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2 John Street,
London WC1N 2ES

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

Editorial Assistant:
Trudy Keyhole

Production:
Sue Denham

Advertising:
Zinat Hassan
UT3subsea@gmail.com

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

Sleipnir in the Caland canal
Image: Heerema

NEWS

NUI COLLABORATION

A Floating Normally Unattended Installation (NUI) design with the potential to unlock smaller and deepwater oil and gas reservoirs has become one step closer to commercialisation following a collaboration agreement between Crondall Energy subsidiary Buoyant Production Technologies (BPT) and Subsea 7.

BPT developed and tested the concept with multiple industry partners including the Oil and Gas Technology Centre, Premier, Total E&P, Lloyds Register, Siemens, Wärtsilä, Ampelmann and BW Offshore.

As part of the collaboration, BPT will bring its proprietary Floating NUI designs while Subsea 7 will provide field development and delivery expertise.

BPT's patented proprietary design is a compact single column offshore facility, designed and equipped specifically for unmanned operations. The unit's low OPEX and low CAPEX deliver optimised lifecycle costs to offshore developments.

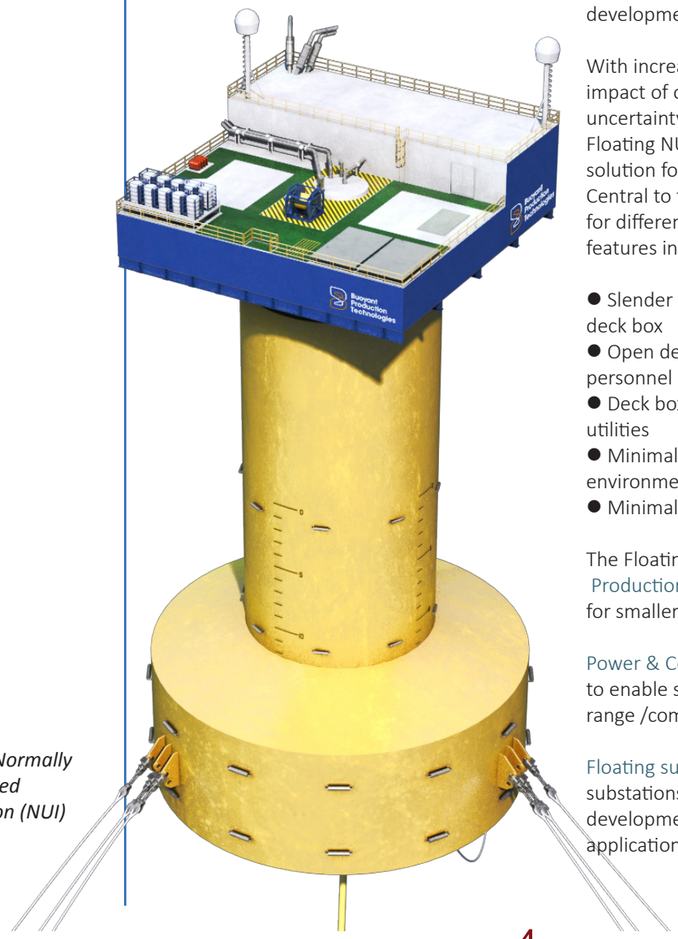
With increasing focus on the environmental impact of oil and gas projects, as well as uncertainty surrounding commodity prices, Floating NUIs can offer a robust development solution for a wide range of future projects. Central to the patented design, which is scalable for different field requirements, are several features including:

- Slender hull structure and integrated (buoyant) deck box
- Open deck for topside process equipment and personnel access
- Deck box housing power generation and utilities
- Minimal motions, enabling deployment in harsh environments
- Minimal offshore installation cost

The Floating NUI series includes:
Production Buoy: A standalone production facility for smaller deep-water developments.

Power & Control Buoy: Providing well-site services to enable subsea developments such as long-range /complex gas and oil tiebacks.

Floating substation: Supporting offshore substations for use on offshore wind developments and power import/export applications.



Floating Normally Unattended Installation (NUI)

Karish North

Energean has made the final investment decision on developing its Karish North prospect, offshore Israel.

The discovery will be commercialised via a low-cost tie-back to the *Energean Power* FPSO, which will be just 5.4km away. In mid-2020, Energean announced that work had been delayed on the construction of the FPSO at the Admiralty Yard in Singapore, following restrictions imposed to prevent the spread of COVID-19

In May, Allseas' pipelay vessel ***Solitaire*** and the construction support vessel ***Normand Cutter*** arrived offshore Israel to lay 90 km of export gas pipeline in water depths up to 1750 m, ending with a 100-tonne end structure PLET.

By October, Jumbo has completed work transporting and installation of 14 suction piles, a tie-in manifold and a 24 inch deepwater gas sales spool.The company broke its deep-water installation record with this project: 1,760m water depth.

Later this year, Jumbo Offshore's work is scheduled to recommence with the hook-up and installation of the *Energean Power* FPSO.

Suction piles Installation

BP ARGOS

The Argos FPU sailed away from South Korea on the BOKA Vanguard and began the journey to the Kiewit Offshore Services fabrication yard in Ingleside, Texas

MORE THAN 200 OIL PROJECTS CAN HIKE OUTPUT, AND PROFITS, FROM SUBSEA BOOSTING SAYS RYSTAD

The saying has it that in every crisis there is opportunity, and the oil industry is no exception, with efficiencies and targeted investments being the prime focus areas during and in the aftermath of a downturn.

Very few stones remain unturned in an upstream sector that has been hit hard by successive crises, and Rystad Energy is highlighting one of the last significant untapped value creation windows – that of subsea boosting – identifying more than 200 projects globally where the technology could make an immediate impact by increasing production profitably.

The report was produced utilizing our newly launched Subsea Processing Screening Tool – a dashboard that analyses the different components of subsea processing – evaluating offshore projects worldwide and identifying the best candidates for subsea boosting. We have quantified costs, profits and the potential extent of increased output that are related to applying this sparsely-used technology,

The increase in recoverable reserves for the top 100 projects, out of more than 200 projects identified where subsea boosting would be profitable, averaged 61 million barrels of oil per project, with the amount varying widely depending on the size and location of each project.

For every extra barrel of oil produced due to subsea boosting, operators can expect a profit of $11.30 on average.

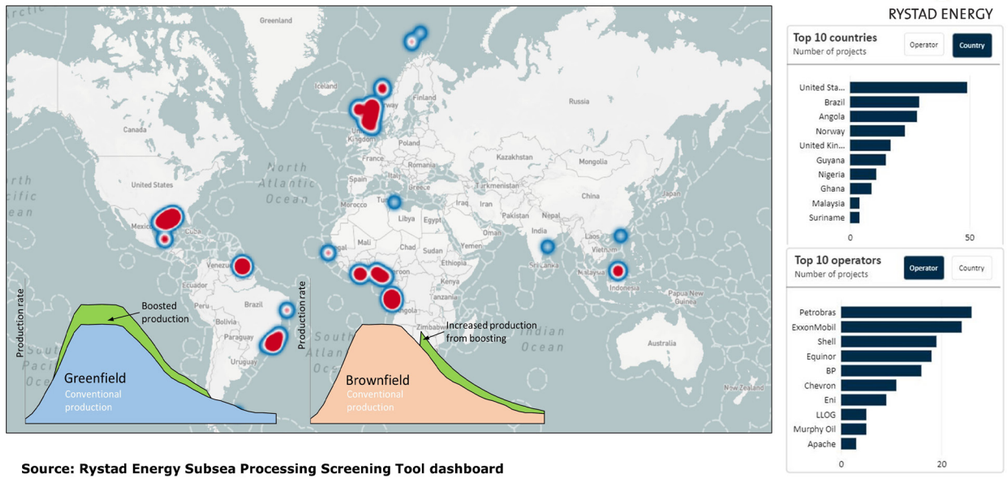
The average investment cost to apply the subsea boosting solution for the above projects is at about $475 million, again varying widely depending on project characteristics.

Most of the identified candidate projects, nearly 50, are located in the US. The other countries rounding out the top 10 list are Brazil, Angola, Norway, the United Kingdom, Guyana, Nigeria, Ghana, Malaysia and Suriname.

The 10 companies that operate most of these projects identified by Rystad Energy are Petrobras, ExxonMobil, Shell, Equinor, BP, Chevron, Eni, LLOG, Murphy Oil and Apache.

Potential candidate project locations for subsea boosting from 2021 to 2030
Curve of oil production increase (map's bottom)

RYSTAD ENERGY



Source: Rystad Energy Subsea Processing Screening Tool dashboard

TREE ORDERS

Westwood has updated its global subsea tree forecast using data provided by the new SubseaLogix service.

Major awards include

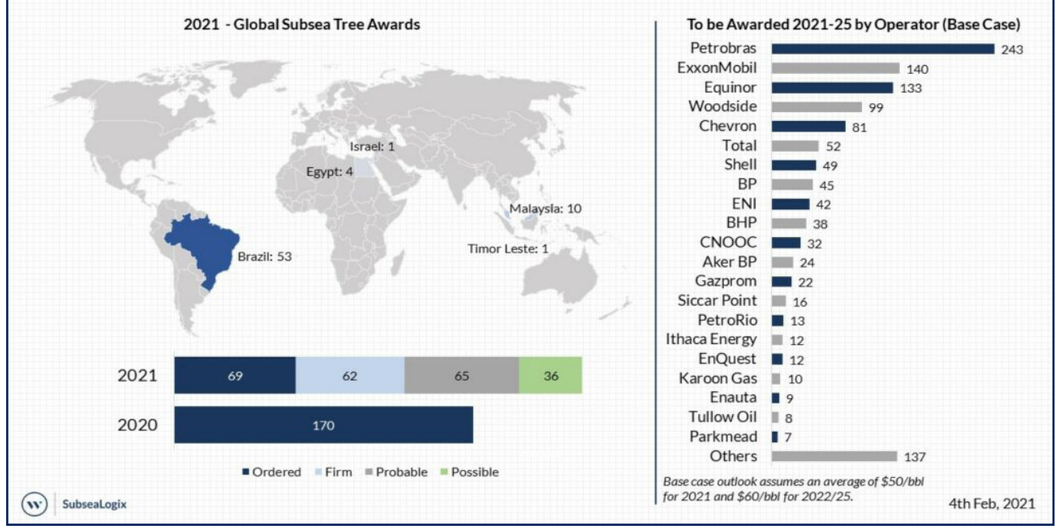
Brazil: Petrobras has awarded the contract to supply subsea trees for Buzios VI, VII & VIII. These units will be linked to the Almirante Tamandare, P-78 and P-79 FPSOs. Other major contract awards still anticipated in 1Q 2021 include 19 subsea tree units for Equinor's Bacalhau project, as well as three units for PetroRio's Frade.

Egypt: In January, Energean sanctioned the North El Amriya – North Idkunea (NEA-NI) tieback project. TechnipFMC was awarded the EPCIC contract for the development including four subsea trees and the associated SURF equipment.
Westwood has revised its total 2020 subsea tree order intake from 153 to 170 units after official confirmation that contracts for Petrobras' Mero III and ENI's Agogo early production system had been awarded to OneSubsea and Baker Hughes respectively.

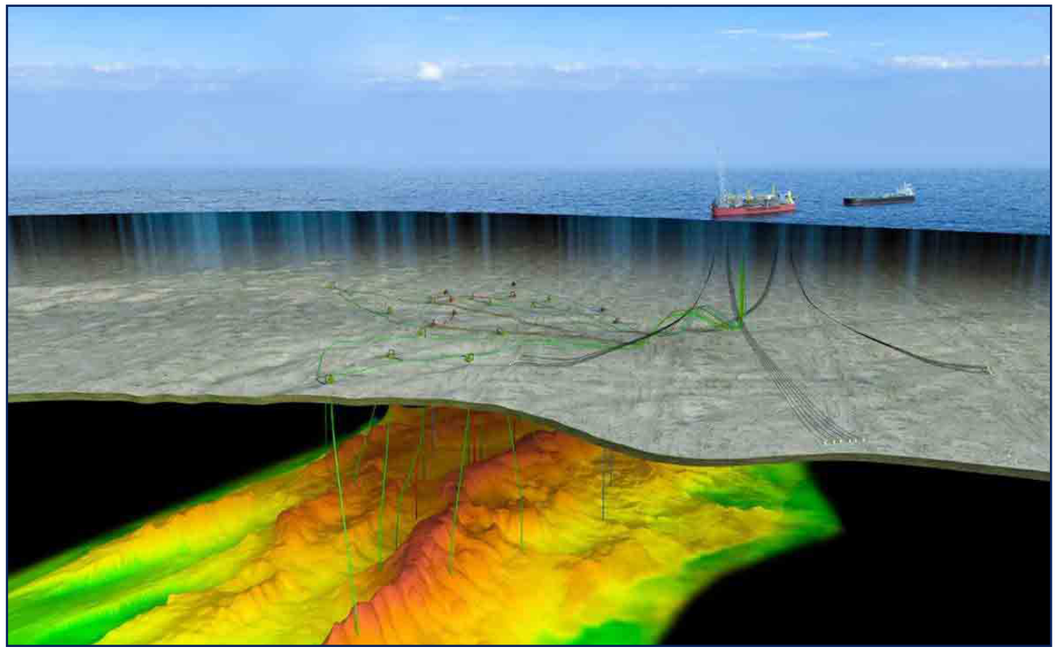
Subsea tree order intake in 2021 has got off to a fast start, with January awards totalling 69 units. This is driven by the award of Petrobras' Buzios development, Santos' Bayu Undan Phase IIIc, Energean's Karish North, as well as the North El Amriya fields, amongst others.

Visible base-case subsea tree demand over the 2021-25 period is now forecast at 1,224 units (excluding units already ordered this year), averaging approximately 260 units a year. Petrobras is forecast to account for approximately 20% of global tree demand over the forecast period.

Westwood Subsea Tree Tracker – February 2021



BACALHAU FEED



Bacalhau FEED

The Subsea Integration Alliance has been awarded an exclusive contract by Equinor for the front-end engineering design (FEED) on its Bacalhau (formerly Carcará) project offshore Brazil.

The Bacalhau Field is located 185km from the coast of the municipality of Ilhabela/SP, in the state of São Paulo, in a water depth of 2050m. Bacalhau is Brazil's first integrated SPS and SURF project.

The contract scope brings together field development planning, project delivery and total life cycle solutions under an extensive technology and services portfolio. The contract is based on a two-step award.

The FEED and preinvestment are starting imminently, with an option for the execution phase under a lump-sum turnkey setup that includes engineering, procurement, construction and installation for the entire subsea umbilicals, risers and flowlines (SURF) and subsea production systems (SPS) scope.

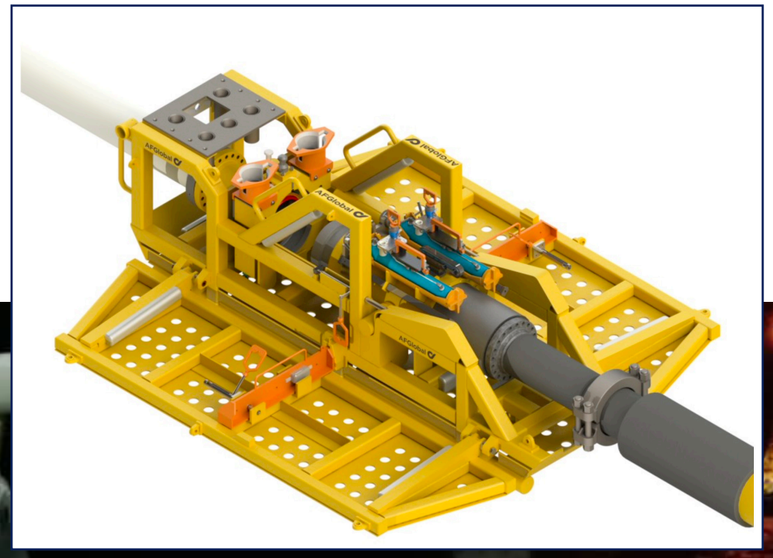
Option for the contract is subject to Equinor's planned investment decision for the Bacalhau project late 2020. The field development will include 19 wells.

Furthermore, Subsea Integration Alliance will also be responsible for life-of-field support, representing a fully integrated contract model across the entire field life cycle, from engineering and early engagement to aftermarket services.

The award comes on the back of a design competition where the company says that it demonstrated itd ability to maximize asset value through our integrated field development service.

This involves dynamically connecting reservoir, production and economic models with well, subsea infrastructure and topside facilities in a single, collaborative environment using the Subsea Planner collaborative field development solution.

PIPE CONNECTION



Stinger-deployed connector

In 2019, AFGlobal started the design of a new stinger-deployed connector. By mid-2020, it had completed its two deployments for a Malaysian national oil company. The designers say that the system can result in savings of up to 20%.

The main driver in the design process was to look for ways of making underwater pipeline connections cheaper. It was originally directed at shallow water applications of around 90-100m depths in which the industry would otherwise use divers. It is the very fact that the system is totally diverless that represents one of the main advantages.

"A diving spread can be very expensive, particularly if a support vessel is required," said Business Development Manager at AFGlobal, Mark Lamyman. "In traditional systems, the pipe would be fed out at the end of the pipelay vessel and a pipeline end terminal (PLET) would be lowered down by crane and attached. The PLET would then be lowered down to the seabed on the end of the pipeline"

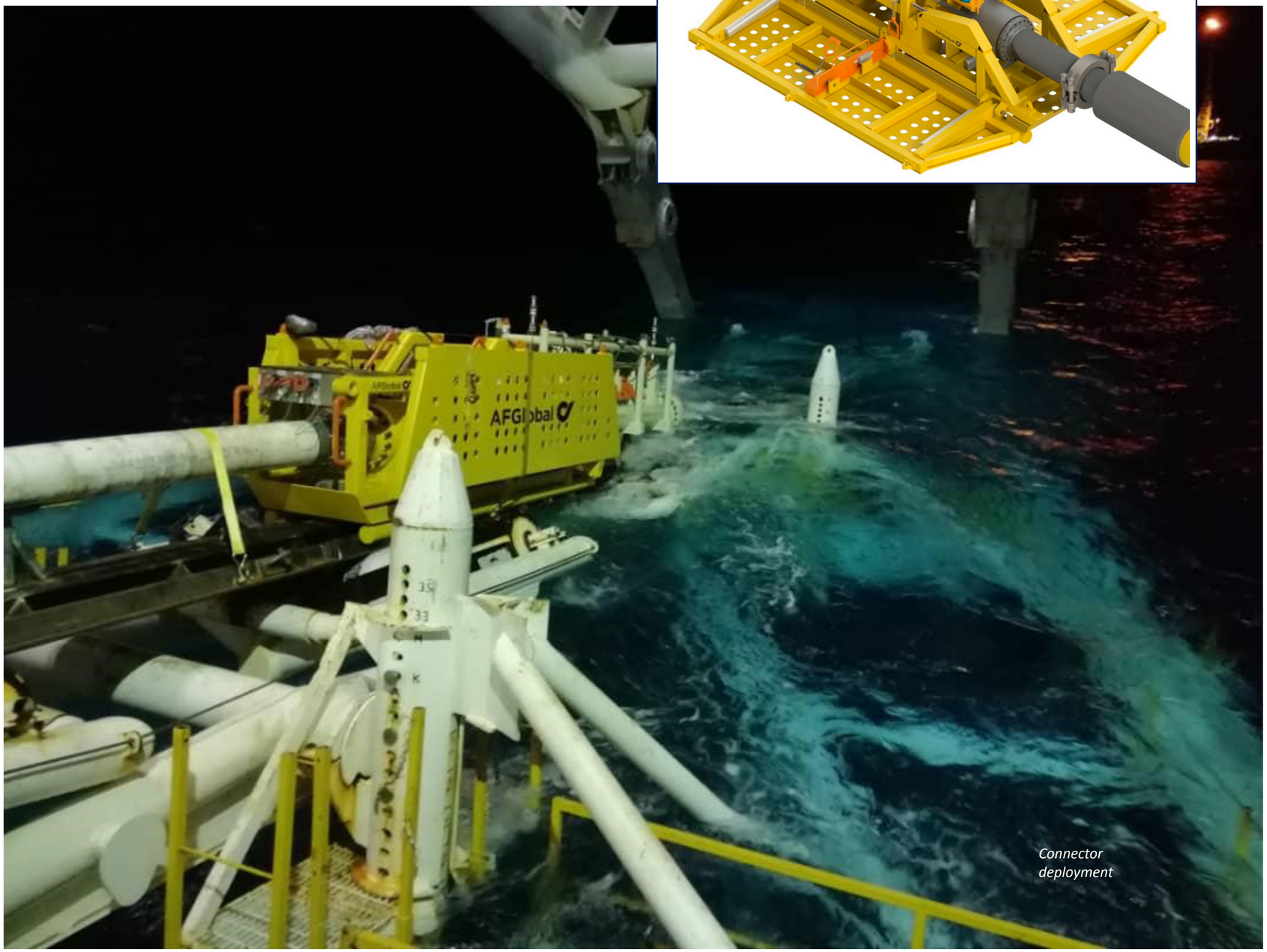
AFGlobal's diverless connector has been designed to be narrow enough to be installed onto the main pipe *before* it is fed out over the stinger, obviating the use of the crane and making the attachment easier.

When the time comes for the second pipeline to be tied in, an ROV attaches itself to its end. The two pipes are joined by means of a hydraulic tensioning tools that, when activated, pull the two together.

"The pipes are connected using Retlock clamp technology," said Lamyman. " In order to make the joining easier, there a large misalignment capability. Once the pipe is securely on the seabed, it only takes 30 mins to make up the connection.

"At it base, the connector incorporates an integral mud mat to stop it sinking into the sea floor. The wings can be folded up to be sufficiently narrow as to allow the connector to pass through the support frame holding the stinger. When landed on the seabed, the wings can be folded down to provide a stable base in order to make the connection. Alternatively, the wings can be folded up to provide protection for fishing nets.

The connector can be used on pipe sizes from 4in – 16in and at depths up to 3000m. The unit weighs up to 4t once installed.



Connector deployment

OKEANUS MMT FRAMEWORK AGREEMENT

Okeanus Science & Technology, has signed a framework agreement with MMT for the provision of critical marine survey and deck handling equipment to support the global survey company's plans to expand their hydrographic and geophysical survey efforts in the United States in 2021.

The announcement comes following a year of ongoing collaboration, during which Okeanus provided MMT with two Okeanus DT-210EHLWR Slip Ring Winches and two Okeanus DT-3025EHLWR Slip Ring Winches complete with full drum lengths of.45" armoured coax cable, slip rings, customized remote controls featuring remote emergency stops, and drum guards to ensure crew safety aboard the vessel during survey operations.

These winches were mobilized on MMT's survey vessel, ***M/V Deep Helder,*** and remain onboard in anticipation of the work ahead in 2021 off of the coast of the northeastern United States.

Meanwhile, MMT has been awarded a major 3 three-year contract, with two one-year options, for Nord Stream AG. The yearly inspections, to be executed through our cooperation with Reach Subsea, include visual and acoustic survey services critical for the pipeline integrity assessments, covering inspection of the European sections of both lines of the Nord Stream Pipeline System running from Russia to Germany.

This award follows on from the original contract awarded in 2017. One of the key advantages from this continued collaboration is the development resulting from the experiences gained during the last four years. This allows for significantly reduced costs and increased efficiency by high-speed survey operations and automated data processing workflows.

Deep Helder Image : Seamar

CHINESE MONITORING

C-Kore Systems has recently signed their first contract for delivery of their subsea monitoring tools for a Chinese operation.

The C-Kore tools will be used to perform subsea testing on the main umbilical before tying back into the existing structures.

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 localizes anomalies within 20cm.

With C-Kore's automated units and on-line training, no extra offshore support is needed to run the equipment.

Greg Smith, General Manager of C-Kore commented further, "It is great that our technology is branching out into the Chinese market. We have developed our tools to be easy to use with no offshore engineer required.

This is a big advantage in the current market when travel is restricted due to the pandemic. We look forward to the successful deployment."

C-Kore's subsea testing tools

AQUIFER MAPPING

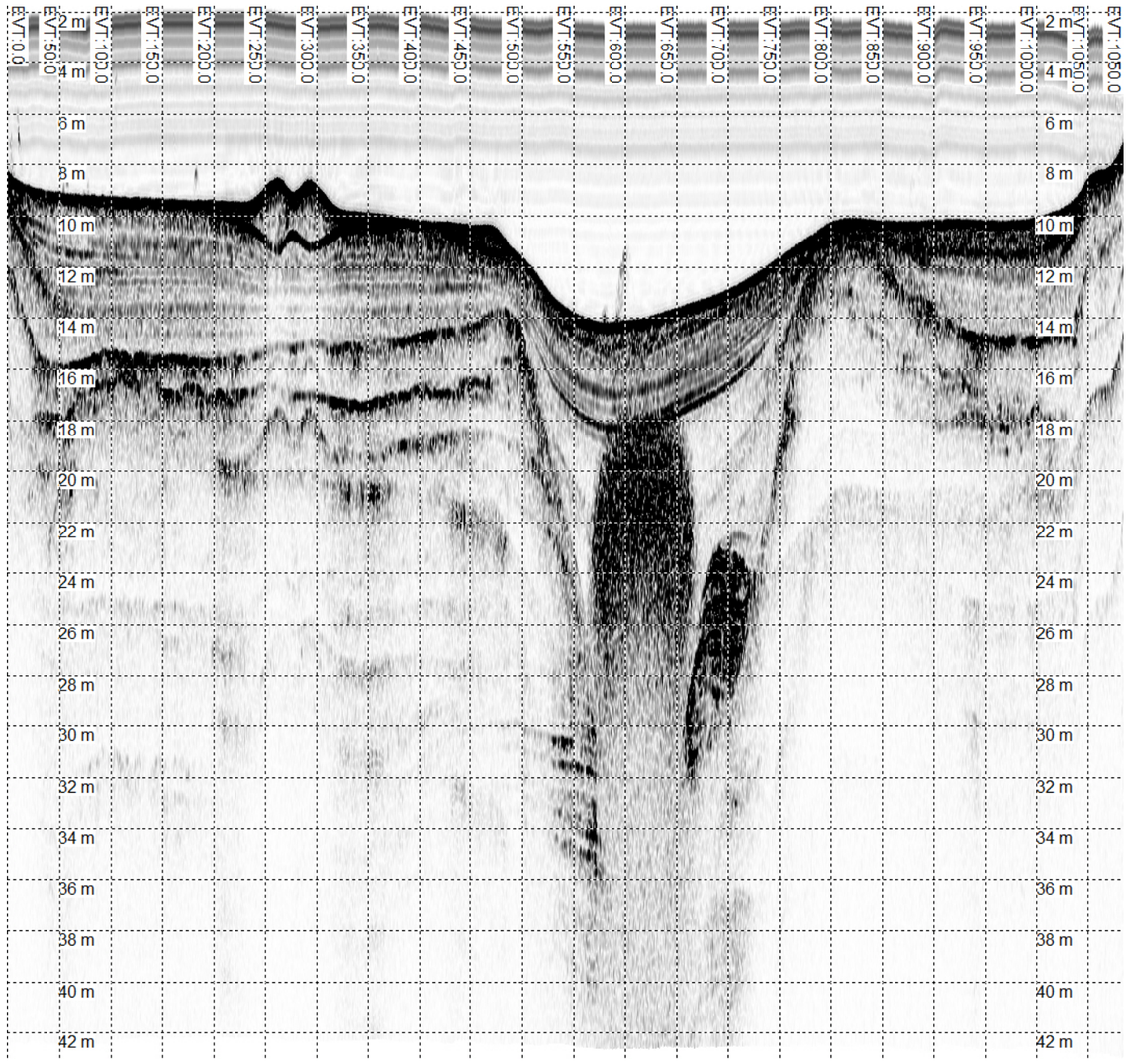
Surrich Hydrographics recently collected an image of a freshwater aquifer in the River Swan in Perth, Western Australia.

The company used Edgetech's 3400 sub-bottom profiling system.

lding on the long running success of the EdgeTech sub-bottom profiler product line, the EdgeTech 3400 provides users many enhancements to current sub-bottom profiler systems.

The 3400 is a wideband Frequency Modulated (FM) sub-bottom profiler using EdgeTech's proprietary Full Spectrum CHIRP technology. The system generates high resolution images of the sub-bottom stratigraphy in oceans, lakes, and rivers and provides excellent penetration in various bottom types.

The EdgeTech 3400 comes in a dual 2-16 kHz transducer configuration. The towfish is configured with new PVDF receiver arrays segmented for standard sub-bottom profiling operations or a unique "pipeliner" mode for optimal location and imaging of buried pipelines.



BACTERIA AND 3D PRINTERS

A team of University of Exeter students are using genetically engineered bacteria to produce a material that could help repair degraded coral reefs.

Their project, called CalcifEXE, uses bacteria to make calcium carbonate which can then be shaped using a 3D bioprinter into coral "backbones" for reef restoration.
Production of high-quality Precipitated Calcium Carbonate (PCC) usually requires high temperatures and therefore leads to carbon emissions.

But the team's bacteria-based method produces no emissions – instead taking carbon from the air and locking it into the PCC.

"Our first step was engineering Bacillus subtilis bacteria to increase its capacity and ability to precipitate calcium carbonate," said Anna Donnan, a third-year Biological Sciences student specialising in cellular and molecular biology.

"To do that, we introduced an enzyme that removes CO2 from the air and converts it into bicarbonate ions.

"This is part of a process called 'biomineralisation', where living organisms produce minerals."
The team aims to use a two-chambered bioprinter containing a bacterial "co-culture" – pairing their genetically engineered B. subtilis with another bacteria to increase calcium carbonate production – and a hydrogel.

The hydrogel contains an "inducer molecule" which activates the bacteria to make solid calcium carbonate.

"PCC is used in many industries, from whitening paper and increasing the brightness of colours in eyeshadow, it combats heartburn and indigestion in the form of tablets, and it can be found in your toothpaste as a cleaning agent.

"As a proof of concept, the first use of our PCC will be as coral backbones. "These are intended to provide an organic 'skeleton' which can be inhabited by coral species – especially in the many places worldwide where coral reefs have died or become degraded."
]
The team need to test their coral backbones thoroughly before they can be placed in degraded reefs to assist with restoration.

FRENCH NAVY TESTS DRIX USV AS PART OF A DGA ARMAMENT PROGRAMME

Shom, the French Navy's Hydrographic and Oceanographic service, recently conducted a test campaign of iXblue's DriX Unmanned Surface Vessel (USV) and its launch and recovery system (LARS) on board the *Beautemps Beaupré* (BHO) hydro-oceanographic vessel.

iXblue's USV was tested in line with the "Future Hydrographic and Oceanographic Capacity (CHOF)" programme, conducted by the French Directorate General of Armament (DGA) with the support of Shom. DriX assessment consisted in evaluating the added value and hydrographic performance of Unmanned Surface Platforms compared to the existing launches and vessels currently in service, as well as in understanding the potential concept of use of such drones.

These tests, carried out under a contract between the French DGA and iXblue, consisted of bathymetric surveys reaching various depths (up to 200 m), with the aim of qualifying the overall performance of the DriX USV. Several Shom reference areas were surveyed, attesting of the bathymetric data quality, even at high speeds (up to 14 knots) and in rough seas. Its autonomy (up to 10 days) enabled a total of over 2,000 km of survey lines to be completed during these trials.

The multiplication of Shom's hydrographic capacities, thanks in particular to the simultaneous use of several USVs, was also successfully tested for the first time.

Two DriX were thus deployed simultaneously within survey areas close to the shore and worked both independently and collaboratively with the BHO Beautemps-Beaupré.

The intrinsic qualities of the DriX USV, such as its positioning and navigation capabilities, were also tested (anti-collision, stability, speed of execution, endurance,

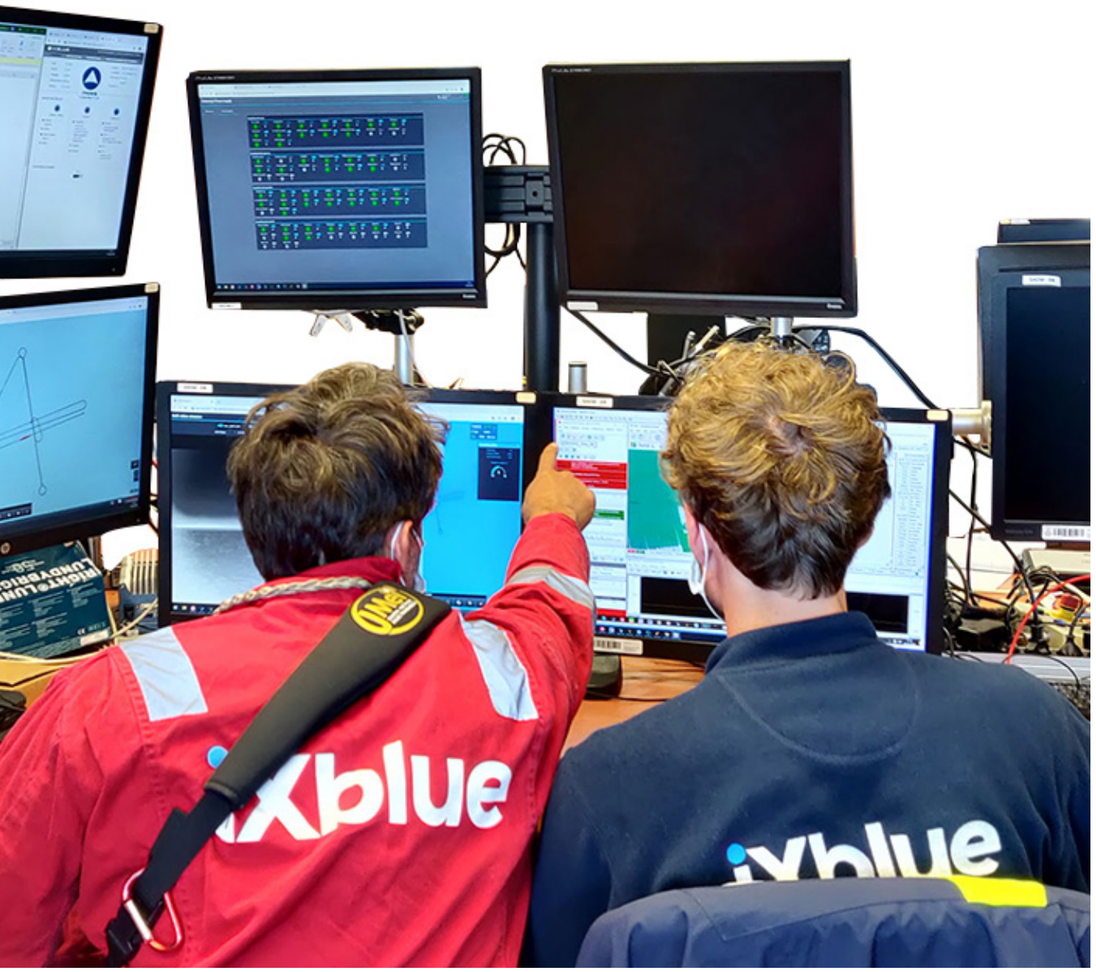
The French Hydrographic Institute, Shom, deployed two DriX to enhance their mapping operations

iXblue survey teams and the French Navy supervising DriX deployment from Beautemps Beaupre *hydro oceanographic vessel*

ability to navigate and work in high sea states, etc.).

"We are extremely proud to have carried out these DriX tests with the Shom, the DGA and the French Navy as part of the CHOF program, and to have reached new milestones together, in particular the hydrographic work with several USVs," said Guillaume Eudeline USV and boats Business Development Manager at iXblue.

"We would like to thank the Shom and the crew of the Beautemps-Beaupré for their unfailing investment and for the positive reception given to our USV during these trials, which were, from our point of view, a real success."



The iXblue survey teams supervise DriX operations

DriX and the Beautemps Beaupre *hydro oceanographic vessel*

HYDRATE REMEDIATION

Flow assurance governs the unrestricted transport of hydrocarbon fluids from reservoir up to the export facilities. When developing the field, engineers examine potential agents that can block flow such as the accumulation of solid deposits of waxes, hydrates, paraffins, asphaltenes, and scales, and then develop strategies to prevent them. There may be a time within the life of the field, however, where conditions or circumstances change and these materials within a line start to build up, blocking flow. Since 2007, Oceaneering has developed remediation systems to solve such problems and have carried out over 200 intervention projects globally.

Blockages come in many sizes. An example of a small-scale blockage might be one that forms in the umbilical lines linking the subsea facilities to the control station. Blocking the line may cause the system to fail and shut off flow. Conversely, the blockage may be in the flow line itself, stopping the hydrocarbon from reaching the export facilities.

Common culprits like paraffin, hydrates, or asphaltene deposits emerge due to changes in temperature or the unexpected accumulation of water in a gas flow line. This requires the addition of chemicals to remove the blockages which, when pumped under pressure may move and disintegrate the blockage.

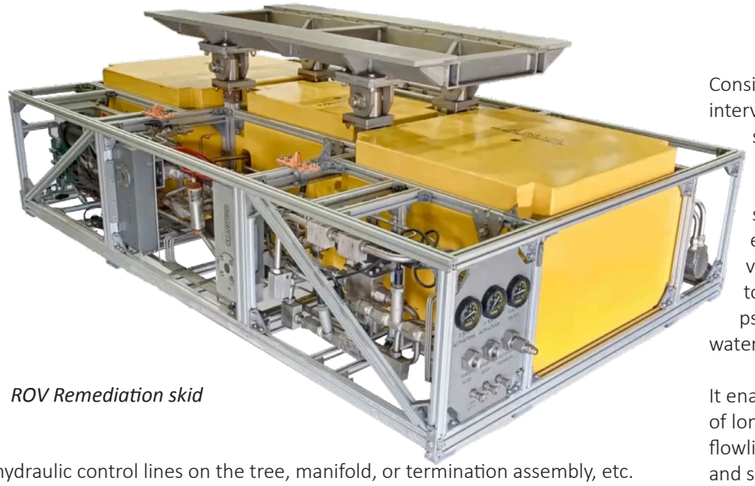
Oceaneering has developed two main remediation solutions to overcome blockages – the Hydrate Remediation Skid (HRS) and Flowline Remediation System (FRS).

INTERVENTION SKID

Oceaneering designed its HRS intervention skid to reverse relatively small-scale problems. This skid can be attached to the base of most work class ROVs and quickly sent to site. Depending on the application, it can use one or more of its three pumps to inject remediation fluid, such as methanol or MEG, or to depressurise cavities by pulling fluids out.

HRS applications tend to fall into one of two categories: low-flow/high-pressure and high-flow/low-pressure applications. The high-pressure/low-flow configuration enables fluids to enter the system at pressures up to 6,000 psi and flow rates of 15 to 20 gallons per minute. Conversely, the high-pressure configuration can reach pressures up to 17,500 psi with flow rates between 3 to 5 gallons a minute. Flow and pressure data are logged from pressure transducers and flowmeters within the skid.

The skid flies down from the surface, interfacing with the



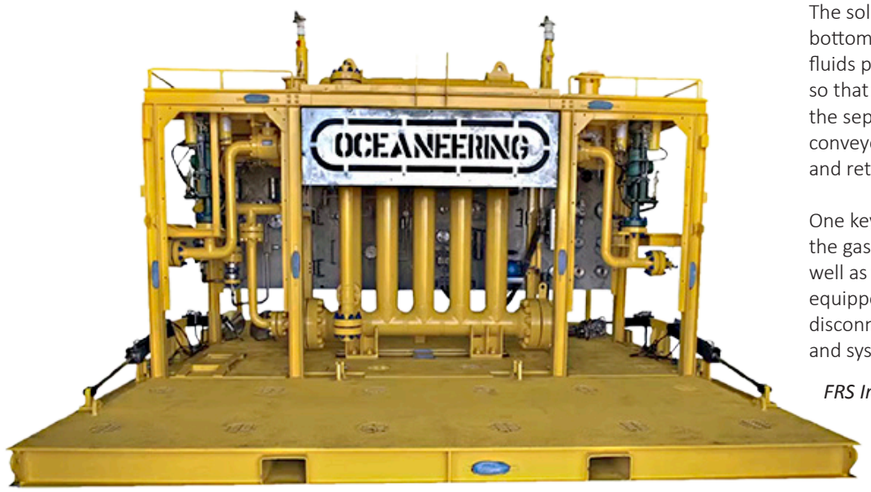
ROV Remediation skid

hydraulic control lines on the tree, manifold, or termination assembly, etc. The skid pulls fluid and depressurises subsea assets so that the hydrate can begin dissociation. This process is caused by pumping down one side of the hydrate to ambient pressure, removing one of the three elements (gas, water, and pressure) needed to create a hydrate. During either process of hydrate dissociation, a 1,200-gallon subsea bladder is used to recover all discharged fluids.

The skid can also be used for flushing umbilicals and jumpers by injecting fluids such as water glycol inhibitors and methanol into subsea assets. It can also inject sealants to repair minor leaks.

FLOWLINE REMEDIATION

The second system developed by Oceaneering is the larger scale FRS intervention package.



Considerably larger than the ROV intervention skid, the FRS lies on the seabed but is linked to storage tanks, a gas buster, surge tanks nitrogen tanks, coiled tubing system control vans and other equipment on the support vessel. The package is designed to supply pressures up to 5,000 psi and work in 10,000 feet of water.

It enables quicker depressurisation of longer and larger deepwater flowlines, use of chemical inhibitors and subsea separation allows for separation of solids, fluids, and gases and allows the operator to restore production quicker.

The larger scale device works to remove blockages in the main flowline. Once the plug is broken down, the effluence enters the skid. The gases are immediately separated and conveyed to the surface by coiled tubing to be cold vented at a topside separator.

The solids and fluids drop to the bottom of the separator, with fluids pumped out through screens so that the solids are retained in the separator. The fluids are then conveyed topside in a coiled system and retained for disposal in a tank.

One key feature of the system is that the gas and the liquid connections as well as the pumping connections are equipped with an emergency quick disconnect to protect the flow line and systems integrity.

FRS Intervention package

SUT LAUNCHES VIRTUAL SUBSEA AWARENESS COURSE

The Society for Underwater Technology (SUT) has launched a foundation level virtual Subsea Awareness Course (SAC) based on its highly successful face-to-face five-day course which has seen over a thousand delegates during more than 20 years.

Week 1 of the first virtual SAC will run on the mornings of Tuesday 6th, Wednesday 7th and Thursday 8th April; and will be followed by two sessions on 13th and 14th April.

The syllabus for the five 3-hour sessions embraces subsea production equipment and systems; flow assurance; pipelines and risers; construction and installation; metocean; renewables and future technology trends; and operation, maintenance, and decommissioning. Future virtual 5-session SACs will be held at regular intervals.

"The face-to-face SAC has been attended by delegates from across the UK and from further afield including Angola, Azerbaijan, Egypt and Norway from oil and gas operating companies, from major contractors and organisations from throughout the supply chain. The SAC has attracted accolades in plenty – the following being very typical:

The virtual course will be presented by specialists from across the sector from operators, contractors, and technology system suppliers, many of whom are recognised Technical Authorities (TA).

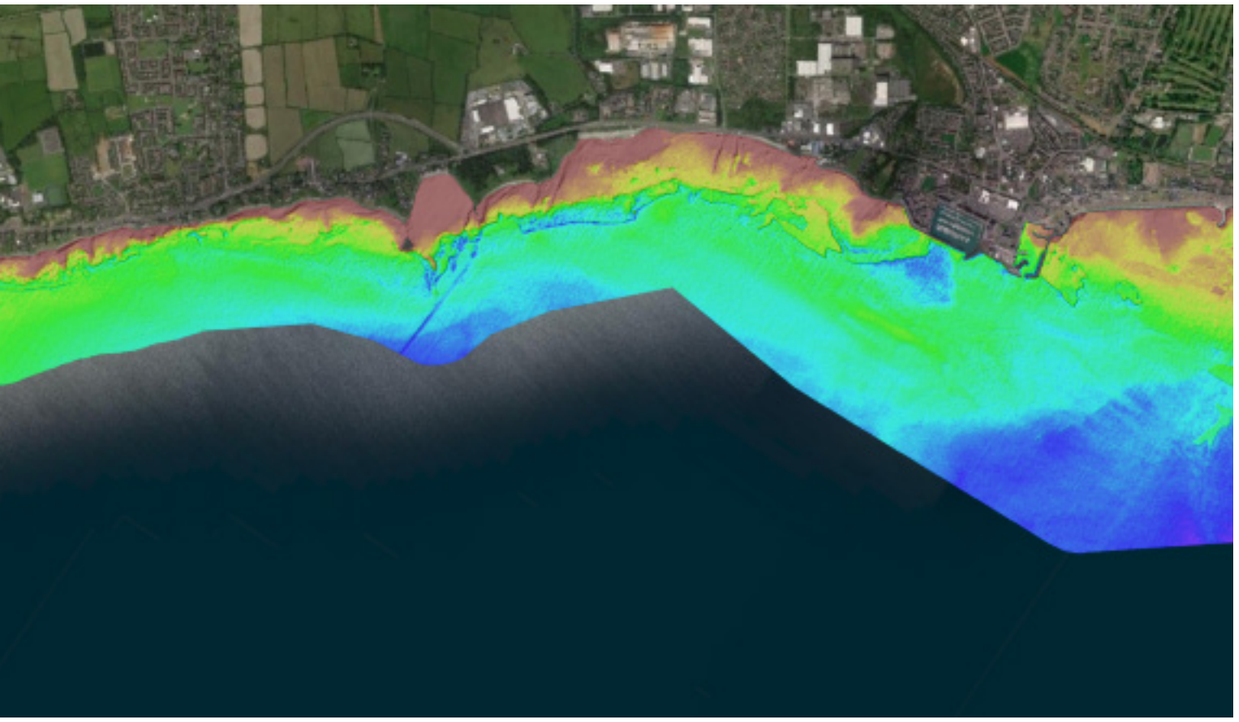
The course fee for SUT members is £715 and £845 for non-members (excluding VAT where chargeable). It is CPD approved.

Registration for the virtual SAC is at www.sut.org/branch/london/virtual-subsea-awareness-course/

Two other SUT virtual SACs are currently under development, one for the offshore wind industry and the second for the insurance industry. Both will be launched

SUT's Houston and Perth (Australia) branches also run SAC face-to-face courses dates and details are available on the SUT's website at www.sut.org

LIDAR



Fugro has won a contract to capture bathymetric lidar of Northern Ireland's coastline as part of a project from the Department of Agriculture, Environment and Rural Affairs (DAERA) to create a detailed 3D elevation model of the coast.

The nearshore survey will acquire satellite-derived bathymetry (SDB) data and, for the first time in the UK, Fugro will use their innovative Rapid Airborne Multibeam Mapping System (RAMMS) to collect lidar bathymetry data.

Coastal flooding is a global concern due to rising sea levels and an increase in extreme storm events. To identify areas most at risk of coastal erosion and marine flooding, and those that may be under future threat, DAERA has commissioned a baseline study of Northern Ireland's 763 km of coastline. The resulting 3D model will help to inform policy makers, coastal managers, terrestrial planners, marine planners and other interested stakeholders.

Work on the project started this month and Fugro's hydrographic experts are acquiring the SDB data in cooperation with EOMAP, the world's leading company for optical remote sensing of aquatic environments, using their remote sensing technology to map the seabed along the entire coastline to a depth of approximately 10 m.

They will also mobilise Fugro's lightweight RAMMS sensor, which can be operated from small aircraft or an uncrewed aerial vehicle (UAV), to capture high-resolution data of a pilot area to depths of three times the visual water clarity. For nearshore projects, these technologies have many advantages over the multibeam echosounder systems used on traditional survey vessels, including faster rates of data capture, less time spent on site, and reduced technical and safety risks.

SEABAT 7123 MINE HUNTING CONTRACT

Teledyne RESON has been awarded a significant order for the supply of SeaBat 7123-MkII forward looking sonar systems for obstacle identification and avoidance for two new build naval mine hunting vessels.

Teledyne RESON's SeaBat 7123-MkII is an advanced dual-use high resolution forward-looking sonar suitable for use in a wide range of applications and platforms, including both surface vessels and underwater vehicles.

In commercial use the SeaBat 7123-MkII can deliver super high-resolution imaging for underwater inspection related tasks, such as long-range detection of objects in the water column or on the seabed, and the sonar can be used as a platform for scientific and oceanographic research applications. The SeaBat 7123-MkII can be integrated on many platforms, e.g., AUVs, ROVs, PVDS and surface vessels and is especially useful for unmanned drone vessels for detecting and classifying objects on the seabed in real time.

In Naval use, the sonar is a vital component in Mine Counter Measure (MCM) systems for detection of Mine Like Objects (MLOs) at long distances. The high-resolution image enhancement solution of the SeaBat 7123-MkII not only provides a clearer image, but combined with machine learning algorithms, provides unprecedented real time computer aided detection (CAD) and tracking supporting the operator to classify objects.

EVOLOGICS RELEASE SINAPS 2

UPGRADED ACOUSTIC POSITIONING SOFTWARE

EvoLogics hs announced the release of SiNAPS 2, the newly upgraded underwater acoustic positioning software.

Rebuilt from scratch, it comes with a more powerful and efficient data engine with improved positioning accuracy. The updated user interface and intuitive workflows allow for easier onboarding and system integration.

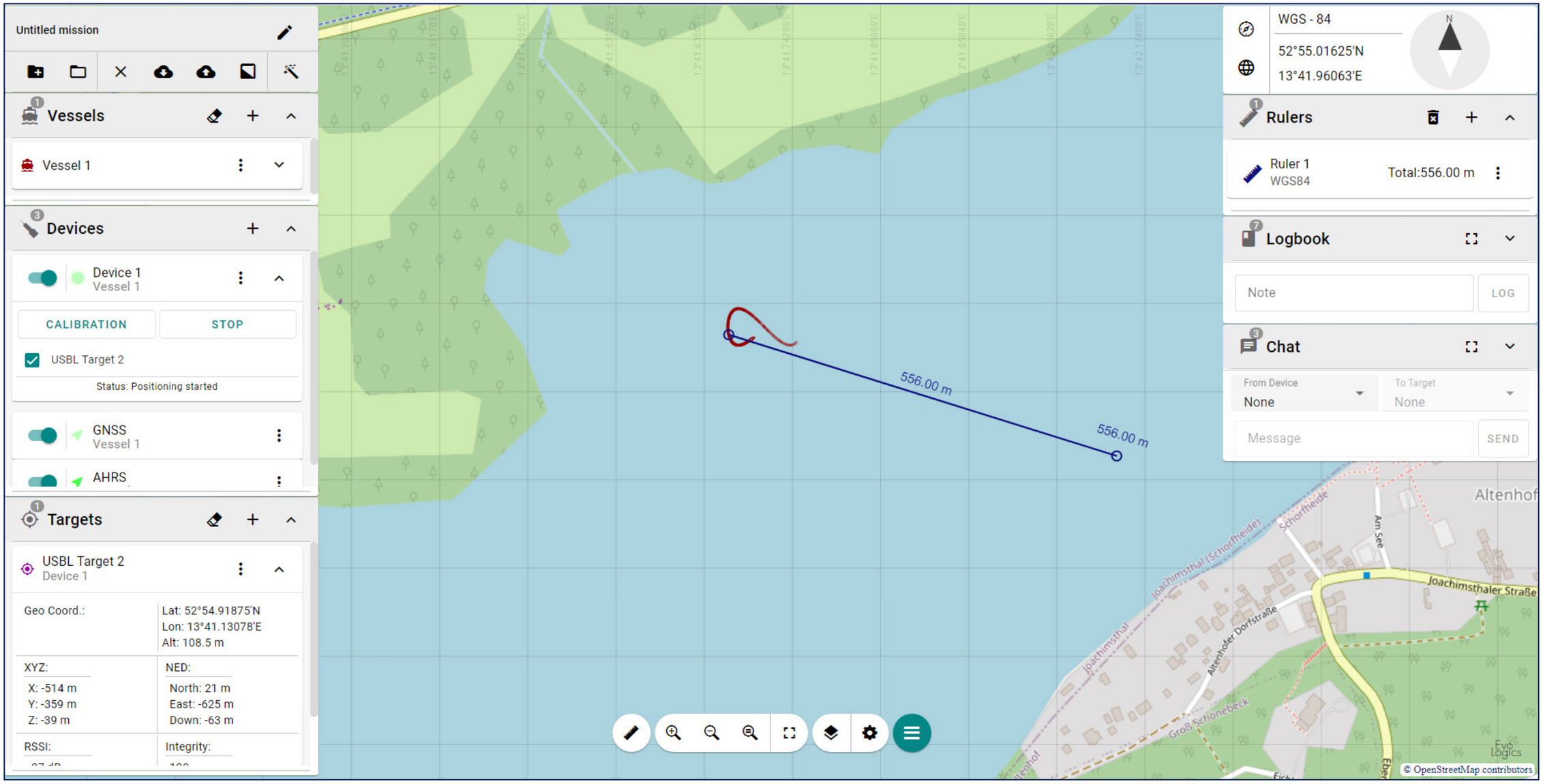
SiNAPS 2 is both powerful and flexible- it supports USBL, LBL, and advanced hybrid positioning methods. The software is intuitive and fast to configure even for complex scenarios and comes with built-in system calibration tools. With SiNAPS, it is possible to manage multiple databases and maintain separate data sets. Automation options and advanced data fusion strategies are available for demanding application tasks.

Real-time multiple target tracking is combined with data input from multiple sensors. SiNAPS is capable of real-time output of positioning and sensor data for custom forwarding and processing.

Its web-based user interface allows using SiNAPS on any device in the local computer network; the extensive display tools include the new option to visualize acoustic communication, as well as adding online and offline background maps.

SiNAPS 2 is fully compatible with the whole range of EvoLogics underwater acoustic modems and USBL devices that support simultaneous tracking and bidirectional communication.

SINAPS 2



SiNAPS 2 Screen image

SWIFT CTD

Designed for a seamless workflow, the new SWiFT CTD is the next generation of Valeport's popular SWiFT profiler range and delivers enhanced accuracy and versatility for those requiring CTD measurements.

The SWiFT CTD profiler provides survey-grade sensor technology coupled with the convenience of Bluetooth connectivity, rechargeable battery and an integral GPS module to geo-locate each profile.

Using Valeport's high accuracy sensor technology to combine sensors for multiple profiles in a single drop, the SWiFT CTD features a new fast response temperature probe and operates down to 500m as standard, delivering directly measured Conductivity, Temperature and Depth.

In addition to the directly measured CTD, computed Salinity, Density and Sound Velocity is calculated using the UNESCO international standard algorithm and the Chen and Millero equation. Data can be quickly and easily downloaded wirelessly, and uses Valeport's new Ocean software for iOS, Android and PC platforms. Data can be instantly shared in industry standard data formats.

Ease of use is at the heart of the SWiFT range and the new SWiFT CTD not only makes any problematic battery changes a thing of the past and delivers fully automated data transfer with no user input required, it also features Valeport's signature SWiFT magnetic switch ring. The switch ring is easy to operate even with cold hands, it simply turns through 90 degrees and reassuringly clicks into position. The end cap features user-friendly LED status indications for GPS, battery and communications.

With an operational battery life of up to five days and the convenience of charge via USB, the SWiFT CTD is intended for offshore, coastal, harbour and inland environmental and hydrographic survey use.

"Developed for those who need precise CTD data for scientific applications, this is the first time that measured CTD has been available with all the benefits of our SWiFT profiler; ease of use, Bluetooth connectivity, rechargeable battery and GPS. The new SWiFT CTD delivers the highest quality CTD profiles in a compact, robust and portable package." commented Guy Frankland, Valeport head of marketing.

Constructed from titanium to provide unmatched durability, the CTD sensors are housed in a strong acetal sensor guard. An optional deployment cage is also available to bolt onto the instrument to help get the SWiFT CTD to depth in fast flowing currents.

eLARS

In 2019, MacArtney committed the first sketches of its iconoclastic all-electric Launch and Recovery System (eLARS) design to paper. Within a year, it had a fully working prototype

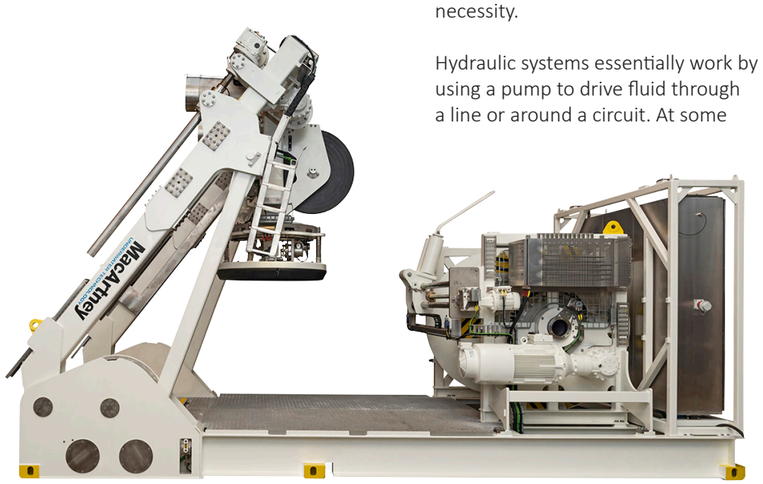
Perhaps the noisiest part of MacArtney's recently launched eLARS is the sound of people nearby commenting how remarkably quiet it is. This, however is simply a beneficial side effect of a project to substitute electric for hydraulic power.

The project was originally conceived to improve the environmental footprint of vessels that used A-frames to launch and recover underwater vehicles. Along the journey, however, the engineers soon realised that designs would reduce costs, to make the system economically as well as environmentally advantageous.

HYDRAULIC POWER

Until recently, the received wisdom of LARS design was that hydraulic power was the only medium able to provide the necessary power density sufficient to move an large A-frame and its heavy payload. Any drawbacks associated with using hydraulics were simply considered an unavoidable necessity.

Hydraulic systems essentially work by using a pump to drive fluid through a line or around a circuit. At some point in the system, this power can be taken off to move a component or end effector. Driving the fluid at high pressures necessary to provide large amounts of power, however,



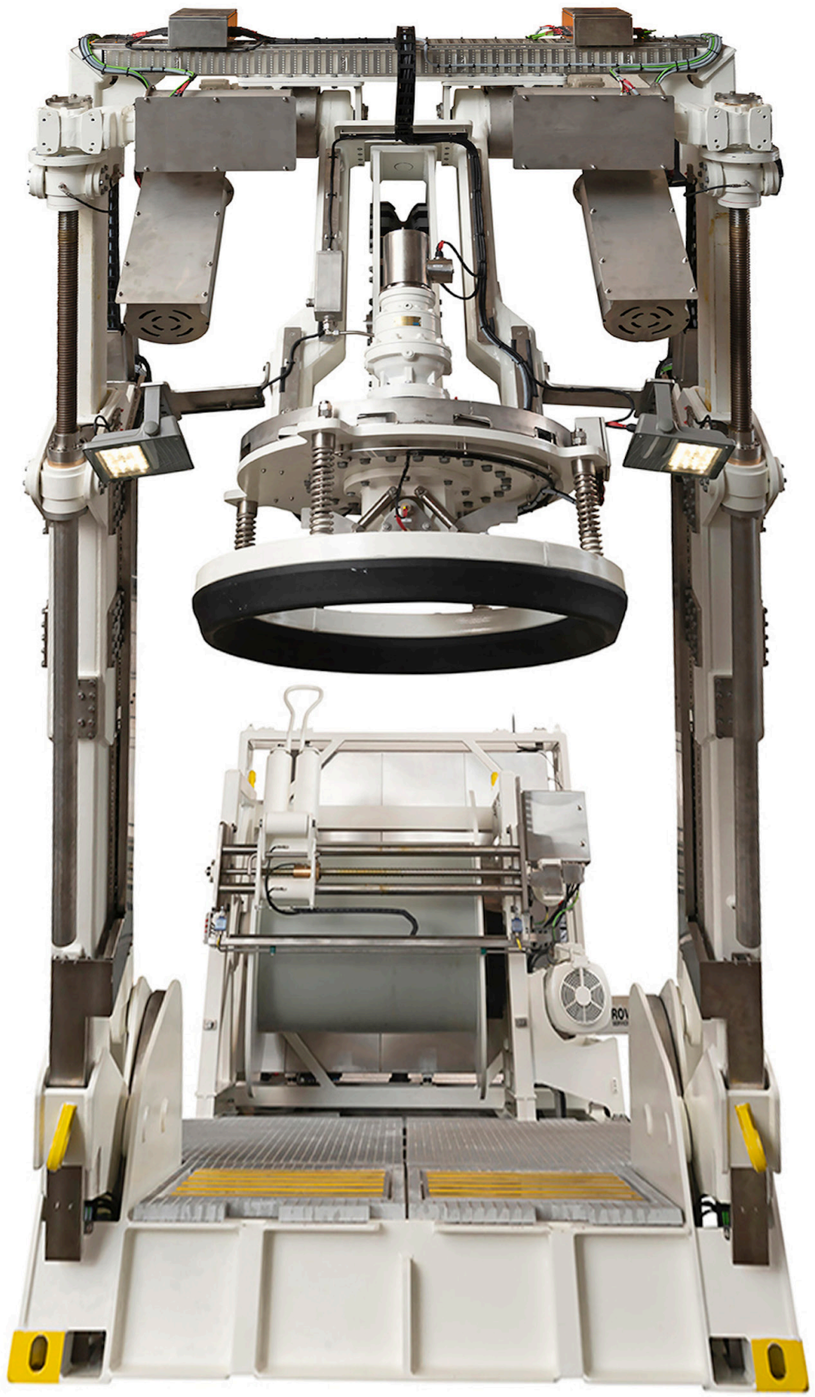
MacArtney's eLars system

TRACK RECORD

A conundrum of introducing any new product into conservative market is that by definition, it does not have a track record and cannot get one unless it is first employed. Macartney quite reasonably asserts that this does not apply to its eLARS.

"We have been manufacturing LARS systems for decades," said said Lasse Rasmussen, CTO at MacArtney, "and enjoy high levels of reliability. This means that from the start, the system already comes with a track record.

Replacing the drive mechanism with an equally well understood but more controllable media will only improve the product line, and we have backed this up by conducting extensive failure mode analysis to each component and subsystem, in order to mitigate any problem that may occur."



eLARS

The difference between MacArtney's eLARS and a conventional arrangement is that the system is totally powered by electricity with software being used to integrate the individual components into a cohesive unit and offer the possibility of remote control.

The new eLARS hardware basically consists of a two parts- the newly-designed MERMAC eA-frame coupled with an electric winch. Macartney already offers a number of electric winch designs including the

- MERMAC R ROV winch,
- MERMAC S multipurpose winch
- MERMAC Q stainless steel winch
- MERMAC M modular stainless steel winch series.

The company, however, say that they can also develop custom winch options or offer the possibility of integrating with a customer's winch.

The eLARS is based on a 20 ft ISO Container. Once on deck, the it is secured by simple twist locks. The distance between the legs is 1.8m while the height can be increased with an extension boom depending on the dimensions of the vehicle being launched.

The eLARS can be configured with a docking sheave or alternatively, a docking head. Powered by electric motors, the head has a rotation of 180 deg and the boom can reach 45deg backwards or forwards.

It can run umbilicals ranging from 17 mm up to 32 mm in diameter. These can be paid out at a typical rate of 30 m/min although with active heave winches, this rate can increase to nearer 60 m/min.

The systems require 63 amp at connection 400 V, although a transformer can be supplied with the transform unit for 690 V applications.

means that the hydraulic tubes or hose conduits, and particularly the connectors and seals are always under pressure, increasing the propensity for leakage.

In the worst case, a damaged line would rupture, with hydraulic fluid (and power) being immediately lost. If this occurs over the water, large volumes of environmentally hostile fluid could discharge at high pressure, directly into the sea. A more common damage scenario, however, would result in a slow leakage, during which, the system would still function.

HYDRAULIC VS ELECTRIC

"When seeking to replace hydraulic with electric lines, this was one first issues we had to confront," said Lasse Rasmussen, CTO at MacArtney. "Unlike hydraulics, damage to electrical cables typically causes the entire circuit to shut down immediately. Finding ways of avoiding this became a principal consideration in the design of the electric LARS.

"Our first task was to build extensive protection around each line, enclosing the cables in steel conduits. In order to work in extreme conditions, it is also important that the motors are protected wave slamming and extreme wet conditions.

"We, therefore, housed the motors in special watertight compartments so they can operate in dry conditions. Of course these could conceivably leak over time so we also incorporated water ingress sensors to alert the control system.

"Coupled with increased protection, we also incorporated very high levels of redundancy into the system. The eventual design is now so robust that if one of the cables were cut, the system would still be 100% operable – in fact, if every single cable were cut on one leg of the A-frame, the system would still be fully functional.

"In the unlikely event that the cables on the other leg were also cut, the system performance would be affected but it would not stop working. Ultimately, if ***all*** the cables in the a frame were cut, it would still be possible to retrieve the asset.

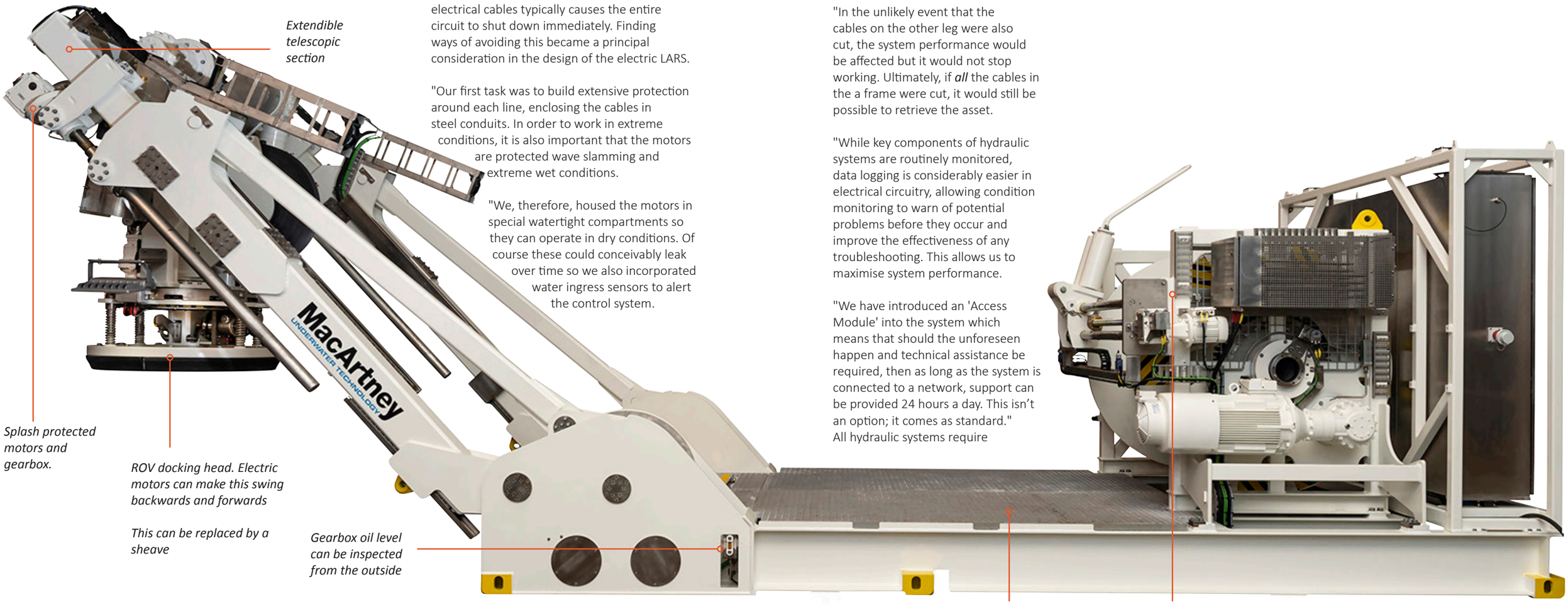
"While key components of hydraulic systems are routinely monitored, data logging is considerably easier in electrical circuitry, allowing condition monitoring to warn of potential problems before they occur and improve the effectiveness of any troubleshooting. This allows us to maximise system performance.

"We have introduced an 'Access Module' into the system which means that should the unforeseen happen and technical assistance be required, then as long as the system is connected to a network, support can be provided 24 hours a day. This isn't an option; it comes as standard."

All hydraulic systems require considerable maintenance with the operator having to inspect regularly for leak paths. Oil filters have to be periodically replaced and components continually retightened.

By comparison, the maintenance of eLARS systems are largely limited to lubricating grease points for the moving parts, especially on the top boom and the docking head. Some of these points, however, are easier to access than others Because of the height of the A frame, sometimes ports can be difficult to reach.

Recognising this, the designers, made



Extendible telescopic section

Splash protected motors and gearbox.

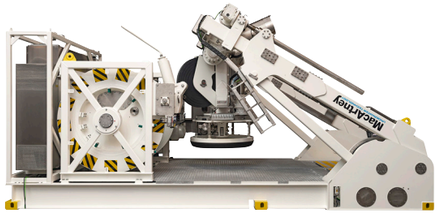
ROV docking head. Electric motors can make this swing backwards and forwards

This can be replaced by a sheave

Gearbox oil level can be inspected from the outside

Drip trays below the entire skid area

Electric winch



The boom can swing down to allow easy inspection and maintenance

it possible to swing the boom down to head height, allowing all parts to be inspected

SOFTWARE

Perhaps the greatest potential benefits of the eLARS is that it lends itself to being controlled, totally or in part, by software. This is useful in a number of ways.

If, for example, the A-frame is installed within a hanger of insufficient height, this could cause a potential collision. Extending its telescopic boom extending could cause physical contact with part of the vessel or door structure.

"Our system allows us to pre-programme exclusion zones into the digital model," said Rasmussen, and this over-rides any physical movement by the hardware, preventing collision.

"Essentially, this same programming function can allow an entire launch and recovery operation to be conducted at the push of a button.
Controlling devices by software lies at the heart of automation, an technology growing steadily in the offshore sector.

For variety of well accepted reasons, automated systems have significant benefits over crewed vessels. Fewer or no people are present offshore and so there is no need to protect or accommodate them.

Potential advantages include increased safety with fewer accidents and environmental gains from reduced emissions. In 2019, BP, for example, set a target to have 100% of subsea inspection performed via marine autonomous systems (MAS) by 2025. Some larger unmanned vehicles have the facility to deploy smaller vehicles and electrically-controlled LARS systems, possibly integrated into the unmanned autonomous vehicle's control software, is entirely compatible with this.

ECONOMICS

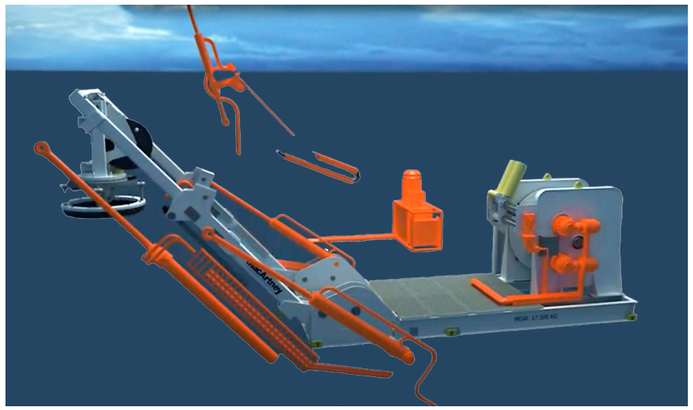
The price of any commodity is not only the up-front capital cost, but also includes cost such as using the item over its operational life. This is where MacArtney say, the electrical option also becomes cheapest.

'Inspecting the electrical system is carried out electronically whereas hydraulic systems require more visual inspection but there comes a time in both cases when key items fail and require replacement," said Rasmussen.

"Most hydraulic components are designed for that for that specific product alone. This means that, depending on where in the world the hydraulic component fails, it may require up to 20 weeks of lead time to procure another. As this is operationally unacceptable, the only alternative is to retain a stock of replacement parts on board the vessel, which ties up both space and money.

"Electrical systems, conversely, don't have such expensive spares with the same motors commercially available worldwide. This means that it is often possible to source replacements locally from stock

REMOVING HYDRAULIC SYSTEMS



The hydraulic system (orange) that can be removed

In a conventional hydraulic LARS system, the control system and the power drives are located in a compartment on deck near the A-frame. In the electrical system, however, this and a variety of other components are not required, releasing valuable deck space.

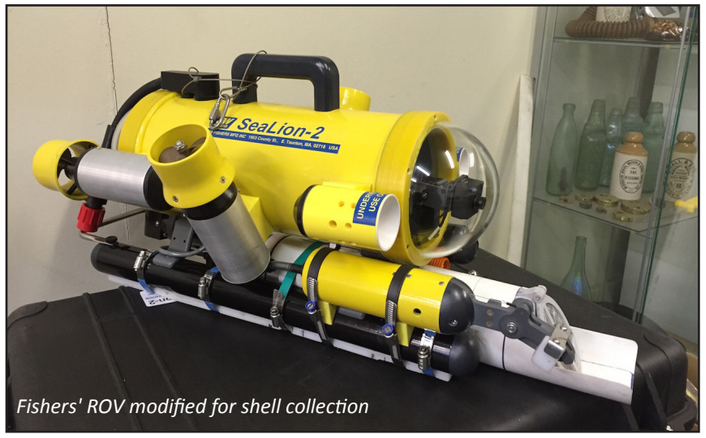
DOCUMENTING SHELLS

Seashells are the exoskeletons of molluscs such as snails, clams, oysters and many others. They have a critical role in coastal ecosystems such as providing nesting materials, a home or attachment surface for algae, sea grass, sponges, and a host of other microorganisms. Fish also use seashells to hide from predators while hermit crabs use them as temporary shelters.

ScubaCom has the only specimen seashell permit (EP0002) in South Australia which is closely managed by the SA Fisheries Department. Founder Steve Robinson says, "it is my aim to offer seashells to the world with a guarantee that all specimens have been responsibly collected ensuring species sustainability. We currently have a database of every seashell taken by us (with photos and unique number) and will be able to verify all shells sold by us."

How did this adventure start? According to ScubaCom's website, Steve was looking for a semi-retirement plan and the opportunity to apply for a specimen seashell permit appeared. It was a tough decision considering his commitment to environmental responsibility and the sustainability of any species collected.

Molluscs



Fishers' ROV modified for shell collection

Steve carefully analysed the environmental implications before starting this type of endeavour. "At this stage I considered very carefully the impact a specimen seashell license would have on the environment."

These considerations included
(1) "this would be the only specimen seashell license in South Australia, so overfishing seemed impossible,"
(2) "the weather would only allow me to fish a small number of days a year,"
(3) "with specimen seashells, only the best shells have value so I would expect to only take about one quality shell out of thirty or more seen,"
(4) "South Australia also has many sanctuary zones protecting many seashell populations and marine parks ensuring minimal impact on species."

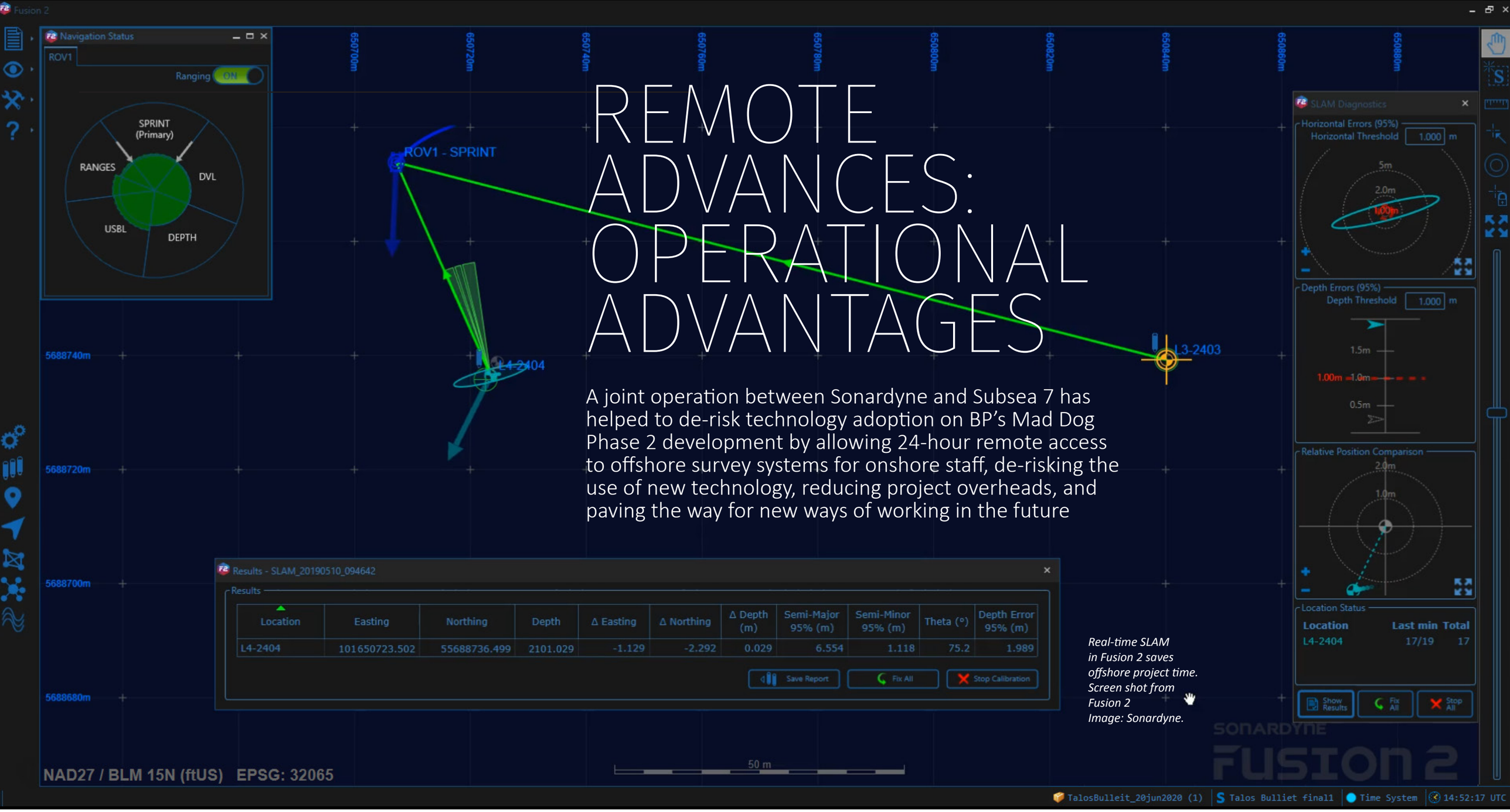
Most seashell collection will be done with a JW Fishers' Sealion-2 ROV to allow for individual seashell collection at a depth of 300 meters. The ROV has a modified manipulator arm with docking station so that seashells can be scooped up effortlessly. The umbilical from the surface is attached to the docking station and 25m of cable are coiled on the top shelf which come out when the ROV leaves the station.

This eliminates the umbilical drag from the surface. This method of operation results in zero damage to the marine environment while searching. Utilising a JW Fishers' ROV also significantly expands the search area to include locations that divers cannot reach.

Any seashells that ScubaCom has for sale on the website will show the fisherman's license number, processors license number, export exemption details, where the shell was caught, identification photo and data base number, and other information. All of these details are available on a database, which the South Australian Fisheries Department can fully access. Also, a certificate will be issued with details, photos, and unique number. This certificate ensures all shells purchased have been collected under strict environmental management.

REMOTE ADVANCES: OPERATIONAL ADVANTAGES

A joint operation between Sonardyne and Subsea 7 has helped to de-risk technology adoption on BP's Mad Dog Phase 2 development by allowing 24-hour remote access to offshore survey systems for onshore staff, de-risking the use of new technology, reducing project overheads, and paving the way for new ways of working in the future



Real-time SLAM in Fusion 2 saves offshore project time. Screen shot from Fusion 2 Image: Sonardyne.

There's more desire than ever to be smarter and more efficient, to reduce vessel days, improve safety performance and lessen environmental footprints – all without losing performance, accuracy, reliability or down time.

Sonardyne has been working with Subsea 7 on reducing hardware requirements and vessel time in survey operations, including through the adoption of sparse Long BaseLine (LBL) navigation.

The latest step-change has been through the roll-out of Sonardyne's Fusion 2 (*UT2, Spring 2019*) software, alongside the adaptation of new embedded calibration routines. By combining inertial navigation (INS) and LBL into a single system, Fusion 2 took away much of the interface complexity that had been involved in sparse LBL operations (using separate INS and LBL systems), reduced hardware overheads, and enabled whole work flows to be removed, through the ability to perform real-time simultaneous location and mapping (SLAM) calibration of sparse arrays without any need for post-processing.

Between August and November 2019, for example, Sonardyne's Fusion 2 real-time SLAM capability for sparse LBL saved more than 10 vessel days across five separate deep water (1000-1500m) projects in the US Gulf of Mexico.

During recent construction operations, at BP's Mad Dog Phase 2 development, in the deep water Gulf of Mexico, mobilising Fusion 2 trained surveyors to the right place at the right time was becoming a challenge, due to the global travel and working restrictions imposed by the coronavirus pandemic.

To ensure continuity of operations across multiple vessels and offshore campaigns, Sonardyne's Zoom-based remote training was utilised to convert Fusion 1 trained surveyors to Fusion 2, which can be done in just one day or tailored to requirements.

In a first for both companies, Sonardyne then supplied its new Remote Operations Access Module (ROAM) giving its survey experts

24-hour remote access to Subsea 7's onboard Sonardyne systems.

ROAM provides an interface between the vessel's Fusion 2 systems and communications systems (***ie,*** satellite or 4G) so that a Sonardyne surveyor can securely dial in, using a secure Virtual Network Computing (VNC) connection to support operations as if he or she were onboard.

In this first project using ROAM, Sonardyne Surveyors in the UK were able to update firmware and software and provide a planned 24/7 operational service during SLAM calibration operations.

The combination of remote training and virtual support de-risked the continued adoption of Fusion 2, and Sonardyne's remote service provided the assurance to continue with Fusion 2 and sparse LBL operations, avoiding the need to revert to full LBL and the extra equipment and inefficiencies that would bring.

The ROAM system was supported by Subsea 7 survey personnel based in Aberdeen and Houston who worked to ensure efficient onboard integration.

Simon Waterfield, Survey Group Manager, Sonardyne, says, "The operation involved piles being accurately positioned at four sites in up to 2133m water depth by the ***Island Venture*** offshore construction vessel. Traditional LBL would have required five Compatts at each site, with multiple box-ins. By using Fusion 2, just two Compatt 6+s were needed at each site and only two box-ins in total, hugely reducing Subsea 7's operational overheads – both in terms of hardware and time-on-task. Further projects have since been run onboard another Subsea 7 vessel, ***Harvey Intervention***."

Edward Moller, Global Business Manager at Sonardyne, says remote operations support like this is an inevitable transition; it's just that Coronavirus has accelerated its adoption. "Remote operations capability has always been part of the Fusion 2 roadmap, driven by our customers looking for ways they can be more efficient, reduce costs and, occasionally, even to mitigate skills shortages," he says. "In fact, we had demonstrated this capability during our Fusion 2 Road Show in 2018, at Lake Conroe in Texas. But, given the environment we found ourselves in this year, it's now become a real enabler."

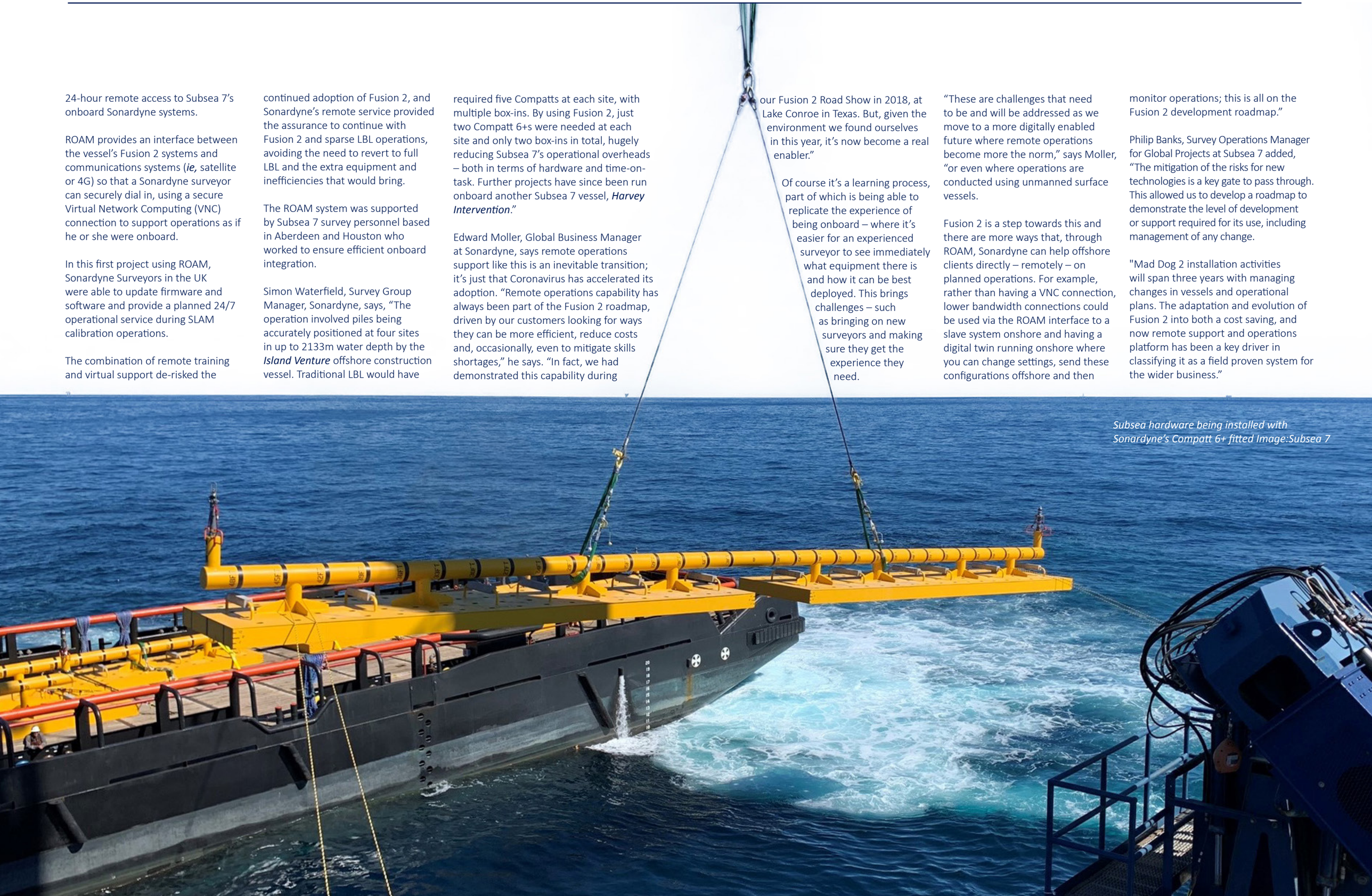
Of course it's a learning process, part of which is being able to replicate the experience of being onboard – where it's easier for an experienced surveyor to see immediately what equipment there is and how it can be best deployed. This brings challenges – such as bringing on new surveyors and making sure they get the experience they need.

"These are challenges that need to be and will be addressed as we move to a more digitally enabled future where remote operations become more the norm," says Moller, "or even where operations are conducted using unmanned surface vessels.

Fusion 2 is a step towards this and there are more ways that, through ROAM, Sonardyne can help offshore clients directly – remotely – on planned operations. For example, rather than having a VNC connection, lower bandwidth connections could be used via the ROAM interface to a slave system onshore and having a digital twin running onshore where you can change settings, send these configurations offshore and then monitor operations; this is all on the Fusion 2 development roadmap."

Philip Banks, Survey Operations Manager for Global Projects at Subsea 7 added, "The mitigation of the risks for new technologies is a key gate to pass through. This allowed us to develop a roadmap to demonstrate the level of development or support required for its use, including management of any change.

"Mad Dog 2 installation activities will span three years with managing changes in vessels and operational plans. The adaptation and evolution of Fusion 2 into both a cost saving, and now remote support and operations platform has been a key driver in classifying it as a field proven system for the wider business."



Subsea hardware being installed with Sonardyne's Compatt 6+ fitted Image:Subsea 7

PILING NOISE REDUCTION

Offshore piling has been a feature of substructure installation since the early days of fixed oil and gas platforms. Designed to resist wave forces and ensure stability, these are no less relevant to offshore wind turbines, wind farm substations and converter platforms.

Conventionally, the piles have been placed in guides and hammered into the seabed using powerful hydraulic hammers. The downside of this percussive technique is that it produces significant amounts of noise. This has been of increasing concern to regulators.

Research has shown that marine mammals fish and invertebrate species may be affected deleteriously by the exposure to such noise This includes concerns about direct hearing damage in animals (temporary or permanent).Inquisitive animals can move towards the noise source or alternatively, flee from it. Either way, the noise can disrupt feeding or hunting routines potentially impacting on growth.

The sounds can also mask underwater communication. Disruption to communication and navigation signals can affect migratory patterns and possibly influence population growth rates. All of these issues can cause stress to marine life, and with difficulties gathering data, the long-term impact is unknown.

This has prompted governments to impose legislation and companies to develop systems aimed at reducing the sound of emitted noise.

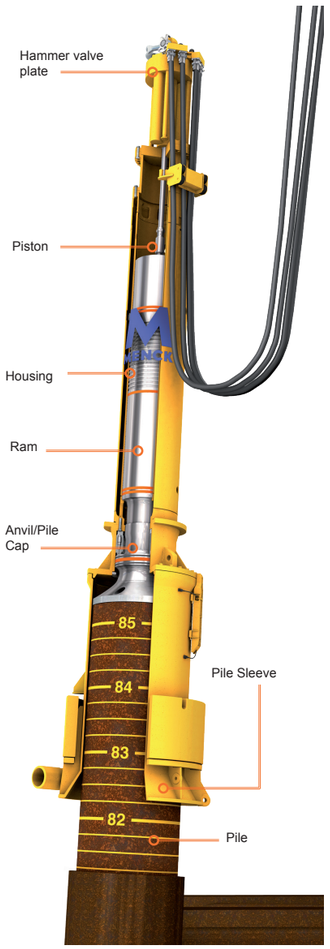
Systems that target the actual reduction of noise before it is being generated are referred to ‘active’ noise abatement systems. Reducing noise ***after*** it has been generated are referred to as passive noise abatement systems.

ACTIVE SYSTEMS

HAMMER PILING

The traditional method of driving steel plies into the seabed, particularly for stiffer, harder soil types has been to use repeated percussive impacts using a hydraulic hammer.

These devices are based on a cylinder containing a large metal ram. This strikes the internal anvil which in turn, pushes on the top of the pile cap, driving the pile beneath into the ground. Water is evacuated from the inside of the hammer to minimise resistance to the falling ram.



Section through a pile hammer
Image: MENCK

The hammer may be single or double action. In single action, the ram is lifted and left to strike the anvil under gravity. Impacting at low velocity allows large amounts of energy to be transferred into the pile, thereby reducing impact and damage to the butt or head of the pile.

This system, however, is impracticable when used underwater, prompting the development of the double-action hammer. In this, the ram is also drawn up by hydraulic pressure.

At a preset point, the valves are switched to put pressure above the piston. This forces the ram downward at an acceleration of only 1–2g.

While the blows are lighter using the double-action hammer, they are more rapid and with force behind it can produce a greater impact than its single-action counterpart. It is used to drive lightweight or average weight piles into soils of average density.

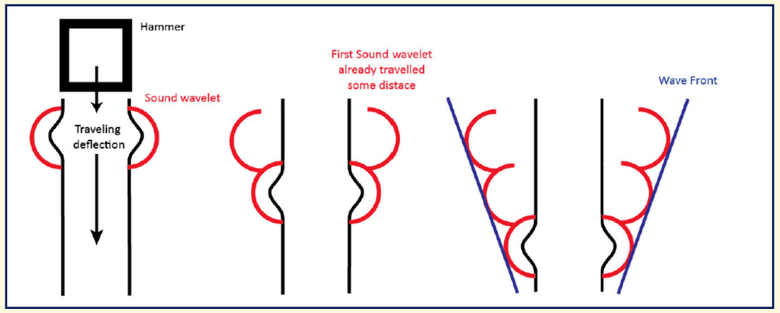
The rapid blows also tend to keep the pile in motion, thereby reducing the resistance of inertia and friction. A cushioned pile cap is used for driving concrete piles.

Important factors controlling impact hammers are blow count, hammer energy, blow rate, pile stresses, soil resistance, driving time and total number of blows.

Deepwater (up to 2000m) equivalents use water instead of oil. This means that it is not necessary to return the liquid medium back to surface.

Water hammers are aimed at applications such as driving pipeline initiation piles, PLEM foundation piles and subsea template foundation piles, as well is piles for jackets, conductors and mooring systems for floating Production systems.

WHEN YOU'RE PILING



What happens after the anvil hits the pile and creates a shock wave.

Heerema explains.

A local expansion of the pile surface produces lateral vibrations, which are transmitted into the water volume around the pile. It is this vibration that is propagating through the sea over a large distance that is potentially harmful to marine life.

A second wave effect takes place as the pile is penetrating into the seabed and produces vibrations that are being re-transmitted into the water volume around the place where the pile is driven.

This seabed-borne sound can enter the water at various distances from the pile, being the effect of reflections on deeper sediment layers in the seafloor.

This is believed to propagate less far, as the transmission of vibrations from pile to seafloor, reflecting on a sediment layer and being transmitted back through the seabed into the water absorbs part of the energy.

But it is sound that is propagated ahead of the direct shock wave depicted below, as sound travels easier through sediment than through water.

MENCK

Piling operator MENCK first looked at noise mitigation systems before 2006 and has carried out considerable activity understanding and appreciating aspects of the noise reduction challenge.

A result was the MENCK Noise Reduction Unit (MNRU) – an add-on to the actual hammer. This reduces the noise for a given hammer by up to 9 – 12dB while the fatigue induced into the pile is also reduced significantly.

The company has also carried out structural improvements of its piling hammer to reduce the noise characteristic.

The first MENCK MHU 3500S monopile hammers for large diameters up to 6.5m have been superceded by a second generation design that actively reduces the noise by 3 – 5dB due to the design of structural components.

Menck has also introduced an even larger hammer to the market, the MHU 4400S. This has recently been built and commissioned, and is currently being transported to Taiwan to support wind developments in the region.

On the digital front, Menck has introduced a suite of sensor technologies that allow for improved and extended monitoring and control functionality, ie, introducing automated penetration monitoring, horizontality monitoring etc.

"The technology roadmap at MENCK entails a number of other initiatives and improvements which over time will complement the known hammer technology and make the step-by-step environmentally 'greener' while maintaining and improving operational capability and versatility," said Fabian Hippe.

IHC HYTEC

PULSE, a new concept developed by IHC IQIP can be connected to a standard hammer, positioned between piling hammer and sleeve. It is used to dampen the impact and noise by using a pair of hydraulic plungers.

In 2019, IHC IQIP started testing a small prototype with S-90 Hydrohammer at its testing facility in The Netherlands. Early summer this year, the company will begin testing PULSE on an actual offshore wind project in the North Sea.

During traditional piling operations, the impact of the ram weight on the anvil generates a very high and short impact. It is this that produces the characteristic noise.

PULSE essentially reduces noise at the source by elongating the impact of the hammer through an cushion of fluid, typically water.

A key feature, however, is that this amount of fluid between the plungers can be adjusted when the hammer is on the pile, altering the system's stiffness.

Comparable systems, however, are not adjustable, meaning that the stiffness must be decided upfront, and, because of the required safety margins on soil information, the decision is likely to be on the conservative side, strongly decreasing the noise reduction.

Pilse system. Image: IHC IQIP

With PULSE, we are not limited by this, but are always able to achieve the maximum performance on noise reduction any existing hammer line-up.

The fact that the fluid layer can be adjusted, also means that if the system should fail, it is possible to drain all water so that the plungers are on top of each other, providing the function of a conventional hammer again. In that way, it is a secure system.

Used on its own with no further noise mitigating measures, calculations and tests prove that PULSE can reduce the SEL of conventional hammers with 6-9dB and the SPL with 9-12dB in the right circumstances.

Furthermore, the reductions will improve exponentially when the size of the hammer grows.

PULSE also uses significantly less energy than bubble curtains and eliminates the need for an extra CO2 emitting vessel. Further adding to its overall cost- and energy-efficiency is its potential to significantly reduce pile fatigue.

When installing a pile with conventional hammers, fatigue damage is induced in the pile. With PULSE, fatigue damage in the pile can be reduced by up to 60 percent.

This could potentially lead to a longer lifespan of the offshore monopile and ultimately to a reduction to the costs of offshore wind energy.

The dampened impact of the strike also reduces the risk of damaging secondary steel if and when installing complete monopiles with transition pieces.

Vibrohammer
Image: CAPE Holland

VIBRO-PILING

Instead of a hammer impacting with the pile using a series of high-energy percussions, an alternative is to use vibrohammers.

The technique is particularly applicable to granular non-cohesive soils. The vibration allows them to penetrate sand while combining this with an eccentric moment, improves penetration in clays. They are used to drive piles with diameters of 4-6m up to 22m.
The driving is governed by penetration speed, power, pile stresses, soil resistances, driving time and total number of stress cycles.

Simply placing the hammer on the top of the pile to vibrate, often leads to early refusal. The installation technique requires vibration and acceleration. Instead, the hammer is run, lifted to gain acceleration and run again.

The advantages of vibrohammers are the low stress levels, the reduced installation times in sandy soils and low peak noise.

Cape Holland has improved operational efficiency by developing hybrid vibrating lifting tool. The same tool that lifts the pile into place is used to drive it.

When approaching a horizontal pile on deck, the tool, held by a crane, can swing too 90deg so that it fully aligns with the top of the pile. Jaws then clamp onto the pipe walls.

The crane then freely lifts the pile/tool, while at the other end, the base of the pile is held in an upending frame allowing the assembly to swinging the vertical while under control.

Once the lower pile is release by the upending frame, the assembly can be lifted into place on the seabed. The locking cylinders that are needed to grip the pile are deactivated, and the load is transferred to the isolating rubber dampers.

The pile may self penetrate with the load often taken back into the crane before the vibration system is engaged. As the pile sinks into the seabed with the vibration, inclination is carefully measured. If misalignment occurs, the pile an be extracted and reinserted.

The tools can be used singly, or in pairs for larger piles, the need for more power or use in different soil strengths.

SUCTION ANCHORS

A very well understood technique, often used to secure moorings specially in deep waters, these consist of a column open at the base.

When placed on the seabed, water is ejected out from ports at the top of the column, causing a vacuum inside and making the pile sink into the seabed. The vacuum keeps the pile firmly in place, resisting movement.

At the end of the field life, water or air can be introduced into the top of the column, breaking the seal and allowing the pile to be released.

Suction anchor on wind jacket

PUSH PILES

Instead of the traditional single open tubular pile being hammered into position, Heerema has developed a novel design in which the open pile is gradually ***pushed*** into the seabed. This results in a far lower impact with a consequent reduction in noise.

In a conventional pile-hammering operation, very large amounts of energy are suddenly imparted into the pile, but for only a brief time measured in fractions of a second. The challenge with pushing a pile into the soil is that it has to generate the same high penetrative forces but for a considerably longer time than a hammer blow.

Similarly, in conventional piling, soon as the anvil strikes the top of the pile, laws of motion result in the pile moving downwards and the hammer moving upwards in an equal and opposite direction. The same laws govern push piling. Pushing downwards requires something equally resistive to push against. Heerema solved this problem in two main ingenious ways.

Instead of a large singe pile, the company has envisaged a system with four much thinner piles arranged in a quad. Cumulatively, pushing all four might require the same force as a single larger diameter pile, but sequentially pushing each individual smaller pile within the cluster requires less force for each action but taking four times as long.

Push piles

The fundamental part of this design is that if one pile is being pushed downwards, the other three act as an anchor, providing the static resistance for the pile to push against.

The piling operation that Heerema has developed consists of two components.

The first involves assembling the four thinner piles into a cluster. A 4-slot frame is placed over the side of the installation vessel. In preparation, piles are taken from the storage area or straight from a barge and sequentially inserted vertically into this frame. These piles are held in place by upper and lower grippers contained within the frame.

Meanwhile, nearby on deck, lies the second part- the driving tool. The active component is an hydraulic jacking module with the capacity of 3000t. At the top of this is a cradle, while underneath is a pile gripper, similar to those conventionally used to lift piles.

Push piles

Push piles inserted into jacket

Four of the jack/pile gripper assemblies are attached to a horizontal cruciform frame, one on each arm, suspended from the upper cradle. Their location along each arm depends on the eventual required pile spacings.

The unit is picked up by a crane and placed over the prepared piles hanging in the frame, the tool's pile grippers sliding into their corresponding tubulars.

Once the pile grippers are engaged, those on the storage frame are released, thus allowing the tool/ pile assembly to be lifted free and lowered into the water.

With the aid of a nearby ROV, the base the piles are located into the custom-made skirt pile housing that forms part of the jacket.

Once in position, the tool's hydraulic jacks are sequentially activated. The first pile is pushed against the remaining three, downwards into the seabed. After all four cylinders are engaged and fully extended, the pressure is released, the body sinks downwards, and process starts again sequentially re-engaging the cylinders.

.

By this method, the piles are slowly pushed to completion. Once at the, correct depth, or fall grippers are released, and the driving tool can be returned to surface.

HELICAL PILES

A second driving technology that Heerema has developed a novel helical pile. These purpose designed piles consist of a to parts. On the top is a normal open pile while the lower component is a much thinner pile with a helical blade at its base.
These are lowered downwards into a shoe at the base of the piles shoe.

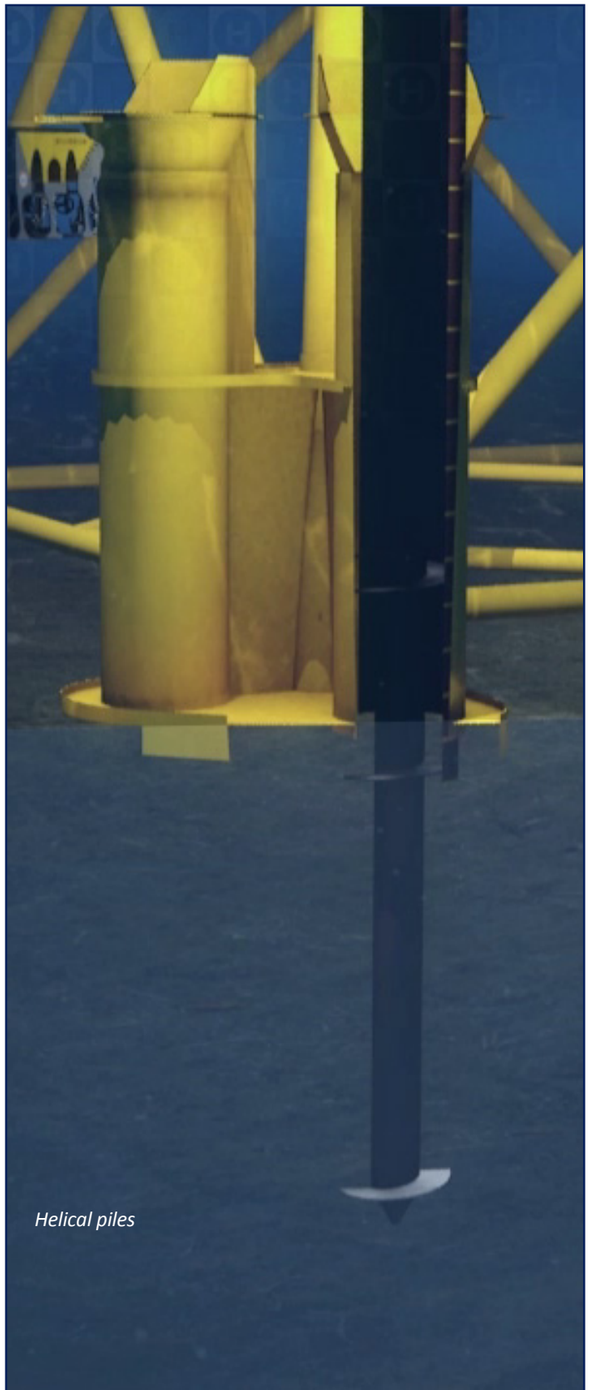
The working principle behind the helical pile is that if the body is rotated, the blade at the base will 'screw' into the seabed. The immediate problem, therefore, is providing torque to the top of the frame. If one part of the torque device applies the rotation, another part must be static for the rotary component to move against.

This is enabled by a frame connected to the installation vessel, that is swung over the top of the pile. This frame contains the hydraulic torque tool device that grips the top of the pile Once it engages, it can impart up to rotary pressure.

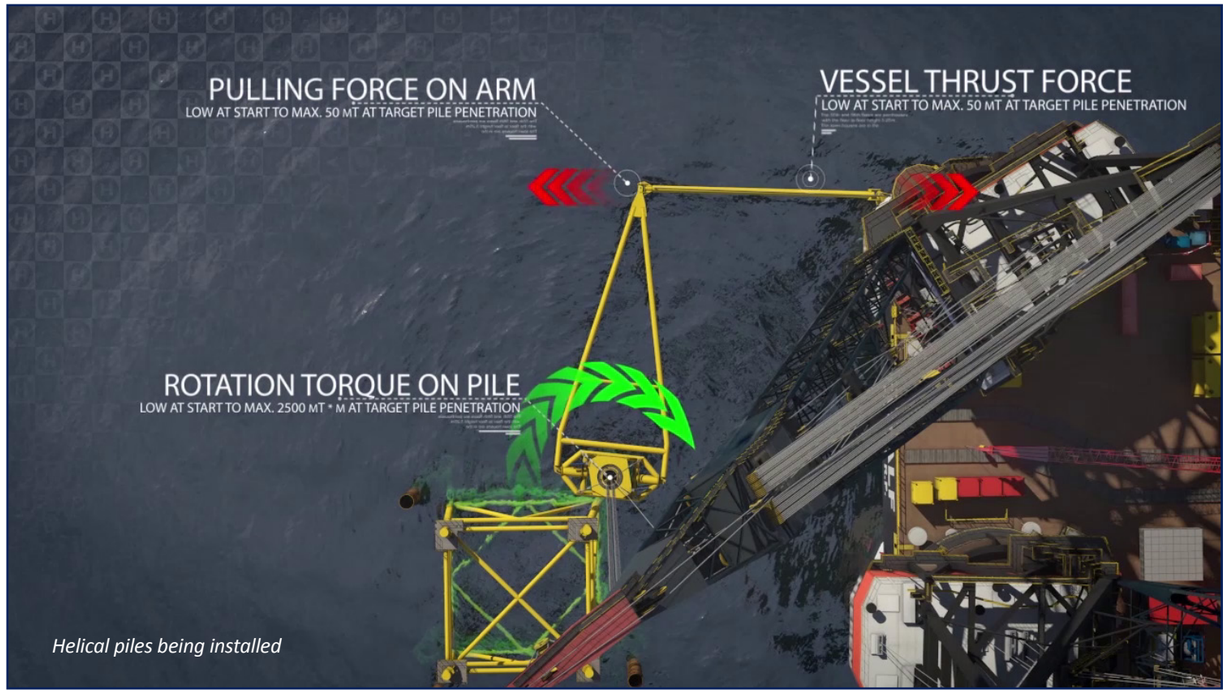
Meanwhile the helical blade on the lower pile enters the seabed in the same way that rotating screw drives downwards, and pulling the main pile downwards with it.

A second helix allows soil from the seabed to move upwards, entering the upper pile

Once this process is completed the installation vessel will move over to the other piles.



Helical piles



Helical piles being installed

UNIVERSITY

The University of Dundee's School of Science and Engineering is carrying out a six-month testing and modelling program. The researchers involved have considerable experience developing helical piles in previous research projects in collaboration with Durham University and the University of Southampton.

This program includes physically testing the piles using 3D-printed steel models in a geo-centrifuge, a device that simulates realistic soil stresses and installation conditions to match full-scale behaviour using small models (1 to 100th scale).

In the centrifuge, the installation requirements (forces and torques) and the installed capacity of the piles and pile clusters can be tested and measured directly.

These tests complement the University of Dundee's ongoing research using discrete element method (DEM) modeling for varying soil conditions and pile designs.

By using this method, a complete evaluation of the installation process and in-place performance can be analyzed using a range of variables.

Their process replaces the millions of soil particles the pile would contact with on the seabed with larger balls with the same behavior as sand particles. Using this approach of combining physical and numerical modeling helps with rapid development in a controlled environment where many impacts on pile behavior can be assessed.

Their testing program will reduce development costs when we move to full-scale tooling development and helps to de-risk future use of these low noise and sustainable foundation concepts.

PASSIVE SYSTEMS

PASSIVE NOISE ABATEMENT
One way of reducing piling noise is to shield the impact source with a lower density gaseous layer to absorb energy from the sound.

One way of preventing the bubbles from leaking was to fit a rigid sleeve fitted around the pile Heerema did this is 2011. Air was then introduced at the surface from the installation vessel. Once bubbles appeared at the base to show the until bubbles come out of the leg, to show the leg was full of air, piling could commence.

Teflon mounted centralisers ensured that vibrations in the pile were not transferred to the leg.

Studies showed a reduction of 6 to 10 dB or of up to 8 times in acoustic energy absorbed by introducing the air layer.

IHC built on this idea with its this idea with its Noise Mitigation System NMS design- a contained barrier and an isolated bubble screen. The isolated barrier has an inner and outer screen The gap the between the inner barrier and the pile contains the bubble

Van Oord's heavy lift vessel Svanen successfully installed the final foundation for the Danish Kriegers Flak Offshore Wind farm in the Baltic Sea. A total of 72 monopiles were transported floating from Rostock, Germany, directly to the offshore site. The transition pieces were transported on barges from Aalborg, Denmark.

Vattenfall awarded the transport and installation of the foundations for Kriegers Flak Offshore Wind farm to Van Oord.

To reduce the underwater noise a 'double big bubble curtain' was used during pile driving.

Bubble curtain Image: Heerema

screen. Meanwhile, the gap between the inner and outer screen is filled with air.
The company claims 360deg noise coverage during piling and up to 100% of water-borne noise. At frequencies of 10kHz, noise reduction can be up to 45dB.

BUBBLE CURTAINS
The original air filled jacket idea gave rise to the bubble curtain, a technique still commonly used.

In this, a circular tube,is placed horizontally on the seabed and wound around the entire structure one or more times. Accurately laying this pipe in a circular or elliptical/pear shape requires a vessel with a winch with brakes.

Along the pipe are a series of closely spaced holes or nozzles. Elliptical-shaped nozzles pipe promote bubble drift.

The bubble curtain forms when which air is pumped from an air supply (usually from compressors located on the vessel) in suitable volumes.

Typical values are a flow of 400 ft3/min under a pressure of 75psi air pressure. There also needs to be a device to regulate the bubble size. All things being equal, the technique is more expensive in greater water depths and currents. Operating at greater depth requires an increased air volume stream (and thus more compressors).

The principle behind these type of noise reduction mechanisms is that they depend on the frequency of the hammer's radiated sound as it passes through the water. When the acoustic pressure wave meets an air bubble,

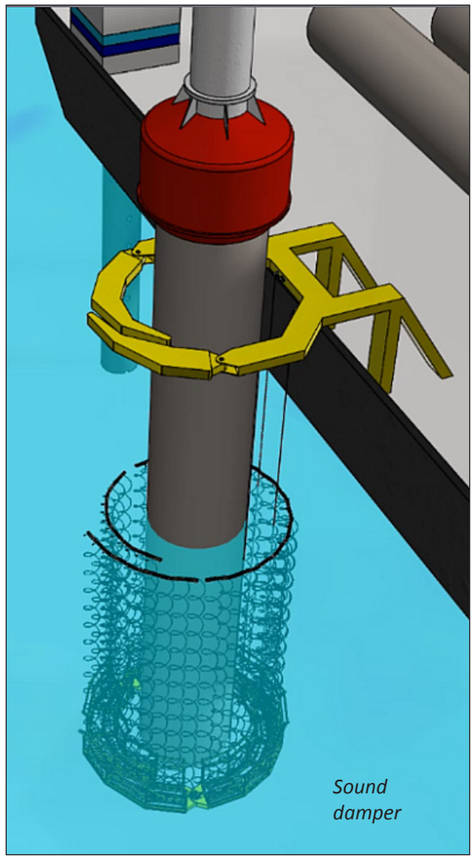
it creates an impedance mismatch. The bubble curtain acts as a reflector, scattering the sound by wave reflections. At higher frequencies, resonating bubbles absorb acoustic energy.

As the bubbles rise through the water column, the increasingly lower pressures imposed on the bubbles cause the gas to expand. Eventually, the bubbles to split.

A single curtain is capable of reducing noise levels with approximately 6-10 dB while 'double bubble curtain', which can cut noise levels by nearer 15 dB."

It is important ti fully contain the bubbles in the curtain, however tidal currents however, may cause the bubble curtain to leak.

HYDRO SOUND DAMPER



Sound damper

One alternative to bubble curtains is the Hydro Sound Damper (HSD).

It is based on enclosing the pile in nets with air filled elastic balloons and special PE-foam elements. These have high dissipative effects to reduce continuous and impact noise.

"During a driven pile operation, the short impact pulse of the hydraulic hammer induces an impact wave in the pile," said Peter Elmer, Project coordinator OffNoise-HSD-Systems.

"Most of the energy is directed downwards into the seabed, however, these travelling waves induce sound waves in the surrounding water. This radiated underwater noise propagates at the speed of sound of water, typically 1500m/s into all directions. In shallow water, it can be reflected off the free water surface and at the sea bed.

"The highest spectral levels of the measured underwater ram noise at the hammer is in the frequency range around 80 to 200 Hz depending on the hammer type.

"Using a stream of unconstrained air bubbles can inhibit or dilute sound passing however, these are affected by leakage through the bubble curtain resulting from bubble drift with tidal currents Air bubbles are good at attenuating sounds in higher frequencies above 1KHz but not so good at lower frequency

Piling with the sound damper installed

sounds emitted by the piling. This is because the large air bubbles (several cm) that have lower resonant frequencies, show chaotic movements when they are slowly arising to the surface of the water and often dividing themselves. Therefore air bubble curtains are used as so called far field noise mitigation systems.

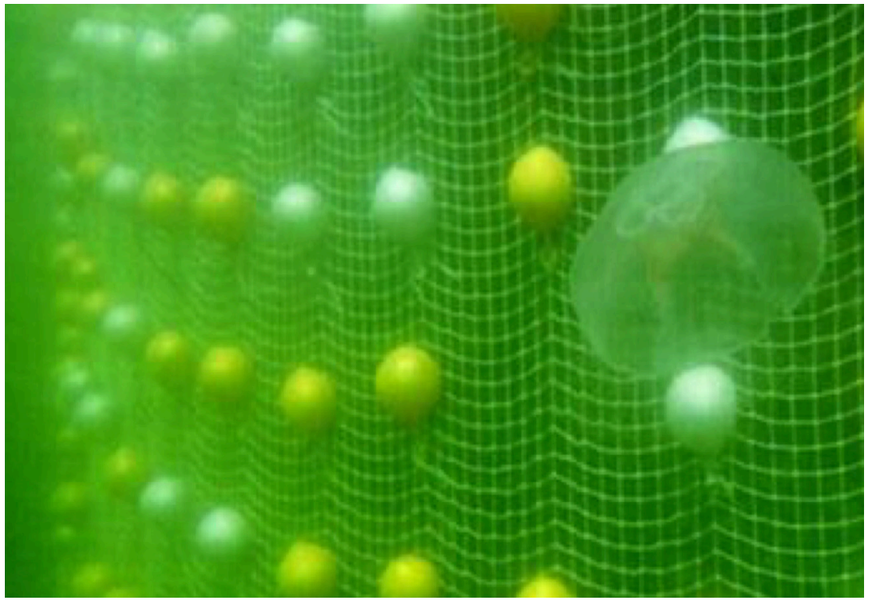
Other features of air bubble curtains are that they can be very expensive at great water depths and high currents because of the installation cost of air pipes on the ground, the demand for access to a compressed air supply and the need to control of the bubble size.

This prompted OffNoise Solutions to develop hydro sound dampers (HSD). In this, the free air is effectively replaced by gas filled envelope bodies and PE-foam elements.

Unlike the bubbles, the size of the bodies, the effective frequency range, the damping rate, the number and distribution of the hydro sound dampers (HSD) and the influence from hydrostatic pressure can be fully controlled.

For easy positioning, these floating bodies surround the pile by fixing them to some nets held in a deployment frames. This makes them immune to influence by tidal currents and are easily adaptable to different applications. HSD-systems are used for near field noise mitigation around the pile to reduce the source of noise directly.

By changing the distribution of the



First ever prototype application of a HSD-Net

elements, it is possible to optimise the frequency range of the entire system.

A typical arrangement is to house the HSD-net in a basket, hanging below the gripper or below the piling frame.
When the basket is lowered towards the sea ground and the lower end of the net is fixed to the basket bottom, the net around the pile is swimming up according to the buoyancy of the net, covering the whole wet surface of the pile.

"There are three different physical reasons for effective underwater noise attenuation," said Elmer. Firstly, the resonant effects of the small elements reduce underwater sound in a wide frequency are possibly, more as it is known from small air bubbles in water. But the resonance frequencies of these locally fixed HSD-elements are controllable. They are depending on the size, the gas pressure inside, the water depth and the stiffness of the envelope materials.

The second are the dissipation and material damping effects according to the material of the HSD-elements. Maximum damping is obtained near the resonance frequencies of a damped element.

Lastly, HSD-elements, like air bubbles in water, increase the compressibility of the mixed water-body, decrease the bulk modulus of the mixture and decrease the sound speed and the specific impedance of the mixture very much. Reflections of sound waves result in noise reductions between 5dB and 15dB. Measured results of underwater noise reductions between 10dB and more than 20dB.

Since the system was deployed and the results analysed on the London Array and Amrumbank West wind farms in 2012-14, the system has been working around the globe.

The most recent application has been the Yunlin Wind farm in Taiwan and the North Sea Borssele 1&2 wind farm in 2020. It was used together with a far field bubble curtain on Amrumbank West, Trianel Windpark Borkum II, Sandbank and the Deutsche Bucht wind farms also in the North Sea with noise mitigation of 20 – 28 dB.

In all applications all noise restrictions of 160 dB(SEL), measured at 750m, are fulfilled.

HSD Net suspended prior to deployment

FRIGG TCP1 1976

Understood to be the first UK-built concrete gravity platform, the two towers dominate the Ardyne Point yard. Work on Cormorant and Brent C were also being built.

It was later taken to the 'Deep Hole' at Loch Fyne for the mating with the deck frame that was being sailed from the Dunkirk yard of UIE at about the same time that this photo was taken.

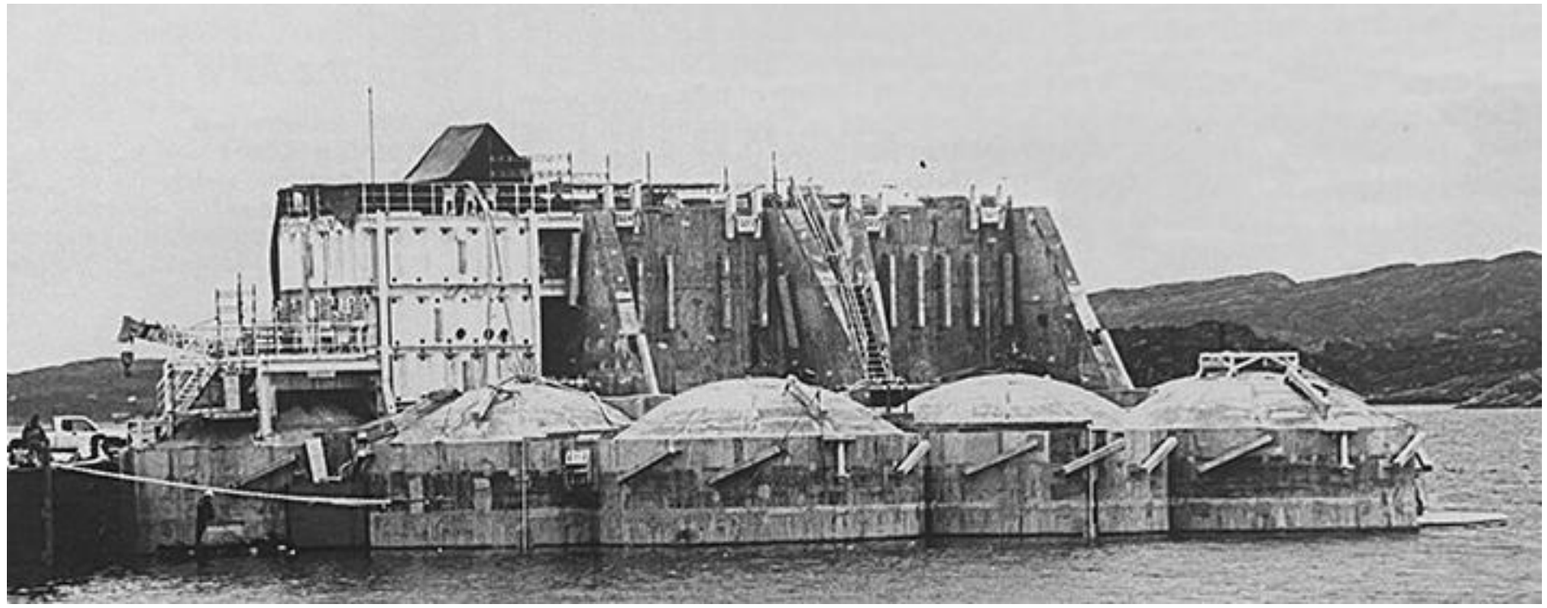
HEIDRUN FOUNDATIONS 1994

Conoco's novel concrete TLP on the Heidrun field was secured to the seabed by 4 concrete foundation templates.
These foundations had 19 cells and weighed 21,000t.

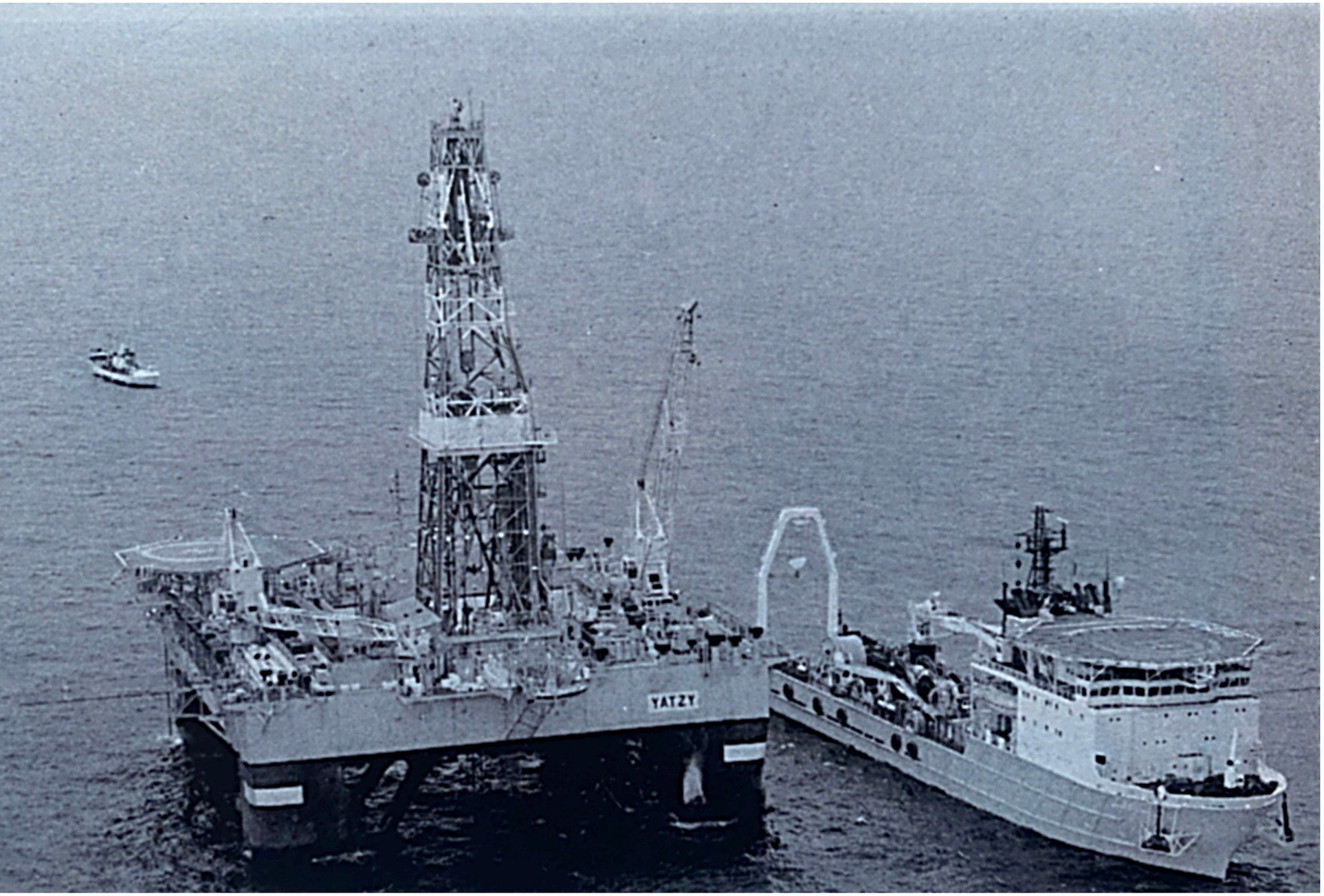
They were subcontracted from Kvaerner Concrete Construction to a joint venture of NCC and Egg-Henriksen Anlegg

Great to see, It was Marin's EVO 250,000 excavator that did all the site preperation & template clearences. Still the largest, most powerful hydrodynamoc mass flow excavator ever built.

Love to see this. Remember Taylor Woodrow designs and GBS tenders. Condeep scheme most selected design. Norway's fiords sites helped. Also McAlpines and Howard Doris designs successfully built



CRAWFORD DECOMMISSIONING



The abandonment of Hamilton's Crawford field was carried out by Stena Offshore and Stena Drilling. 7km of flow lines and control umbilicals were recovered from the 5-well development.

It originally came onstream in 1989, but technical difficulties put an end to operations in December 1990, after the field had produced 3.9 MMbbl of oil.

The photo shows two dynamically positioned vessels, the 112m diving support vessel Stena Constructor and the Yatzy. The time bonuses of both having DP capability were said to be significant.

Jeez! It was only a couple of short years earlier that we helped develop this lot with KD Marine (BUE) It certainly didn't last long, this Hamilton Bros. field

I recall the rig Deepsea Pioneer being around about too. Kd's were working off the Stephaniturm prior to BUE's British Argyll being commissioned.

Do you remember when she caught fire ? I remenber working onboard in 2010 in Brazil

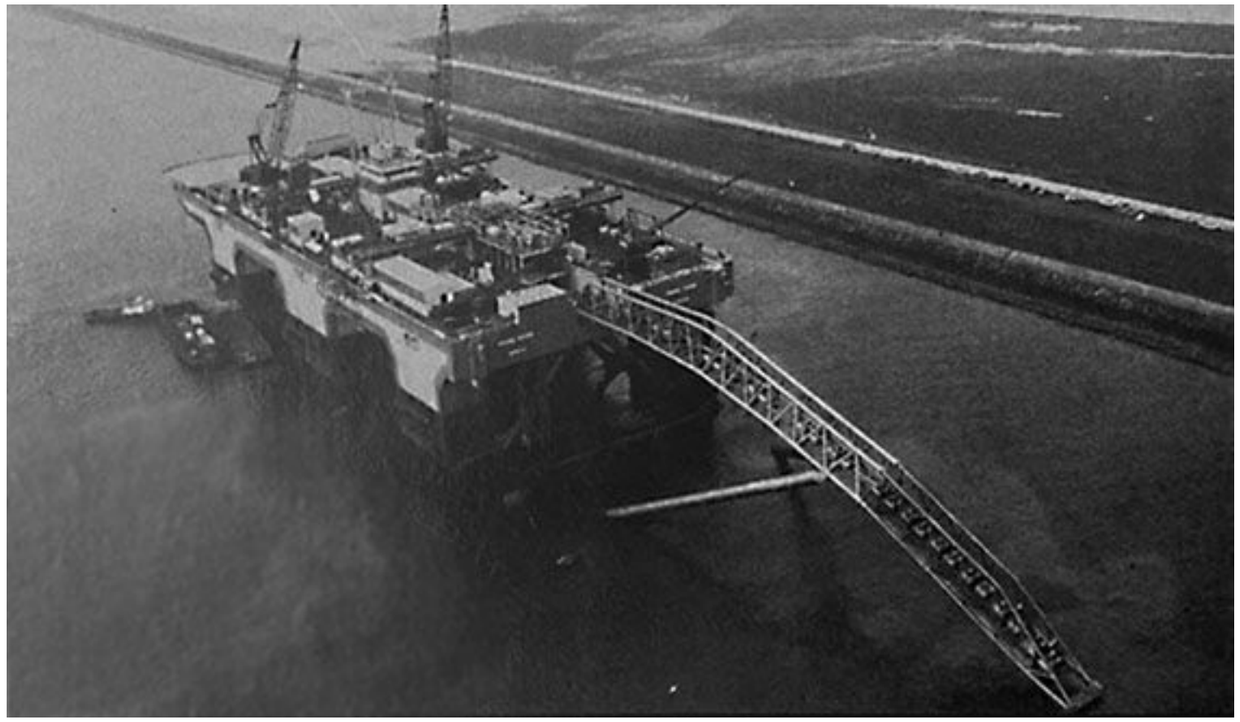
I recall the rig Deepsea Pioneer being around about too. Kd's were working off the Stephaniturm prior to BUE's British Argyll being commissioned.

My first hitch on the ROV Industry on board The Stena Constructor, working on the Super Scorpio # 1 and RCV-225. At that time we had an Ametek technician, exclusive for the vehicle maintenance. Good times. 1987.

Between 1991 and 1994 I made numerous embarks during the Diving and ROV operations at DSV Stena Construtor, at this time I also worked with the ROV Scorpio Cobra that was mobilized and operating at Semi Sub Yatzi in contracts with Petrobrás here in Brazil, Yatzi was a comfortable platform at that time it was operated by the company Arethuza Zappata and was known with the prefix SS 37. At that time the DSV Construtor already belonged to JV Coflexip Stena Offshore, which is now the giant FMC Technip, good old times.

DEEP CONSTRUCTOR

VIKING PIPER 1977



This sophisticated 167.5m long semisubmersible was designed and built by IHC Gusto and owned at the time by Viking Jersey Equipment. It was not self-propelled but positioned by fourteen 400,000lb anchors using 76mm diameter rope.

It was designed to lay up to 54in pipe and work in wave heights of 4.5m

At the time of the photo, it had carried out work for BP on Ninian and Occidental on Claymore.

When I was with McDermott in the North Sea we chartered it as an accommodation vessel for a platform hook up (forgot which one). A monster storm blew up and set everything adrift except the LB 200 as it was renamed.

I think this photograph is of the vessel at Europort before its actual completion in 1975.
Only two of the Manitowoc gantry cranes appear to be installed at the time of this photograph. Major parts of these cranes were airfreighted to Holland and installed during mobilisation due to late delivery.
RJ Brown & Associates of Scheidam played a major role in the concept and feasibility of the vessel.
The Owners/ Operators were Viking Jersey Equipment during construction, and then Viking Offshore during operation. Viking was a joint venture of three European organisations; Spie Batignoles of France, Fearnly & Egar of Norway and Royal Bank of Scotland UK.
I spent the 70's working with this vessel For Viking Jersey, Viking Offshore, Santa Fe and finally Mc Dermott.

This is of huge lovely memories, especially when you're in charge to crew it with 375 professional Person as LB-200 while performing ZPipe-2, 42" concrete coated pipeline for Statoil, 4000KM from Kristiansund North Norway to Dunkerk North of France!!

Yes, Viking Piper, was on and off her a lot during the McDermott-ETPM pipeline installation Joint Venture between 1990 and 1995. McD's used the LB 200 and ETPM used the DLB 1601. I seem to recall that she was originally built for the deep water lays across the Norwegian Trench but could be wrong.

As a young Engineer, I hiked across this big semi in 1978 to catch a helicopter from Claymore platform to Aberdeen, after riding the SEDCO J from Halifax to North Sea for 36 days on about a 2 knot tow. Thanks for the photo!

We handled their anchors 24/7 and I can tell you a hell of a job.

A great pipelaying lady. She ended her working days and was scrapped in India. I spent many years engineering for this vessel and we squeezed more capability out of her year by year.

I was on the diving team (for Hydrodive) in 1976 or 1977, project for Oxy, hydraulic pipeline tie-ins using large frames that kept leaking and needed to be repaired underwater quite often.
At the time the barge was used for dive support from a sat system on deck and accommodation for the construction and installation crews of Piper A and Claymore A.

I believe this became the Lay Barge 200 in McDermott's fleet.

January 1981
McDermott Incorporated has announced that its wholly owned subsidiary, McDermott International, Inc., has purchased the semisubmersible pipelaying barge Viking Piper from Viking Jersey Equipment Limited, a 75-percent-owned affiliate of Santa Fe International Corporation, for the sum of $85 million.

Was on there many times then it moved to ETPM/Acergy
Her last adventures went under the name of Castoro 7 with Saipem.
Right after the purchase I supported the first major overhaul as the Piper was left idle for a significant amount of time.

The rigid pipe lay stinger above water line is quite the sight. Rigid was seen as risky but lasted ~20 years, some nice engineering there.

4.5mtr seas wow impressive

BALDPATE 1998

Amerada Hess' Baldpate platform was the world's tallest freestanding structure when it was launched, measuring a record breaking 580m. It was installed in 3 sections- a base, main and topsides.

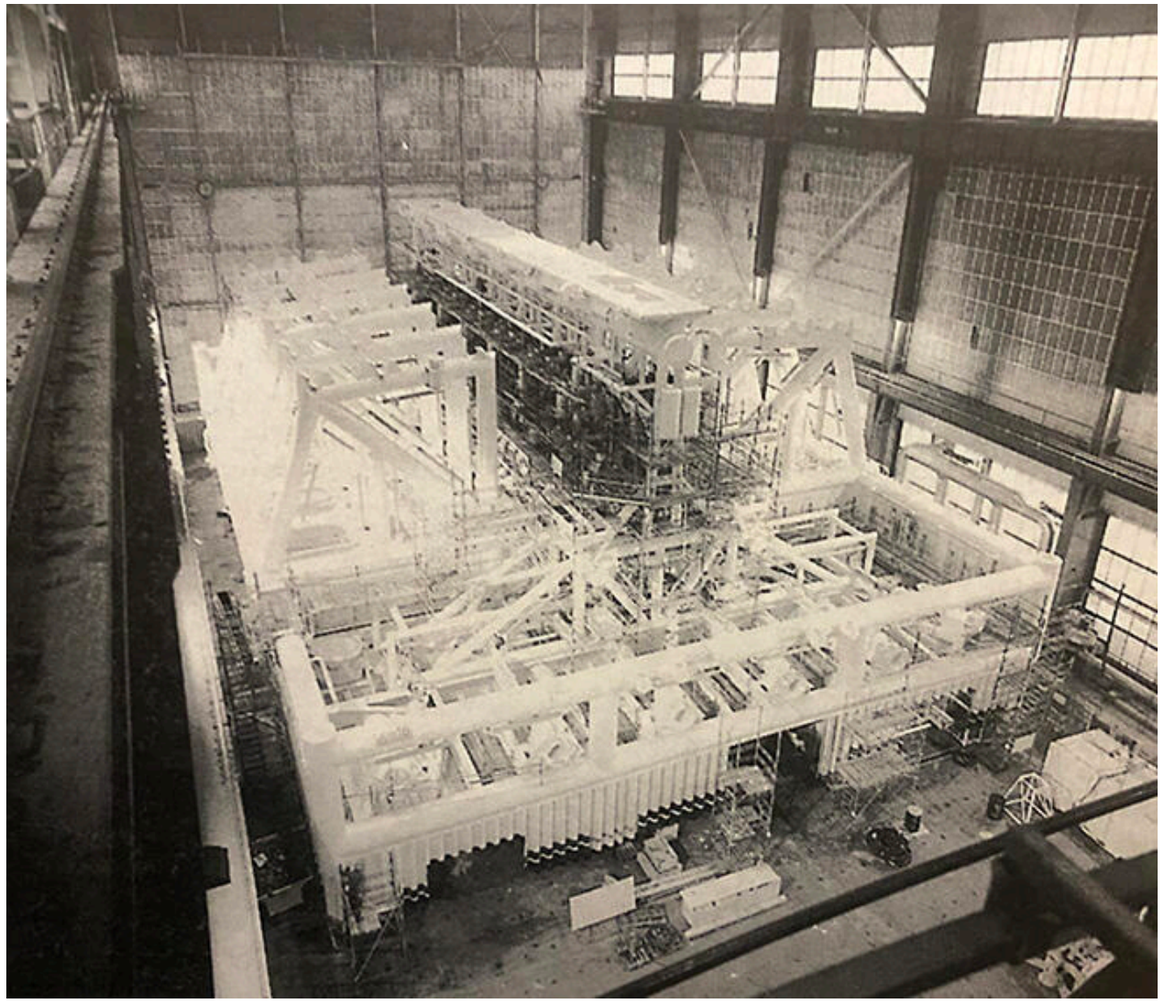
This is the 107m high base section weighing 7900t moving out of the Morgan City yard.

Impressive height of structure. McDermott has developed and implemented some impressive designs.

I worked on that puppy. Hudson Engineering was owned by McDermott. It was a clever design. I believe the top tower section disappeared after launch due to open valves. It was sitting upright on bottom where HMC could reattach and continue with the installation. It was a great recovery.

SNORRE SUBSEA STATION

Saga Petroleum's Snorre subsea station in Kvaerner Rosenberg's new assembly and testing shop



BP BRUCE DRILLING PLATFORM 1996

Phase 1 of the field was originally developed using bridge-linked platforms, a Process / Utilities / Quarters (PUQ) platform and the Drilling (D) platform, were linked by a 47m bridge.

I recall that the Production Module for the BP Bruce was built on Teesside by Redpath, on the south side if I recall (Lin-Din) during the aggressively busy period of Oil and Gas Platform Fabrication Projects where they were coming through the North (Port Clarence) and South Yards like conveyor belts. Looking at pictures like this you wonder how on earth they ever made it under the Transformer Bridge.

yes I also worked on both the Nelson and the Troll, but not the Gannet. The Troll was sadly my last project on either yard as Redpath Offshore decided to do their own Pipework Installation instead of utilising Redpath Engineering Services, who continued to only undertake the E&I.

BP Bruce drilling and production platforms, together with their interconnecting bridge, were installed during summer 1992 by SAIPEM 7000, still named MICOPERI at that time.
Two episodes:
1) During the jacket legs welding to the first topside, on production platform, there was a little fire because one of the plastic sheets, layed around the leg to protect the welders from bad weather, get fire. One of the supply vessels, RN GENOVA, was estinguishing the fire with minor damgages to the platform topside lower deck.
2) During the flare installation one of the two external 30" hydraulic clamps was not opening due a hose leakage/ break: I remember that I was climbing up on the vertical ladder, together with a rigger foreman and 4 riggers, pullng up the new hose to let the clamp open and release the main crane.

Last of the proper hook ups- remember jake and bulldogs brother hit the drink when the scaffold gave way under deck- both made there way to the ladders on the jacket leg and Rasmussen marine dream team Picked them up by the FRC- drill module was sabotaged with traps inside mud lines and ear plugs in the instrument control lines by the yard in Europe.accomadation barge was poly confidence on the first part then we switched- fond memories back in the day.

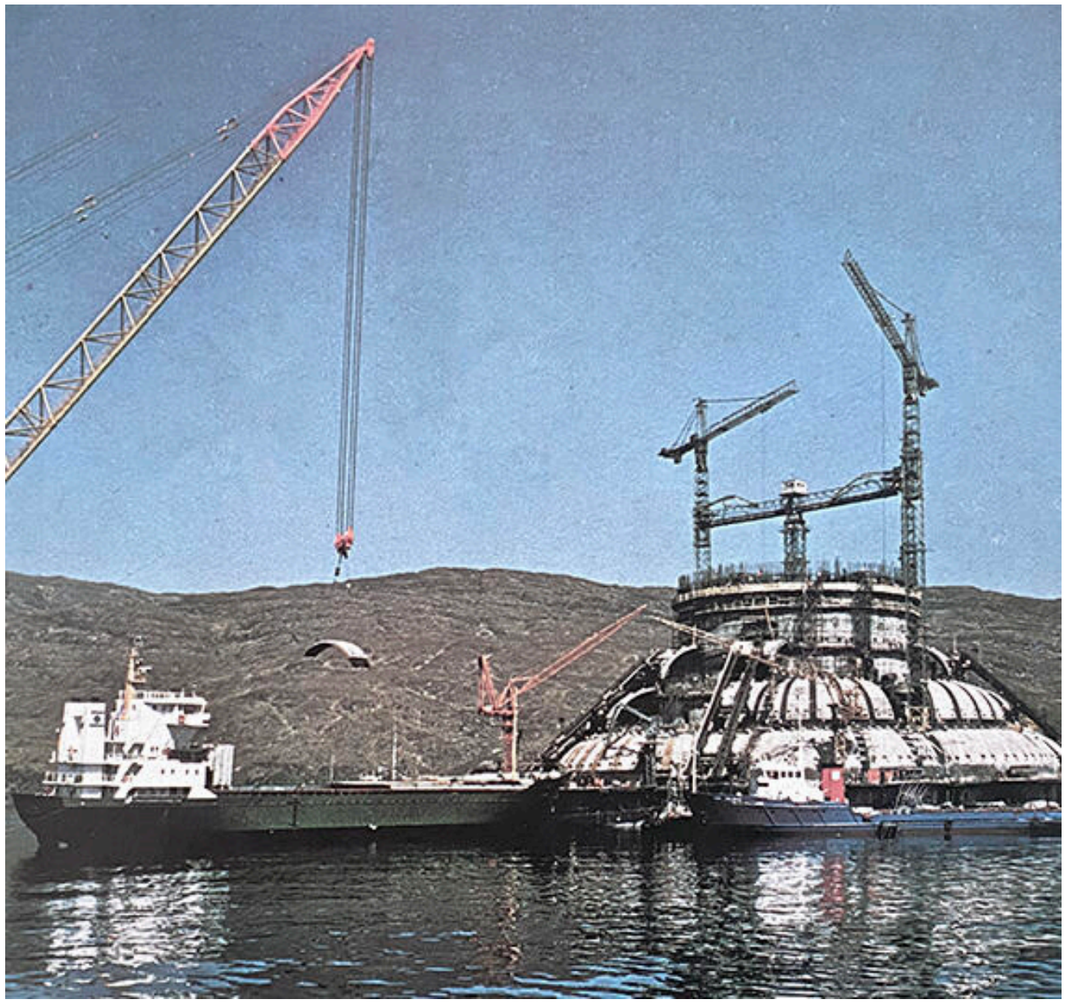
Looks like a picture from the Eiffel Construction yard Fos Sur Mer in 1991 during load on to barge. Great memories of that time with a top team.

VALHALL A 1981

Looks like the Valhall Q (Quarters) platform during construction. Jacket, MSF and 2 modules in place. Module with helideck missing still missing. When comparing with more recent pictures, say after 2000, the air gap has become smaller.

Presume Waiting for Modules I saw in Lowestoft 2010
Power to shore etc

NINIAN



A cargo vessel unloading precast dome elements at Howard Doris' Kishorn site. A total of 3000 people were employed on the project, 600 working on the platform in 12 hour shifts, two-on, one off.

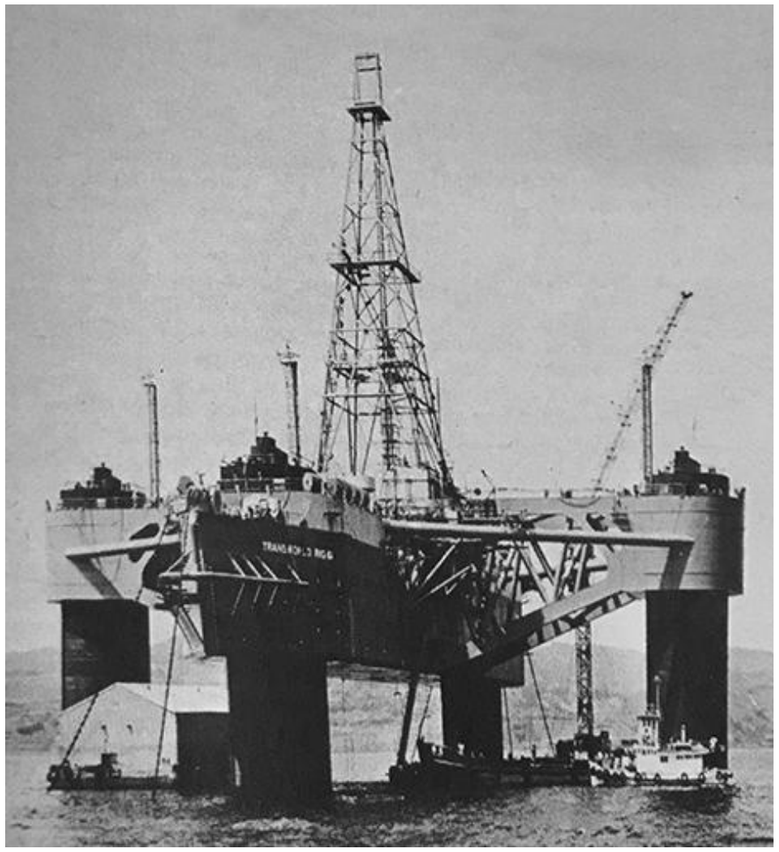
There were 3 rows of domes, with the top layer prestressed to accommodate the tower bending moment. The precast domes were not part of the original deign- they were originally planned to have flat tops but the more efficient domes reduced the total weight.

The structure had 250 elements, each weighing up to 60t. The slipformed walls had to have a vertical accuracy of 70mm.

SEAN SOUTH

Shell's Sean South with the Safe Concordia? accommodation vessel alongside.

TRANSOCEAN 61



In the winter of 1973, the newly-built Transocean 3 was in Stavanger for fitting out. She was moored in 104m of water, waiting for an improvement in the weather.

Cracks, however, started to appear and by New Year's day 1974, the barge was abandoned. Later that day, the port leg broke off and it capsized.

Around the same time, her twin sister rig, Transworld 61, showed damage in the leg connections, albeit less severe, and was towed to Bergen. It had already shown extensive cracking while drilling for Sun Oil two years earlier. It was able to provide valuable information for the Tranworld 3 inquest.

When TO3 went down on location offshore, TW61 was just over the horizon in the same weather.

Weather was not that bad. In the inquest investigation, TO3's demise was blamed on the crew not understanding the need to keep leg wedges in place, and the UK authorities prescribed "better training."

This analyses by the UK authorities was completely flawed. The true story never came out. That in fact TO3 construction was modified in the German shipyard in an unapproved fashion which resulted in outer leg movement and main holding pin failure.

No crew could have saved the unit at the time. (The photo shown is TW 61 in the Sasebo Shipyard in Japan before it's first drilling work in South Africa.)

Virtual Subsea Awareness Course

SUT
Society for Underwater Technology

SUT is delivering a 5-day foundation-level virtual Subsea Awareness Course presented by leading industry figures.

This course is CPD Approved.

6-8th April & 13-14th April 2021
Interactive Sessions will run from 10am-1pm

The virtual SAC is aimed at new entrants who are already technically qualified but just entering the offshore energy industry and/or the subsea sector; technically qualified experienced personnel undergoing a technology transfer and conversion process into the subsea sector; and non-technical personnel from legal or finance sectors who regularly deal with the subsea sector.

Sessions will cover:

Subsea production equipment & systems
Flow assurance
Pipelines & Risers
Constructions & Installation
Met Ocean
Renewables and future technology trends
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