SCOTLAND

THE GLOBAL LEADER IN

SUBSEA

ENGINEERING

Scottish Development International

#SCOTLANDISNOW

Introducing
Scotland's Subsea Expertise

Subsea engineering and technology PIONEERED in Scotland

Almost 700 COMPANIES with subsea capabilities reside in Scotland

These companies boast £7.5BN revenue and support 45,000 JOBS

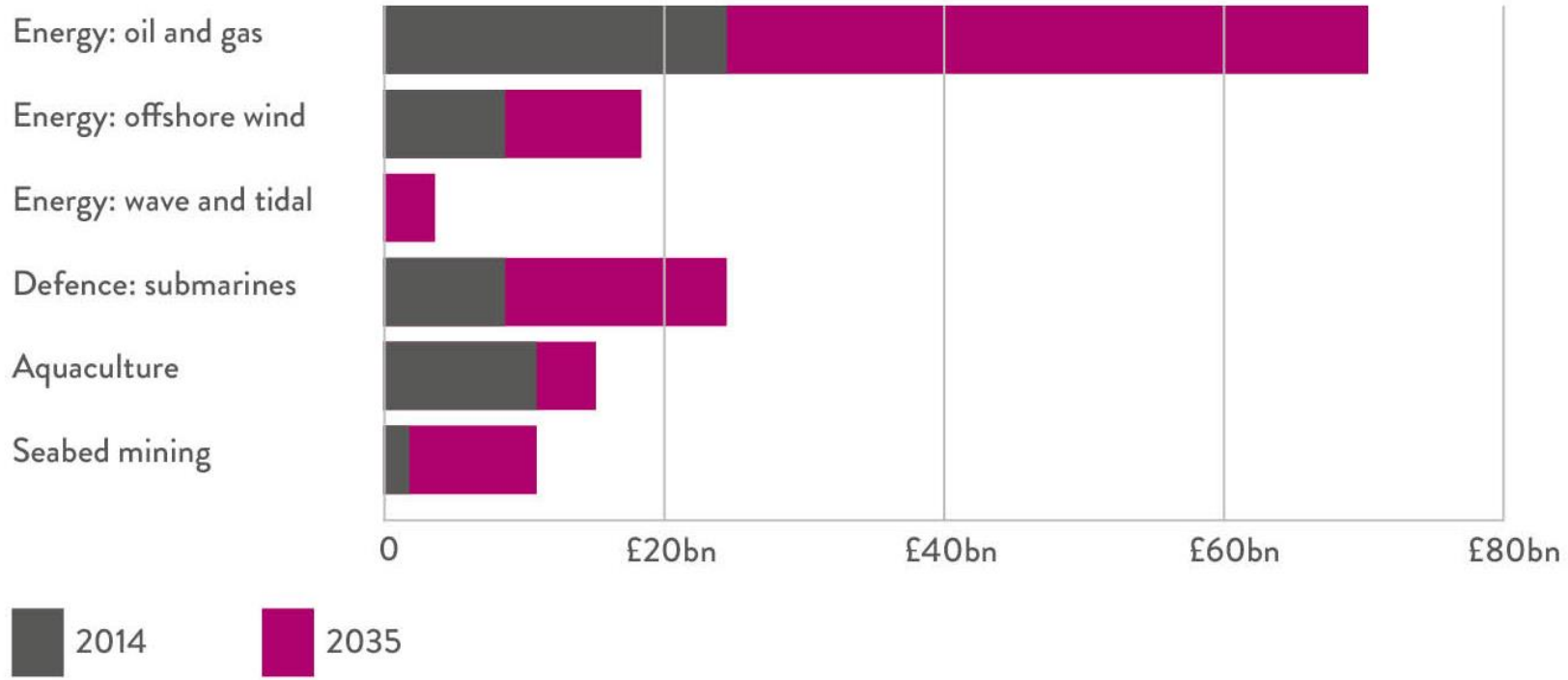
OVER 50% of the Scottish subsea output IS EXPORTED around the world

Scotland is a global, MARKET-LEADING, subsea engineering hub

Introducing
Scotland's Subsea Expertise

- Using their expertise of operating in harsh North Sea waters, Scotland's 700 subsea engineering companies carry out projects globally to make offshore exploration and production safer, more productive and cost effective.
- Advanced robots developed by Scottish companies help to improve operational safety by performing high-risk inspection, repair and maintenance works instead of climbers and divers, especially as projects move farther and deeper offshore.
- Scottish well control, plugging and abandonment specialists, and high-performance remotely operated vehicles, ensure that complex drilling and decommissioning works can be carried out safely and sustainably in challenging waters.
- Scotland's asset integrity management specialists help operators around the world ensure international compliance, enhance health and safety, reduce operational risk and minimise environmental impact.
- Scotland is home to leading national trade bodies such as Subsea UK, and global centres of excellence such as the Oil and Gas Technology Centre, National Subsea Centre and Offshore Robotics for Certification of Assets (ORCA) Hub, which together provide the world's leading R&D and training ground for the global energy industry.

Global Opportunity
Building on the UK's Position as Global Leader



Scottish Enterprise Subsea 2030 Strategy

£100BN

Annual global spend forecast to increase to c.£100 billon by 2035 from c.£20 billion in 2017

40%

The UK currently leads the world with around 40% global market share (c.£7.5 billion in 2017)

Centre of Excellence
Subsea UK

"Subsea engineering was pioneered and honed in the North Sea. With over a third of global marketshare, our subsea industry leads the way and Aberdeen is recognised around the world as the epicentre of underwater engineering. Indeed, international subsea companies consider a base in Aberdeen as vital to their operations.

From Scotland, our subsea supply chain exports knowledge, expertise, skills and technology that are fundamental to optimising the production of oil & gas and offshore wind but are also highly transferable into wave and tidal, defence, deep sea mining, ocean science and aquaculture."

Neil Gordon
Chief Executive Officer, Subsea UK

Centre of Excellence
Oil & Gas Technology Centre

"The OGTC was created to help unlock the full potential of the UK North Sea, creating a culture of innovation that attracts the brightest minds and cutting-edge organisations to Scotland.

I am confident that together with industry, we can exploit the 4th industrial revolution and make Vision 2035 a reality."

Collette Cohen
Chief Executive Officer, OGTC

Inspection, Repair and Maintenance

How Can Scotland Help?
Inspection, Repair and Maintenance

Subsea Cable Protection

Scottish subsea cable specialists can help to address a range of challenges concerning risers, umbilicals and flowlines. These include the use of innovative integrity management techniques to reduce insulation degradation, and preserve the condition of subsea cables through quick and cost-effective intervention.

Subsea Energy Storage

Scottish battery technology companies provide cutting-edge and reliable power systems for deepwater and autonomous IRM operations.

Subsea Robotics and Digitisation

Scottish ROVs and underwater technology specialists provide a range geophysical surveys, digital monitoring and imaging services to support inspections of ageing subsea pipelines and structures.

FPSO Asset Integrity

Governed by industry-leading standards, Scottish IRM specialists offer best-in-class subsea integrity assessment and management to address issues with mooring, corrosion under insulation and unplanned drydocking.

Case Studies
How Scottish IRM Specialists Deliver Value

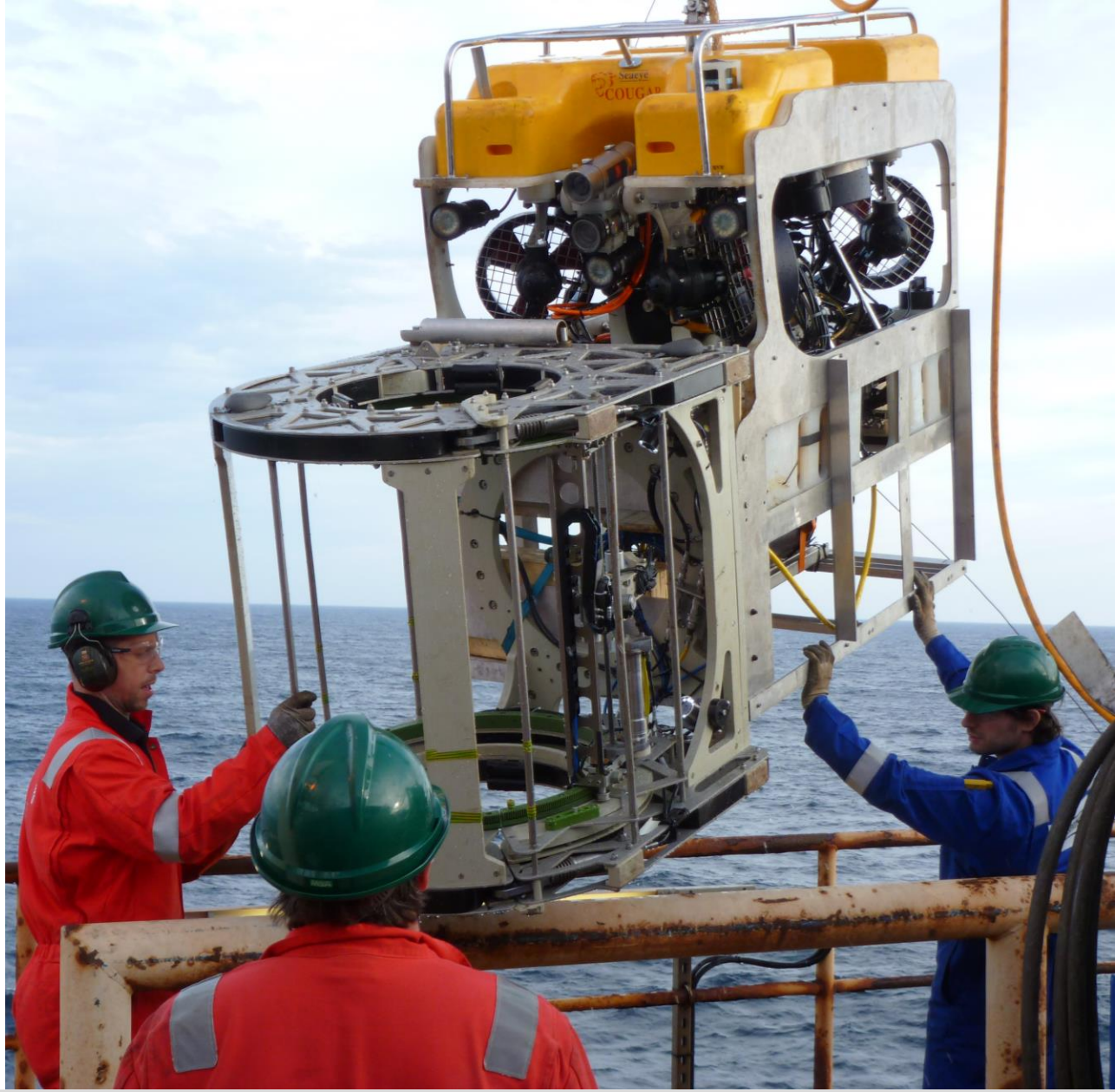
Click on the company name to jump to the case study

• Flexlife	Brazil	Ultrasonic Non-Destructive Testing
• AISUS	Mediterranean	J-Tube Inspection
• Brimmond	North Sea	High Pressure Pump Unit
• ITC	Abu Dhabi	U100 Diver Umbilical Reeler
• Apollo	Middle East	Digital Integrity Management
• Boskalis	Mediterranean	Subsea Intervention
• Aleron	US East Coast	ROV Geophysical Survey
• Viewport3	Angola	ROV 3D Data Scanning
• InterMoor	Nigeria	FPSO Mooring Integrity
• Motive	North Sea	Subsea Recovery
• EC-OG	North Sea	Subsea Energy Storage
• i-Tech 7	Asia Pacific	Hydrate Blockage Remediation

Flexlife / Brazil
Ultrasonic Testing

Flexlife pioneered the use of Ultrasonic (UT) Non Destructive Testing as a means of determining the integrity of unbonded flexible pipes. Ultrasonic NDT has a particular benefit for this application due to the requirement for a liquid medium (couplant) to enable acoustic signal transmission. This information is extremely valuable as it allows operators to accurately determine the annulus condition which, in turn, has a direct link to the fatigue characteristics of the pipeline's metallic layers.

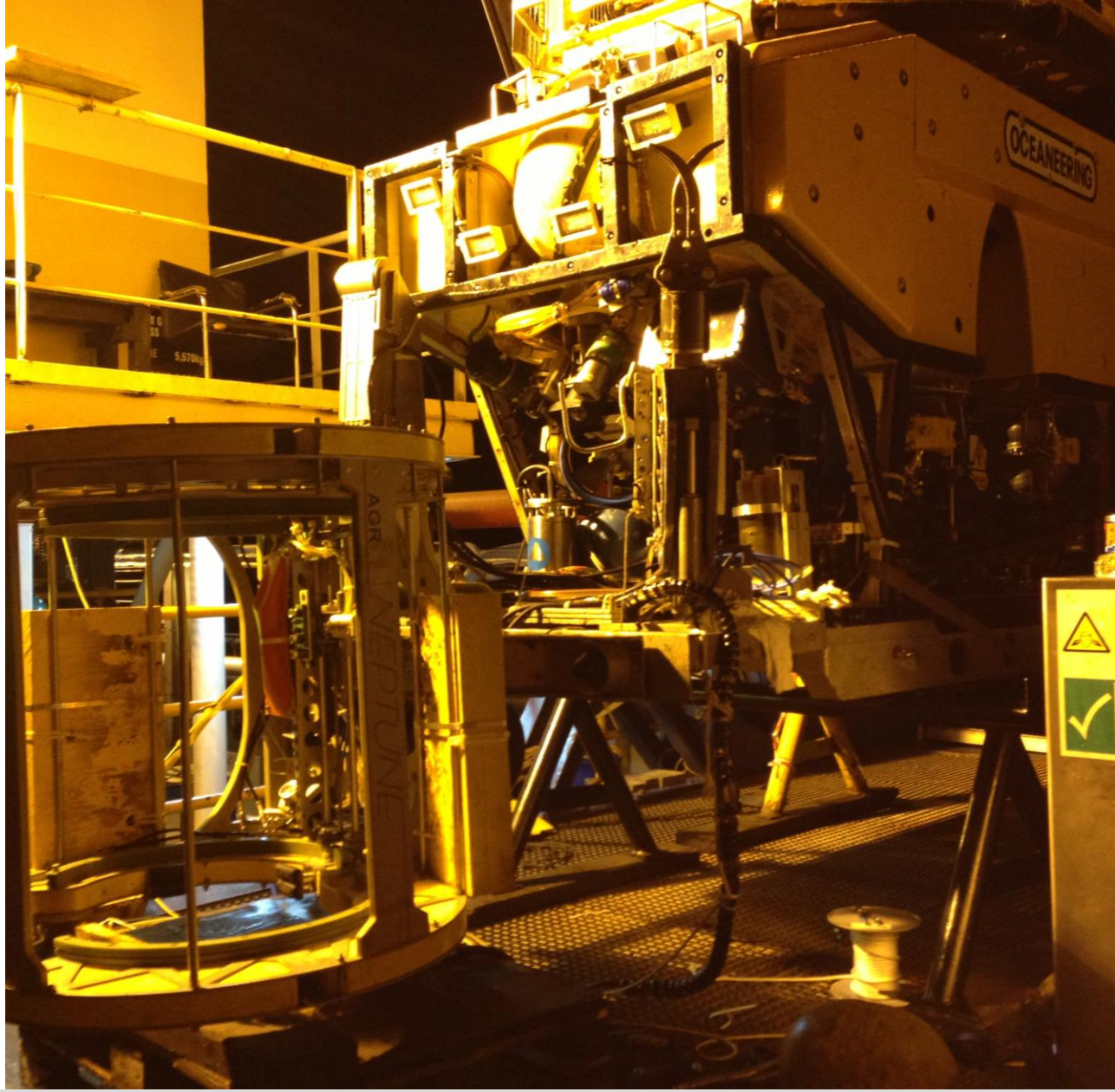
Over recent years a leading NOC has suffered catastrophic failure of several flexible risers, believed to have been caused by permeation of carbon dioxide, which reacts adversely with liquid within the flexible pipe annulus.



Flexlife / Brazil
Ultrasonic Testing

Flexlife's patented FlexScan® technology is the ideal tool to determine whether, or not, these pipelines are suitable for ongoing service.

Flexlife, with their partner Oceaneering, carried out an in-depth research and development project which further fine-tuned the data recovered from this NDT technique. This breakthrough enabled the NOC to award a multi-year contract for subsea inspection utilising FlexScan® technology deployed via the Neptune, ROV deployed, subsea UT scanner confident in the knowledge that data gleaned can be used to definitively ascertain the operational integrity of these safety and business critical pipelines.



AISUS / Mediterranean
J-Tube Inspection

AISUS was approached by an international client to carry out an internal visual inspection, high-pressure cleaning and messenger line installation of two J-Tubes on a fixed platform. The purpose of the campaign was to ensure the cleanliness of the J-Tubes and install new messenger lines for the client to pull umbilical through to the seabed.

AISUS' highly specialised engineers were deployed to first retrieve the existing messenger lines prior to visual inspection. Then, the team lowered the camera equipment to gain an understanding of the general condition of sidewalls and the level of cleanliness of the pipework. The findings satisfied assumptions that multiple parts of the J-Tubes needed thorough cleaning.

AISUS / Mediterranean **J-Tube Inspection**

AISUS carried out the high-pressure cleaning within the pipework including the bends where there was built-up debris and sand. Finally, a camera inspection was then performed to confirm that the cleaning process had been successful.

The team of engineers moved on to carry out the messenger line installations. AISUS achieved the installation by driving the messenger lines down the J-Tubes with an in-house developed crawler system.

AISUS / Mediterranean **J-Tube Inspection**

Due to the configuration of the J-tubes with bell mouths, AISUS designed and deployed a messenger line deployment solution to lead the new messenger line beyond the bell mouth. The lines were installed effectively and the crawler system was recovered using a pneumatically driven air winch.

Integrating efficiently with the client's engineering team, AISUS' engineers guided the others on all aspects of the overall project. This flexible approach minimised mobilisation costs and transit times for the client, all contributing to the overall success of the project.

Brimmond / North Sea
High Pressure Pump Unit

Our client required a High Pressure Pump Unit capable of pressurizing pipelines ranging in diameter between 152 mm and 406 mm and multiple kilometres long with a water/MEG mixture.

Ensuring the internal pressure of these pipelines did not drop below a critical value was of key importance and would determine the success of the system and upcoming projects for the Client.

The High Pressure Pump Unit would need to fully integrate with existing vessel systems, including the vessel management system and the existing deck equipment PLC/SCADA control system.

Brimmond / North Sea
High Pressure Pump Unit

Brimmond Group designed and manufactured a fully PLC controlled High Pressure Pump Unit. The control system within this unit was based upon the Siemens S7-300 PLC, this was chosen to complement the existing deck equipment PLC hardware, onboard the clients vessel. The unit featured a Siemens IPC277E HMI which allowed control over all functions of the unit locally.

The control system was interfaced with the existing Vessel PLC via ethernet and allowed for remote control of the unit's function from the main control room. Various interlocks were programmed to bring a stop to certain pieces of deck machinery onboard the vessel should internal pipeline pressure approach the critical value.

Brimmond / North Sea
High Pressure Pump Unit

This interface was also used to synchronise E-stops and equipment alarms with the vessel's SCADA ensuring that the client's product was protected in any eventuality.

The control system featured an automatic pressurisation mode, this mode constantly monitored pipeline pressure and topped up as necessary to ensure the critical low pressure was never met.

ITC / Abu Dhabi
U100 Diver Umbilical Reeler

A global Tier 1 marine solutions provider required a NORSOK U100 compliant divers subsea habitat umbilical winch to meet a contractual commitment. This umbilical is a combination of water, gas, electric and fibre optical lines. No such compliant systems had been designed or built.

ITC's engineering team reviewed the requirements and developed two concepts that would enable compliance to the U100 standard. These were discussed with the certifying authority and a workshop held with the client to review the merits and risks of each option. Following these discussion the full design was developed and the reeler design finalised.

ITC / Abu Dhabi
U100 Diver Umbilical Reeler

This design provided a means of "the habitat-umbilical shall have a quick-disconnect system on the DSV allowing for a disconnection and re-connection". As a secondary emergency method of disconnect an overboard chute was designed with an integral.

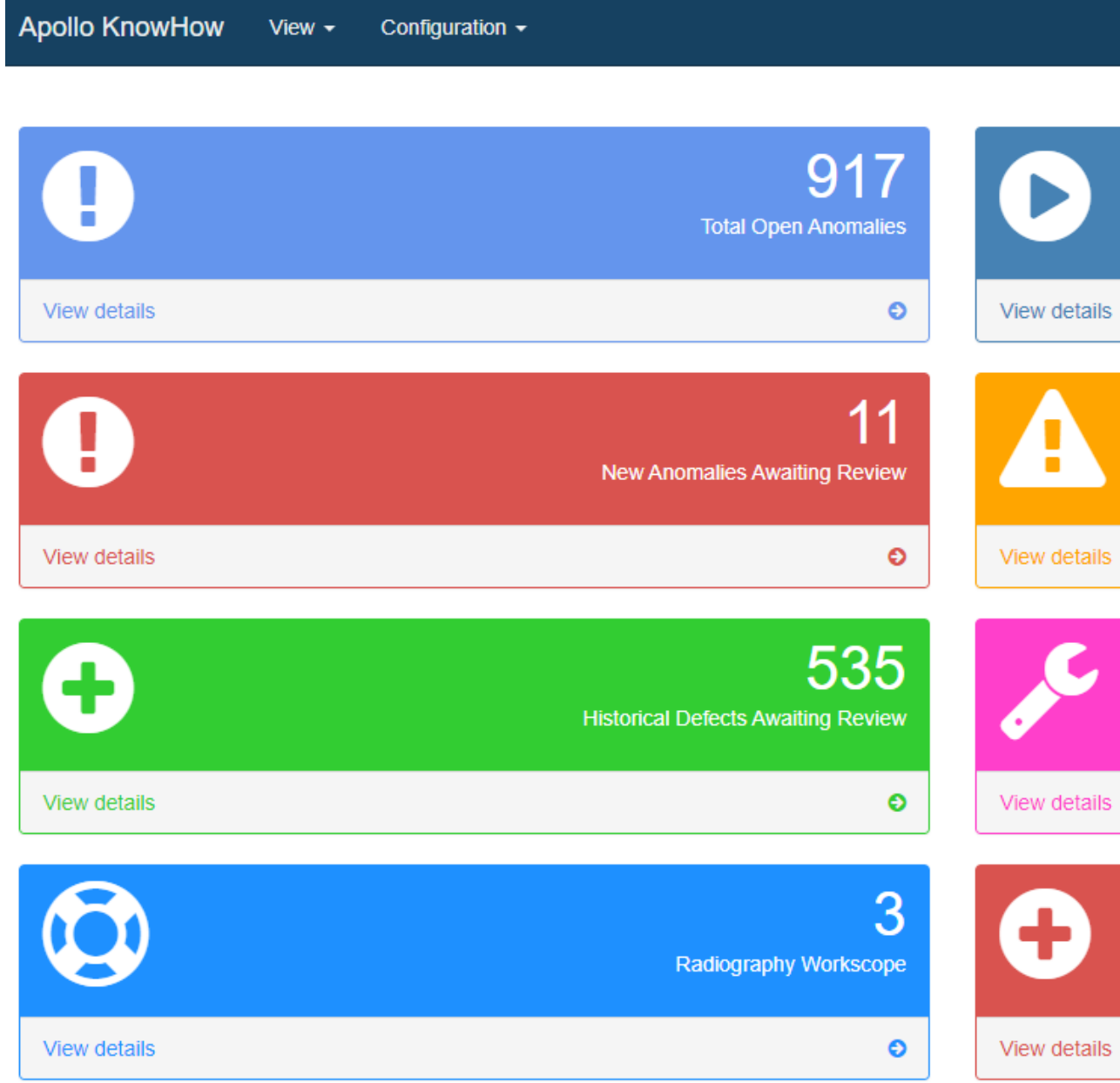
The new design was successfully built and tested in time for the clients full system integrity testing and is understood to be the first NORSOK U100 compliant and 3rd party certified diver umbilical reeler.

According to the Client's senior project manager, "*this was an excellent job and ITC kept us fully up to date on progress. I wish all parts of the project had been this easy.*"

Apollo / Middle East
Digital Integrity Management

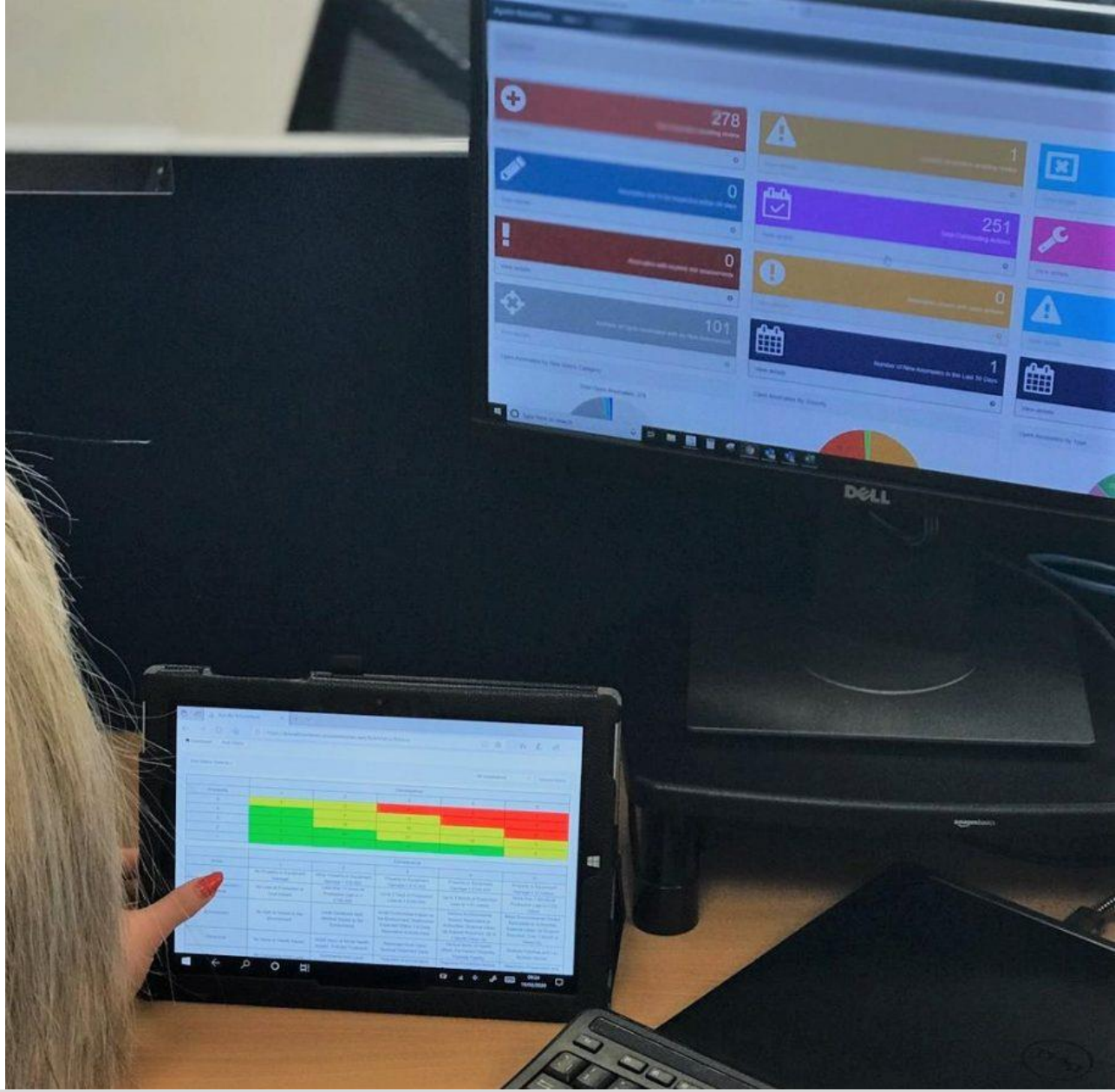
In 2019, Apollo deployed their integrity management software Apollo KnowHow™ for a large, international oil and gas operator. Apollo KnowHow™ was selected to replace an aging, legacy software system with modern, fit-for-purpose integrity management solution. Since going live for subsea IRM, Apollo KnowHow™ has delivered further benefits:

- Via the user-friendly, web-based application, data is more visible of critical integrity data to the key personnel who need to see it.
- Simple, remote installation onboard ROVSV for subsea IRM operations. Legacy tools have often required on-site installation by the software vendor, but Apollo KnowHow™ is installed by the vessel operator saving time and costs.



Apollo / Middle East
Digital Integrity Management

- Faster data entry during IRM/ROV real-time operations. In only their first use of Apollo KnowHow™ offshore, the client reported a 5% improvement in data capture and processing time onboard the ROVSV, reducing the vessel hire duration and costs. This saving alone recouped their initial purchase costs for Apollo KnowHow™.



Boskalis / Mediterranean **Subsea Intervention**

Boskalis Subsea Services (BSS) were contracted by a leading Oil & Gas Operator in 2019 to complete an IRM workscope at various locations in the Mediterranean Sea. The Boka Da Vinci was selected for both Saturation Diving and ROV Intervention using both Work Class and Observation class ROV systems.

Diving works completed on behalf of the client included the following:

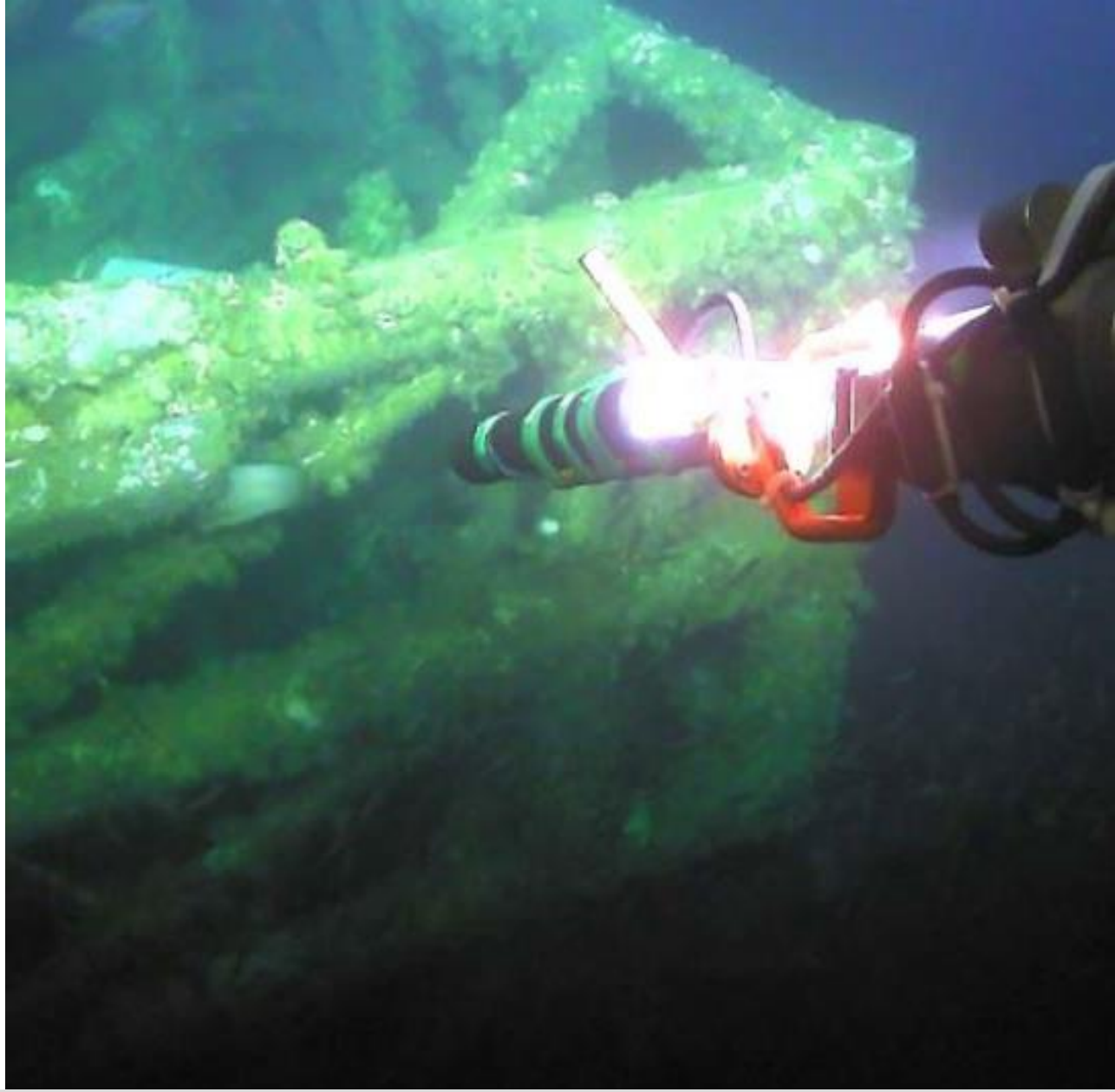
- Hydraulic reconfiguration works
- Chemical Injection and Monitoring line isolations
- Anode sled installations
- Flowline disconnections & pressure control line isolations

Boskalis / Mediterranean **Subsea Intervention**

ROV Intervention works completed included the following:

- Anode skid and clamp operations
- Cutting operations
- Jumper replacements
- Multiphase pump installation

Project managed from BSS Aberdeen headquarters, this was a truly international project with equipment mobilised from Norway, Rotterdam and the UK prior to arriving on site in the Mediterranean. Both the Saturation Diving and ROV scopes will extend field life, and reduce the effects of corrosion adding value to the integrity strategy. The ROV operations were completed at depths of greater than 300m and through the on and offshore planning, combined with the ability to amend procedures whilst offshore, resulted in a safe and successful campaign.



Aleron / US East Coast
ROV Geophysical Survey

The specialist TRACKROV was used in 2018 to perform a geophysical survey on Block Island, south of Rhode Island, US, by the National Grid and Ørsted for their offshore wind farm. Aleron deployed the system from the beach and surveyed from the water line out to measure the depth of burial on an export cable that they were concerned as having been exposed.

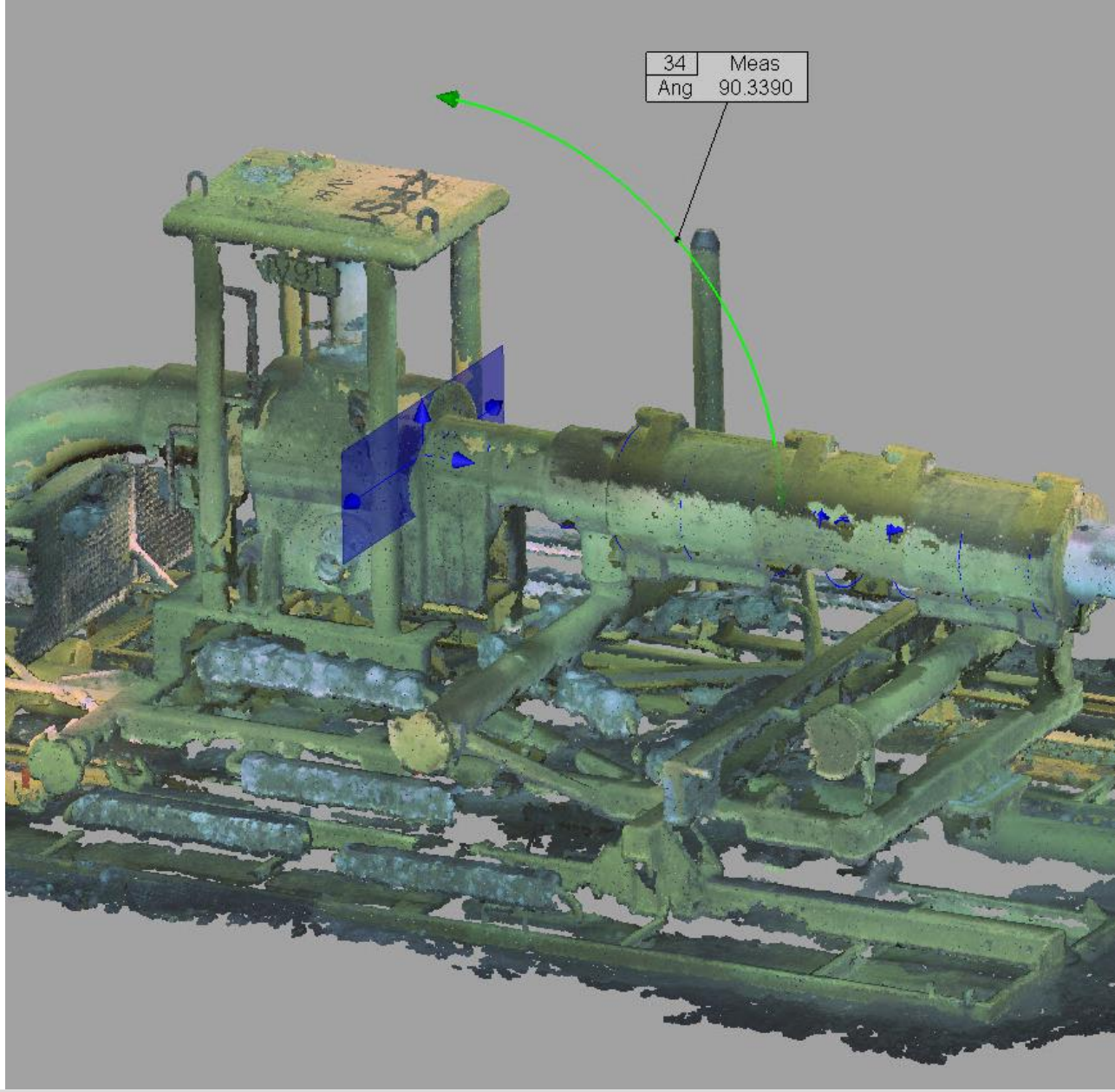
This was innovative because they would have otherwise had to deploy divers through the splash zone, which is difficult and costly. Like most wind farm operators, they also prefer to perform these operations remotely wherever possible, so using a tracked system provider is the only real alternative to divers in the water due to the ultra-shallow water leading to the shore. Both the National Grid and Ørsted were extremely pleased with the result of this project.

Viewport3 / Angola
ROV 3D Data Scanning

An oil and gas operator experienced changes in the geometry at the end of a pipeline in a deepwater environment. The client needed to understand the current 'as-is' status, and relative angle of the pipeline as it entered the subsea structure, while also investigating any further damage.

We worked closely with the marine in-country contractor to ensure that the scan was performed correctly, and that it would provide the answers the operator required.

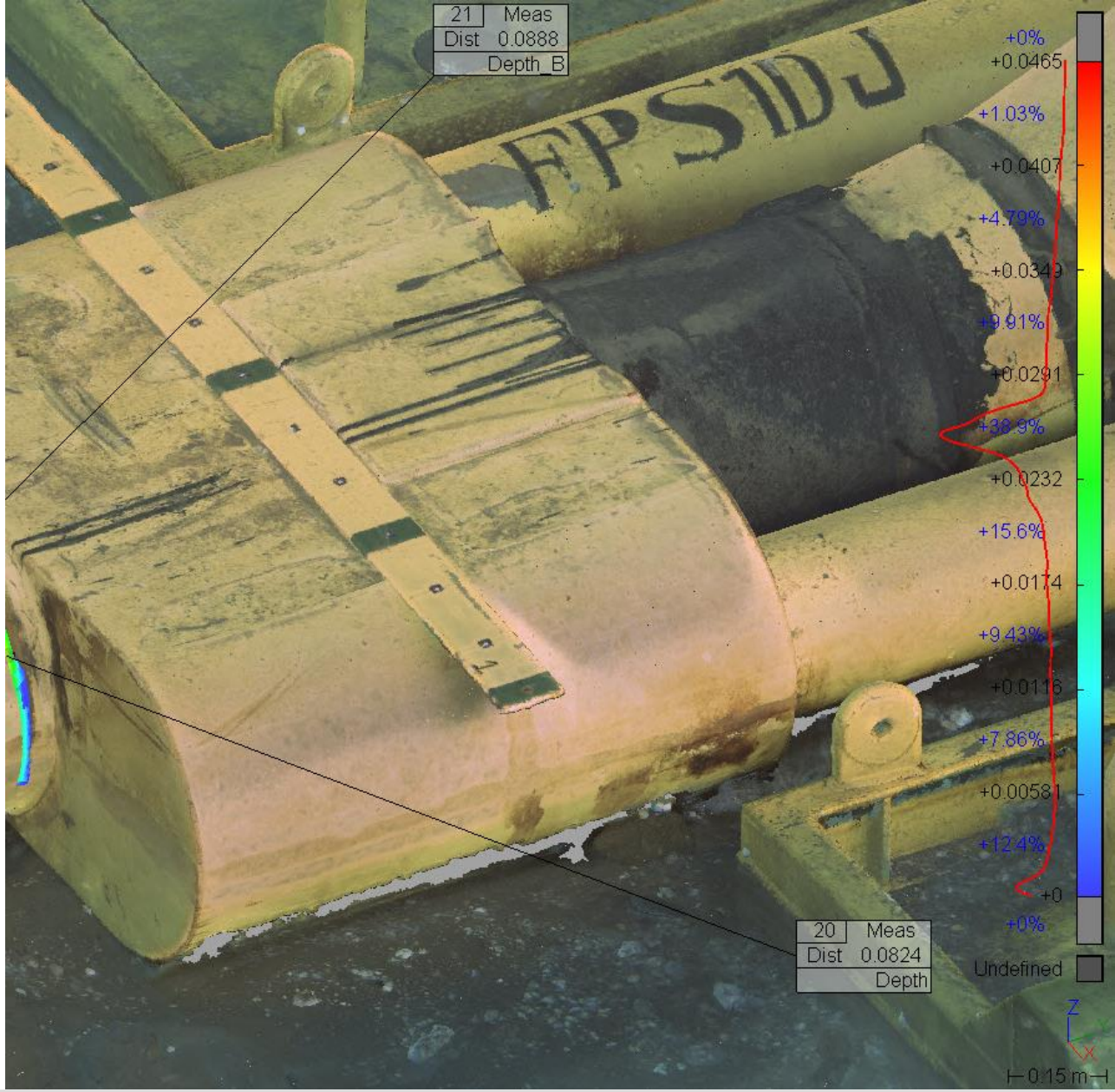
The only equipment required to access the deepwater site was a single work class ROV, and the capture sessions were completed within 2 dives.



Viewport3 / Angola
ROV 3D Data Scanning

A two-tiered verification system was employed by Viewport3 in order to maintain control of both the data captured, and accuracy statement being achieved. The onboard ROV team custom made equipment that allowed the camera system to scan particular specified angles with minimal supervision.

The scanning results enabled the marine contractor and operator to fully understand the angle of the pipeline and the 'as-is' geometry. As a result, any doubts regarding the stability and geometry of the remaining subsea structure were removed. The 3D data supplied to the client enabled them to make a complete revision to the future intervention operations at the structure, without adding contingency plans.



InterMoor / Nigeria
FPSO Mooring Integrity

Following the successful replacement of the top chain on three of the 12 mooring lines in 2018, InterMoor, an Acteon company that provides mooring services, foundation solutions and offshore installations, was commissioned for Phase 2 of the mooring integrity work on a major FPSO offshore Nigeria in about 1168 m of water.

The FPSO is 285 m long and 63 m wide and has accommodation facilities for 100 people. It has a storage capacity of 2.2 million barrels, making it one of the largest FPSOs in the world.

InterMoor / Nigeria
FPSO Mooring Integrity

InterMoor's scope of work involved engineering and project management (including offshore procedures and logistics), procurement of equipment, offshore personnel, and replacement of the top chain for the remaining nine mooring lines. That amounted to over 1.5 km of chain. In total, over 2 km of chain were replaced on the entire mooring system.

The project was completed successfully and without incident.

The Client's Subsea Execution Manager thanked the InterMoor Project Team, saying "*Your display of excellent technical capacity, expertise, teamwork and adaptability has been a key driver to achieving this feat.*"

Motive / North Sea
Subsea Recovery

Following supply of a full back-deck spread that included 3 hydraulic drum winches for a cable lay installation, Motive Offshore were again commissioned by the same major subsea contractor to provide an urgent solution for recovery of the product subsea after it had become damaged.

Motive offered a 200Te Spooling Winch and custom manufactured reel with a core diameter of 2.8mtr to accommodate the minimum bend radius of the product to be recovered.

Our in-house team fully designed, engineered and loaded out a suitable reel, from raw steel through to end product within just seven days.

Motive / North Sea
Subsea Recovery

This project demonstrated Motive's ease and ability to deliver a technical solution, working expertly to bring the project from concept to reality within an extremely limited timeframe.

Additional products and services to supplement the project included:

- Reel Lifting Arrangement
- 10Te Winch
- Personnel to commission/install equipment
- Transportation direct to the mobilisation site

The client was very happy with the service received, with the Lead Engineer commenting on the proactive approach taken by Motive to provide a viable solution.

EC-OG / North Sea
Subsea Energy Storage

EC-OG are specialists in subsea battery storage and clean energy systems for offshore applications. Based in Aberdeen, our offshore engineering pedigree places us at the forefront of the energy transition and electrification of the blue economy.

Together with an overseas partner, EC-OG have developed a Subsea Data Acquisition Platform suitable for extended duration subsea deployments, integrating EC-OG's innovative Halo subsea battery storage technology with our partners industry proven data acquisition toolkit.

Removing the restrictions of power availability and battery life, EC-OG's Halo technology offers high energy capacity and low energy overhead, with the ability to recharge in-situ from marine renewable energy devices or vessel downlines..

EC-OG / North Sea
Subsea Energy Storage

The Subsea Data Acquisition Platform enables fully autonomous, long term asset and environmental monitoring for a range of applications, including pipelines, moorings and seabed seismic.

By working with EC-OG, our client was able to access EC-OG's industry leading expertise in subsea battery storage and the efficient management of energy systems enabling significant improvements in operating duration.

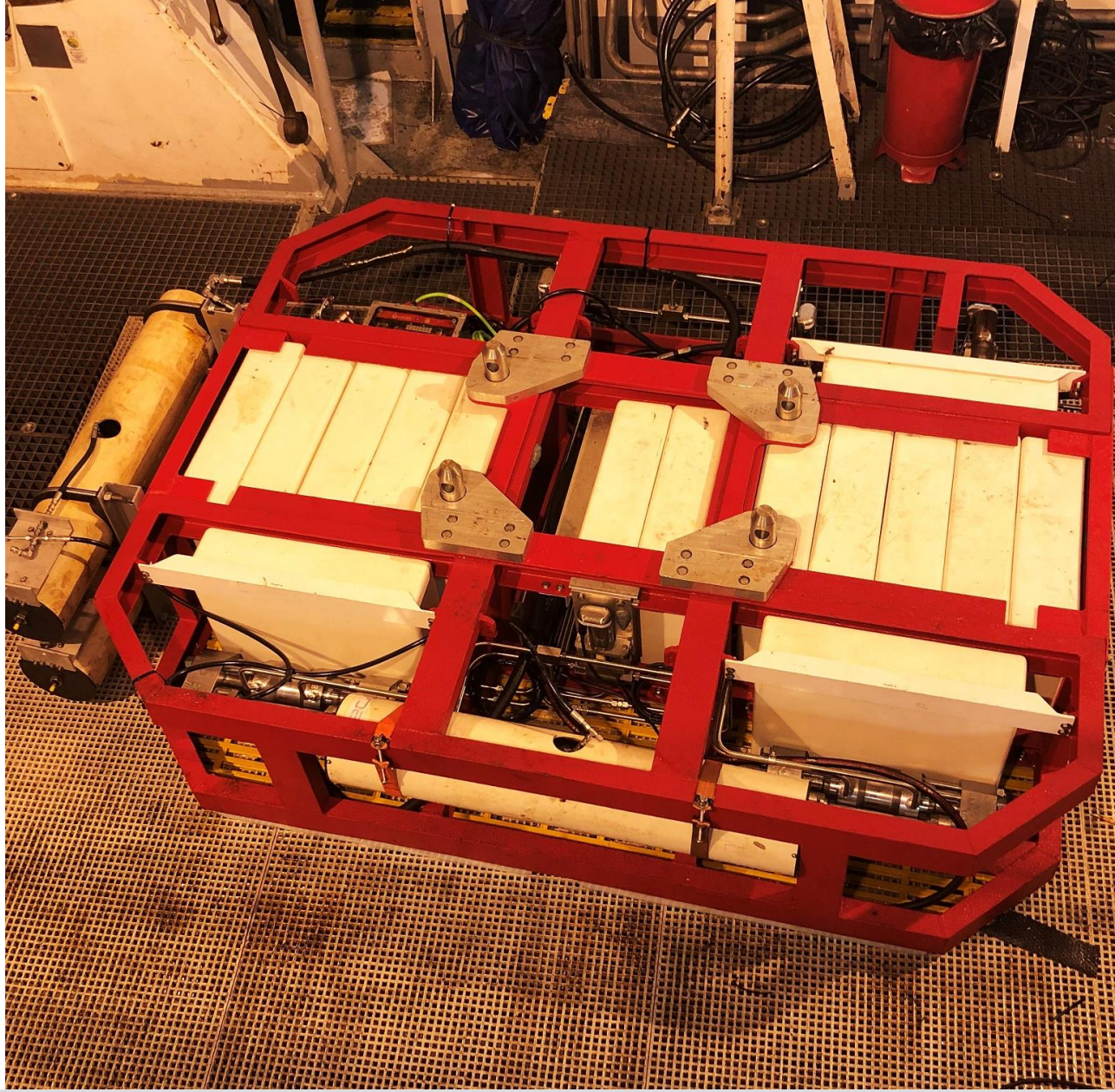
The technology is set to deliver extensive cost savings for retro-fit asset monitoring applications by reducing the reliance on expensive, diesel powered vessels for intervention and battery change-out, achieving cost savings >£1m/year for oil & gas industry customers

i-Tech 7

i-Tech 7 / Asia Pacific
Hydrate Blockage Remediation

The client requested support in the removal of blockages in a gas lift system. Remediation was required to remove blockages in the umbilical termination head and gas injection port of the riser base manifold. Higher pressure wells that could flow without gas lift were diverted to a single flowline. Wells that required assistance from gas lift were shut in along with one of the production flowlines impacting production levels.

The remediation approach involved integration of the i-Tech 7 HRS onboard a client-provided vessel to ensure existing resources were maximised. The technique utilized pressure reduction and mono ethylene glycol (MEG) injection for the purpose of clearing the blockage. The i-Tech 7 HRS was able to inject MEG into the line and pressurise the line to 7,500 PSI when required.



SDI Global Energy Trade Team
Specialist Trade Promotion

Scottish Development International is Scotland's trade and investment agency. The Global Energy Trade Team, comprising 26 specialists in Scotland and overseas, are responsible for promoting Scotland's world-class engineering and construction services, advanced technologies, expert consultancy and training to the global energy industry.

Scottish Energy Supply Chain

- Subsea Construction
- Inspection, Repair & Maintenance
- Subsea Equipment
- ROVs and Robotics
- Geotechnical Services
- Environmental Services
- Decommissioning
- Education and Training
- Marine Energy Technology
- Hydrogen and Fuel Cells

End Users

- Oil & Gas Operators
- Offshore Renewables Developers
- Energy Services Companies
- Power and Network Operators
- National and Local Governments

SDI Global Energy Trade Team
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