UT

UNDERWATER TECHNOLOGY

ISSUE 5 2022

SUT Society for Underwater Technology

MTS marine technology society

SUT
Society for Underwater Technology

SOCIETY FOR
UNDERWATER TECHNOLOGY

HQS Wellington,
Victoria Embankment,
London WC2R 2PN

Vol 16 No 5

Editor: John Howes
John@ut-2.com
+44 7859905550

Editorial Assistant:
Fallon de Floor

Production:
Sue Denham

Advertising:
Zinat Hassan
UT3subsea@gmail.com

Tel: +44 (0) 845 6522 483
Mobile: +44 (0) 781 1200 483

Published by UT2 Publishing for and on behalf of the Society for Underwater Technology.

MTS
marine technology society

TRELL AND TRINE

Aker BP and licence partners Petoro and LOTOS have submitted a plan for development and operation (PDO) for Trell and Trine fields to the Norwegian Ministry of Petroleum and Energy (MPE). This development will use the planned extended lifetime for the Alvheim field, increase production and reduce unit costs per barrel.

"Trell and Trine represents the third PDO submission in the Alvheim area in just one year, following close on the heels of Frosk and Kobra East & Gekko.

The development is planned with three wells and two new subsea manifolds to be tied back to existing infrastructure on East Kameleon and further on to the Alvheim FPSO.

One of the three wells is Trell Nord, which, although not yet proven, has a high likelihood of productivity. When the Trell production well is drilled, the plan is to first prove hydrocarbons in Trell Nord, then drill the wells in Trell and Trine. The programme will conclude with the production well in Trell Nord.

Total investments are estimated to approximately NOK 6 billion (about US$ 700 million). Production is scheduled to start in the first quarter of 2025.

Recoverable resources are estimated to approximately 25 million barrels of oil equivalent. They will produce with very low emissions, estimated at 0.3 kg CO_2 per barrel.

The Alvheim field consists of the Kneler, Boa, Kameleon and East Kameleon structures, subsequently joined by the Viper-Kobra structures and the Gekko discovery.

The Alvheim area includes satellite fields Bøyla, Vilje, Volund and Skogul. All of these fields are produced via the Alvheim FPSO, which came on stream in2008.

SLB AS S7 JV

Schlumberger, Aker Solutions and Subsea 7 have formed a joint venture to deliver a step change in subsea production economics by helping customers unlock reserves, reduce time to first oil and lower development costs while simultaneously delivering on their decarbonisation objectives.

The proposed joint venture will comprise the subsea businesses of Schlumberger and Aker Solutions, with Subsea 7 purchasing 10% of the joint venture for $306.5 million. This combination brings together deep reservoir domain and engineering design expertise, a field-proven subsea production and processing technology portfolio, world-class manufacturing scale and capabilities, and a comprehensive suite of life-of-field solutions to customers all over the world.

The transaction is subject to regulatory approvals as well as other is expected to close during the second half 2023. Following completion of the transaction, Schlumberger will own 70% of the joint venture, with Aker Solutions and Subsea 7 owning 20% and 10%, respectively.

The new joint venture will form part of Subsea Integration Alliance, currently an unincorporated alliance between Schlumberger and Subsea 7. The alliance will be extended by 10 years from the transaction completion date.

AKER BP LUNDIN

Lundin Energy's E&P business was transferred to Aker BP in June. "Our ambition is to create the world's best oil and gas company with low costs, low emissions, profitable growth and attractive dividends. We will also play an important role in the global energy transition," says Aker BP CEO, Karl Johnny Hersvik.

The merged company is the second largest operating company on the Norwegian continental shelf (NCS). The company has a substantial resource base which provides a good foundation for growth with low costs and emissions.

JACKDAW

Shell has taken the final investment decision (FID) to develop the Jackdaw gas field in the UK North Sea, following regulatory approval earlier this year.

Jackdaw will comprise a wellhead platform that is not permanently attended, along with subsea infrastructure which will tie back to Shell's existing Shearwater gas hub.

The project is expected to come online in the mid-2020s, and at peak production rates, could represent over 6% of projected UK North Sea gas production in the middle of this decade, with operational emissions of less than 1% of the whole UK basin. That is enough energy to heat 1.4 million homes.

The Jackdaw development consists of a new Wellhead Platform (WHP), four production wells and a 31 km pipeline from the Jackdaw WHP to the Shearwater gas hub.Peak production from the field is estimated at 40,000 barrels of oil equivalent per day.

Announcing the award on Tuesday, Aker Solutions said it follows the completion of front-end engineering and design work (FEED), awarded in June 2019. The scope includes engineering, procurement, construction, and installation (EPCI) of the complete wellhead platform, consisting of topside and a steel jacket, as well as related load-out and offshore hook-up and commissioning.

Jackdaw wellhead platform

Fabrication of the wellhead platform will happen at Aker Solutions' yard in Verdal, Norway, and at its peak, the project will employ over 300 people.

The steel substructure including a pre-drilling deck is to be delivered from Aker Solutions' facilities to Shell in 2023, and the topside in 2024. In the project, Aker Solutions will continue the cooperation with external suppliers Rambøll and Leirvik, who were part of developing the FEED.

CYPRE

Trinidad and Tobago (bpTT) is proceeding with the development of its Cypre offshore gas project.

Cypre will become bpTT's third subsea development. It will include seven wells and subsea trees tied back into bpTT's existing Juniper platform via two new 14 kilometre flexible flowlines. Drilling is due to commence in 2023 and first gas from the facility is expected in 2025.

The Cypre gas field is located 78 kilometres off the southeast coast of Trinidad within the East Mayaro Block, in water depth of approximately 80 metres. At peak the development is expected to deliver average gas production of 250-300 million standard cubic feet a day (mmscfd). Production from Cypre will go towards satisfying bpTT's existing gas supply commitments.

This subsea development will capitalize on the existing subsea enabling infrastructure at Juniper allowing gas to be brought to market in a shorter time than a normally-unmanned installation (NUI) development.

N05

ONE-Dyas, together with partners EBN and Hansa Hydrocarbons, have made a final investment decision for the development of the N05-A gas field in the North Sea. The decision involves an investment of more than EUR 500 million. This makes it the largest investment in a natural gas development in the Netherlands in the past 15 years.

The Ministry of Economic Affairs and Climate (EZK) has awarded the final permits for the development of the N05-A gas field in the North Sea on 3 June 2022. This was preceded by a careful permitting process during which ONE-Dyas had regular and proactive discussions with multiple stakeholders.

The result of these discussions, as well as the submitted views, has been incorporated into the project and environmental impact report, which was part of the permitting application for N05-A. The same applies to the views of the Government's statutory advisory bodies.

The Environmental Impact Assessment Committee concluded on 18 February 2022 that the environmental impacts have been sufficiently outlined, and that the utility and necessity of the N05-A project have been satisfied.

Chris de Ruyter van Steveninck, CEO of ONE-Dyas: "We are bringing emissions close to zero as the nearby offshore Riffgat wind park will supply the N05-A platform with wind energy.

The energy transition requires cooperation between all stakeholders. For this project, ONE-Dyas is exploring opportunities for nature-inclusive construction, further system integration between wind and gas and opportunities that can contribute to research and nature development in the area. ONE- Dyas has always valued open and transparent dialogue with stakeholders and is keen to continue to engage with them.

GEMS stands for 'Gateway to the Ems'. In this area, ONE-Dyas, together with partners EBN and Hansa Hydrocarbons, is investigating gas production opportunities. The development of gas field N05-A is part of this.

The expected volume to be produced from the N05-A field and surrounding prospects is 4.5 to 13 billion Nm3. The potential of the wider Dutch-German GEMS field has been estimated at around 50 billion Nm3 in total, depending on exploration success.

Visualisation of the N05-A platform and the connection to the Riffgat wind park

RotoTech has launched the new Roto Climber Mk 1 (Mini), its smallest and most lightweight device for cleaning and visually inspecting smaller sized pipes. It can measure wall thickness on conductors, piles, risers and caissons.

"We really believe that what we have is leading edge" Says Simon Hartog, Managing Director at RotoTech Pte "Outside of the North Sea, many platforms are small and aging and need maintenance that most other equipment cannot perform suitably."

The Roto Climber Mk 1 (Mini) has been designed to clean and inspect the more smaller tubulars from 6in to 12in in diameter. It has a lightweight, (43kg) and compact design which enables it to be delivered in three pelican cases with no platform deliverables.

Once on the platform, no crane is required and it can be physically carried anywhere, only requiring a three man crew to operate the Climber.

It is constructed from new composite materials giving a high strength to weight ratio and fitted with a number of sensors and tools, including 3-4 high resolution cameras. These use DWE explorer HD 2.0 with a Sony Image sensor IMX323 1/2.9 to detect and map defects.

It is battery powered (two batteries) with the option of being solar charged and lasts 24 hours per charge. Rated ATEX 2 Zone, it is able to work in hazardous environments at a depth of 50m.

The RotoClimber uses three NDT techniques – a Pulsed Eddy Current allowing coated risers to be inspected. It can also carry out ultrasonic testing using a phased array system to map corrosion on a riser down to 50m. The cleaning systems are based on either ultra high pressure (UHP) water or Caviblaster which do not inflict damage to pipe coatings such as Neoprene.

The business model is to have agents around the world. Rototech will own the equipment and the agent will contract with the Oil and Gas company to perform the necessary work using Rototechs' equipment.

The equipment will be based in Asia, Middle East, Caspian. N. Sea, Gulf of Mexico etc where it is needed. By doing this, Rototech will not need to employ a large manpower base.

There will be no need for work permits, no large mob and demob fees for operators, no language problems, a better health and safety environment and a much smaller carbon footprint which will be cheaper for the operator.

NORTH SEA CAMPAIGN

C-Kore Systems recently completed a successful campaign on a subsea oil field located in the North Sea. The C-Kore tools were used to test the electrical integrity of the subsea assets, giving quick feedback to the operator for their maintenance decisions on the field.

C-Kore's subsea testing tools are used by operators and installation contractors around the world on both installation campaigns and fault-finding operations. The Cable Monitor unit confirms the insulation resistance and continuity of the electrical lines while the Subsea TDR unit localises anomalies within 20cm. With C-Kore's automated units and on-line training, no extra offshore support is needed to run the equipment.

C_Kore's Optical TDR tool–

Their latest product, the Subsea Optical TDR unit now allows customers to easily test their fibre optic lines subsea.

The C-Kore Cable Monitor units provide quick and accurate readings on the insulation resistance and continuity of electrical lines. The Subsea TDR unit localises faults with an accuracy of 15cm, and the Pressure Monitor data-logs the hydraulic pressure of the umbilical hoses.

600 UP

C-Kore Systems has announced the deployment of their 600th subsea testing tools. This milestone event occurred within an installation campaign in the Gulf of Mexico, one of C-Kore's growing markets and included their new Subsea Optical TDR tool.

So far C-Kore tools have been responsible for the installation of 50 assets (umbilicals) and have been used to find more than 230 faults in existing subsea fields for a total of 10,000 days of tool hire. The company has continued to grow its customer base to over 70 clients by combining cost-saving technology with exceptional customer service.

This mobilisation included a wide range of the company's testing tools.

Greg and Cynthia at Buckingham Palace of receiving The Queen's Award for Enterprise: Innovation 2019

APPOINTMENTS

Following continued growth , the company has appointed of Greg Smith and Cynthia Pikaar to the C-Kore Board of Directors.

Greg is one of the founding members of C-Kore and has held the title of General Manager since its inception. He designed C-Kore's first product the *C-Kore Cable Monitor*. Cynthia joined C-Kore shortly after the company's launch to take up the role of Sales and Marketing Manager.

As a two-time winner of the Queen's Award for Enterprise: Innovation 2019 and International Trade Award 2021, C-Kore are committed to continually developing ways to undertake subsea testing.

"As the industry looks to the future and improves current working practices and/or transitions to new ways of energy production, all this confirms C-Kore's continued commitment to being an organisation with industry knowledge right at the heart of it," said Cynthia Pikaar

L6 SUBSEA LIGHT

OceanTools, global supplier of underwater technology, has added another AC lamp to its range of industry leading subsea lighting.

Available as either a floodlight or a spotlight the L6 lamp has been designed to be used on underwater vehicles and installations with a 120VAC/DC supply.

The lamp offers up to 10,000 lumens of illumination with flicker free dimming using either RS232, RS485 or analogue control and a range of colour temperature options. Depending on the operating depth requirement, the L6 is available in Anodised Aluminium (4000m rated) or Titanium (8000m)

The L6 Subsea LED lamp is the latest addition to the OceanTools extensive range of pioneering underwater technology which includes not only lighting but also DyeTection Systems and Subsea Cameras.

L6 lamp

CT REELER

Logan Industries' coiled tubing (CT) reeler suite for OneSubsea,

Logan Industries has successfully delivered a unique, space saving coiled tubing (CT) reeler suite for OneSubsea.

More than simply storage reelers, they provide full torque control for the tubing without the need for a standard injector head. This reduces space required compared to standard tubing reeler / injection head combination and allows for a larger fluid storage footprint on deck.

When the equipment required to handle CT has a small footprint, more deck space can be dedicated to hauling fluid, which increases profitability for the operator.

This is the first unit Logan has delivered with a removable drum, which means the unit footprint can remain static on the vessel while the drums can be taken to a shore base for unspooling and respooling.

The swap out drum also makes the machine faster to build, reducing typical assembly time for the drum and drive train from two weeks to two days.

.

OCEANEERING INSPECTION COLLABORATION WITH INNETIQ

Oceaneering has formed a collaboration agreement with InnetiQs (IQ) to explore and develop advanced inspection solutions for the offshore and onshore energy markets.

This collaborative agreement combines IQ's advanced inspection technologies for subsea pipelines, risers and structural assets with Oceaneering's global operations and ability to provide cost-effective, in-depth inspection and cleaning methods that lessen exposure risks to personnel.

This agreement also ties into the current integrity management systems and Inform software suite of predictive analytic solutions.

Work is underway to help evolve the development of IQ's state-of-the-art Splash Zone Scanner. This solution combines multiple inspection methods and cleaning capability into a single scanning system to deliver a combined result not currently available in the industry.

Integrating the results of parallel methods delivers a level of confidence to evaluate asset integrity in the splash zone area that is a game changer in this critical area of an offshore installation.

● In another announcement, Oceaneering will use the Inspection Data Management Software (IDMS) platform provided by Austin-based software firm HUVRdata (HUVR) to enhance its current Integrity Management offerings.

The arrangement leverages industry-leading subject-matter expertise and accelerates HUVR's technology roadmap to create new and enhanced software products.

With the launch of a new digital asset management system, Oceaneering expects to engage closely with its network of partners and deliver digital solutions to the integrity management market.

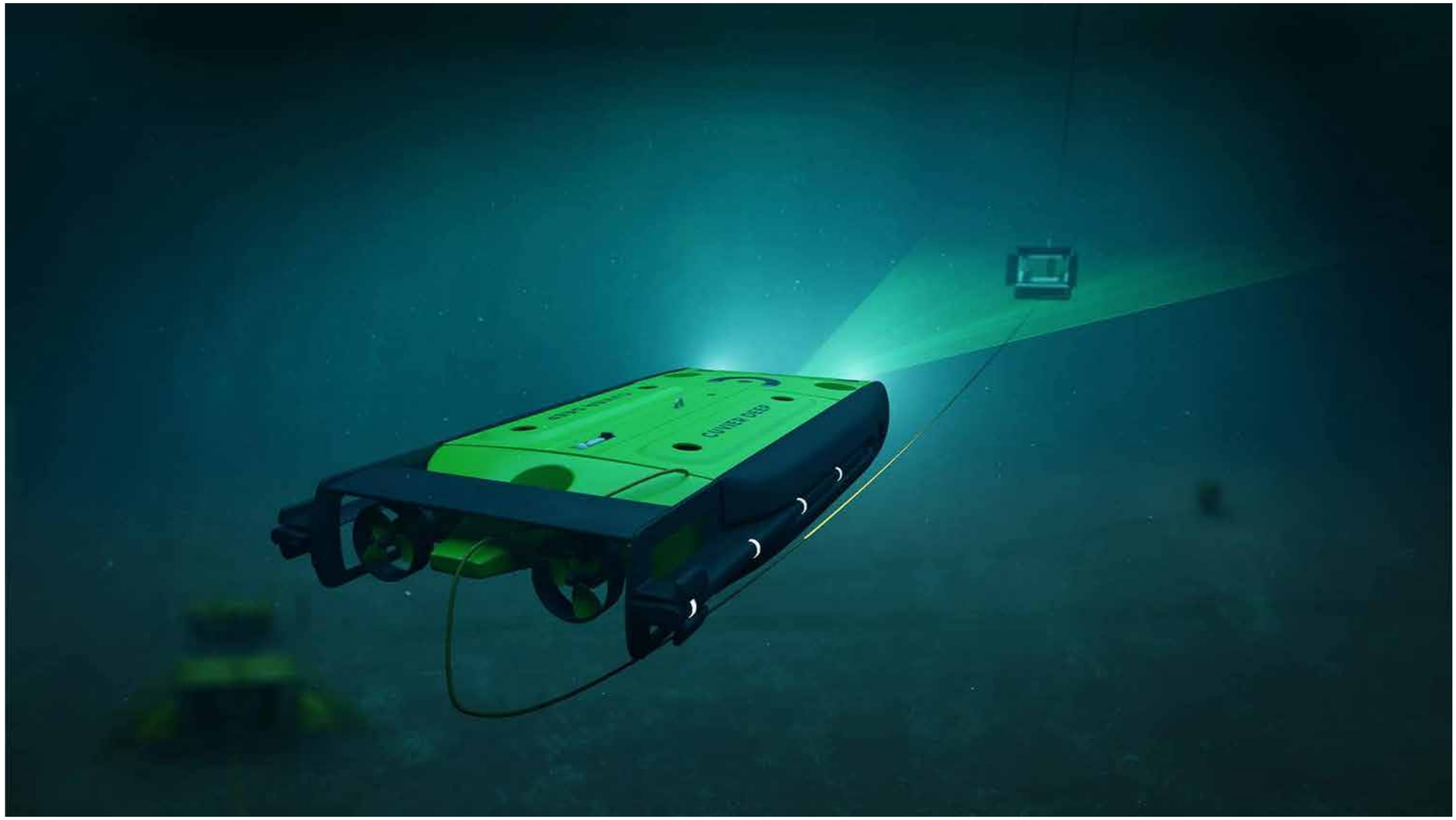
HUVR's cloud-based IDMS platform is mobile-connected, flexible, scalable and vendor-agnostic. Its capabilities support automated inspection data collection and analysis, enabling data-driven risk mitigation and reduction of the total cost of asset ownership.

Cuvier DEEP

SOPHISTICATED TECHNOLOGY ESSENTIAL FOR THE BLUE ECONOMY

According to the World Bank, the Blue Economy is the "sustainable use of ocean resources for economic growth, improved livelihoods, and jobs while preserving the health of the ocean ecosystem."
It can be said that it is the responsibility of all corporations to do whatever they can to promote the Blue Economy.

Specialising in the development of Subsea LiDAR systems with in-house developed end-to-end data workflows that address underwater inspection needs, 3D at Depth caters to both deep water energy and shallower water depths, targeting the offshore wind sector. With a background of offering autonomous underwater solutions, they have set out to develop a complete package that goes beyond measurement and provides acquisition to answers, for the benefit of the Blue Economy.



The underwater vehicle entering the Habitat

Leveraging on their existing LiDAR technology, they combined class-leading sensors and high-end system performance with a focus on continual improvements to derive unparalleled data quality.

3D at Depth has worked on its all-in-one solution called the Cuvier DEEP a Hovering Autonomous Underwater Vehicle System.

An important part of this all-encompassing solution was to offer clients a safe and convenient transport and deployment solution for the technology. They devised a low-drag hydrodynamic subsea garage solution called Habitat.

The low drag profile is designed for in-water towing. Water transit or inspection speeds can be up to 4kts, allowing for reduced deployment and recovery timings, all of which minimise risks and unnecessary emissions. The garage works in a multi- functional capacity, with the ability to host power distribution, sensors, and wireless communication options-including optical and acoustic modems- all of which allow for supervised in-water operations.

Positional information is obtained from resident inertial navigational sensors interfaced with market standard Ultra Short Baseline (USBL), or Long Base Line (LBL) aiding options.

Habitat's removable front nose section hosts a constant tension winch, with up to 4km of fibre optical tether, power and sensor interfacing, and Habitat's brain. The extended optional tether allows for high-speed data to be delivered from the Cuvier DEEP to the vessel with deep-water long layback touchdown monitoring applications.

Up to a 3.5km offset can be achieved depending on operational conditions via the optical tether solution, thanks to the thin fibre lines' outer diameter of 4mm.

The unit also impressively allows for semi-residency and multi-vehicle deployment operations making future SWARM applications possible. A quick release top section with load-bearing structures allows for multiple vehicles to be safely launched, recovered, or serviced on deck.

When used with the rotating Launch and Recovery System (r-L&RSTM), it can also provide charging, data downloads, and in-water transits from the deck to water depths of up to 3000m. The entire solution is remotely controlled onshore via a satellite uplink.

This futureproofing allows for supervised or tethered deep water operations. The r-L&RSTM can rotate its electrically driven main lift winch and overboard A-frame 310 deg, allowing for flexible deck mounting options and an overboard reach of distances of up to 5.5m.

Having the flexibility to mount the r-L&RSTM adjacent or perpendicular to the vessel's side increases the vessel footprint and deck design solutions.

Control and launch and recovery system

Depending on the vessel or offshore work platform, the operation can be complemented with deck-mounted class-certified workshops and control cabins for bare boat charters. It can also be separated offering only what's required and leveraging current vessel tooling such as over boarding cranes or workspaces for the control room.

The entire spread is designed to fit onto standard ISO containers, allowing for easier international shipping and road transport, without the need for loading or permit restrictions.

The system design has been modified to enable greater endurance and more diverse sensor payload integration, meaning both better in-water operational time and higher data capture accuracy. This innovation has been heavily influenced by years of marine design and operational experience to unlock an operationally unique platform with incredible agility.

The result is a highly adaptive work platform that greatly reduces the on-deck turnaround time due to a modular power solution.

For the blue economy, global climate change and the energy transition have created an impact as major ecological events. 3D at Depth has worked hard to provide an end-to-end approach to a complete solution has offered flexibility, lower emissions, allowing inspection in deeper water depths from smaller vessels with lower mobilisation footprints, spanning shipping, lifting and deck fastening.

SEAGRASS RESTORATION

The largest seagrass restoration, education and innovation project in England, LIFE Recreation ReMEDIES, will receive support from environmental sensor manufacturer, Valeport, for the project's final two years.

The marine conservation project which is led by Natural England, focuses on five Special Areas of Conservation along England's south coast and Valeport's sponsorship announcement coincides with an extension to the project which will now run until October 2024. The newly extended five-year ReMEDIES project seeks to protect and restore sensitive seabed habitats which are at risk and aims to plant a total of eight hectares of seagrass meadows – four hectares in Plymouth Sound and four hectares in the Solent Maritime Special Area of Conservation.

Seagrass meadows are increasingly being recognised for their essential carbon capture abilities – seagrass can be as effective at absorbing and storing carbon as woodlands. It also provides a vital nursery bed for juvenile fish and protected creatures like seahorses and stalked jellyfish, cleans surrounding seawater and helps stabilise the seabed which can help to reduce coastal erosion.

However, seagrass meadows are a globally threatened ecosystem – with estimates suggesting the planet loses an area of seagrass the same size as two football pitches every hour. At least 44% of the UK's seagrass has been lost since 1936. The delicate and endangered seagrass meadows in the UK are vulnerable to factors including wasting disease, pollution and physical disturbance such as anchoring, mooring and launching of leisure boats, as well as other shore- and water-based activities.

In addition to planting new seagrass meadows, ReMEDIES is working to protect existing meadows by helping recreational users to minimise impacts on these sensitive habitats.

The project is trialling Advanced Mooring Systems that help reduce impacts from recreational boating on the seabed, producing best practice guidance for boaters, seagrass location maps and conducting seagrass monitoring.
The project, which launched in July 2019 has already achieved a number of significant milestones; 3.5 hectares of seabed has now been planted (comprising 2.5 hectares in Plymouth Sound and 1 hectare in Solent Maritime) with approximately 70,000 seagrass seed bags.

During July and August this summer, seagrass seeds were collected by divers from healthy seagrass meadows in the Solent and Cornwall.

As part of ReMEDIES, the Ocean Conservation Trust (OCT) is also trialling planting seedlings directly onto the seabed. They are currently growing square 'pillows' of multiple seedlings in the lab at the NMA which will be transferred to the seabed within the Voluntary No Anchor Zone in Jennycliff Bay, Plymouth Sound. .

ISURUS 5 AND 6

Oceaneering launched its fifth and six Isuru ROV systems in March and May 2022, respectively, due to increased customer demand for high speed, high current-capable work class ROV systems for offshore wind and renewables projects.

Isurus was designed to execute operations in high currents and adverse weather conditions. Traditional work class ROV systems are designed to operate powerful tooling in deep water environments, but they struggle to operate in tidal currents exceeding 1.5 kts.

Severe tidal currents can prevent a regular work class ROV from executing construction tasks for up to 25% of any given day.

HARSH CURRENTS

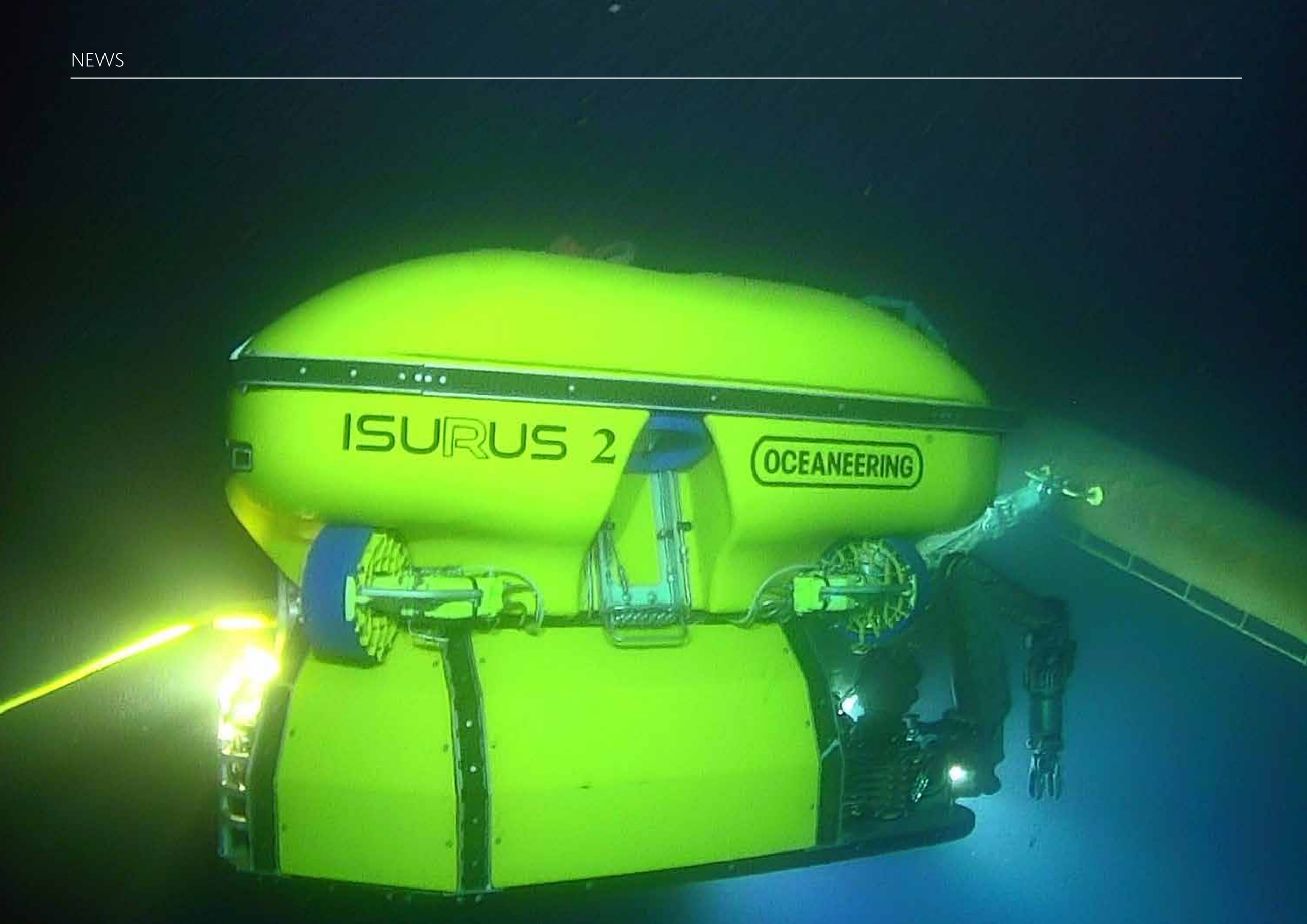
The benefits of expanding an ROV's operating window in harsh currents are clear when the typical cable lay or construction vessel day rate exceeds US$250,000.

"Working with our clients, Oceaneering identified that a hydrodynamic form factor for a work class ROV could significantly increase its speed in water and enable projects to continue in currents exceeding 2.5 knots," said Nick Rouge, Subsea Robotics Product Manager for Oceaneering.

"Isurus is the result of a focus on using existing designs and adapting them through small changes to deliver significantly improved performance for the offshore renewables market."

As previously reported in UV2 (Issue 4, 2021), the Isurus vehicle is based on Oceaneering's proven Magnum Plus ROV design.

"The vehicle's frame, foam block, and body skins were modified to make the vehicle


ISURUS 2
OCEANEERING

more hydrodynamic," said Rouge. "But, unlike other high speed ROVs, the Isurus is a fully capable work class system with two hydraulic manipulators that can deliver the same hydraulic and electric power for tools and payloads as the Magnum Plus vehicle."

Another issue affecting traditional work class ROVs: visibility challenges in shallow water environments. Isurus offers an innovative solution to this issue to keep operations going.

"We added multiple high resolution sonar systems to provide the required visibility to continue operations in the turbid water that is generally encountered in shallow near shore environments," added Rouge.

Rouge said in the future the Isurus fleet will be upgraded to enable faster installation of additional sensor systems and subsea switching between sensors as required by the operational conditions.

All six Isurus systems are currently in operation in Northwest Europe and East Asia, supporting offshore wind and tidal project construction, including monopile installation, inter array and export cable installation, and inspection and maintenance. There are plans to introduce a seventh and eighth system in Q4 2022.

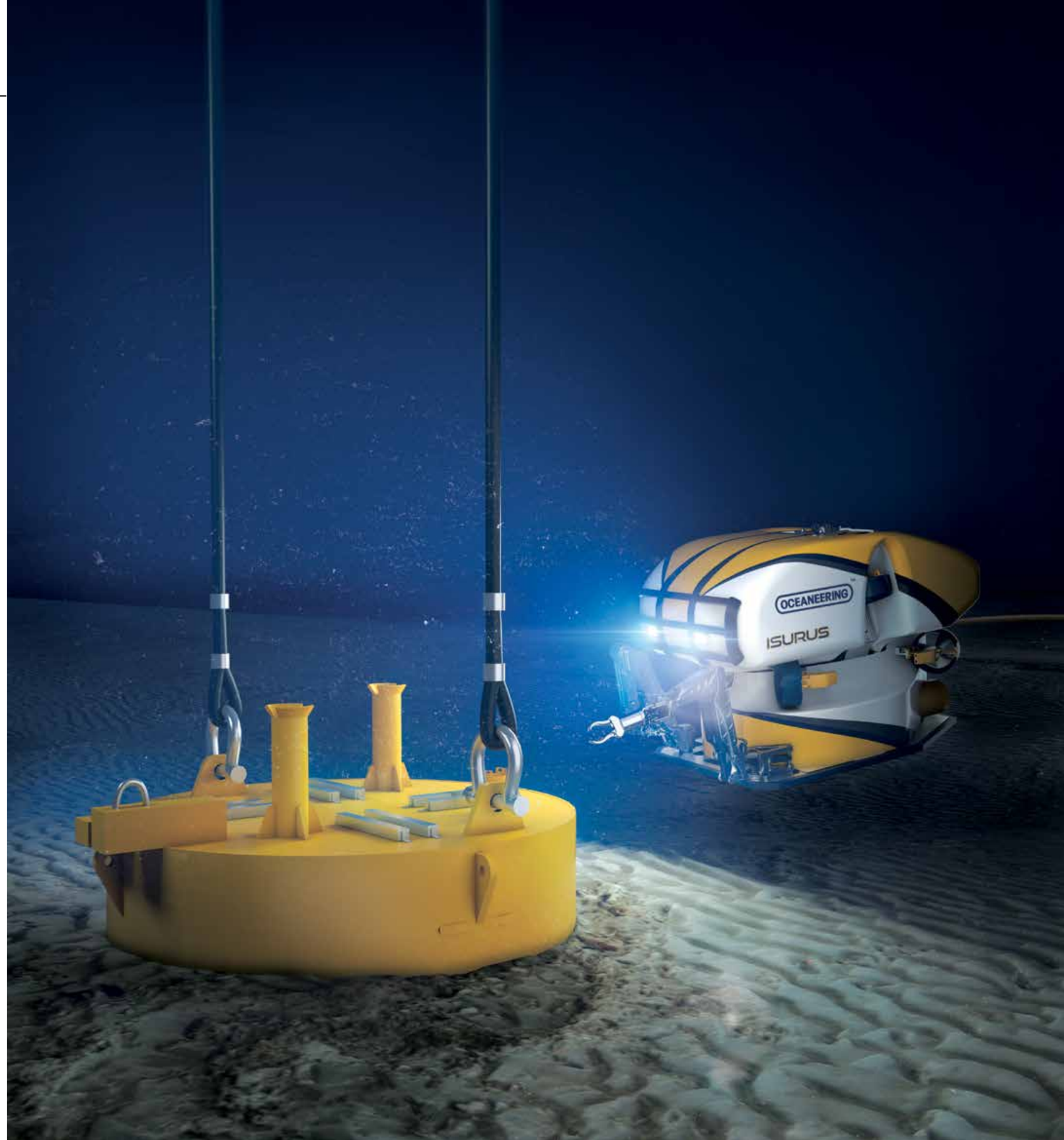
"Oceaneering has completed the design for a TopHat tether management system (TMS) style Isurus that will become available in 2023 for Isurus 10 and beyond in order to provide flexibility for customers whose operations prefer TopHat-style TMS," said Rouge. "Oceaneering is also in the process of designing an electric Isurus that will improve in-water speed performance, reduce power required to operate, and eliminate hydraulics from the vehicle's propulsion system."

Focused on Project Economics
Since the launch of the Isurus ROV system, the work class vehicle has demonstrated its ability to improve economics for offshore renewables projects by expanding the operating currents and vehicle speeds beyond those achieved by traditional work class ROVs.

With more than 2,400 days of operations accumulated across six systems since November 2019, the Isurus fleet has amassed over 12,600 dive hours with 99% uptime.

"Together, the six operating Isurus systems deliver 65% improvement in speed relative to traditional work class ROVs," said Rouge. "All six have not encountered currents that exceed the systems' capabilities to maintain station and execute work class tasks."

Oceaneering's Isurus ROV continues to provide differentiated project economics to the global offshore renewables market. The systems provide a direct replacement solution to today's work class systems while increasing operational windows and project efficiency while lowering carbon footprint.



SEAWATER HYDRAULICS

Norwegian subsea tooling company Deep Water Tooling has developed a series of powerful heavy-duty underwater tools powered by sea water. These have considerable advantages over the conventional hydraulic equivalent. Originally developed for deepwater salvage, the tools have been recently employed in the oil and gas structure decommissioning market.

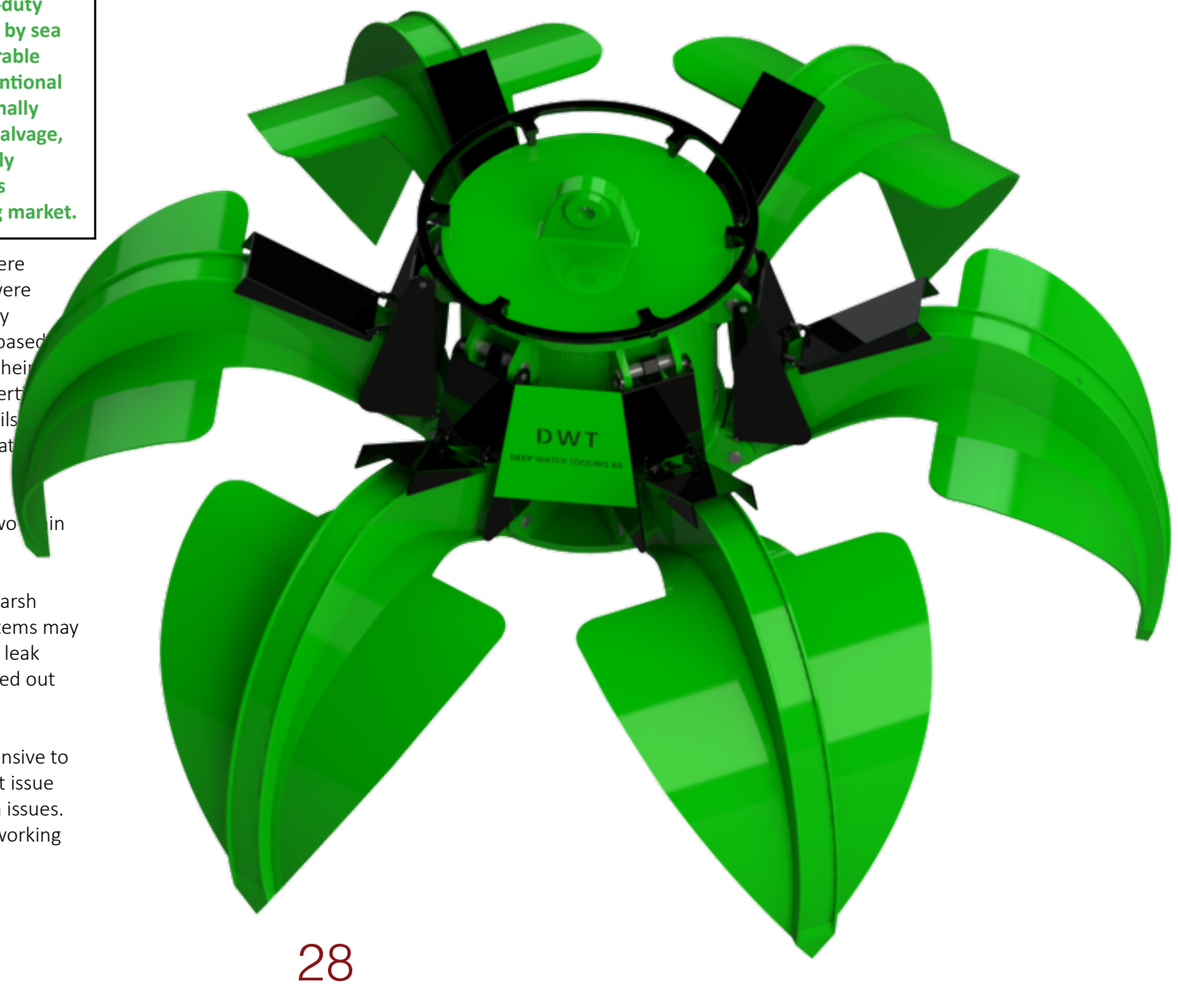
When hydraulics systems were originally developed, they were based on water. The industry subsequently moved to oil-based hydraulic fluids because of their very useful lubricating properties high energy transmission. Oils are also better at dissipating heat and keeping parts cool.

With this, however, came two main drawbacks.

Like any system subject to harsh environments, pressure systems may fail – possibly a hose or seal leak causing the fluid to be ejected out under pressure.

While fluid is relatively expensive to replace, the more important issue is that it can cause pollution issues. This is unacceptable when working in some sensitive areas.

Mega Claw 6



Bag 10 Grab

Furthermore, once the pressure equalises, water can ingress, contaminating the entire system, the multiphase fluid potentially damaging the pumps and valves and demanding increased maintenance and repair. A certain amount of water always enters any hydraulic system.
The second drawback is that heavy-duty devices characteristically require a large hydraulic reservoirs.

When using such mechanical device, especially in deep water, it is common that they are lowered from a support vessel above, but the actual power is provided locally via a hydraulic workclass ROV.

This means that the ROV requires a storage receptacle piggyback. This could be as large as 60-80 lit.

WATER

About 10 years ago, Deep Water Tooling looked for ways obviate these associated problems by re-engineering the system and returning to water as the energy carrier medium.

“Since then, the system has been refined, tried and tested,” said company owner Ronnie Hauglund, "and, we have used it on a number of keynote projects from retrieving the rockets from the original Apollo 11 mission on in the Bermuda Triangle to recovering silver for Odyssey.

"More recently, we have been looking for ways of applying this expertise to the offshore sector.

"Lately we have also been using it for Subsea 7, Aker BP and a variety of other companies. We have had good feedback and the design is clearly starting to take off.
"When Swire Seabed was dissolved three years ago, we recruited a number of people with oil and gas expertise as part of the drive to enter this decommissioning market. Since then, we have been working closely with major operators on their campaigns."

“We originally started looking for an alternative to conventional hydraulic systems after carrying out work in 5000-6000m water depths,” said Mike McLeod, CEO of DWT and the person involved in designing and making the engineering modifications.

"In those situations, any loose fittings or burst hose meant that the entire system had to be recovered to the surface. At around 6000m, this corresponds to a round trip of 7-6hrs excluding repair time.

"Converting to a water-only system means that if this same hose/fitting leaks within an all-water system, there will be a noticeable loss in flow and pressure, but it is still possible to carry on working.

Naturally as it is effectively seawater entering more seawater, there are no environmental issues. This means that the leak can be repaired when convenient rather than having to discontinue operations immediately. McLeod. "The operator just turns the pump up slightly until they finish the job.

Mega Claw 6

"It is not easy to make the transition from hydraulics to sea water systems. Hydraulic fluid is a good lubricant and the cylinder always suffers less wear and tear. We have to accept this as part of the equation.

By using ceramic liners and modern materials as well as well as advanced filtration system to remove any sand or particles, any disparity between the two is minimised. We have also developed numerous procedures and preservation techniques when the system is returned to deck including flushing the internal with freshwater or store even glycol.

"A key component of hydraulic power underwater is the use a valve pack which distributes power around the vehicle. With this water system, however, we have had to design a valve pack especially for sea water. The water tooling pack is a complete plug and play device compatible with any work class ROV. It includes a safety hot stab developed to minimise downtime and leakage. It also contains an auto release.

EQUIPMENT

"We use the sea water based system as the basis of our grabs and shear cutting tools," said Hauglund. "The largest shears are powerful enough to cut big steel beams."

One of the most useful tools is the Mega Claw six-claw grab with an 8m³ Bucket volume capacity. The tool is based on six cylinders which can generate maximum working pressure of 90 – 200 bar with the water flow at 30 – 120 litres / minute. Fully open, it extends almost 5m wide. Fully closed, it measures nearer 3m.

There is a smaller three-claw version with a similar capacity to the six claw grab and this weighs only 5t instead of 6t.

"We have also developed a bucket grab based on 4 cylinders. The 10t version has a capacity of 10m³ with the 2.4m wide bucket able to extend to 5.5m and carry a single lift weight of 50t.

For even smaller applications,There are two smaller versions with a load capacity of 3t , on with a width of 1m and the other 1.2m. Lastly, they offer a Dala Gripen' units able to grab 125mm diameter pipe or cable.

ROTARY

"So far, the movement of the seawater tools we have developed are essentially powered hinges based on single cylinders. We are, however, currently looking to manufacture a range of standardised dredgers, grinders and other types of rotating equipment.

At present, these run on hydraulic oil but we are at an advanced stage of converting them to run on water."

Water tooling pack accompanying the Bag Grab 10

POWER STORAGE

LONG DURATION P

A perennial concern of harnessing renewable energy is security of supply. Turbine blades cannot turn if there is not enough or too much wind. The problem is that power availability does not always coincide with demand.

Sometimes, it is possible to reduce the cost of off-peak energy to encourage the market to change the way it functions but a more robust and universal solution is energy storage. Stored energy can also provide an off-grid solution to supplement congested grid systems.

Wind turbines feed power directly into the grid via cables. This continually fluctuates with the variable strength of the wind causing the turbine to change its speed. This volatility can be difficult to manage, however this highlights another key advantage of storing energy. Because it is not converted directly into electrical energy, the output is much cleaner.

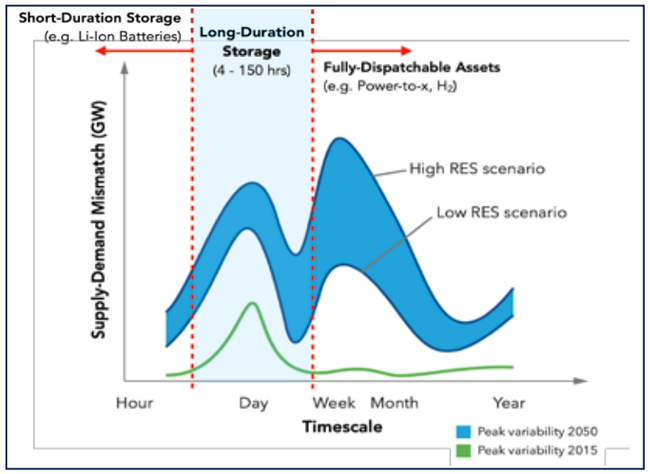
“When examining the various energy storage alternatives, a major consideration is the time scales in which the various solutions need to operate,’ explained Daniel Buhagiar, CEO of the Dutch company FLASC. “Some systems require power within an hour of it being produced.

Others may need availability the next day, week to month.

"Another consideration is how long it takes to discharge this stored power. It may be charged in the morning to be discharged later that evening or alternatively, be charged throughout the summer for discharge in the winter.

"Energy systems that are only stored for under an hour are called *short duration systems*. This requirement is often satisfied by fuel or batteries. At the other end of the scale are *fully detectable assets*. This describes converting the energy into another medium such as hydrogen. This leaves a gap in the market between this short (sub one-hour) and the longer (weekly, monthly) demand,” continued Buhagiar.

“This is sometimes referred to as *long generation storage*- something between 4 and 150 hrs. A number of power storage technologies fits into this gap such as compressed air, pumped hydro and thermo mechanical solutions. There are logistical advantages in locating these types underwater near the place where the power is generated, thus taking up space within the same footprint.



Peak variability of residual load at different time scales in a European electricity grid in 2015 and expected in 2050 (modified from: DNV)

FLASC POWER BUNDLE

Earlier this year, FLASC and Subsea 7 were awarded a £471 760 UK Government grant to further develop its novel offshore energy storage system. Called the PowerBundle, it is based on FLASC's proprietary Hydro-Pneumatic Energy Storage (HPES)

"The best way to explain how the HPES system works is to imagine a large tank or rigid steel structure," said Buhagiar. "Inside this receptacle is a volume of relatively high-pressure gas, typically Nitrogen which is both safe and inert.

"When seawater or any other incompressible fluid is pumped into the tank, the trapped gas has nowhere to go and becomes confined into an increasingly smaller and smaller space which in turn, raises its pressure.

"The water effectively acts as a liquid piston and the whole tank becomes a power storage solution.

"In order to discharge the power cell, the operator opens a valve to let the water escaping at high pressure, drive a hydraulic turbine to produce electricity."

Like any power conversion systems, the system suffers energy losses. In this case, compressing the gas causes heat build-up which is something largely unwanted. The ambient cold waters of the marine environment, however, quickly regulates the system, keeping it at a constant temperature.

The compression component itself an energy efficiency of 96%, however, there are other losses, particularly in the pump and the turbine

Trials in Malta

which, when included, brings the estimated round trip efficiency to nearer 70% – 75%. Nevertheless, calculations show this is within acceptable limits.

“The concept is highly scalable and unlike many systems, can be deployed in shallow waters," said Buhagiar. "It can be used to store energy over a range of time-scales from one hour to 150hrs.

"One immediate application is to re-purpose the oil and gas pipelines and storage infrastructure currently being decommissioned as offshore developments come to the end of their field lives.

"By firmly sealing one end of the line, the pipe immediately doubles as a robust large, ready-made pressure vessel. To this end, we have been collaborating closely with Subsea 7 to re-purpose or install new pipeline bundle technology, something in which the company has considerable experience within the oil and gas sector.

"It is based on a long pipeline fabricated onshore in lengths of up to 7km. At one or both ends lies a towhead from which the entire assembly is towed out to site.

"Instead of incorporating oil and gas conditioning equipment and a connection system, the bundle head can house core hydro pneumatic energy conversion technology".

In a hydrocarbon pipeline, pigs are routinely used for inspection purposes and for cleaning debris from the inner wall. When repurposed the designers envisage the pig being used to separate the gas and the liquids within the pipeline.

"There are many variations to the basic concept," said Buhagiar. "Because it is agnostic to any power source, the system can be fed by power from waves or solar we well as wind. Regarding wind energy alone, we have opted to look for different ways our system could be deployed.

"In essence, there are two main components, the storage tank and the energy conversion unit. In solutions with a vacated pipeline on the sea floor, this becomes the storage but the conversion system could be either on the seabed as well, or on the fixed wind turbine.

“We are,also, working on a prototype to fully integrate the storage into a floating turbine. This project being run at the university of Malta funded through the horizon programme . We are currently talking to entities that already have an established platform design.

STENSEA

German applied research organisation Fraunhofer has been working on a novel energy storage device called StEnSea or Storing Energy at Sea.

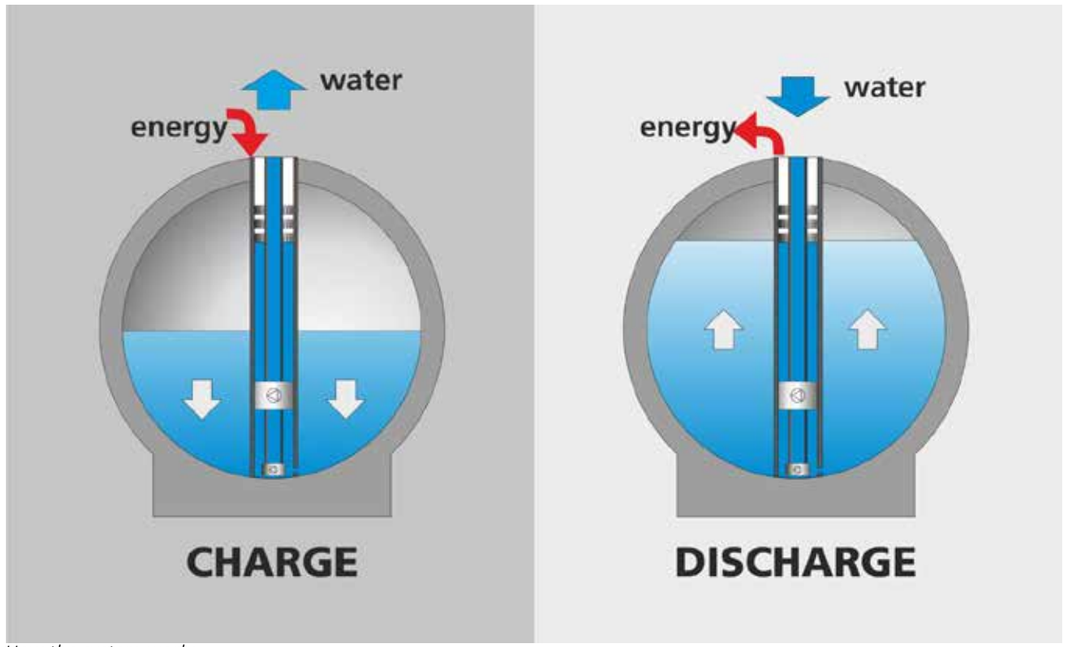
This is based on an offshore pumped hydro energy storage system (PHES), which uses the pressure in deep water to store energy in hollow concrete spheres. In many ways, this is the reverse of the FLASC system.

The StEnSea system consists of two main components.

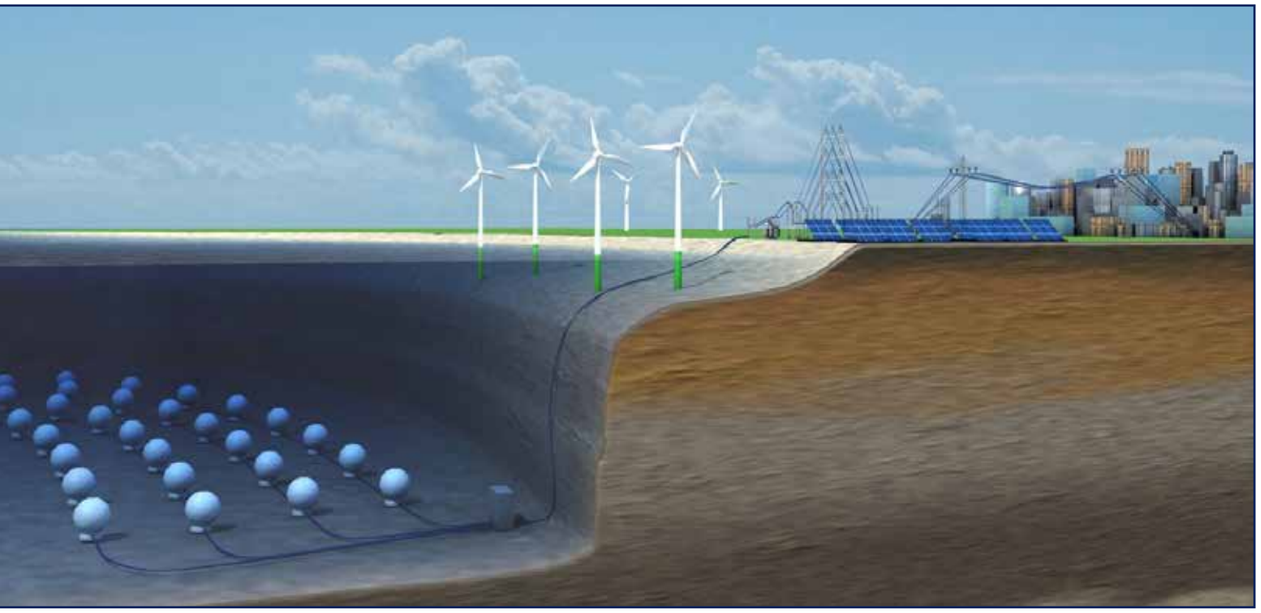
The first is a hollow spherical concrete storage tank. The other is a cylindrical technical unit that incorporates the pump turbine, a controllable valve and the components of the Supervisory Control and Data Acquisition (SCADA) system. This technical unit is removable and can be recovered separately, for repair and general maintenance.

The storage body is designed to be located deep in the water at depths of 600-800m. Charging is achieved by pumping the water out of the sphere against the surrounding water pressure using energy from the grid. When empty, the sphere corresponds to a fully charged storage unit (as opposed to the FLASC system where a full receptacle is fully charged).

Opening the controllable valve enables water to flow through the technical unit into the sphere. In



How the system works



Spheres in operation

doing so, the inflowing water drives a turbine and a generator that feeds electricity into the grid.

Storing energy offshore by means of hollow concrete spheres placed at the bottom of the sea is a very attractive solution, however, the design, construction and installation of large concrete spheres as well as the required electro-mechanical equipment such as pump turbines and controls, require R&D at system and component level as well as for the offshore logistics and grid integration.

The first scaled test was based on a 3m diameter sphere which was installed and tested in about 100 m water depth in Lake Constance through the winter period of 2016/2017.

StEnSea are about to launch the next phase of the project, a 1:3 scale version (10m in diameter) in water depth of 700m. Currently they are looking for a site with good conditions regarding installation and operation for a research project. This is a long process as many aspects need to be considered.

The group expects to come up with a suitable site within the next 6 to 9 months. After that they will start building and testing the 10m sphere.

With experience from that project it is possible to go for the target size: 30m diameter, 3m wall thickness, 5 MW power, 20MWh capacity at 700m water depth. It can go even deeper, which means more pressure, more capacity but also more strength in the construction needed to withstand the pressure. The engineers consider that 700m is the optimum but other depths are possible.

OCEAN HYDRO OMNI

In 2918, Hydro Wind moved from the UK to the US to work on a novel solution to long-duration power.

"Around 80% of the worlds wind is in deep waters," said Co founder and CEO, Lee King. "We took the decision that we needed to develop technology to exploit this area.

"The result is the OceanHydro Omni, a floating system that can be quickly relocated or retrieved to a harbour as necessary or redeployed elsewhere. The energy conversion component occurs above the sea level which means that any repair maintenance is likely to be easier than if it were located underwater.

The technology HydroWind selected was a mechanism in which wind energy is used to lift a submerged heavy mass, to a height. It is a gravity based energy storage.

"Gravity storage is not a new concept," said King. "It refers to the using energy to place objects at height. These are then lowered under natural gravitational force which turns mechanical motors and create electricity.

GENERATION

Most offshore wind turbines are of a horizontal axis design. These lend themselves to a very long turbine blades and a high volume of wind capture. Locally, the further from the surface, the higher the wind speeds are found and these tall blades can harness much higher energies.

In order for the blades to clear the sea surface, however, the towers that support the nacelle have to be at least the length of a single blade. If the turbine is bottom-founded, the tower in addition, has to be of a length greater than the sea level while for a floating unit, the support structure has to withstand any overturning moment from such a tall structure. The cost of these can be considerable.

Ocean Hydro Omni

Ocean Hydro Omni

The OceanHydro Omni, however, uses a vertical system. Most such turbines have either Darrieus and Savonius rotors. Savonius wind turbines, lying closest to the main axis look like sails. They are can operate at low wind speeds and are relatively independent of the wind direction. Darrieus wind turbines, conversely, are like aerofoil blades that sweep around the vertical mast. Like Savonius systems, they move largely independently of wind direction.

In the Omni, the two blades are joined together with everything rotating as one and eradicating problems the company recognises as with some Darrieus designs being difficult to self-start.

"The rotor height will be 15m, making the system much easier to access and particularly to

manufacture," said King.

Underwater, the floating structure will be connected to a gravity anchor anything between 100m and 500m below the surface. Running between two and running on supporting wires, is a large block which s is connected to a winch at the surface."

Instead of a taut leg system like on spar, the mooring system that has been selected will use a centenary system.

The final version will probably be looking at a mass between 35 – 40t but for the initial trials. The basis of the design is that as the irregularly moving turbine turns in the wind, it generates power. This feeds the winch to raise the block to the surface.

At some point, this block is released and gravitates downwards and in doping so, causing the system to generate electrical energy

The charge time can be anywhere up to an hour while it descents at 5-10m/sec, giving a total power generation time of 5 mins, depending on the water depth. The energy stored per cycle is around 70kWh.

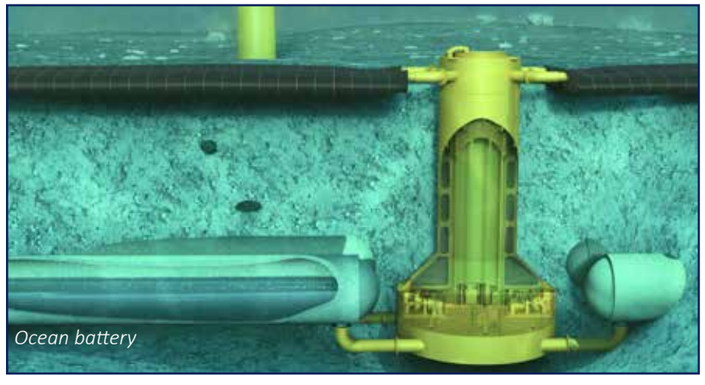
At a rate of 20-190 cycles per day, this means the generation on 1.6 to 13MWh. The actual figure is influenced by the depth and weight of the actual mass

Perhaps the greatest benefit of the system is that the units come in at around $500 000. This makes them affordable to such a point that it may be cost effective to install a number of such devices within a relatively small. Engineers point out that sea life attaching to tendons could affect the free movement of the mass weight.

OCEAN BATTERY

Issue 2 of UT2 2022 included an Ocean Battery system Long Duration storage system.

Its concrete body is mostly installed under the seabed. Radiating from the base are one or more large rigid tanks which contain water. There are also a commensurate number of flexible bladders connected to the central pump housing. Excess wind energy powers subsea pumps to drive water previously stored inside the rigid reservoirs, into the flexible bladders on the seabed. The diaphragm effectively stores potential energy in the form of water under high pressure.



Ocean battery

Issue 2 of UT2 2022

When there is demand for power, a valve is opened and the hydrostatic weight of the water column pushes down onto flexible bladders, driving the water back into the low pressure rigid reservoirs. In doing so, this passes through multiple hydroturbines to generate electricity.

Survey & Mapping

Sampling

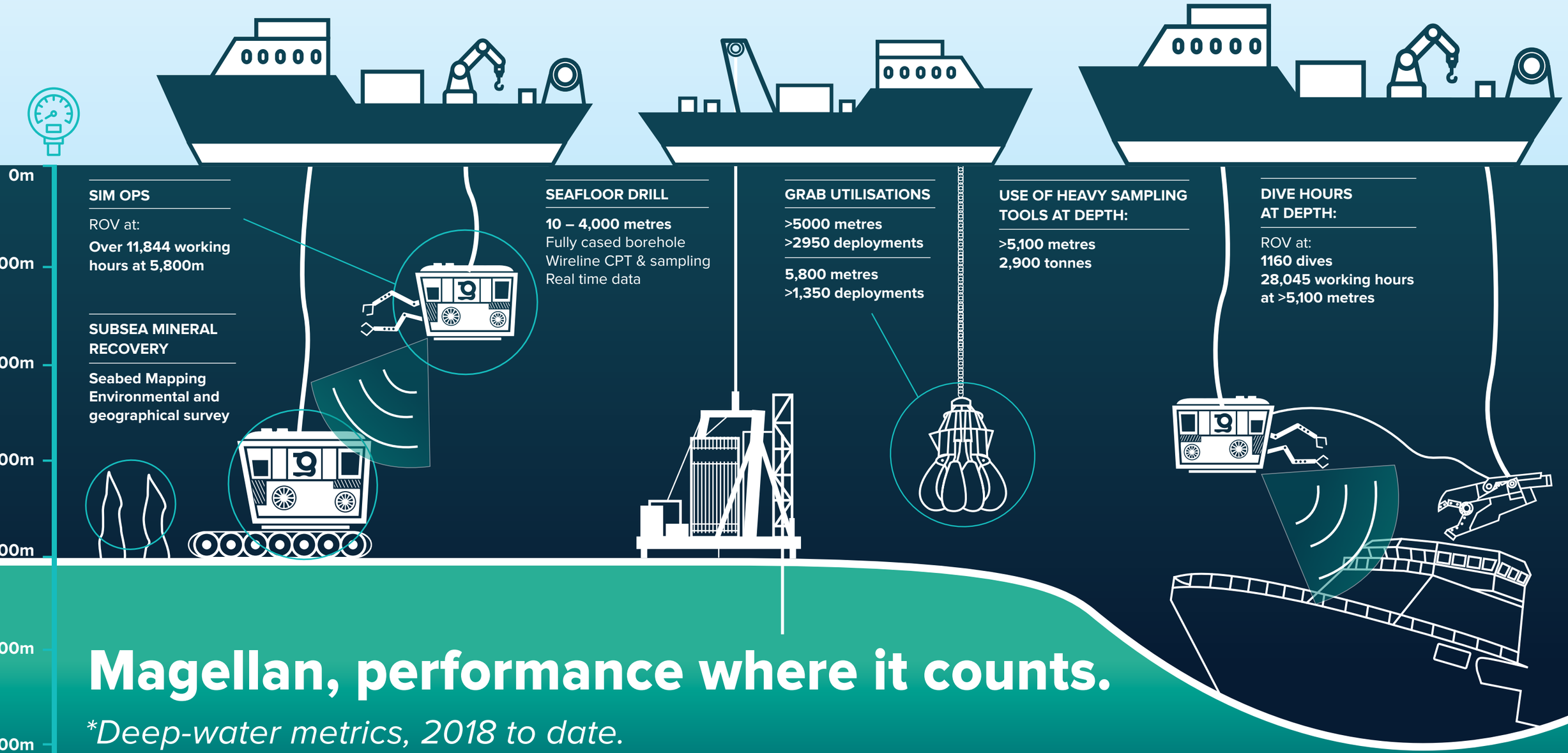
Environmental

Intervention

MAGELLAN

When you need to carry out a task at depth, Magellan have set a new standard in deep and ultra-deep water operations. From our permanently mobilised vessels MV Coco and MV Freja.

www.magellan.gg



Magellan, performance where it counts.

**Deep-water metrics, 2018 to date.*

MINERALS | ENERGY | RECOVERY | SEAFLOOR DRILLING

ACOUSTIC FM DETECTION

Impact Subsea has released a new generation of underwater, Flooded Member Detection system: ISFMD V3. This provides a highly intuitive yet simple to use flooded member detection system for deployment by divers or remotely operated vehicles.

The system provides capability to test and store results for multiple members at a time. Multiple members can be preconfigured prior to commencing the survey with details of diameter, length and angle. Multiple readings can be logged per member, including at different test positions around the member.

Members are automatically classified as flooded, part flooded or dry, using an advanced digital correlation detection technique. This technique allows acoustic returns to be detected even if the return is below the ambient noise level. This approach to detecting an acoustic return ensures exceptionally high accuracy and reliability in readings.

The ISFMD V3 system operates by transmitting an acoustic pulse into an underwater member. If there is a liquid inside the member the pulse will transfer through the member, bouncing off the opposite member wall and back to the probe. If however the member is full of air the signal is attenuated and will not bounce back to the probe.

The use of acoustics to determine the presence of a liquid inside the member is a safer and logistically more simple solution than alternative gamma radiation based Flooded Member Detection systems.

Moving away from the traditional analogue detection methods, used in some alternative acoustic based Flooded Member Detection systems, provides a step change in the system performance and reliability.

Users of the original Impact Subsea ISFMD system will benefit from a free upgrade to V3 as part of the company's commitment to lifelong support of its products.

FMD V3.jpg': Monitor with ISFMD software

Dartmouth Ocean Technologies have developed an Autonomous eDNA Multi-sampling system for the detection of biological genomic signatures in water. It is a portable and convenient solution for use in many data collection scenarios.

"eDNA sampling is a valuable tool for studying both prokaryotic and eukaryotic biodiversity in the water column. The programmable nature of the instrument allows for increased sampling resolution over long periods of time – ideal for time series studies," said Arnold Furlong.

"DNA can be extracted from filters using various commercial kits (ie. Qiagen, BioMeme). The integrated multi-sample holder makes transporting the samples more convenient The operation can be carried out automatically according to a preconfigured mission profile

DNA extracted from the sampler filters can be further processed with methods such as qPCR PIXIE 4-Channel Fluorometer. Available as an add-on to the eDNA Sampler, the PIXIE mounts inside the unit to enable intelligent triggering and simultaneous correlation to fluorescence data to captured samples.

It weighs 11.3 kg (24.9 lbs) in air or 3.3 kg (7.3 lbs) in salt water. It measures 72.1 cm (28.4 in) in length and has a diameter of 16.8 cm (6.6 in). It is rated for 20 m water depth. There are nine filters per cartridge.

VIBRACORE

TDI-Brooks' recently brought a shallow water (<75-m) pneumatic vibracore (pVC) to market to supplement its other electric VC options (Feritech FT550 and Rossfelder P-5).

The pVC is a light weight (4600-lb in air), high power vibracorer which can be used for cores up to 6m in length (and down to 9m or 12m with frame extension). The topside display informs the winchman of the exact penetration of the barrel into the soil at any point during the vibrating insertion. The pVC has been deployed successfully on the US East Coast more than 200 times for offshore wind farm (OSWF) projects.

Additionally, TDI-Brooks has added a second Datem Neptune Seabed CTP to its inventory with now includes both N3K and N5K units.

The deployment of the N5K off the stern of the R/V BROOKS McCALL

BRUNEL

Last November, Bonheur established an innovation company called Fred.Olsen 1848 to focus on the development and commercialisation of new technologies related to renewable energy. To this end, the company recently announced its Floating Foundation concept, BRUNEL. Its modular design leverages the existing global supply chain and helps create a sustainable industry.

“The design is based on a simple, yet challenging design philosophy: to see if we can build a foundation based on generic steel tubulars and hence enable manufacturing at commercial scale, ”said Sofie Olsen Jebsen, CEO of Fred. Olsen 1848

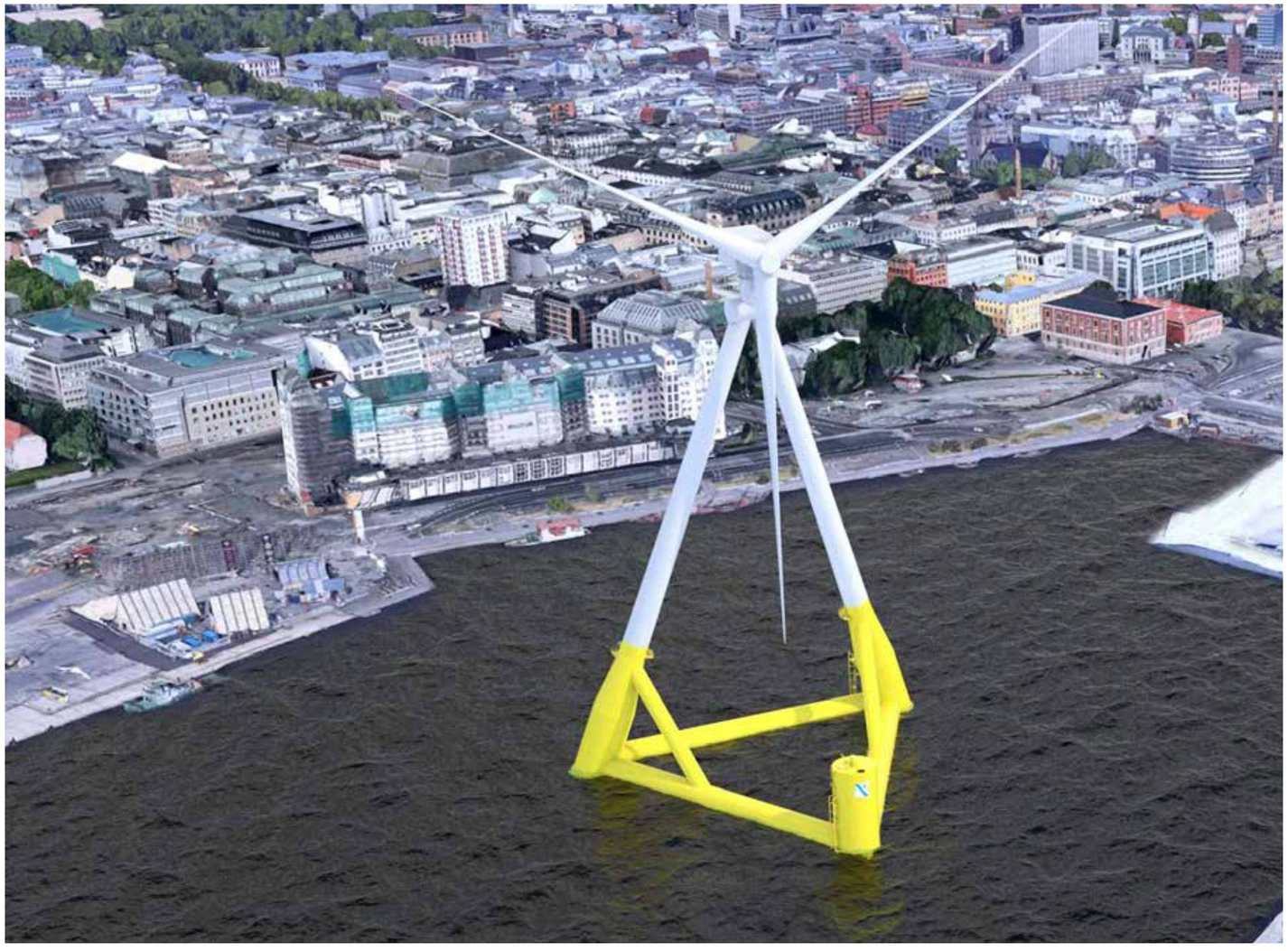
"This radical focus on commercial requirements, while at the same time attending to excellence on all technical parameters, will allow the floating offshore wind industry to realize its enormous potential."

DESIGN PHILOSOPHY

The design uses building blocks for serial and automated mass production. It prolongs existing lifetime on current manufacturing capacity.

The size of components is favourable for shipping, heavy-duty crane and handling operations while assembly methodology allows for local content maximisation

Building on existing and proven technology, it enables:
- Low-weight integrated structure
- Low draft and passive ballast system
- Low accelerations
- Strong geographic feasibility
- Strong scalability potential for WTG and site-specific environment
- Good hydrodynamic response for carrying a WTG.



Fred. Olsen 1848's Brunel concept

BRUNEL is now at an advanced technological stage, with a final tank test successfully completed at SINTEF Ocean in February 2022. In parallel, it successfully received DNV’s statement of feasibility in April 2022. With the tank test and DNV statement, BRUNEL has completed a significant milestone to reach Technological Readiness Level 4 (TRL 4). Fred. Olsen 1848 plan to make BRUNEL available for commercial use as quickly as possible.

Working with SINTEF Ocean, a Physical-Numerical Validation Approach will be applied to demonstrate and qualify BRUNEL according to standard procedures from Oil and Gas and maritime, ie, exempting the need for piloting and full-scale demonstration.

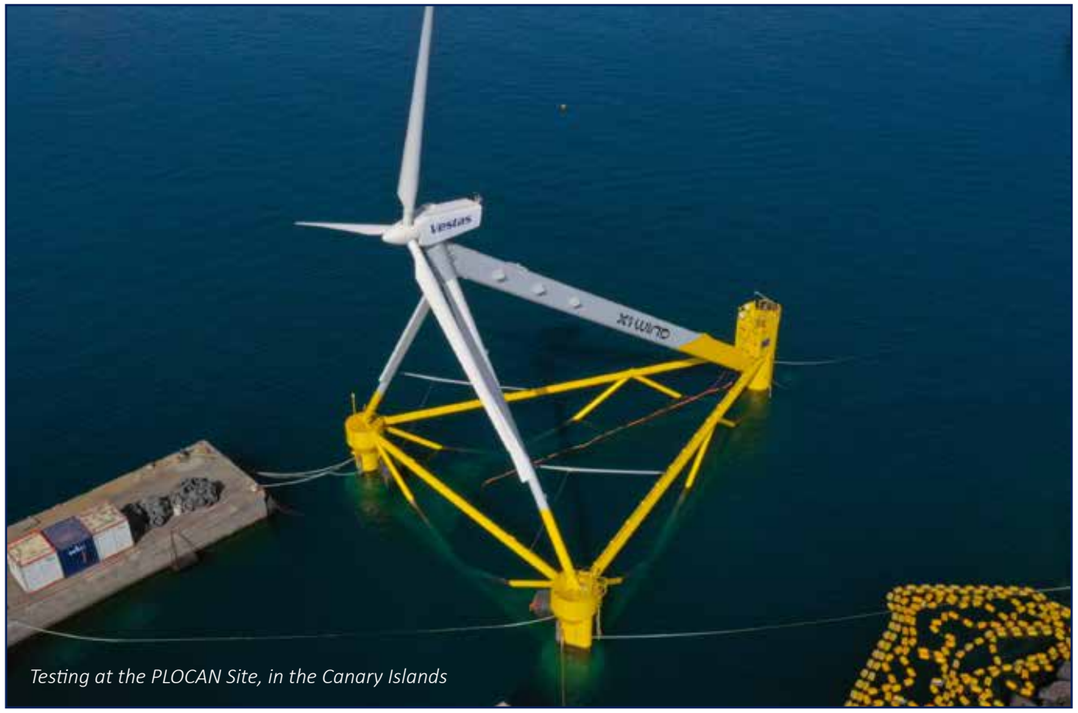
Through this process, BRUNEL hope to reach TRL 8 at an accelerated pace and will be ready for commercial application within 3 years.

Fred. Olsen 1848 will involve leading engineering and fabrication specialists in the process to ensure the requirements of the industry are being addressed; both technically and commercially.

BRUNEL also offers a wide range of geographical deployment areas, and scalability to fit the next generation of wind turbines without noticeable changes to the design. In addition, Brunel has a low draft implying flexibility in ports. This should allow the design to drive down cost .

An instrumental part of BRUNEL has been to reduce the maintenance requirements, including component exchange at the floating offshore wind site while a voiding having to tow the foundations to shore for component exchange, will further drive down the cost.

X30



Testing at the PLOCAN Site, in the Canary Islands

Wind technology developer X1 Wind has successfully laid the dynamic cable as the final stage of its floating wind prototype.

The 20kV dynamic cable will allow the company to fully validate the floater and wind turbine performance, feeding the electricity to PLOCAN's smartgrid, as well as transmitting data through its fibre optic connection.

TheX30 platform is based on PivotBuoy floating wind technology Fitted with a Vestas V29 turbine, the X30 1:3 scale prototype will be stationed at a 50m water depth through a single point mooring system in a downwind configuration – creating a 'weathervaning' solution which maximises use of passive systems.

"PivotBuoy is a self-orientating floating design that reduces the weight and minimises the costs of installation and maintenance, making floating wind competitive," said a spokesman.

The technology combines the easy installation advantages of single point mooring SPM systems with the weight reduction and high stability of TLP platforms. This enables a radical weight reduction, achieving a platform much lighter than most current spar and semi-submersible systems under test.

"The SPM the PivotBuoy to passively weathervane and self-orientate," said the spokesman. "The pyramidal platform that is more efficient in the load transmission.

"Downwind turbines also show some benefits compared to upwind systems, since downwind solutions do not need to tilt angles, rotor coning, or the use of pre-bent blades to avoid tower strike, which reduces turbine manufacturing costs and critical when scaling up to large 15MW+ rotors"

TOUCHWIND

Touchwind testing

Earlier this year, the Dutch company TouchWind announced a collaboration with Mitsui O.S.K. Lines (MOL) of Japan to develop floating wind technology.

The pair signed a Memorandum of Understanding (MoU) under which they plan to work closely together on the development and launch of the novel floating wind turbine. They hope that this collaboration will accelerate the development and potentially open it up to more markets.

TouchWind says that conventional wind turbines are designed to stop functioning when the wind speeds exceed 25 m/s, in order to protect the rotary elements from heat build-up. Their design prevents this, however, by changing the pitch of the entire turbine.

The structure essentially consists of vertical axis turbine at the end of an angled mast. A conventional turbine has to meet a force (perpendicular to the mast) of 12 million kg. The company says that their design in which the force is semi-parallel to the mast, is nearer 4 million kg and thus, half the price.

Most wind turbines have three blades. The TouchWind design, however, has a two blade although the single piece is much thicker than the conventional blade. Engineers say that they are designed to be scalable.

A 200m rotor, is capable of an power output of 12.5MW. These don't require expensive pitch-control systems and the company says that estimated costs are 30% compared to current turbines.

The Touchwind Mono design

The turbine is based on a light weight A-shaped mast. The base of this mast is connected to a tethered cylindrical floatation drum . This keeps the mast above water while doubling as the fulcrum around which the structure can move.

A Touchwind field

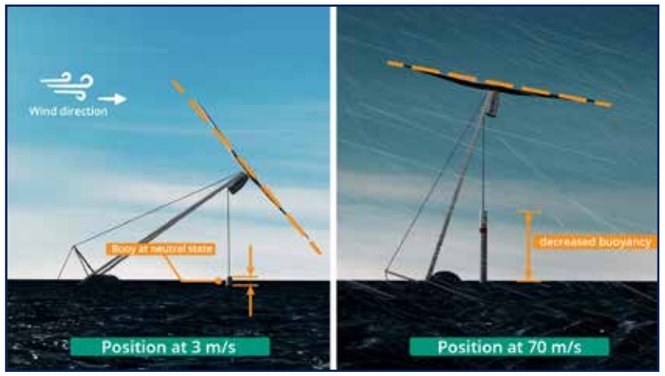
The mast always stays upright because of an underwater counterweight but in the base level conditions, it lies roughly at a 45 deg angle.

There is a line from an outrigger on one side of the mast. Always in tension, this provides strength to the mast. On the other side is a line hanging from under the rotor which terminates in a buoy. In normal conditions, this is part supported by the water.

When in operation, the mast automatically weathervanes to always lie in parallel to the direction of the wind. Furthermore it can self-adjust its angle.

To describe the way it works, it is easiest to think of the two-dimensional disc that the sweeping blade makes as a parasol shape.

In normal operation, the mast assumes a 45 deg angle, and the blade path 90 deg to this. As the



wind speed increases, the wind slips under this parasol disc shape, pushing it upwards, essentially reorientating the blades to be parallel with the wind direction. In doing this, the wind force causing the blades to rotate decreases to zero, automatically preserving the turbine. As such, it is able to handle wind speeds of up to 70 m/s.

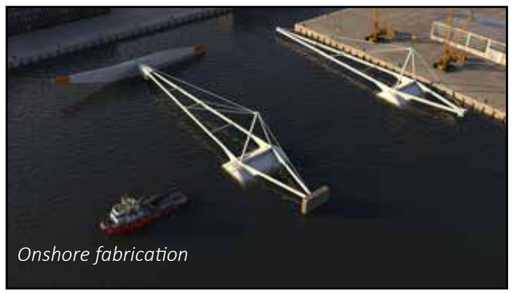
As the high wind speed drops, the weight pulls the mast back to nearer 45 deg , the wind bites against the blades and the rotation of the blades increases to generate power.

One advantage of the design is that it is easier to carry out maintenance offshore, when compared to reaching conventional turbine blades.

The Touchwind Mono undergoing repairs

Touchwind say that a normal turbine costs around €20 million. Their design costs half that.

"According to IRENA (2017), up to 37% of the price of offshore wind turbines is under the water surface (support structure/foundation and construction/ installation)," said a spokesman. "That is approximately €7.5 million each. Being able to build these turbines in harbours reduces costs significantly.".



Onshore fabrication

SEAWIND

Seawind's twin-bladed turbine Image: Seawind

MOL insist that the partnership with TouchWind is part of a greater plan to expand into offshore wind. It also recently announced another collaboration with Seawind Ocean Technology to develop another two-bladed wind turbine and a concrete floating support structure *(See UT2, Issue 3, 2022)*

In order to generate as much power a possible, turbines have to adjust their exposure by changing their pitch. If the wind is too powerful, they turn the blades to spill wind. Seawind's system however, is based on teeter hinge which adjusts the entire rotor head like on a helicopter. This eliminates the need for a complex blade pitch mechanism, a source of failure in many turbines.

A radar measures wind speeds feeds this information to the system The designers have increased the length of the blade by 5m to compensate for the fact that there are only blades.

The twin blade system has a number of advantages, particularly that the reduction in the number of blades makes it cheaper to fabricate and easier to install. The two blades also results in lower air resistance so the blades can rotate faster.

Its mechanism has fewer moving parts. The mechanisms are simpler, fewer failure sources, and parts are readily available in the open market which also reduces costs and makes systems easier to maintain. Simplicity should also reduce times between maintenance.

TLP

INSTALLATION

One of the reasons that the offshore wind industry has progressed so very rapidly in relative terms, is that it has been able to benefit from a considerable amount of expertise, technology and infrastructure developed progressively over decades by the oil and gas industry.

Most shallow water wind turbines are based on large diameter monopile tubular structures driven into the seabed. These are often accompanied by substations supported by steel jackets. Many companies, are now looking to exploit the higher energy environments and have turned to floating systems moored to the seabed as mainstream development concepts.

The majority of units integrate the floating component and the mast/ turbine into single units. In order to support a large mast and turbine requires an equally large floating compost.

These are so large, they have to be wet-towed to the field. This presents logistical challenges, as well as there being pressure on the number of suitable harbours.

“It prompted us to look for alternative methods that would not require a wet-tow said," Jeroen van Oosten, Business Unit Director Wind. "Upon looking at various ideas, we began to focus on tension leg platform technology.”

Since the first was installed in 1984, Tension Leg platforms (TLPs) have become a very useful and well

The flotation units are transported to the installation site by vessel

INSTALLATION

established technique for exploiting deep water environments.

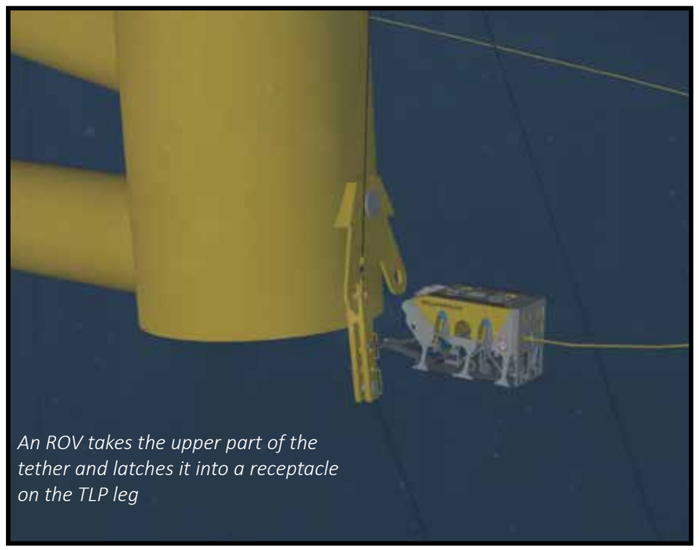
The principle behind a TLP is that the structure is tethered to the seabed by taut lines. One issue of TLPs is that they can be challenging to install.

floating structure is connected to the seabed anchors, the tendons have to be made taut and this requires some sort of top tensioning capability within the floating body.
The installation scenario that Heerema envisage is based on floating foundations being constructed on land and wet-towed, the hulls being small and light enough to be dry-towed on a transport vessel to the location, reducing transport and marshalling costs and infrastructure requirements

The installation uses a novel floating installation frame which is lifted over the floating stubstructure where it

An ROV is deployed to attach the tether

The installation frame latches onto the floataion body and they are lowered into the water as a single entity



An ROV takes the upper part of the tether and latches it into a receptacle on the TLP leg

Installing the turbine

The frame unlatches from the body

latches on. This allows the pair to be lifted into the water as a single unit.

The considerably heavier mass of the floating installation frame, however, pushes the floating substructure down. A drum on the frame lowers a line down to the preinstalled seabed anchors and this is connected up at the seabed with he assistance of ROVs. It then attaches an upper termination to the floatation body. By incorporation this on the frame, it effectively removes the requirement to build these functionalities into each floating hull and this, minimises the weight

Once the connection is made, the frame unlatches and is brought to the surface. With the weight removed, the buoyant flotation body also rises but is constrained by the tendons.

It means floater and WTG campaigns can be decoupled, reducing supply-chain pressure, and resulting in a more https://sut-us.org/mags.aspx

GBS

Gravity base platforms have an important place in the history of oil and gas engineering. Normally – although not always – fabricated in concrete, they use their large mass to resist movement from environmental forces. Gravity Base Structure (GBS) platforms are typically of a conical shape with a large base to distribute their weight on the seafloor.

The GBS design has been recently adopted by the wind industry. Last month, the first of 71 gravity-based foundations for the 500 MW Fécamp offshore wind farm were lifted from the transport barge and installed at the project site off the coast of Normandy by Heerema Marine Contractors' vessel *Sleipnir*.

The field is located between 13km and 22km off the coast of Fécamp in Normandy. The site was selected due to strong and regular wind and shallow depth of 30m.

A consortium of Bouygues and Saipem was responsible for the structure. Bouygues carried out the construction with Saipem managing the installation of the turbine bases on the sea bed. Saipem subcontracted some work to Heerema because its Saipem 7000 heavy lift vessel was preoccuiped elsewhere.

The Dutch company will also carry out scour protection and ballasting of the foundations after installation

The GBS structures are made up of a reinforced concrete structure filled with ballast and set into the seabed. Boskalis worked on the foundation ballast, installing protection systems as well as filling the bases with ballast.

Each foundation weighs 5000t and measures 31m in diameter at its base, while the height of the gravity-based foundation depends on where the unit will be installed and ranges from 48 to 54m. The massive weight of these foundations is enough to ensure their stability and support the weight of the machinery and equipment.

The GBS and wind turbines will be assembled offshore in 2023. SPIE will perform all the end-to-end electrical connections.

GBS Fabrication

GBS Installation

ORION

DEME Offshore recently installed the final XXL monopile in the Baltic Sea, off the coast of Rügen. This was the first project executed by DEME's new floating installation vessel *Orion* , which installed the foundations using its DP3 system.

The 28 XXL monopiles are the largest monopile foundations ever installed, weighing more than 2000 tonnes each, and having a diameter of 9.5 m and a length of up to 110m.

Parkwind's Arcadis Ost 1 project in the Baltic Sea, is located North-East of the Kap Arkona Cliffs, within the 12 NM Zone of Germany. These have water depths of up to 45m and challenging soil conditions. It will receive its 27 Vestas V 174 – 9.5 MW wind turbines later this year and produce green electricity to supply up to 290 000 households. Throughout the campaign, the *Orion* ran on LNG.

The vehicle is equipped with a 5000t crane and a tailor-made, motion compensated pile gripper system able to handle enormous XXL monopile foundations.

The integrated motion compensated pile gripper tool enables the crew to upend and drive the monopiles, which are transported horizontally on deck. Coupled with the vessel's DP3 capability, the motion compensated gripper keeps the monopiles vertical and stable despite waves and vessel motions.

INNOVATIVE TOOLING

In addition, an entire set of new specialist tools have been used during this maiden project for 'Orion'. These innovative tools include an adjustable monopile sea fastening system, a newly-built automated monopile lifting spreader beam to enable the horizontal lifting of the XXL monopiles, automated quick-lifting tools to avoid manual handling on deck, as well as several new noise mitigation systems.

WIV

Most shallow water wind turbines are installed by a classic jack-up workboat. The demand for installing them quicker and cheaper, in deeper waters, however, has led companies revisiting the basic vessel design.

This recently prompted Huisman to developed a new Windfarm Installation Vessel (WIV) which, it says, will improve the efficiency of offshore windfarm installation, providing a stable platform even in rough sea conditions. The company contends it can achieve 85% workability in the North Sea.

The WIV is a semi-submersible 240m long and 88m wide. This allows a deck space large enough to accommodate 10 monopiles (125m length by 12m diameter) and transition pieces or 8 Wind Turbine Generators (WTGs).

It has light transit speed of 12kt based on a DP3 system with 8 x 4MW thrusters and 44MW of installed power. Fuelled by methanol, this gives a significant reduction of CO_2 emissions. The vessel has 200 beds, which can be used for the construction crew, marine crew and others.

“The WIV offers a viable and cost-effective installation method for both floating and fixed-bottom windfarms,” said Joop Roodenburg, President of Huisman. The keynote feature is a novel 3500t 3D-motion compensated installation tower that rotates to enable various operations simultaneously. Operations are assisted by a 3000t hybrid boom crane

Installing a monopile

MONOPILES

Stored horizontally on deck in front of the Installation Tower, one end of the monopile is attached to a rising gantry arm/grab, effectively upending it to the vertical. It is then held by upper and lower gripper arms. Once so secured, the entire installation tower then rotates 180deg to bring, the monopile from one side of the tower, round to the other where it can be lowered down through pile guides towards the sea bed.

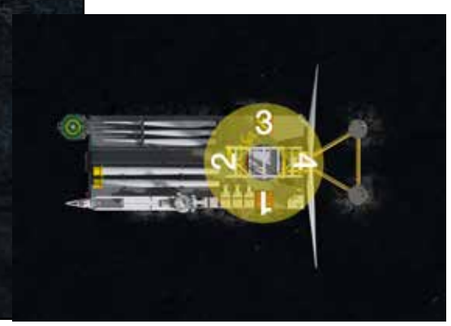
A pile hammer assembly emerging sideways out from the centre of the tower, positions itself just above the monopile, driving it to completion. During the piling operation, a new monopile can be picked up at the other side installation tower to repeat the process. It is possible to install one to two monopiles per day.

TURBINE TOWERS

The vessel is also able to assemble complete WTGs on board, off the critical path.

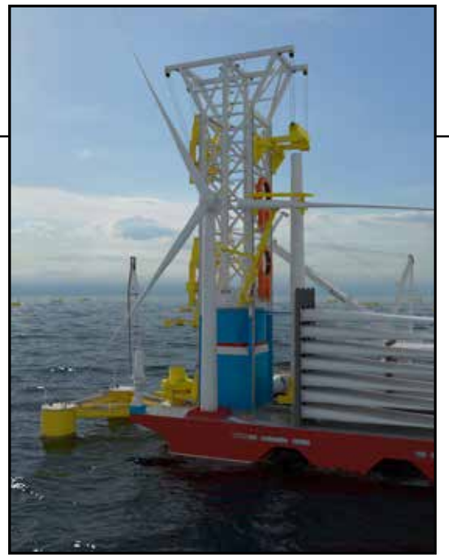
Arms on the vessel will connect around the installed monopile or with the stick-up of a moored floating foundation.

Unlike the installation tower turning



Four Statios

The blades attach to the rotor in station 3



180 deg for monopile installation, it can rotate 90 deg effectively allowing 4 workstations all acting independently.

Components ferried to the installation vessel are transferred by means of the hybrid boom crane. The boom is designed to move three dimensions, isolating the hookload from the movement of either vessel.

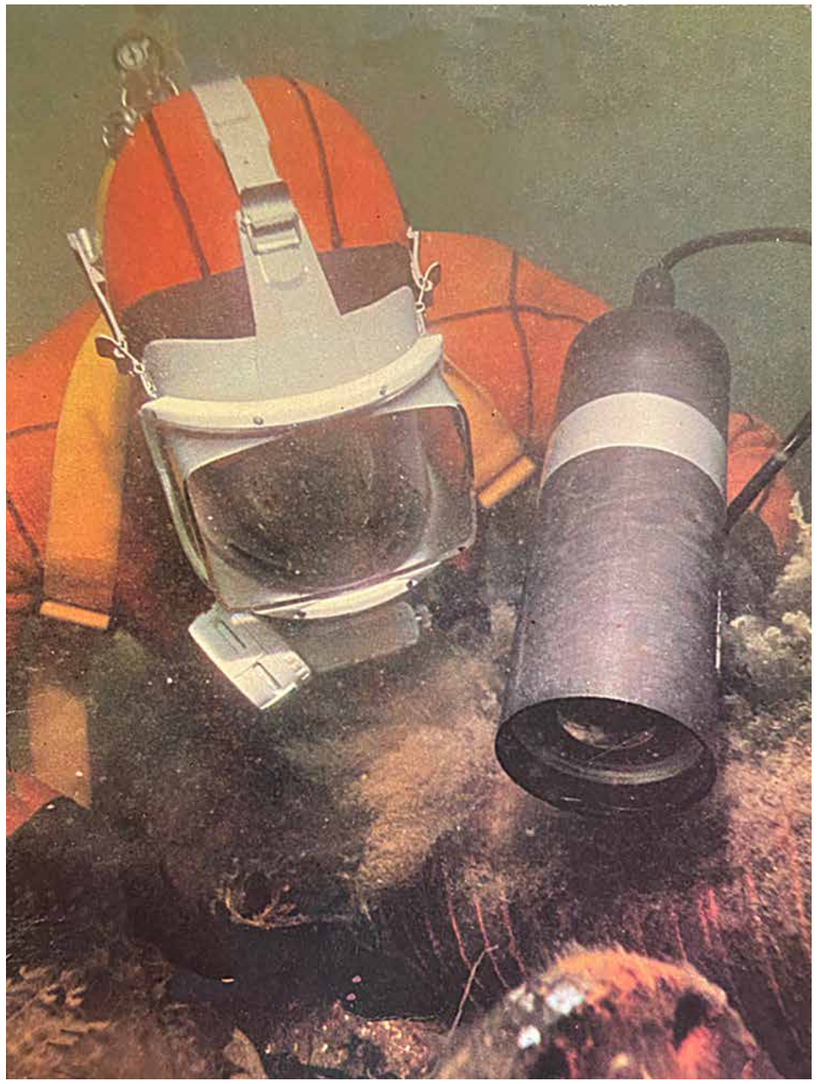
Like the monopile, the turbine tower is upended to the vertical and held in upper and lower grab arms. It then quarter turns to the first workstation where the crane lifts the nacelle and installs it on top of the tower at workstation two. Once secured, the installation tower then turns the assembly 90deg where an articulated arm lifts blades from a storage rack on the side of the vessel and introduces each in turn to the rotor where they are connected.

Once all three blades are attached, the turbine tower rotates the final 90deg to the last station directly above the monopile/ floating foundation. This is then lowered and attached.

This system allows one wind turbine to be installed in a day.

Stabbing the tower onto the floating body

FRIDAY PHOTOS



DIVING INSPECTION 1977

A closed circuit TV being used to explore a seabed pipeline.
The Hydroscan camera was used on BP's West Sole. Work was carried out by Marine Unit Technology

BLEO HOLM 19987

Over 6000t of process and engine room equipment being installed at the UIE yard on Clydebank. The yard also carried out the installation of the accommodation module and the integration of the turret.

The Intersub manned vehicle working on Piper Alpha

UIE Yard, Inchgreen

STADIVE

Shell's emergency response vessel in the northern sector of the North Sea oil field.

DISCOVERY ROV

This was kindly sent by reader David Lawrence

BERYL B 1983

The second half of the lower production deck on mobil's Beryl B being lifted into place. The lower production deck, built by UIE was installed in two 2400t sections. The upper production deck, built by Cleveland Offshore, was 2600t.

This was largely made possible by the advent of heavy lift vessels. The Balder could lift 3000t.

The Thor crane vessel installing the Inde jacket

SEA OWL MK IV AROUND 1995

Designed for inspection and light work duties. Its most notable feature is the externally mounted brushless 400W thrusters which delivered 260kW of power, an 80% improvement over the previous model.
One was delivered to the Norwegian group DOC for inspecting the foundations of the tension leg platform.

Sutec was part of Bofors Underwater Systems.

Jack up drilling over a fixed platform, this shows the Santa Fe Monarch and the Rowan Gorilla simultaneously jacked out over Shell's Clipper platform

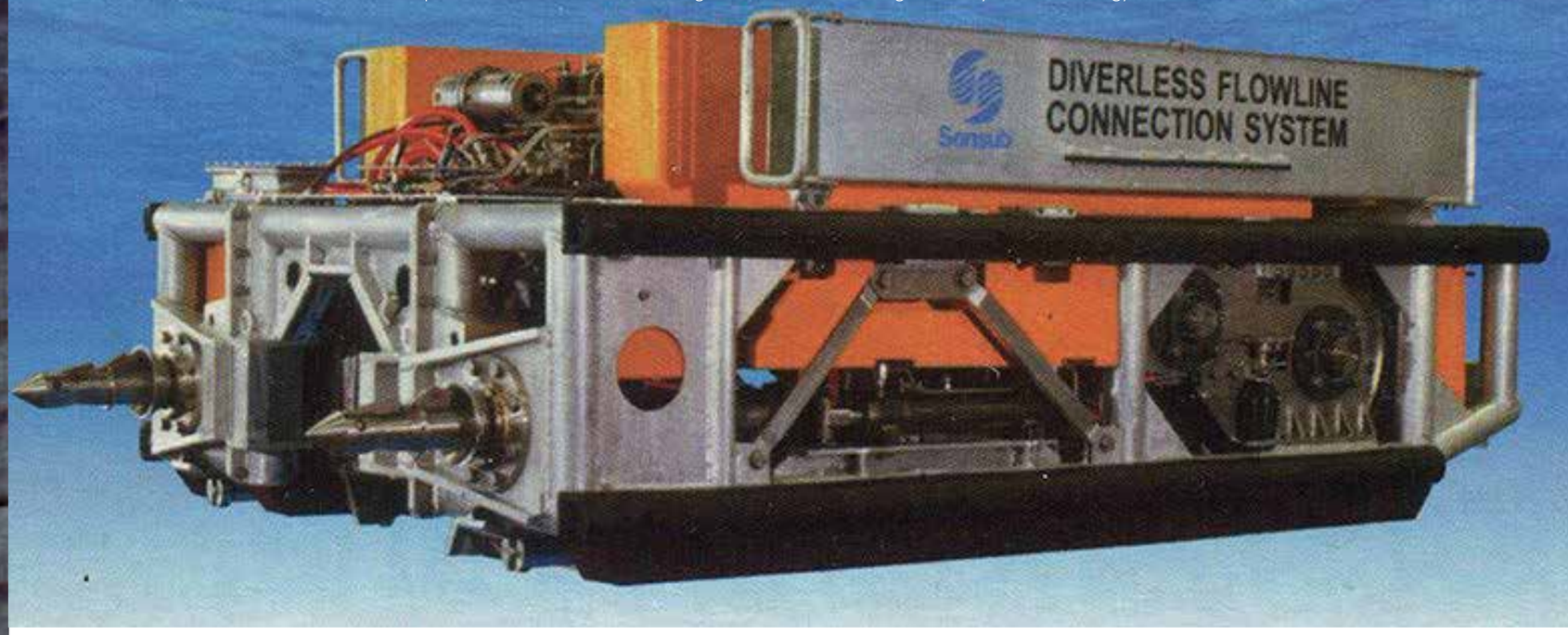
EKOFISK

If you remember the large wall on Ekofisk, you may be interested to know what it looked like behind it.

DFCS 1996

This sits under an ROV and is used for the diverless connection of the flow line . It was first used by Amoco Orient Petroleum Company in Liuhua. The company teamed with the SonSub to be the first in the world to use ROVs as the primary interface with the subsea production system and accomplish driverless tie-ins.

The first system was used to connect three flexible flow lines from an FPS to an FPSO. At 13.5 in dia two of the production flow lines were the largest ever connected using remote systems technology in over 1000 feet of water.



DOLPHER

No , not the best photo, but what I it?

Full marks to this that recognised it as the Dolpher from Rauma Repola Oceanics. It was developed as a rescue unit for the recovery of lost objects of any depth This version was specifically targeted at the rescue of the 6000m research vessel MIR 1 and MIR 2

The dead vehicle pays out a thread. The dolpher attaches itself to this thread and consumes it, carrying a lift rope down to the bottom. It then clamps itself to the dead vehicle allowing the lifting to the surface.

It weighed 300kg in water

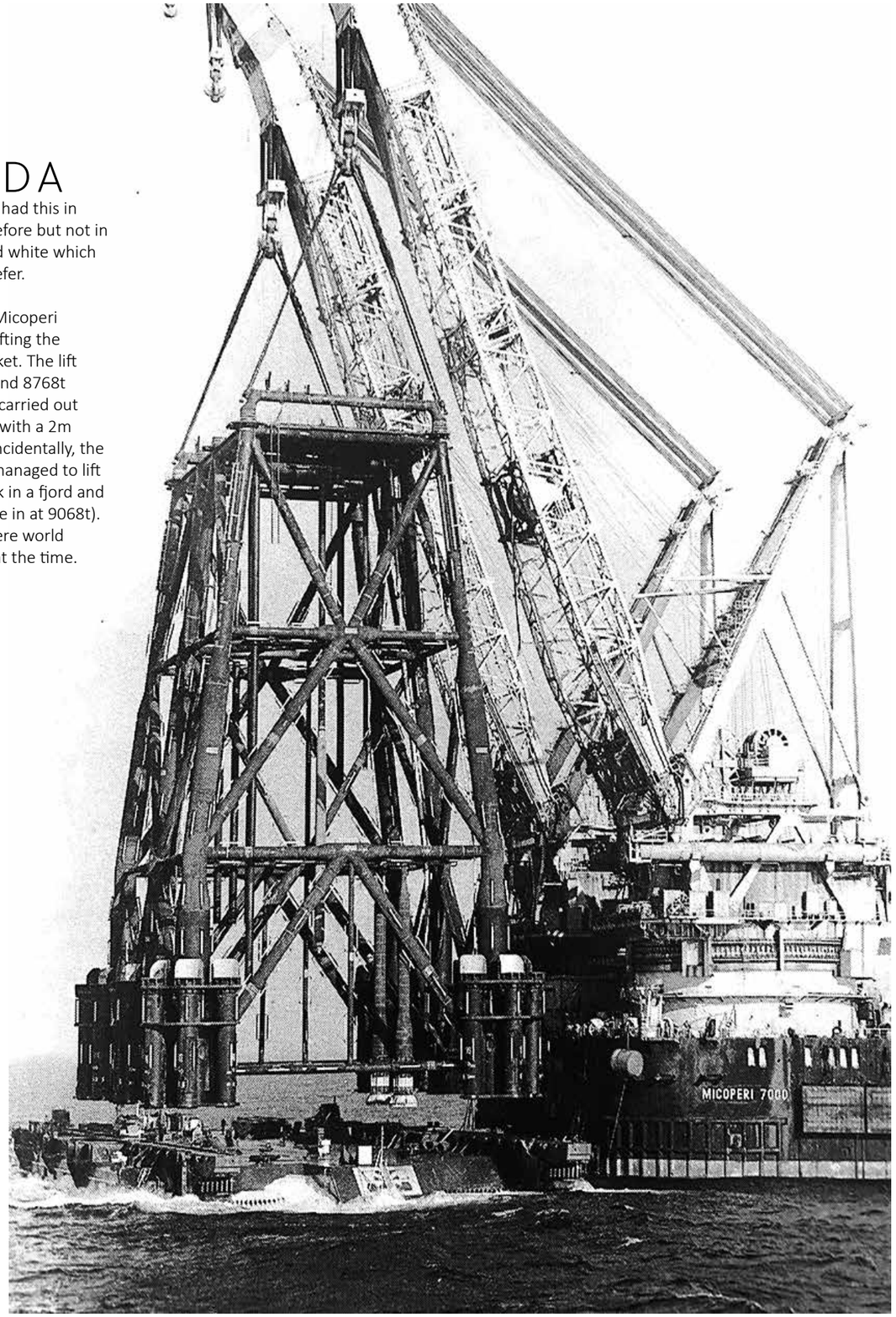
LEIF ERIKSON

Working in the Beaufort Sea.
The vessel in the centres is the Arctic Tarsiut.

GYDA

We have had this in colour before but not in black and white which many prefer.

It is the Micoperi M7000 lifting the Gyda jacket. The lift was around 8768t and was carried out offshore with a 2m swell . (Incidentally, the M7000 managed to lift Veslefrikk in a fjord and that came in at 9068t). These were world records at the time.



TRIDENT

The Trident jack up drilling development wells of Britoil's Amethyst platform.

THE ORIGINAL APACHE


STENA APACHE

NORTH ALWYN A. 1985

Built at the RGC Methil yard, the picture shows the first of two upper pile guide clusters or bottles being lifted in place. This used twin 84m high towers spanned by a 70m girder.

NA KIKA
2003

At its time, the largest and most elaborate deepwater development in the world. It included the world's deepest permanently moored semisubmersible production unit. It was essentially 6 deepwater discoveries tied back to one unit.

GLOMAR BALTIC 1

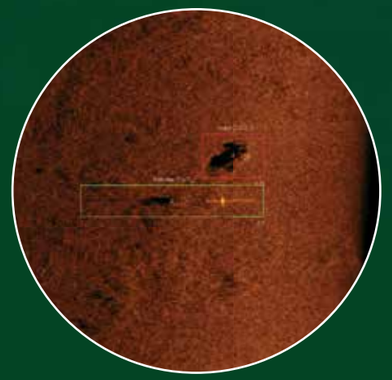
In 1993, the Glomar Baltic 1 drilled the North Sea's longest and the world's third longest horizontal well . When suspended, it had a horizontal section measuring 2169 m and it precluded the need for an additional well saving £5 million on BP 's Hyde project drilling costs.

Evo Logics®

SONOBOT 5

UNCREWED SURFACE VEHICLE

- Accurate georeferenced bathymetry and cartography missions, search and survey in hard-to-reach areas
- Autonomous and remotely-controlled operation
- Data logging and real-time acquisition over redundant mesh network
- Exchangeable battery packs for 9+ hours of operation
- System software for planning, execution and data evaluation
- High-precision measurements and recordings, different GNSS and sonar options available
- Rapid system deployment, excellent maneuverability and area coverage with powerful and efficient drives



OBJECT RECOGNITION

- objects of interest are detected and highlighted live during the mission
- AI-based system as an extra module that runs directly onboard the vehicle and analyses raw data

sales@evologics.de

EvoLogics.de