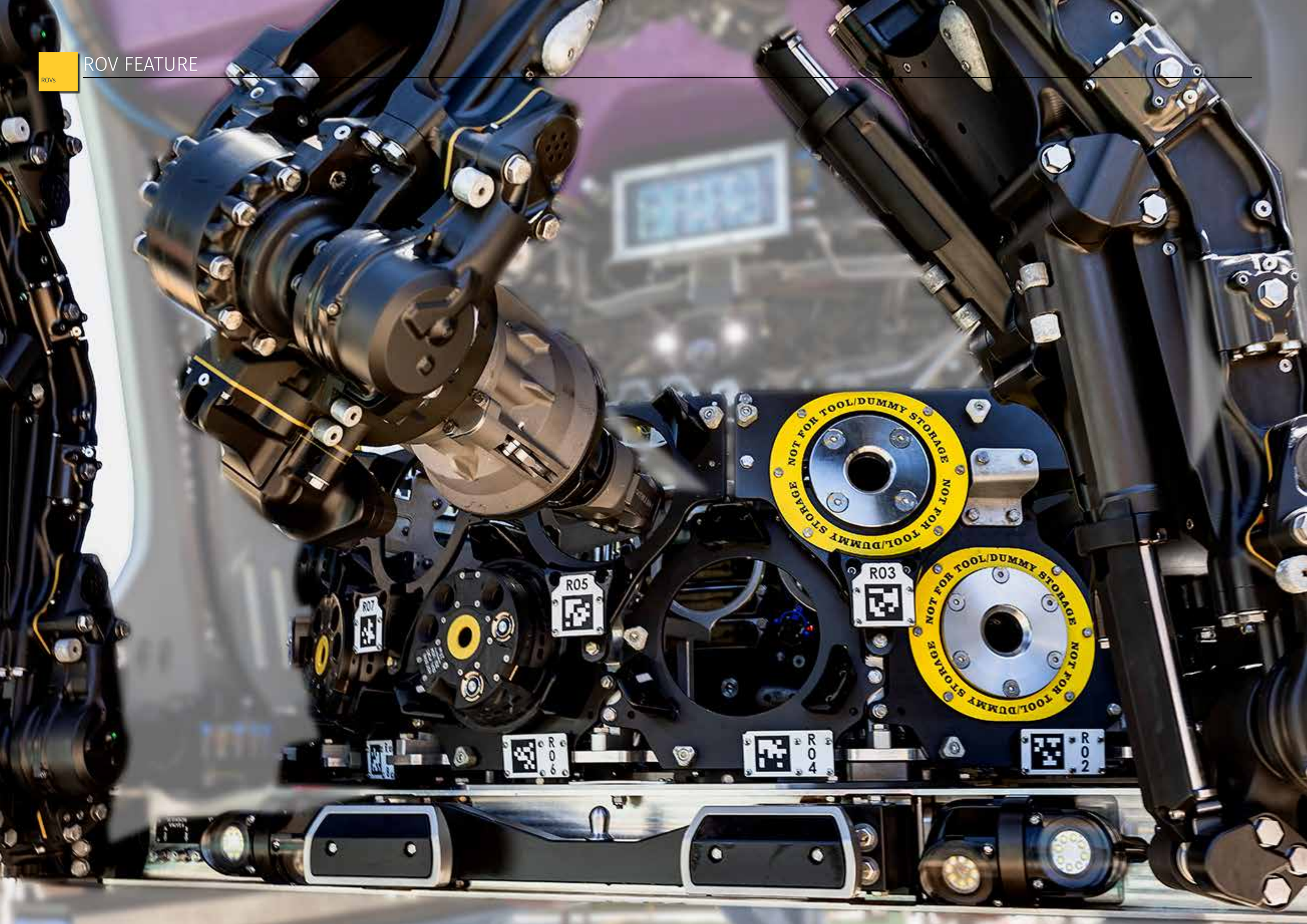
The ability for the arm to pick up a tool and indeed, the ability to stab this tool, if required, into a receptacle on a piece of subsea hardware is enhanced by machine vision cameras located on the ROV and the wrist of the manipulator.

While the machine vision system enables operations on any existing subsea equipment, the addition of a Fiducial (which resembles a QR code) increases the precision. This QR code helps the machine vision cameras recognise true 3-D perspective allowing more precision. It does, however, afford other potential benefits in becoming an information source for subsea production system equipment.

"The code could also automatically link to a database, allowing the pilot to retrieve information pertinent to the target such as a Subsea Tree. The database could then provide a history of that piece of equipment and information relating to the manufacturer and when it was installed".

"It could also be used to identify prior operations that were conducted on such equipment. For example, the database could include information on Tree valve operations and how many turns and what torque was applied. It could also identify when fluid was injected to which port, and what volume and/or pressure was applied".

Interchangeable Tools


NOT FOR TOOL/DUMMY STORAGE
NOT FOR TOOL/DUMMY STORAGE
R07
R05
R03
R06
R04
R02

gives a performance improvement by a factor of four in extreme environmental conditions and up to a factor of ten in normal operating conditions", said MacInnes. The result is an extremely stable platform from which high-precision intervention tasks can be performed without the need to anchor and stabilise the ROV to a subsea asset.

"It actually gives the ROV the ability to maintain vehicle position within a 1 inch (25 mm) watch circle in currents exceeding 2 kts. Once the ROV is stationary, five machine vision cameras on the vehicle, including two on the manipulators themselves, assist in getting the ROV and manipulator in the correct position. The decision on precisely when to conduct the actual operation is that of the pilot.

"Once positioned and ready to interface with the target, the system is capable of rapidly acquiring or stowing a tool on the TMS," said MacInnes, " and the designers coined the term 'Cobra strike' for the final, critical action.

An additional new feature is the adoption of a typical game controller for manipulator control. It is only necessary for the pilot to concentrate on the tip of the tool and move the joystick in Cartesian mode XYZ axes. In the background, the machine's control system ensures the rest of the tool is at the correct angle. When acquiring tools from the TMS, the pilot is also aided by a visual target engagement indicator. Once a signal light turns green, the system becomes locked on and ready to commence the action and the tool , say, is inserted into the receptacle in seconds.

"It is the ultimate demonstration of the ROV and the manipulator arm all working together under control of marine machine vision technology in the most challenging of circumstances."

FORCE COMPLIANCE
In the world of animation, the tool will enter the receptacle seamlessly, but in reality even a slight change in angle in any direction means that pushing against this offset can create a tremendous amount of force, possibly causing the entire ROV to rebound backwards. Worse, it can damage the hot stab or receptacle.

The solution that Schilling devised to resolve this issue is called force compliance. As the tool is pushed forward, sensors distributed 360 deg around the wrist, detect movement resistance.

The control system then instructs the whole arm to automatically microadjust the tool angle and, using the sensor information, realign it with the receptacle. As resistance falls to zero, the tool can be inserted further. These fine microadjustments are carried out autonomously, leaving the pilot to concentrate on the task of inserting the tool correctly.

Hot stab

"It would be possible for the entire procedure to be carried out autonomously," said MacInnes, "but the industry is not yet comfortable to have a robot automatically insert a tool in subsea hardware without human supervision. We therefore call this supervised autonomy".

ISOL-8
Executing the sort of underwater operations that the Gemini is called upon to perform requires both high power and the ability to pump large amounts of fluid. The main HPU is a 250 hp system but the vehicle also houses an auxiliary HPU called ISOL-8, a carry-over from the UHD-III system.

SPECIFICATIONS

Working Depth:	3000 or 4000m
Docking InterfaceSWL:	20,062 lbs (9,100 kg)
Through-Frame Lift:	7,716 lbs (3,500 kg)
Weight in Air:	12,610 lbs (5,720 kg)
Dimensions:	3.9 m x 2.5 m x 2.5 m
Payload:	66 lbs (30 kg)
Peak Thrust Performance	
Forward/ Aft/ Lateral:	8,680 ft-lb (1,200 kgf)
Vertical- Up/ Down:	7,233 ft-lb (1,000 kgf)
StationKeep	1in (25mm)
Equipment	
Manipulators:	2) GEMINI
Depth Sensor:	Valeport miniIPS
MRU:	IXBLUE OCTANS NANO
DVL:	Teledyne RDI Pioneer 600 kHz
Lights:	(11) 120 VAC and (3) 24 VDC•
Cameras:	SD and HD Options
Pan and Tilt:	(2) Schilling Electric
Available Valves:	(4) 2 gpm (8 lpm)
Hydraulic System	
Thrusters:	(7) Schilling
HPU:	250hp
Auxiliary:	150 hp
Operating Pressure:	(3,000 psi (207 Bar)

"The isolate pump gives us a tremendous degree of flexibility," said MacInnes. The package is about the same size as a briefcase while most competitive fluid intervention systems require an additional skid located underneath the vehicle and weighing two tons. The ISOL-8 consists of eight separate reciprocating pumps that work in parallel with each other.

If the operator needed an output of 50 gpm at 5,000 psi (189 lpm at 345 Bar), sufficient to actuate BOP shear rams, shear and seal, in 45 seconds or less as specified by API 53. The user simply dials the details into the control console and the pump automatically produces that pressure and flow without having to make any mechanical or hydraulic configuration changes.

It can pump hydraulic fluid, water glycol or seawater, thus offering fully independent pressure and flow control of each hydraulic circuit through the onboard Schilling Robotics multi-function valve packs.

ROV FEATURE

NAVY ORDER

VideoRay announced that another multi-million dollar order for Defender ROV systems has been placed by the U.S. Navy.

The purchase is under VideoRay's existing $49M contract to deliver the Navy's Next Generation ROV. The systems will be assembled and tested in VideoRay's Pottstown, Pennsylvaniafacility prior to being shipped to the Navy for worldwide operations.

"This order is the culmination of years of tight integration with many Navy units in San Diego," said Scott Bentley, CEO of VideoRay. "It will result in additional hiring and significant spend in the Pottstown region, and with our development partners throughout the U.S. and beyond."

The procurement process was facilitated through the Defense Innovation Unit (DIU), which provided open communications and a competitively awarded production contract which allows further scaling within the Navy based on requirements set forth by PMS-408, allowing VideoRay to collaborate on a solution. As a result, the VideoRay Defender systems have been optimized to best support the U.S. Navy EOD technician and warfighter.
The VideoRay Defender is a highly capable remotely operated vehicle, and is also becoming a standard in other markets beyond defense, most notably in offshore energy and infrastructure industries.

The VideoRay Defender systems will be used by the Navy for defense and security operations including very shallow water, littoral mine counter measures, port security missions and hull and pier inspection.

The systems will be delivered with solutions from Greensea, Blueprint Subsea, Nortek and Eddify integrated onto the Defender ROV platform.

MAD DOG SPAR STEM CLAMPS

C-Innovation has completed the installation of several stem clamps for BP beneath the Mad Dog Spar in the Gulf of Mexico, utilizing its subsea inspection, maintenance and repair (IMR) remotely operated vehicle (ROV) vessel, MV Dove.

Throughout the planning process, several risks were mitigated for C-I and BP assets by modifying the ROV. This included armoring with Lexan polycarbonate, design of new manipulator mounting subframes to extend the reach of the manipulators by 12 in. and installation of enhanced manipulator controls systems. The project was a success and completed 10 days ahead of BP's schedule.

IN THE CLEAR

Seaclear is a European-funded multi-agency 4-year project, part of the Horizon 2020 programme and aimed at developing autonomous robotics to collect marine litter. The project brings together 9 partners coordinated by the Technical University of Delft. Most are universities with the two end-users, being the port of Hamburg and the city of Dubrovnik.

The project will combine a pair of ROVs connected to an unmanned surface vessel (USV). In clear waters, this may be assisted by a captive unmanned aerial vehicle (UAV) also connected to the USV.

The USV will provide support communications and power Subsea Tech has been selected to provide the expertise as well as surface and underwater vehicles that will physically remove the discarded waste.

"We are not looking at floating litter but focussing on discarded waste material lying of the seabed," said Yves Chardard (CEO of Subsea Tech).

"For the detection of the seabed litter, we will be using our small 6 kg Guardian ROV to map the area. This will provide information for the main collection vehicle, the larger Tortuga ROV.

This will dispose of the litter by placing it in the basket previously lowered to the seabed.

DETECTION
The small Guardian ROV will incorporate a combination of sensors for detection. Cameras provide the highest definition images but the downside is the limited visual range, especially in turbid waters.

Vessel and vehicles working in unison

One possible method of improve the picture is to employ image enhancing software. Subsea Tech are distributors of the LYYN system that offers this very facility.

The project also considers using a multispectral camera in order to enhance litter discrimination work, especially for plastic debris. This might be combined with the use of UV lights that are more able to detect plastic and better classify the debris in terms of material.

"The Guardian vehicle will also incorporate an Oculus high-resolution imaging sonar from Blueprint Subsea (also distributed by Subsea Tech in France)," said Chardard. "This will be used to detect and classify litter from distances that are not achievable with video cameras, especially when working in low visibility conditions".

Beforehand, the USV will have modelled the seabed using a 3D bathymetry sonar in order

Guardian ROV

to pre-identify and classify debris. We will go a Norbit bathymetric system that we know can be used for detecting objects down to 10 cm such as plastic and metal debris.

"The challenges is not just to detect plastic or other litter to be removed, but also observe and differentiate any flora and fauna which must be undisturbed. The job of detection and classification of specimens identified in the sonar and video imaging will be mainly carried out by engineers at the Technical University of Delft and the University of Cluj-Napoca.

REMOVAL

Once detected, the next challenge is to physically remove the materials. Even if the target is identified as litter, there are constraints and limitations in terms of size and weight able to be picked up by the second ROV. The removal system is being developed by the Fraunhofer CML department. *Contd next page* This will consist of two complementary systems.

Tortuga ROV

A suction device will be used on pick up material too small or flexible to be picked up by the grabber such as small plastic bottles or bags.

For larger materials, they will be picked up using a three finger grab located under the Tortuga.

"The main criteria to determine what sort of materials that can be lifted are weight and size," said Chardard.

"At the moment we are looking at a downscaled pilot system but we estimate that the maximum weight of discarded material that can be lifted is around 10 kg in water which is basically the lifting capacity of the Tortuga ROV. A typical example of this may be a something like a bicycle but probably not anything much heavier

"Once picked up, it will be disposed of in a basket around 1m x 2m and 1m high. In practical terms, therefore, we are probably looking objects of various shapes with the maximum size of 1 m x 1 m.

"We plan to use artificial intelligence in looking at the size of the objects and from its shape, estimating the likely weight and thus deciding whether the ROV would be able to pick it up or not.

For materials that are too heavy to be removed by the Tortuga, their positions are marked on the virtual map. This will then allow divers or larger vehicles to revisit the site for further removal.

SEACLEAR

SeaClear is a four-year project with the final trials taking place in Hamburg and Dubrovnik some time in the final-year. This means that an operational system should be available in the third year, allowing the users to refine the automatic detection modes.

The USV selected for the project is a SeaCat. that Subsea Tech has developed to perform open sea survey operations. The concept is based on a catamaran hull capable to carry an important payload.

In addition to being unmanned, the advantages of the concept are low mobilisation and operational costs, operational flexibility and time saving, limited damage risk for targeted infrastructures and reduced environmental impact compared to traditional spreads. The complete system fits inside a standard 20ft container.

"The system is approaching final assembly and should be ready for preliminary trials in tele-operated mode to commence during next year. We will carry out some image acquisition using sonar and video in Marseilles and Dubrovnik and will pass this on to the University of Delft and University of Cluj who are both working detection systems.

"We are still in the design phase of the launching and recovery system but by the first quarter next year, we should be fabricating the missing hardware parts and the basket This means it will probably start detection and pickup initials trials mid next year.

SeaCat

SΣAGMA

Orange Marine has completed the refit of its 800hp Seagma light trenching ROV. It is designed to bury power and telecoms cables, oil and gas umbilicals and pipes in water depths up to 1000m. It can achieve a trenching depth up to 3m and a speed of 300 m/h.

Seagma can work on product diameters anything up to 350 mm and when travelling on tracks, it can cover 2500m in an hour. The vehicle weighs 13.5t with an adjustable weight in water.

It carries up to 6 cameras on two pan and tilt units and eight LED spotlights. It also has a Blueview sonar, two altimeters, a compass stress cage and a Sonardyne mini Ranger 2 positioning system. It also has a TSS 440 and 350 cable tracker.

The high and low power rear jetting tools and the front low-power jetting tool are fed by jetting pumps 14 bars and 7 bars respectively.

Orange Marine is also working on the design and manufacture of two Alpha 8 ROVs (to be called Alpha 1 and Alpha 2). These are also dedicated for energy and telecoms cables and burying and survey inspection pipes.

While the Seagma has 600 kW of power, the Alpha 8 comes in at nearer 450 kW but it can operate at 2000m. It can achieve a trenching depth of 3m and a width of 150 –400 mm.

In free swimming mode it can move travel at speeds of 2.5kts. When fitted with tracks, however, it can achieve speeds of 2500kph. The tracks bring the total weight up to 12t in air, althougg it can also be fitted with skids to make the weight one tonne less.

It carries a Conan 7-function Schilling manipulator and a Schmitt 2-function manipulator as well as tools include a cutter gripper. It has 7 cameras, 10 spotlights, Blueview sonar, a depth meter, , altimeter and cable sensor.

ACOUSTIC POSITIONING

GAPS SERIES

CHOOSING THE USBL FOR YOUR REQUIREMENTS

iXblue recently unveiled its new Gaps M5, the latest addition to the company's USBL product range, which already included the renown Gaps (now renamed Gaps M7).

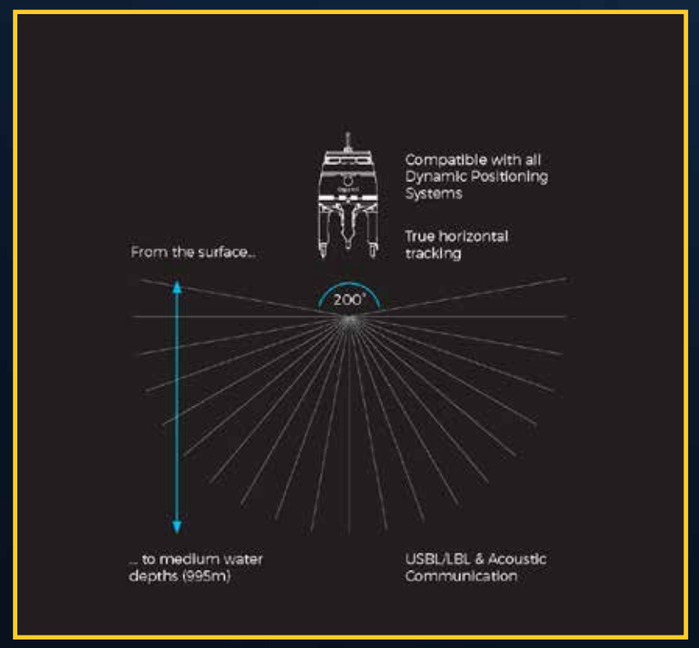
With over 300 units operating worldwide, Gaps high-accuracy USBL system has become a reference for many users across the world, and is used for various applications such as diver tracking, work-class ROV surveys, AUV shallow water missions, or dynamic positioning of 100-metre long vessels.

Striving to meet all users' needs, including accuracy and performance for less constraining jobs, iXblue decided to extend its USBL Series with the new Gaps M5, a compact, export-free, cost-effective and omnidirectional USBL system.

WHAT IS GAPS M5

Gaps M5 is an omnidirectional USBL acoustic positioning systems that does not require any on-the-field calibration. It embeds a motion sensor within its housing: a free-of-export Octans Nano AHRS based on iXblue FOG technology for stable heading roll and pitch compensation and a true North reference.

Smaller and lighter, the new Gaps M5 is easy to install and ready-to-use. It is suitable for vertical and horizontal tracking of subsea assets for ultra-shallow water to medium water depths and offers an accuracy better than 0.5% of the slant range up to 995m, In practice, this means that, when positioning a vessel at a 500m distance, Gaps M5 is accurate to a maximum of 2,5m. The maximum operating range is achievable even in extremely noisy conditions. Another big benefit of Gaps M5 is that it is export-free and allows hassle-free shipment and operations.



A UNIQUE DESIGN FOR MAXIMUM PERFORMANCE

Gaps M5 has kept the M7 unique design, but with shorter legs and an overall height reduced by about 12 cm. The 3D 4-hydrophone antenna still has different legs lengths to enhance horizontal tracking capabilities and the acoustic still offers maximum aperture and allows up to 200° omnidirectional coverage without needing to tilt the antenna. This is extremely efficient in shallow water and horizontal tracking conditions especially when multiple vehicles must be simultaneously located at 360°.

HOW TO CHOOSE BETWEEN GAPS M5 AND GAPS M7?

Gaps M5 is especially suited for subsea positioning needs of 1.000 m or less, for any tracking operation, from diver to multiple subsea assets- or inspection ROV-tracking, while Gaps M7 remains the best asset for highest survey requirements, subsea multibeam and laser scan positioning (it indeed offers an accuracy that can reach 0.6% of the slant range up to 4000m).

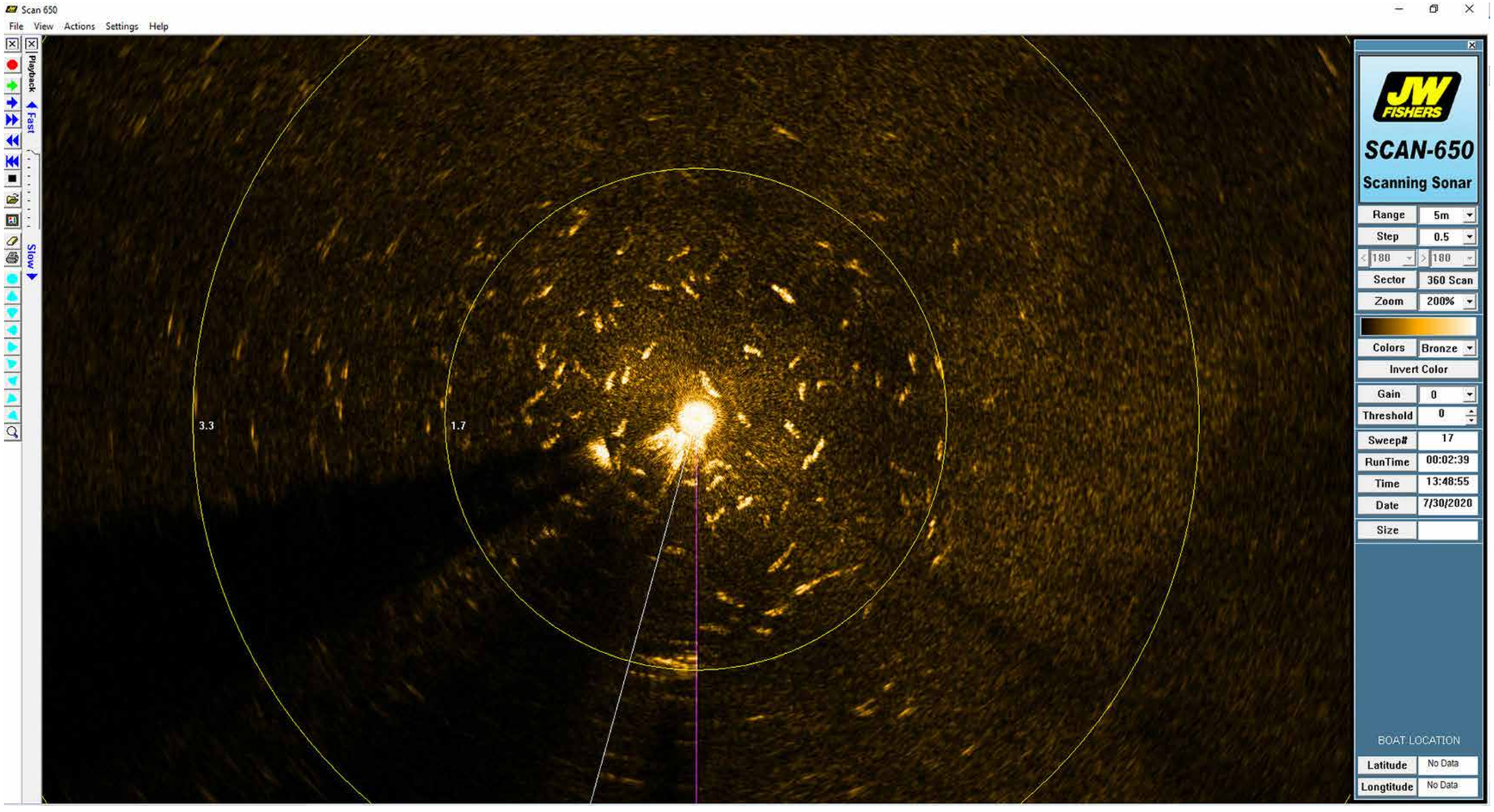
For reservoir dam IMR operations, where a ROV must be positioned below a distance of 100 m with sub-metric accuracy, Gaps M5 will be the go-to solution.

Overall Gaps M5 will be the preferred solution for all short distance applications such as rivers, lakes and dam environments. Thanks to its compact size and embedded AHRS, it is easy to integrate and operate and can be used on small vessels with a reduced crew onboard or even deployed on instrumented buoys

SPECIFICATIONS

	Gaps M5	Gaps M7
Export-Free	Yes	No
Compatible with third-party beacons	Yes	Yes
Telemetry function	Yes	Yes
Positioning[1]		
Accuracy (% distance CEP50)	Better than 0.5%	0.06%
Performance		
Operating range	995m	4.000m typ.
Coverage	200°	200°
Positioning rate	0.8 to 15 seconds	0.8 to 15 seconds
Max number of targets	40 enabled, 10 simultaneously	40 enabled, 10 simultaneously
Embedded gyro		
Type	AHRS (Octans Nano)	INS (Phins)
Heading	0.5° sec lat	0.01° sec lat
Roll	0.1°	0.01°
Pitch	0.1°	0.01°
GNSS accuracy improvement	unchanged	3 times better
Dimensions		
Height x Diameter	520 x 296 mm	638 x 296 mm

SONAR IMAGE TO HELP DETERMINE CROP YIELDS



Traditional methods of wild-capture fishing cannot possibly satisfy the ever-increasing demand. Aquaculture, or the practice of farming marine life, has increased to meet this demand and now accounts for over half of all shrimp production. However, the shrimp aquaculture industry operates with little understanding of how much shrimp is in a pond. Farmers must take a “best guess” approach that ultimately results in incomplete and inaccurate information.

So how does a shrimp farmer measure their stock accurately and determine if their supply is large enough to meet market demands? A combination of JW Fishers technology and the ingenuity of an experienced aquaculture professional resulted in innovative solutions to this problem in Maryland.

JW Fishers SCAN-650 sector scanning sonar is a tool widely used throughout the world. The SCAN-650 produces a detailed image of the underwater environment regardless of the water visibility. It does this by sending out a sound wave that reflects off objects on the bottom or in the water column. The reflected wave returns to the sonar head where it is received and sent to the surface for display.

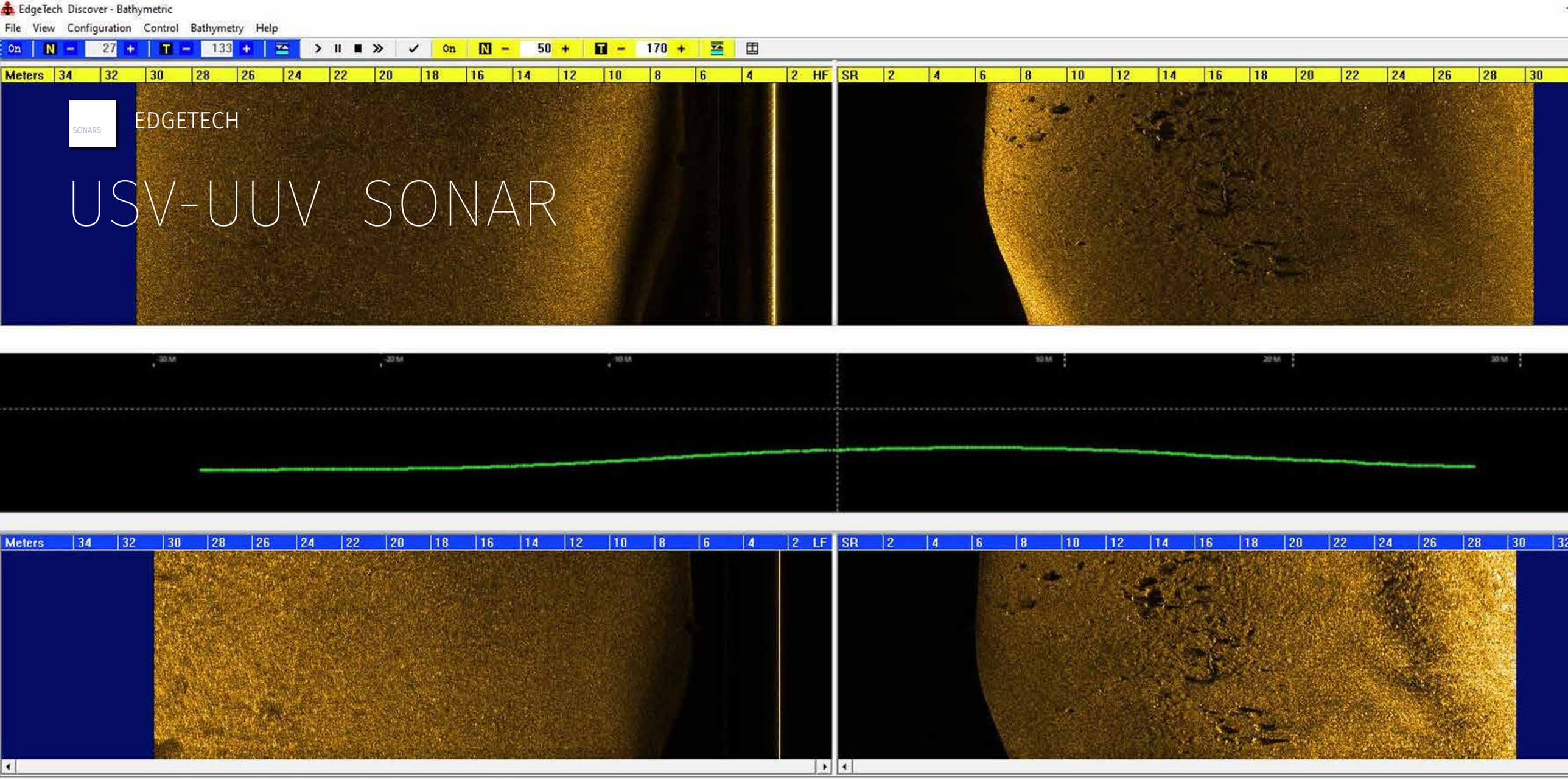
Minnowtech LLC was founded in 2018 in Baltimore, MD as a collaborative effort between Dr. Suzan Shahrestani and Early Charm Ventures. Early Charm Ventures is a start-up studio that co-founds early stage intellectual property intensive companies out of universities and federal labs.

According to their website, Minnowtech “provides a software imaging platform to enable shrimp farmers to estimate shrimp abundance non-invasively with precision.” Using their data-based imaging tool, “shrimp farmers optimize the health and growth of their hatcheries, enhancing harvest of market-size shrimp while minimizing risks to juvenile shrimp.”

Using a JW Fishers SCAN-650A, Dr. Suzan Shahrestani is investigating ways of quantifying shrimp in these facilities. Using the high-resolution data output from the sector scan, Shahrestani provides shrimp farmers with meaningful information on their biomass and behavior to help maximise efforts and increase production.

Shrimp biomass analysis empowers farms to make critical and timely decisions for their business.
Currently, farmers have few ways to accurately measure how many shrimp they have. The yield amount is also a guess for them because they are using nets for sampling that are up to 50% inaccurate. Without the in (feed) and out (crop yield), their understanding of how efficiently they are growing shrimp is poor.

This makes it very challenging to improve efficiency or FCR (Feed Conversion Ratio) with new feeds, feeding regimes, or treatments that might optimize pond and growth conditions.



EdgeTech Introduces New Sonar Frequency Combination

EdgeTech has recently introduced a new sonar frequency combination ideally suited for shallow water Unmanned Surface Vehicles (USV) and Unmanned Underwater Vehicles (UUV).

The new 850kHz and 1600kHz dual frequency combination provides high resolution side scan sonar imagery at both frequencies and optional bathymetry at 850kHz.

The high frequency combination is ideally suited for small vehicles operating in shallow water or close proximity to the seafloor.

The new frequency pair is available in EdgeTech's 2205 hosted platform product line of solutions. The EdgeTech 2205 is a compact, extremely flexible and configurable sonar system for integration on underwater and surface vehicles.

This modular unit can be configured, based on the customers' application, to collect side scan sonar imagery, sub-bottom profiles and bathymetric data, singly or in concert with one another.

The system is provided as a complete package where the 2205 electronics are enclosed in a pressure vessel, or alternatively the core electronics can be provided as boards mounted onto a chassis so the customer can integrate the system into their vehicle's dry electronics area.

Two transducer arrays are provided for the side scan sonar and bathymetry that can be mounted on the vehicle where there is a "clear view" of the seafloor. (Sub-bottom profiler transmit and receive are separate from the side scan/ bathymetry arrays.) The system can operate independent of the hosted platform by simply storing the data or it can be configured to autonomously interoperate with the vehicle during its mission.

The system offers co-registered dual frequency side scan and bathymetry with swath coverages up to 200deg with a selection of equidistant and equiangle output options.

One operator said "the frequency combination is a great selection because a user can get full high resolution side scan sonar at 1600kHz over 30m per side while getting coregistered bathymetry covering the same swath at the same time and it includes nadir gap coverage."

AUVS

PingGuin

EvoLogics has marked its 20th anniversary by launching the PingGuin, autonomous underwater vehicle with low-drag bionic design.

The vehicle was developed as part of the MUM (“Modifiable Underwater Mothership”) collaborative R&D project and was first demonstrated in Kiel, Germany, in June 2020. Outstanding hydrodynamic properties of a penguin’s body became the starting point for the AUV design within the NaviMUM subproject, assigned to EvoLogics.

One of the EvoLogics co-founders, Dr. Rudolph Bannasch studied Adélie penguins and the effectiveness of their locomotion since the 80s, undertaking several field trips to the Antarctic and performing numerous wind tunnel and water tank experiments in Berlin. This research demonstrated that spindle-shaped flow bodies, modeled after penguins, achieve ultra-low drag coefficients in the water.

Hence, the design choices for the vehicle’s components were directed at maintaining the shape and contour of an idealized penguin-like spindle to maximize the drag efficiency, so the AUV has very few protruding parts that affect its hydrodynamic performance.
The NaviMUM PingGuin is intended for use as a multifunctional communication node. It would operate in a self-coordinated AUV swarm that enables adaptable positioning and communication scenarios for the MUM system. Each vehicle carries a built-in streamlined EvoLogics USBL modem for underwater data transfers and position estimations, the modem features an integrated atomic clock for precise synchronization of the acoustic network. The AUV’s surface communication module comprises Wifi, Radio and GNSS with a combined collapsible antenna (and an optional Iridium/GSM modem).

The propulsion system includes 4 horizontal thrusters in X-shaped configuration and 3 vertical thrusters for maneuverability and speed, and the vehicle is able to hold position and hover in the water column.

The PingGuin’s step back from its wildlife counterpart is the anchoring mechanism that extends out of the vehicle’s body and allows it to remain stationary at the seafloor. The anchoring tripod is a pop-out construction coming flush with the vehicle’s body when retracted. The PingGuin’s “beak” features a grip mechanism that can enable docking. Within the MUM system, a group of PingGuin AUVs is designed to form a flexible and adaptable acoustic network. When hovering, the AUVs can form a relay to transfer data from mobile or stationary MUM modules.

A PingGuin can operate as a surface node and transfer data over WiFi, radio, or optional GSM to a support vessel or a shore station. With its GNSS antenna and an acoustic modem, the surface node can perform geo-referencing of other underwater assets deployed within the modular MUM network. For operations that require accurate LBL positioning, a group of PingGuin AUVs would use the anchoring function and become seafloor nodes performing as the LBL baseline. Using AUVs as LBL baseline would eliminate the need to recover seafloor nodes when the LBL coverage area needs to be repositioned.

The PingGuin’s basic functions (mobility, communication and positioning) were tested in tank and open-water trials and presented at the MUM project demonstration in Kiel. Team EvoLogics is now finalizing the advanced functionality of the AUV to conduct further trials.

MUM'S THE WORD

The MUM (Modifiable Underwater Mothership) project is coordinated by thyssenkrupp Marine Systems and funded by the German Federal Ministry for Economic Affairs and Energy.

MUM is a collaboration between industry and science since 2017, and the partners are thyssenkrupp Marine Systems, ATLAS ELEKTRONIK, EvoLogics, University of Rostock, and Technical University of Berlin.

MUM is envisioned as a new class of extra-large modular unmanned underwater system for various applications in the civil maritime industry, such as transport and deployment of payloads and exploration of remote areass.

The June 2020 demonstration in Kiel presented the results of the collaboration’s research on feasibility, usability, construction and operation of such modular underwater vehicles.

DIVING

µ-Habitat

DCN Diving, a global hyperbaric specialist, recently employed its novel underwater micro-habitat (µ-Habitat) system to execute repairs on a North Sea platform jacket. In total, four welds were successfully conducted on horizontal and 45deg diagonal support braces in water depths up to 76m.

Ever maturing North Sea jackets subject to high fatigue stresses, high utilisation and a low redundancy design often results in fatigue cracking.

If not closely monitored, these fatigue cracks can propagate both through and around the circumference of a brace relatively quickly—ultimately leading to severance. Historically, when confronted with a loss of structural integrity, operators were faced with two options; expensive subsea repairs or decommissioning the asset.

It is important that the crack be removed entirely prior to repair welding – should a portion remain, the weld repair could crack relatively quickly. The most effective way of removing the cracks is by excavating the defect. DCN, for example uses Hydro-Carbon-Arc-Gouging techniques.

There are two main methods of underwater welding ¬– dry and wet.

MICROHABITAT

WET
Wet systems involve diver welders working directly on prepared underwater metal surfaces using special consumables in which the electrode has a modified chemistry to produce a very localised gas blanket that emulates the dry atmosphere.

Wet welding is normally used for temporary repairs, welding anodes etc. It is, however, unsuitable for permanent repairs such as to a load-bearing structure or pressure-containing pipelines.

The deeper the weld, the greater chance of increased porosity (gas bubbles in a solidified weld) and so the wet welding technique is limited to around 30 – 35m.

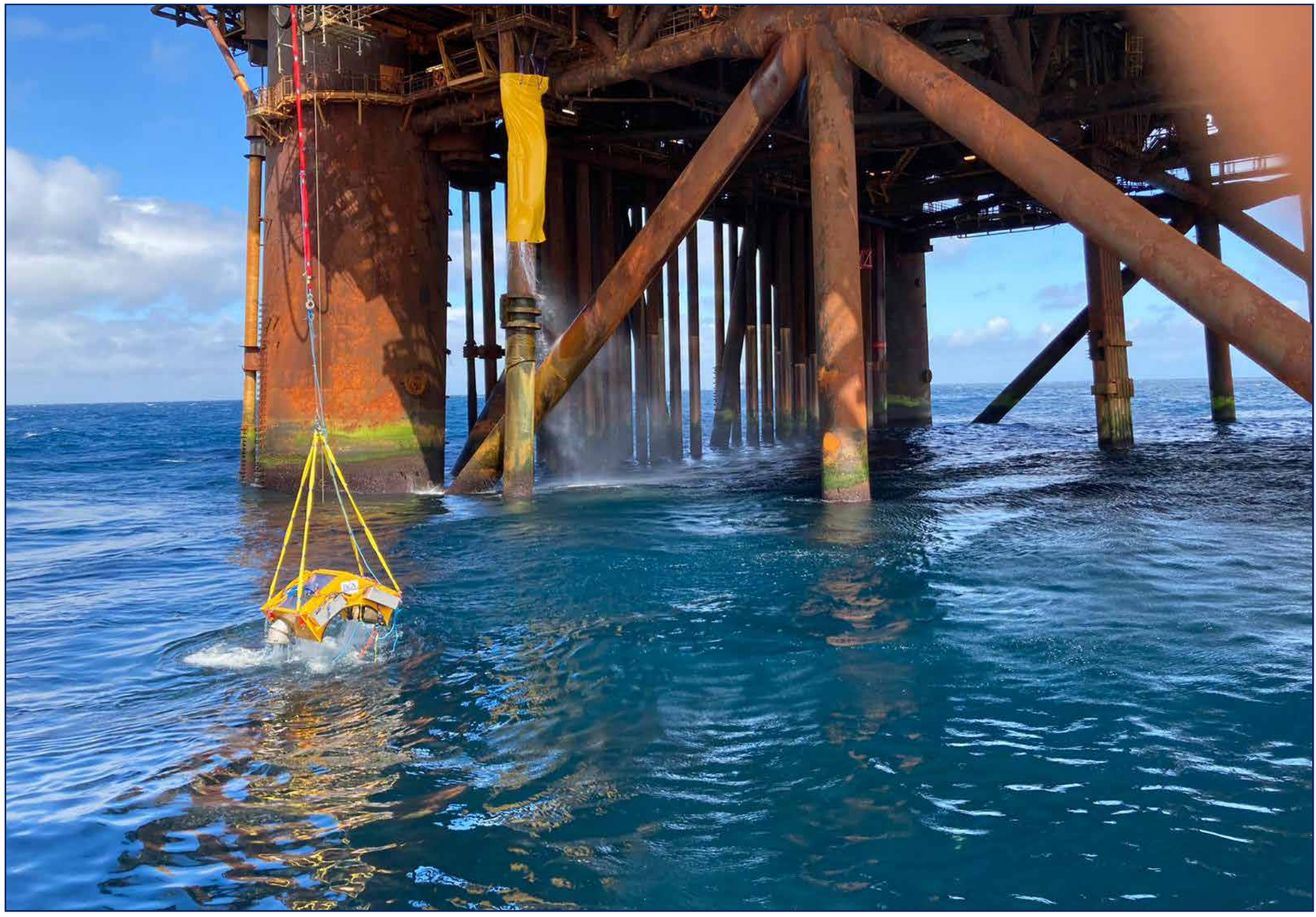
“In order to achieve a high-quality subsea weld, a number of main demands have to be satisfied,” explained Earl Toups, Hyperbaric Welding & NDT Manager at DCN Diving.

“It is beneficial to pre-heat the repair area prior to welding as this slows the cooling of the weld pool and reduces the residual hardness of the weld making it less prone to cracking.

"The most common way of preheating the weld area is to use electrical resistance or induction systems but these techniques cannot be carried out in water. Furthermore, any surrounding water has an immediate quenching effect, raising the hardness levels and increasing the propensity of cracking.

“Water is composed from hydrogen and oxygen. Sufficient Hydrogen introduced into the weld metal often leads to hydrogen cracking which reduces its integrity. Throughout the welding process, it is imperative that in-process welding defects are removed by grinding to keep the weld free from discontinuities. It is very difficult to do this underwater in the wet.”

Left. The node repair habitat on the same field in the early days of the North Sea



Lowering the microhabitat

MICROHABITAT

Challenged with executing permanent welds at 43 m and 76 m below the surface in the most cost-effective way, DCN Diving concluded that the only realistic alternative was to carry out dry underwater welding in a specially designed subsea habitat. Over the years, a wide a variety of habitat sizes have been developed depending on the application, but all have the essential aim of enclosing the weld and thus isolating it from the surrounding seawater.

Some habitats are large enough to totally enclose an entire trunkline or node. Once the seal is made, the habitat is evacuated and the divers can enter to carry out the work in the dry atmosphere. These are extremely expensive and used where a fully enclosed dry-space is beneficial eg, for connecting large horizontal trunk lines. They are not particularly efficient for vertical and diagonal tubulars that form part of platform jackets.

At the other end of the scale, are small enclosures attached to the outside of the tubular and the water is evacuated. At the front of the enclosure is a Perspex screen. With water tight grommets, and no preheat capabilities, through which welding rod consumables are introduced.

Realising the market gap, DCN Diving explored alternate repair strategies leading to the development of its patented µ-Habitat welding system. This makes it possible to respond quicker, execute subsea repairs faster and guarantee quality at a fraction of the cost using bespoke or modular habitats.

By reducing the size, it is possible to reduce fabrication, production and handling costs. Furthermore, the smaller footprint of the µ-Habitat reduces installation time while simplifying the sealing and dewatering offshore, saving both time and money.

“This enclosure is placed against the outer wall and then securely fastened in place” said Toups. "Once in place, the weld could be worked on by divers standing on a platform outside. It would be small enough to be easily transportable and quickly deployable on tubulars of any angle,

The diver using gloves to opeate the equipment

DRY
"Different habitats, or habitat sections, would have to be designed to match the radius of the tubular. In this case, ranging from 1200 to 1800mm.

HABITAT
"Inside the habitat is ample space for all the welding consumables and tools", said Hyperbaric Welding and NDT Manager Earl Toups.

"After being strapped to the metal wall, previously prepared and cleared of marine life to ensure a good seal, inert gas is introduced from the top to drive out all the water out leaving a dry and pre-heated metal face. The divers can then position themselves in front of one or more large Perspex panels to get a good view of the weld groove from the outside.

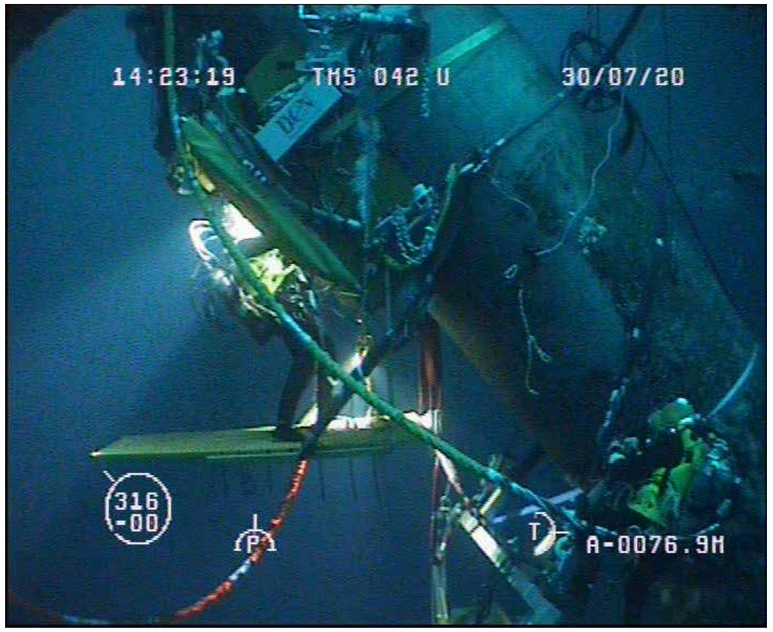
"Below this lies the access ports. When the divers insert their hands, their fingers are introduced into of rubber gloves that are integral to the microhabitat. These flexible gloves provide the interface between the wet outside and the dry clean habitat inside. They not only allow the divers to carry out the weld, but also to grind the metal and use other tools previously secured within the habitat.

"The welding process typically results in the generation of smoke which must be removed to provide good visibility. This can be easily enabled by flushing the system with gas.

This makes it possible to clean the microhabitat from the inside, or change the gloves in case a spark makes a pinhole rupture of the rubber. In one of the repairs the divers carried out on a 60mm thick member positioned at 45°, they were actually able to change the entire Perspex viewing window and recommence work without flooding the habitat or cooling the weld."

The system was mobilised in early July on a jacket lying in the UK sector of the Northern North Sea. The work consisted of four hyperbaric welds one at 43m and the other three at 76m on tubulars with wall thickness ranging from 30mm to 60mm.

The work took just over five weeks (ahead of schedule) to successfully complete the four welds from start to finish. An intervention using a conventional habitat could easily have taken three times as long.



The diver carrying out the welding operation through the microhabitat

SLEIPNIR

Sleipner 1996
The installation of the jacket on Sleipnir T by the S7000. On the left is the slightness a concrete platform bridge-linked to the riser platform and flare structure. At the base of the jacket are 14 m diameter. suction buckets

DL
First use of bucket foundations on a jacket I believe

PB
First large jacket in the world to utilise suction can technology- Sonsub had 4 WROV systems on the S7000- one on each can so that the jacket was level throughout this pioneering activity.

Thor 1983

Heerema's Thor barge installing part of the gas compression platform on the Inde gas field -at the time, the largest gas compression project in the world.

AK Thor got demolished as DB 52 in '94 ; Tolteca is former Blue Whale. Indeed both are monohulls with large single maincrane

Perenco’s upcoming SHARP project combines the INDE and LEMAN fields info 1 hub. See: https://itportal.ogauthority.co.uk/eng/fox/path/PATH_REPORTS/current-projects?PATH_PROJECT_ID=1123

DB Inde. Dived there in 77/78. Scuba jumping out of baskets hanging off the platform crane, crazy days, but we didn’t know any better and there was no regulation as such. The Cod fishing was superb.

TOGI 1990

A diverless subsea station installed in 305 m of water to collect and produce from five gas wells on Troll East. The gas was transported to Oseberg for pressure maintenance and increased oil recovery

KF Coincidently finding an old picture from the 1990 TOGI service line bundle installation 48 km between the TOGI template and Oseberg A. A quite unlikely vessel for the task but Regalia and the purpose installed lay spread installed the three duplex tubes and power cable bundle with very few issues

Total's Alwyn North

As seen from the South West

There is quite a history along with a catalogue of events, (some sad) that lead up to the launch and installation of the first jacket at this location. '87??

Very old pic that! It's had the new TOTAL logo on west face of of NAA TR for at least 12 yrs... great platform and great memories!

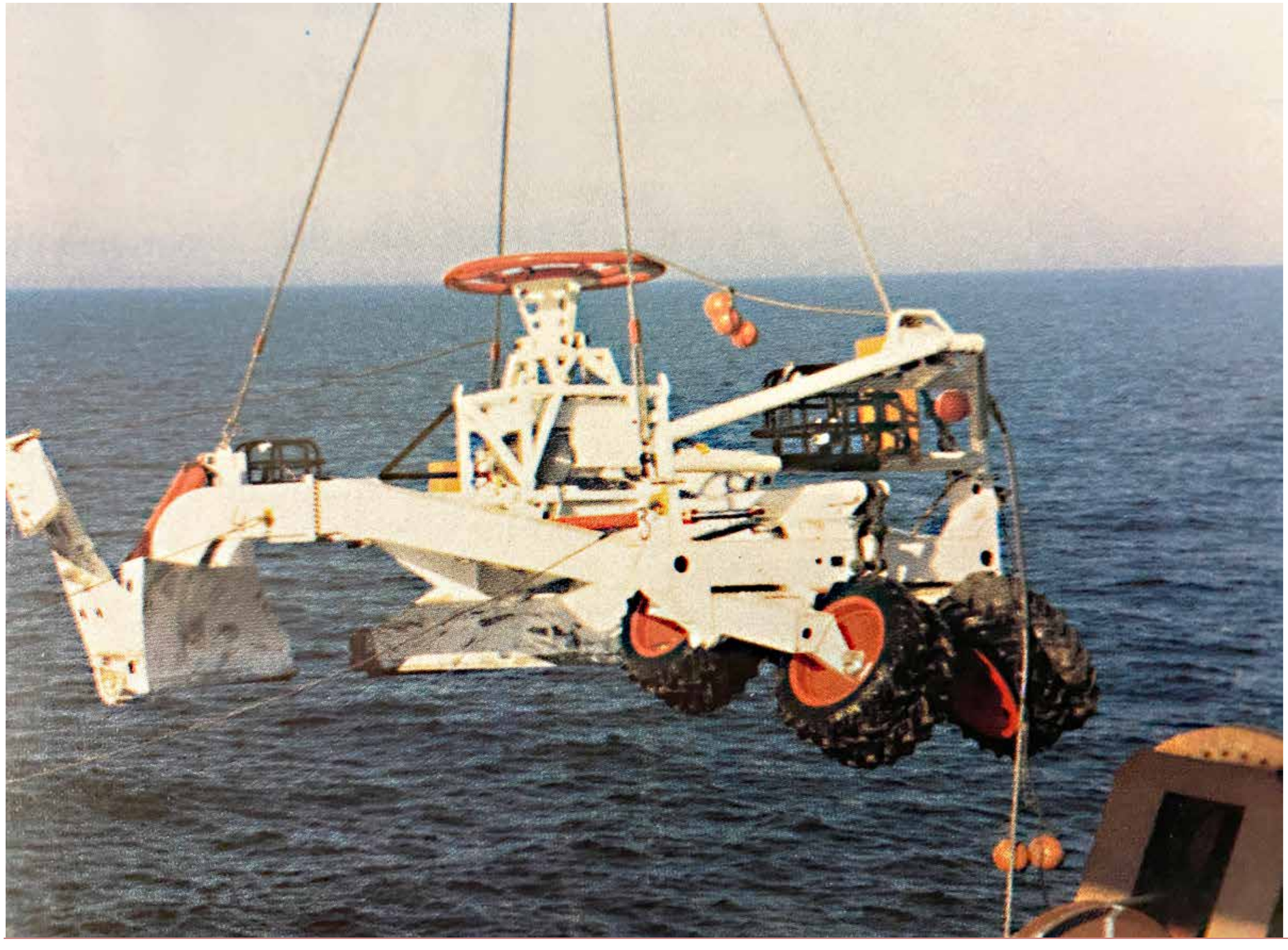
NC I was on board the Heerema barge with KD Marine (Diving) during this install. I recall that Initially there was a delay with the launching of the jacket, due to some squabbling between Total and the insurance company as a result of the plummeting oil price, at the time. Eventually the launch took place, the jacket got landed in situ and was piled in place to completion.

Then, whilst the top side package build and associated Hook-Ups were taking place, one of the barge's big rigs was positioned over the top of the platform rigged up to a pre installed tubular casing, lifting it through the structure intending to marry up a couple of flanges, the slings/wire ropes parted, the barge heaved some what and as a result of the falling/damaged rigging it wiped out a couple of guys who never made it home from work that year. I was in the chamber at the time so never experienced the subsequent medivac stuff that took place as a result of this failure, but then we had to do an inspection survey of damaged jacket members as a result of the casing crashing back down to where it had been hung off originally.

I do also recall an incident with a couple of lads getting washed over board on one of the anchor handling tugs at the time too but can't exactly recall whether that incident was at this particular location or not.

The crane driver responsible, apparently was understandably distraught (although not necessarily completely to blame because the casing/conductor had got hung up somewhere unbeknown to the riggers on the platform and they continued to request the crane to "come up" he obviously had a strain gauge to refer to, but all too late!) and climbed down from the crane and requested a relief.

1986 Brown and Root Backfill Plough

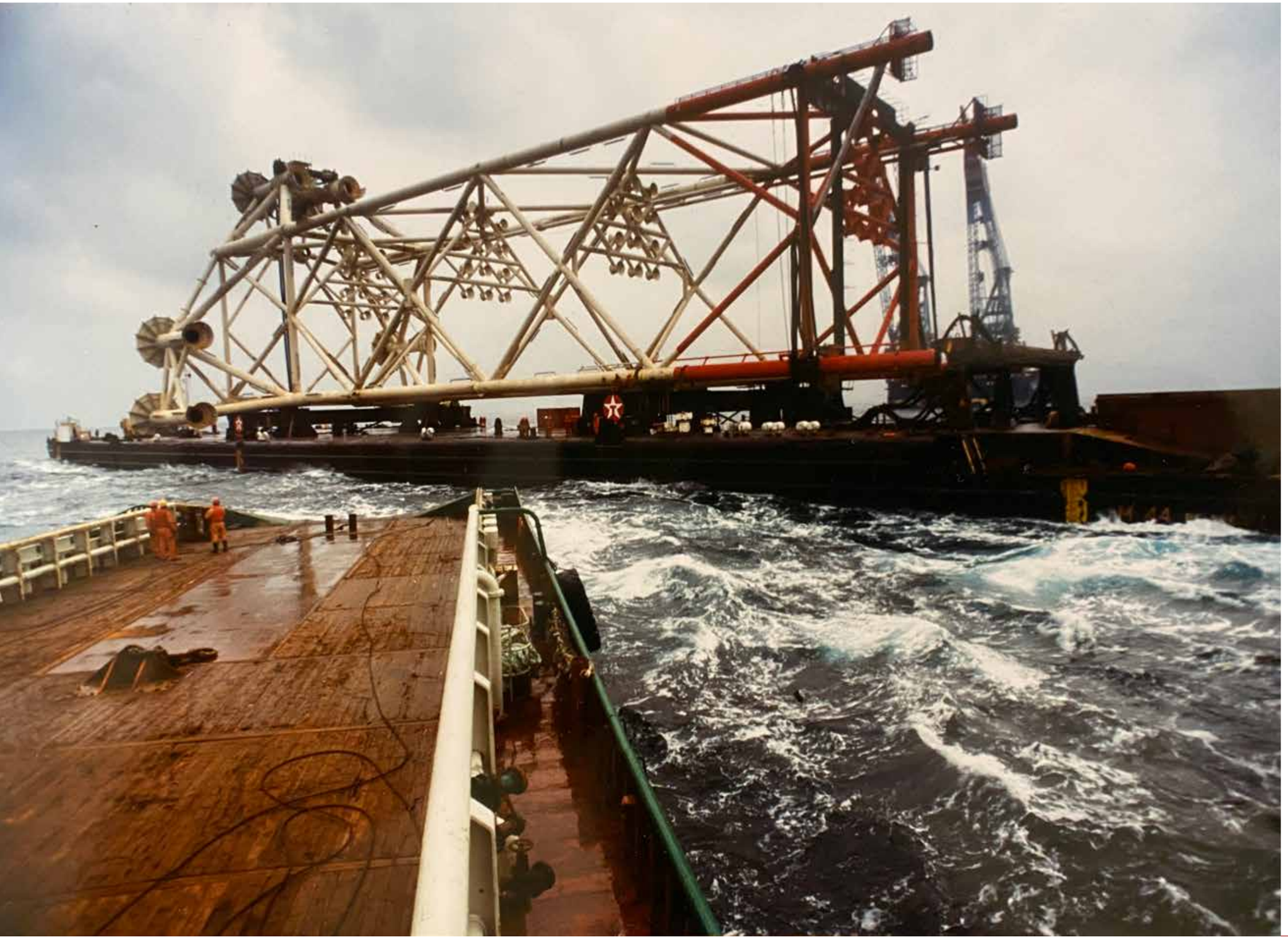


Its inaugural job was to bury 12km of 8in line between Auk and Fulmar for Shell using the BAR Protector. It's manufacturers, Soil Machine Dynamics, hailed this is a 'world's first' for a surface-hauled backfill plough.

The line was previously trenched by Brown and Root's PL1 pipeline plough, built by SMD. The work took 34 hours.

The combination was later used on Texaco's Petronella field.

Erskine 1996



The 2720t Erskine jacket on the Saipem M-44 barge prior to its installation in the field by the Saipem S7000 heavy lift vessel

TS remember A number of Dry xTrees at top of jacket..some completed . Hence provision of Large cigar docking pin to locate TS landed and rotated into position over live trees HP HT. Opening in lower deck closed after set down

TP Joined the project 1996, was there until 2010 held many positions, learned so much and worked with some very talented people. First NUI- HPHT in UK so experience was invaluable. We could start up the installation from onshore well over 20 years ago. For me a technological breakthrough in the industry that was unmatched at the time. This type of technology was the first step to operating offshore installations from onshore.

DM Many of technological advancements in our industry then and today remain - only known and recognized within this industry. Due to its inherent nature, today's public view of O&G does not recognize the vast number of people who worked very, very hard to make it as safe and as environmentally friendly as practical (and much more so than many other industry branches). Thanks for sharing Tom., Take care

CC
Worked on the design and construction of the topsides at McNulty's with the Erskine topside deck being picked up by the Stanilav Yudin direct from the quay and taken to the jacket. Great project to be on.

1983 land and Marine trencher RTM III

The remotely controlled underwater trenching machine RTM III was used to cut two 45 km trenches from Britain to Sangatte, France in order to lay 2000MW electricity cables. An identical backup machine was also built in case the first broke down or was damaged. The machine was controlled from the support vessel LM Balder by means of a 350m umbilical line.

The machine was used to lay a 35 mm diameter steel wire. The following year, a cable laying machine developed by Balfour Kirkpatrick pulled itself along using this wire to lay the two 105mm diameter cables.

The model is still on show at the college down by camel lairds

https://www.theengineeringcollege.co.uk/
The guys there have a real enthusiasm for getting young guys and gals into the workplace, especially when connected to marine works. They can tailor courses to suit the business needs. They work with Mersey Maritime and other prominent local businesses. At Land & Marine we mainly trained marine Electricians, Fitters & Welders, all now good examples of the college success (contact Terry Weston CEO)

BR We still have a sample of the electric cable sitting on a desk in our hall! Sad that Land & Marine no longer exists; we have watched it being taken over by one company after another; each one carving off what it wanted then selling on until there was nothing left and now it doesn't even exist in name only! The 70s and early 80s were indeed the glory days of L&M.

I also have a sample of the electric cable that was laid after L&M completed the trenching operations. I absolutely agree, it's a great shame that L&M are no longer a significant player in the subsea Engineering and construction industry. An industry I am still actively involved with.

Hadn't seen one of these large trenchers fitted with buoyancy tanks before. Reminiscent of a much smaller unit we used to bury pipelines in the GOM with Frank Wade and Marine Jetting. It was 'ballasted' using two 55gal drums with vented compartments, and filled using the diver's pnemo hose. Once the jets started, you couldn't see anything, so I often crawled around it on deck with my eyes closed; 2200psi will put a hole in you.

John, was on the Land & Marine Balder in 1990 with Martin Dane, we were in Cruden Bay trenching the replacement BP Forties export line. I seem to recall that was the Mkiv Trenching tool, got pretty trashed by all the boulders. Oceaneering had a 1 Atm suit onboard as well. Martin was the BP Rep and I was on there for McDermott/Etpm then later out to Forties Charlie for the spool tie-ins and hydrotest. Great days and even greater jobs.

SG There was still life in the old dog (L&M) when we developed the subsea nuclear particle recovery vehicle (PRV-II). Operating at Dounreay for 3 seasons 2010- 2012. It proved so efficient that the recovery program was stopped after the number of particles we recovered exceeded all expectations! (Classic shooting yourself in the foot!)

MF I was working for L&M during this time, my contribution to the project was to study the cable routes and landfalls for what was probably the first electrical Interconnector to the UK. I remember this period as being the high point of L&M which was reflected in a Queens Award for Technology

NF I remember this well!! I was on the assembly build and commissioning of RTM III, over in Teeside. Then I was a part of the operations team on the LM Balder down in the English Channel throughout the trenching operations. Happy days!!

The cable Image Beth Rees
The project manager was Tony Rees and his wife, Beth, sent me this image of the cable they used. Their son, Daniel, is a Marine Superintendent with Murphy's , one of the very few original Land and Marine employees

PHOTOS

IKM's 2000hp workclass electrical ROV carrying out work in East Malaysia Image: Dinesh Krishnan

TESTING SHELL'S EIDER PLATFORM 1985

Shell's Eider featured vertical unguided piles driven by underwater hammers resulting in weight savings. It was the largest platform to be barge-launched (the others being floated out) and was self-upending.
Tests were carried out at the BMT ocean test facility in Feltham.

In the passive system, water slowly flooded through holes in the jacket legs, but buoyancy tanks kept the entire structure off the bottom. This method obviated a conventional ballast control system.

The uprighting sequence was quick making it less susceptible to weather changes

1980 HENRIK IBSEN

Perhaps the first great tragedy of the North Sea was the sinking of the Semisubmersible Alexander Kielland. The Kielland had a sister ship, well, a Pentagone type rig, the Henrik Ibsen. The Ibsen had recently undertaken an 8-month conversion to accommodate 600 offshore workers.

Following the Kielland's sinking, the NPD revoked the Ibsen's operation certificates on the day it was due to be towed to Edda. 10 days after the Kjelland sinking, the Ibsen started listing in its inshore berth. This was due to a buoyancy valve

PHOTOS

WHESSOE YARD 1986

£2.7million of improvements at Whessoe's Middlesbrough yard in 1985 included a new 5000t heavy load out quay. It conducted a joint venture with Haden Moore to offer a larger range of disciplines.

PHOTOS

DYVI OMEGA

This was one of Kvaerner Maritime's Catamaran class (CS) platforms (rigs). Others in this series included this Scarabeo 5 and the Stena Don. They had deck loads of in excess of 5500t.

ROCKWATER'S REGALIA ON PIPER B

PHOTOS

TESTING SHELL'S EIDER PLATFORM 1985

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The uprighting sequence was quick making it less susceptible to weather changes

TOWING HOLSTEIN.

SLEIPNER

The large scale separation of carbon dioxide was carried out for the first time on Sleipner West (left, bridge-linked to Sleipner East's A platform).

DRILLSHIP EXPLORER 2 1985

Canmar's reinforced drillship Explorer 2 was the first drilling unit to reach Alaskan waters fro the Canadian Beaufort Sea.

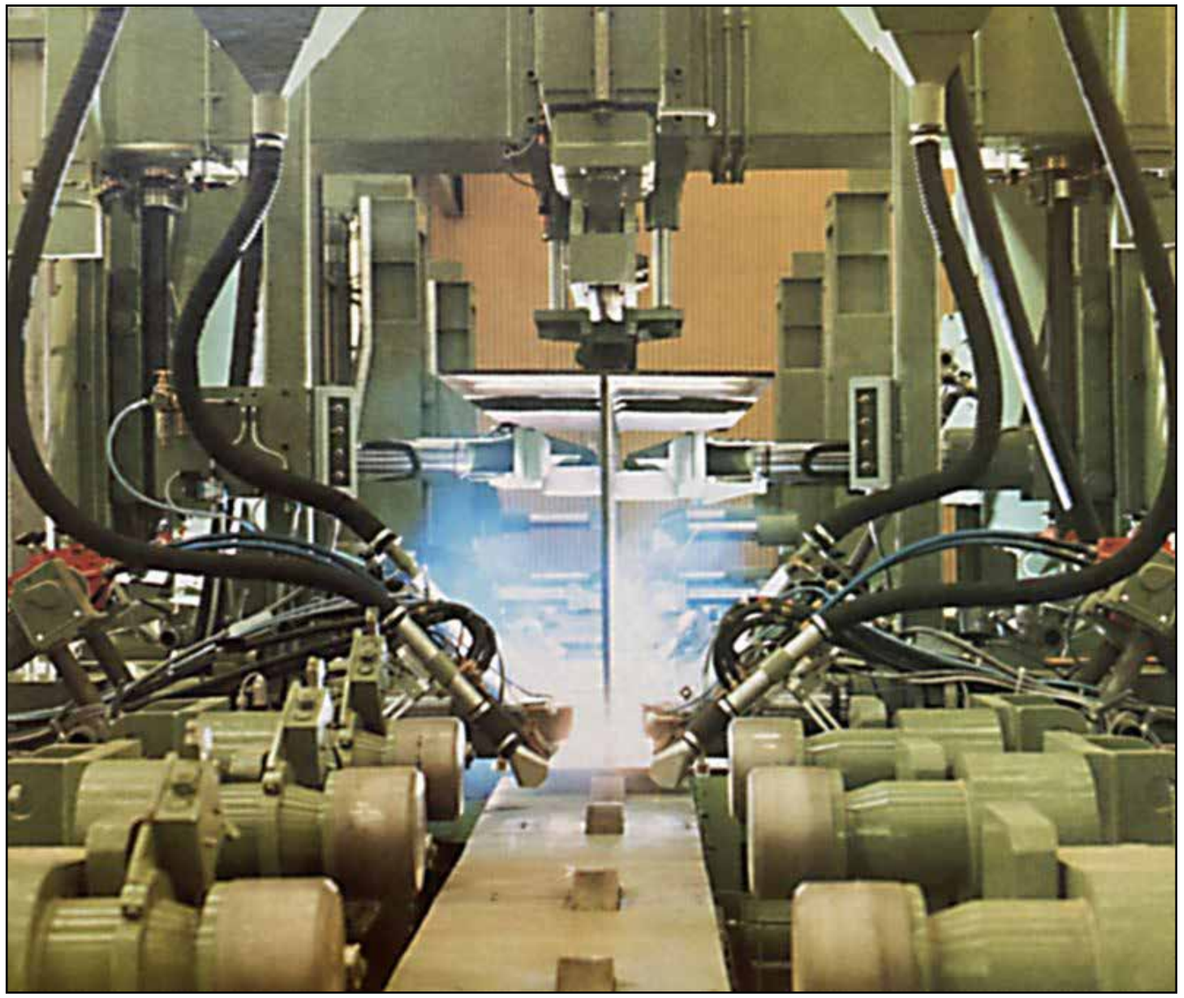
WEST VENTURE. 1999

In September 1999, Hitachi Zosen completed the fifth-generation semisubmersible West Venture for Smedvig Offshore. It could operate in 1500 m water depths, with twin derricks permitting simultaneous drilling of two wells.

PETERHEAD 1980ISH

The Ocean Rover undergoing routine inspection.

ARDERSIER, 1987



McDermott carried out a £22 million modernisation programme at its Ardersier yard. At the time, it was carrying out fabrication work on the 22,500-ton marathon Brae B jacket and piling for Conoco's V block jackets. The contracts for the jackets themselves came to Ardersier after the Howard Doris yard at Wallsend went into liquidation.

This image shows the automated fabrication in the Plate Girder Shop.

From 1973 to 1986, Ardersier fabricated 363,158 tons.

EUROPEAN MARINE CONTRACTORS SEMAC

STAG 1998

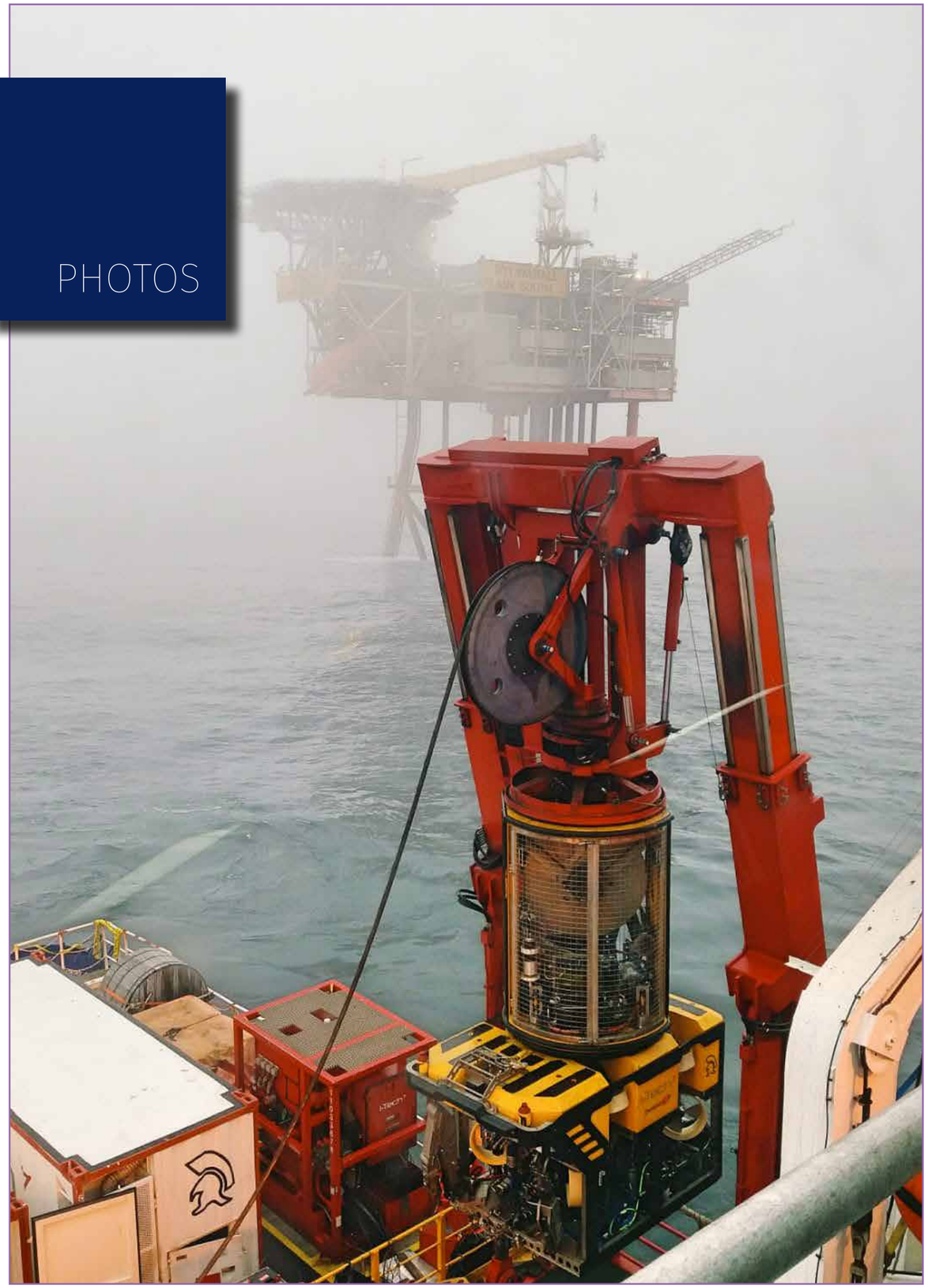
The Central Production Facility EPC contract for Apache's Stag field was won by Bouygues Offshore. It was based on a design that was self-installable and reusable. It was transported to site by the submersible vessel Mighty Servant 3.

Left:
EMC was formed in 1988 by Brown and Root, and Saipem. Included in the fleet were the Castoro 10, BAR221, BAR Protector, Castoro Sei and the Semac 1.

DEEPWATER NAUTILUS 2000

Most rigs are built in a dry dock. R&B Falcon's Deepwater Nautilus , however, was built on land. The pontoons and columns were fabricated and then the entire hull structure was lifted onto them using an intricate strand jack and tower superlift jack

PHOTOS



ROV Operations on Valhall South Flank
Adam Poland