

# Wave @ Tidal

**ENERGY NETWORK** WINTER 2017 ISSUE 9 | £7.50

COMMUNICATION HUB FOR THE WAVE & TIDAL ENERGY INDUSTRY

## SPOTLIGHT ON IRELAND

LEADING INDUSTRY  
MOVERS AND SHAKERS

## ANCHORING & MOORINGS

FIXED ASSETS

## MEYGEN ENGINEERING EXCELLENCE

MEGA PROJECT FOCUS



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## SmartBay

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- Marine Support Services.
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[www.smartbay.ie](http://www.smartbay.ie)



#### CONTINUING CHANGE

In 2016 we made the decision to join both Wind Energy Network and Wave & Tidal Energy Network magazines together. We are very pleased that the feedback has been very positive.

#### COMMUNICATION

As our mantra is that we serve the industry as a 'communication hub' it is very pleasing to hear that it is making it much easier for our readership to communicate across both industries.

#### MORE SUCCESS STORIES

We continue to hear of companies in either sector getting in touch with their counterparts after finding out what their respective companies offer. This means that collaborating companies continue to grow and prosper.

Products and services can be different in the two sectors however we have found that many companies offer a very similar product or at least can adapt equipment or their offering to suit a particular challenge encountered.

#### CONTINUING MAGAZINE FEATURE

We would like to continue to hear from any of the companies who have been collaborating across the sectors – we will then feature them in the magazine.

Please therefore get in touch – remember genuine editorial is featured completely free of charge, without any conditions attached.

Duncan McGilvray  
Editor | Wave & Tidal Energy Network

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#### OUR FOUNDING PARTNERS:





# SWANSEA BAY – HARNESSING THE POWER OF THE TIDES

In late 2015 our magazine produced a major feature on the planned Swansea Bay Tidal Lagoon project.

As we reported at the time at 320MW installed capacity it would be the largest marine energy development in the world and have an entirely predictable 495GWh output each year of clean, green electricity which would power more than 155,000 homes for 120 years – that's about 11% of Wales' domestic electricity.

Early in 2017 the Government gave the green light to move this ambitious project forward by releasing the results of a study carried out by the former Energy Minister Charles Hendry. We therefore feature a selection of comments from the leaders in the industry commencing with RenewableUK.

## OFFICIAL REPORT HIGHLIGHTS GROUND-BREAKING POTENTIAL

RenewableUK welcomed a review of the benefits of tidal lagoon energy. Energy Minister Charles Hendry said tidal lagoon

technology can deliver a secure supply of energy for a price that's competitive in the long term – the equivalent of the cost of a pint of milk per household per year. He added that tidal power is a completely predictable source of energy.

Tidal Lagoon Power, the company which secured planning consent in 2015 aims to begin construction within a year of getting a final green light after the successful conclusion of negotiations with Government.

## RINGING ENDORSEMENT

RenewableUK's Chief Executive Hugh McNeal commented: *"It's great to have this ringing endorsement of innovative technology and modern industry. The world's first tidal lagoon in Swansea Bay can provide power for our national energy needs and create local jobs for decades to come. Government should finalise*

*negotiations so that work can start on this important infrastructure project as soon as possible.*

*This is a new growth sector with huge potential to bring industrial-scale economic opportunities to the UK. Each new tidal lagoon will drive down costs due to economies of scale, benefitting consumers, as well as strengthening the security of our energy supply."*

## AWESOME LOW CARBON OPTION

Juliet Davenport, Chief Executive and founder of 100% renewable electricity company Good Energy, which was one of the first investors in Swansea Bay Tidal Lagoon, enthused: *"By kicking off a British tidal lagoon industry we are presenting the world with another awesome low carbon option, and its British know-how that will be called upon should other countries look to take up that option.*

## DELIVERING AFFORDABLE ELECTRICITY IN THE LONG TERM

Perhaps in a more measured and cautious view Ben Warren, Head of Environmental and Energy Finance at Ernst & Young commented: *"Any support for the Swansea Bay tidal lagoon project appears, on the face of it, to be a rare piece of positive news for the UK's renewables sector.*

*"Whether the UK Government is adopting a strategy of fostering a more sustainable energy industry by supporting local jobs remains to be seen, both by the final decision but, more significantly, by the purchase price the Government will agree to pay for the power produced.*

*"Currently, truly affordable clean energy from offshore wind and solar is being left to fend for itself while the benefits of subsidy are enjoyed by new nuclear and even fossil fuels.*

*"Should Swansea Bay get the go ahead it remains to be seen whether tidal energy can deliver affordable electricity in the longer-term. For now we wait to see what price the Government is prepared to pay Swansea Bay for its power, and what risks it is prepared to take on board to ensure this ambitious project gets realised."*

## A PATHFINDER PROJECT

Dr Simon Harrison, Chair of the Institution of Engineering and Technology's (IET) Energy Panel, concluded on a more positive note: *"The recommendation to support the Swansea Bay Tidal Lagoon is welcome news from an electricity system perspective.*

*"Although it may seem relatively expensive at first, it's important to remember that this is a pathfinder project which, when applied at greater scale in other locations, promises long term cost competitive and predictable renewable energy, and a potentially exportable technology.*

*"While, there are no major underlying concerns over technical viability there are many issues to explore through Swansea Bay, both technical and environmental, and the learning from this project will be essential in shaping future developments and in determining their viability.*

*"Tidal energy projects produce predictable electricity outputs every day, but ones that vary with the timing of the tides. This has the potential to make a valuable contribution to the electricity system as we move more to a smart system where consumers will be able to respond to price signals by adjusting the timing of some of their demand, such as when they charge their electric car. Rapid recent and continuing developments in the cost of storage will also facilitate the use of this type of renewable energy source, given the daily certainty of its output.*

*"Tidal lagoons are large and complex construction projects, but if Swansea Bay performs well we might expect to see large scale contributions to the UK's electricity from tidal sources by the late 2020s or 2030s."*

## LAGOONS: THE FUTURE

It is the intention to follow Swansea Bay with five full-scale lagoons. Early feasibility studies are already underway in a number of locations throughout the UK with survey work and data gathering having begun to inform proposals, support engineering designs and act as a foundation for environmental assessments.

Continuing to work in partnership with a wide range of stakeholders to achieve an optimal balance between power output, economic profile, environmental sensitivity and social acceptance. If successful, they can deliver 8% of the UK's electricity demand for 120 years.

**DUNCAN MCGILVRAY**  
(WITH VALUABLE INFORMATION FROM MANY PREVIOUS CONTRIBUTORS)  
**EDITOR**  
**WAVE & TIDAL ENERGY NETWORK**

*"Tidal lagoons are a brilliant way for Britain to diversify its energy mix and keep the lights on. They will also create a whole new industry and thousands of jobs as well."*

## UNEQUIVOCAL CONCLUSION

Rémi Gruet, CEO of Ocean Energy Europe added: *"The UK government has analysed tidal lagoons every which way and the conclusions are unequivocal. Tidal lagoons have a major role to play in providing UK households and businesses with reliable, clean and affordable electricity. It is time to give Swansea Bay the go-ahead and support the development of a new industry with the potential of creating thousands of jobs in the UK and across Europe."*





# INDUSTRIAL PARTNER ON INNOVATIVE TIDAL STREAM TURBINE PROJECT APPOINTED

**Intertek, a Total Quality Assurance provider to industries worldwide, recently announced that Intertek Energy & Water has been invited by Cardiff University to become an industrial partner to support a three-year tidal stream turbine research project.**

The project, which will also involve a number of international partners, will examine various tidal stream turbine array configurations for layout optimisation and develop operational procedures to mitigate the impacts of extreme loading patterns.

### INVALUABLE INFORMATION

The company's research experts will employ both experimental and numerical analyses to ensure that the results and findings are transferable to real-life applications. The project will provide invaluable information to developers to help safeguard tidal turbine arrays from being damaged by currents, waves or wind, while at the same time, delivering the lowest cost of energy.

Intertek has many years' experience in marine consulting and will, therefore, be able to impart knowledge and provide expertise on a wide-range of tidal energy-related areas, including field surveys, geophysical and geotechnical assessments, hydrodynamic modelling, metocean assessments, geographical information systems (GIS), as well as cabling and environmental considerations.

### PROJECT POTENTIAL

Dr Paul Evans, Intertek Energy and Water expert commented: "This project has real potential to move the UK's tidal energy industry forward from its current early-stage status to a future where full-scale, grid-connected arrays form a key part of the UK's energy mix."

*"Our role as an industrial partner supports our vision to be a leading adviser for the development of innovative clean energy tidal technologies for the benefit of current and future generations. To deliver this vision, we must stay at the forefront of research and we are privileged to be working with leading universities in this field."*

### COMMERCIAL PRESENCE

Professor Tim O'Doherty, Principal Investigator on the project added: *"Given the current status of tidal stream turbine technology, it is vitally important to have a commercial presence to help understand the industry's requirements. It is also*

*crucial that collaborative research is undertaken into device development and the environmental impact of deploying arrays of tidal turbines.*

*"The project will be based in Wales, a country that has vast potential to become a major player in the global marine energy industry, which will help ensure the success of this project."*

Intertek tackle complex environmental, regulatory and operational challenges throughout the project life cycle – from concept, feasibility and design, through construction and operation, to decommissioning. They also partner with developers, operators, asset owners, utilities, lenders and governments.

**Intertek**



# CONTRIBUTING TO THE FUTURE



for the global oil, gas and renewables industries.

Jee Ltd is an independent subsea engineering and training company with offices in Aberdeen and Tonbridge. Founded by Trevor Jee in 1988, they now offer engineering services spanning the entire project lifecycle from design, operations support, integrity management and decommissioning

### PROJECT EXPERIENCE

The company has been involved in many projects ranging from pipeline design, lifetime extension studies (to allow pipelines to be operated beyond their design life) and more recently subsea cable-related projects such as design, routing and analysis for the wind and tidal industries.

### TIDAL SECTOR

Jee's new Excalibur project is a fantastic opportunity to work in the developing tidal sector and help solve problems that could really have an impact on how quickly the company can export power to the grid. They are able to use their experience from oil & gas projects as well as from past windfarm projects to contribute to the future of tidal energy generation.

### EXCALIBUR

Excalibur is a novel subsea infrastructure solution for the deployment of tidal turbines and the protection of the associated subsea cables. It will enable the cost-effective installation and maintenance of the turbines, also known as tidal energy converters (TECs), on a large scale. It will also standardise and modularise the design of the structural foundation, cables, cable protection system and the TEC connection to the infrastructure. Ultimately, the solution will reduce the levelised cost of energy (LCOE), which is a metric used to compare the cost to generate each unit of power taking into account lifetime costs and inflation.

The Excalibur concept also focuses on the cable management solution and the cost benefits to be gained by improving the speed of connection and the cable protection. Cables are often overlooked in the design phase but can be the main source of problems during operation. The cables for Excalibur will need only a basic layer of armour as they will be shielded from the environment and pre-installed with the structures.

### PREVIOUS SUCCESS

The concept for Excalibur is built on the company's previous success with a novel cable protection solution for aggressive tidal environments. They recently carried out a full-scale test of this device in the waters around Orkney where tides can reach up to 6 m/s. Excalibur utilises the cable protection benefits of this device with a unique way of accessing the TECs in the dry.

### LOOKING AHEAD

The aim of this project with Innovate UK is to prove the concept with the support of a steering group, so that it can be taken to the next phase – detailed design and testing. Jee is keen to market the device globally so that the off-the-shelf solution can drive down CAPEX costs for all developers, regardless of technology.

Focus is on supporting the growing renewables industry with new, innovative solutions for offshore wind, tidal and wave. Excalibur will help the tidal industry deliver cost-effective projects by reducing the overall LCOE to make more projects viable and economical, whilst also improving reliability.

### Jee Limited



**ENERGY**  
A BALANCED FUTURE 2017

**NOF ENERGY NATIONAL CONFERENCE & EXHIBITION**  
8<sup>TH</sup> MARCH 2017 (7<sup>TH</sup> NETWORKING RECEPTION)  
SAGE GATESHEAD, NORTH EAST ENGLAND

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# EMEC SUPPORTING CHINA MARINE ENERGY CENTRE

UK wave & tidal energy experts are building innovation links with China based on the world-leading experience at the European Marine Energy Centre (EMEC) in Orkney.

Image credit – Mike Brookes-Roper

As Chinese academics turn their attention towards the global potential for marine renewable energy, they invited EMEC and other UK industry experts to visit their developing 'blue silicon valley' in Qingdao, discussing the creation of a Chinese version of EMEC: CMEC.

## PROSPERITY FUND PROJECT

The Prosperity Fund project, supported by the UK Foreign and Commonwealth Office and China Britain Business Council (CBBC), was set up to help progress policy support in China towards developing a demonstration site to facilitate innovation in wave & tidal energy.

The project involves EMEC providing feasibility studies around the creation of a CMEC facility as part of a brand new £200 million (2 billion Yuan) marine laboratory campus in Shandong Province, China.

Qingdao National Laboratory for Marine Science and Technology will serve as the base for the project, drawing researchers

from a number of Chinese universities. An ocean energy demonstration site has already been identified as a key aspect of the lab's innovation activities.

## WORKSHOPS

Following an initial workshop in Orkney in October this year, Neil Kermod, EMEC's Managing Director visited the new lab in Qingdao this month to take part in a follow-up workshop, part of the 'Aoshan Forum':

Neil commented *"EMEC has more than a decade of experience in the design, build and operation of its marine energy test facilities with more wave & tidal devices having been tested at EMEC than anywhere else in the world (27 devices from 17 companies from 9 different countries). This important R&D activity has created a UK-wide boost to innovation in the maritime economy supply chain which is world-*

*leading and already exporting its knowledge and expertise.*

## WORKING TOGETHER

*"The maritime capabilities in and around Qingdao are astonishing, and China has a very strong stance on tackling climate change. Combined, this makes marine energy an interesting and important endeavour for their researchers. We met several academics who are already developing technologies and the new laboratory campus in Qingdao gives them a perfect base from which to progress their innovations.*

*"We've been met with a real appetite in China to learn from the experience gained over the last decade at EMEC, and we're keen to continue building collaborative R&D and innovation links between the UK and China to help drive the development of ocean energy on a global scale."*

## CHINA'S 13TH FIVE YEAR PLAN

James Brodie, Director of Energy at CBBC added: *"With the inclusion of marine energy in China's 13th Five Year Plan, and ambitious targets, it's an emerging sector that the country would clearly like to see developed rapidly but significant gaps remain in their innovation infrastructure to make this a reality. As the world leader in marine energy, the UK is in a fantastic position to support and benefit from this development by engaging at an early but crucial stage."*

## THIRD WORKSHOP

A third workshop focusing on wider commercial dialogue between the UK marine energy supply chain and China will take place between 15th-17th February 2017, and companies are invited to register interest.

## EMEC

The vertical Pulsus prototype tidal energy turbine.



# TIDAL TURBINE SUCCESSFULLY TESTED

Vesconite Bearings is proud to be associated with tidal energy equipment developer Norwegian Ocean Power, which has successfully trialled its Pulsus horizontal-axis spiral-design tidal turbine, as part of the development of its first commercial unit.

## TESTING

The turbines were tested in Drammensfjorden, Norway, where a dynamic test on the composite structure and bearings was performed. The structure bends and flexes with tidal currents, which can produce significant turbulence and considerable upward and sideward forces, so the testing of uneven forces is a key part of testing for this tidal-turbine.

*"We were hoping to separate out any vibration from the structure,"* commented Technical Director and founder Kent Thoresen, noting that the company's turbine was successful in this aim. The thrust bearings moved backwards and forwards and eliminated the vibration as planned, that may have otherwise lead to a systemic failure.

## BEARING SELECTION

The 0,5m-diameter Vesconite bearings, meanwhile, which were installed on each end of the horizontal unit, also performed

well in their ability to absorb vibration. They were chosen after the testing of various competing products that were less flexible and exhibited dry-run problems. They are also shown to exhibit no swell in water; require no grease, oil or additional lubrication; and have a load capacity that is unaffected by water.

*"There are many failed projects in the tidal energy industry due to turbulence that causes vibration and uneven force distribution. That is why it was important to fully test our unit in real sea conditions,"* Kent concluded.

## NORWEGIAN OCEAN POWER

Norwegian Ocean Power is the owner, financier and developer of the innovative turbine technology, which will be installed in the sea of Norway next year and begin commercial production of 1TWh of energy per year for use in Norway.

The intention is to start production on several turbines in 2017 and 2018, with Canada and the UK being the most likely first markets for these turbines.

## Vesconite Bearings



Image – Simon Gillet, CEO, Wave-tricity (Left) and Stewart Graves, Managing Director, Mainstay Marine Solutions

# £5.8M CONTRACT SECURED

A designer, builder and maintainer of workboats and renewable marine energy devices has won a contract to build a new energy device for a £5.8m scheme in South Wales. Pembroke Dock-based Mainstay Marine Solutions will complete the first major stage of an innovative wave energy converter development project on behalf of client Wave-Tricity.

### COMPANY GROWTH

The contract win continues a successful period for Mainstay, which now employs 80, with 10% of the direct workforce consisting of apprentices. The firm's turnover has increased by a third, from just under £4m to more than £5m, during the last twelve months.

### FUNDING

Wave-Tricity was recently granted a £4m investment from the European Regional Development Fund via the Welsh Government. It will develop and test a

new device called the Ocean Wave Rower, which will convert the natural motion of the waves into clean energy.

The device will be deployed in the Pembrokeshire Demonstration Zones, a wave energy site off the Pembrokeshire coastline, for two years. This trial, which is scheduled for sea trials in February 2017, will help produce a commercially viable, real world wave energy converter.

### ENVIABLE REPUTATION

Mainstay's Managing Director, Stewart Graves commented: *"We have built an enviable reputation for our work on projects in marine energy. We are looking forward to working closely with Wave-Tricity on this pioneering scheme."*

*"It's the third contract win we have won in the second half of 2016. Our dedicated and skilled workforce, which has doubled in the last 2 years, has been instrumental in our growth and success."*

“WON A CONTRACT TO BUILD A NEW ENERGY DEVICE FOR A £5.8M SCHEME”

### KEY GOAL

Matthew Fairclough-Kay, Managing Director at Wave-Tricity, concluded: *"One of our key goals was to ensure the scheme benefited the local economy and created supply chain opportunities for the region's businesses."*

*"We're thrilled to be working with Mainstay, which will play an important role in bringing the prospect of clean wave energy a step closer to commercial success."*

**Mainstay Marine Solutions**  
**Wave-tricity**

## SUPPORTING UNIVERSITY OF LIMERICK'S PIONEERING RENEWABLES PROJECTS

Forum Energy Technologies has won an order to supply the University of Limerick with a Remotely Operated Vehicle (ROV) to support its subsea inspection and intervention work on renewable energy infrastructure.

### RESEARCH CENTRE

The University's Mobile and Marine Robotics Research Centre (MMRRC) has purchased the Sub-Atlantic Comanche 2,000 metre Observation Class ROV and associated launch and recovery system for delivery in March 2017 under a MaREI Science Foundation Ireland infrastructure grant (15/RI/3232).

The Comanche was selected due to its high thrust to drag ratio enabling it to operate in strong waves, currents and winds – typical conditions for the offshore renewables industry. The system will be equipped to a high specification with precision positioning and navigation systems, camera and lighting systems and sonars.

### AIDING RESEARCH AND DEVELOPMENT

Dan Toal, Director MMRRC, University of Limerick commented *"To aid research, development and roll out marine renewable energy, it is vital that we can operate in the high energy wave, wind and tidal regimes of target sites and understand the environment from an operational capability. Wind, waves and currents can make it an extremely difficult environment for humans to operate in, so it is necessary for us to use advanced subsea robotic systems and vehicles which are capable of operating in the harshest of underwater conditions."*



### BLENDED AUTO-CONTROL APPROACH

*"Forum's Sub-Atlantic Comanche ROV is designed and proven to work effectively in strong wind and current regimes. Coupled together with University of Limerick's OceanRINGS autopilot systems we believe a blended auto-control approach can push the capabilities of current underwater platforms, reducing the dependence on the few in number most experienced pilots, extending operational weather windows and allowing us to get to infrastructure that otherwise we would have no way of inspecting, repairing and maintaining."*

*"This vehicle is based on years of research and development and will help us in our work to improve renewable technologies and learn how to make effective use of our oceans resources."*

The vehicle will be housed at Limerick Docks where experimentation, testing and demonstration will be carried out. It will also be mobilised on vessels at other ports in Ireland, for offshore work at wind, tidal and wave energy test sites and farms.

Kevin Taylor, Vice President for Subsea Vehicles at Forum said: *"It is a pleasure to be supplying one of our vehicles to support the University of Limerick with their pioneering research in marine and renewable energy. Our*

*Comanche ROV is an extremely powerful unit for its type, and its ability to house components makes it ideal for this type of work."*

### MMRRC

The MMRRC in the University of Limerick, established in 2000 by Director Dr. Daniel Toal, is the only research centre focused on the application and development of marine robotics within the island of Ireland. This research centre consists of a mix of postdoctoral researchers and PhD students from various disciplines including electronic, computer, mechanical and aeronautical engineering backgrounds. The research centre brings together a highly capable engineering group focused on developing practical and industrial relevant marine technologies.

### FORUM ENERGY TECHNOLOGIES

From marine robotics to navigation, sensor development, emergency response planning, ROVs and unmanned aerial (UAS) technologies, they are actively involved in developing a diverse range of practical technologies in Irish funded (including Science Foundation Ireland), European funded and industry collaborative projects.

**Forum Energy Technologies**

# ELECTROMECHANICAL MOORING STRETCH HOSES

## EXPERIENCE

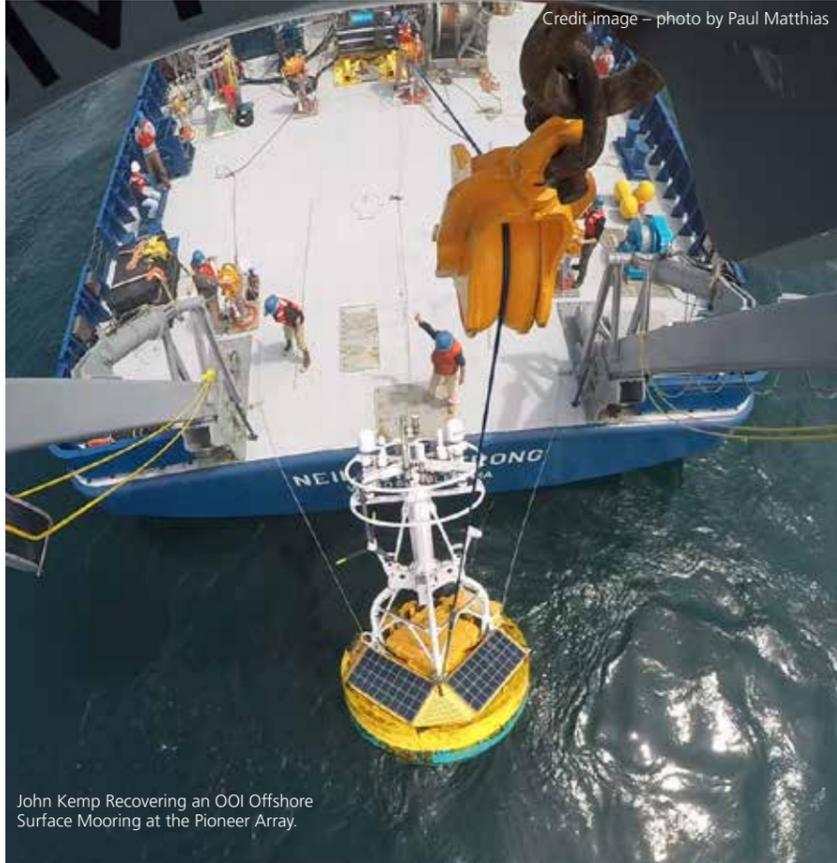
Engineers at the Woods Hole Oceanographic Institution (WHOI) have spent the last 20 years developing highly compliant, fatigue-resistant mooring elements for power and data transmission – from surface to seafloor, in order to meet the challenging requirements for ocean systems ranging from delicate sensing instruments to power transmission. EOM Offshore (EOM) is a startup company founded in 2009 to commercialise key specialised mooring technologies resulting from that work, and remains the exclusive licensed distributor for patented stretch hose technology.

Stretch hose moorings are capable of stretching and contracting to accommodate wave action (heave and surge) and are currently revolutionising mooring-reliant projects and industries worldwide, not only by providing mechanically silent, electrically conductive moorings for hydrophone and other sensitive listening installations, but also by extending mooring lifetimes due to the extended resistance of the stretch moorings to wave action fatigue.

## OCEAN OBSERVATORIES INITIATIVE

A primary user of the EOM stretch hose technology is the National Science Foundation-funded Ocean Observatories Initiative (OOI), a long term, integrated infrastructure project composed of science-driven platforms and sensor systems that measure physical, chemical, geological and biological properties and processes from the seafloor to the air-sea interface. A WHOI-led team has designed and deployed global buoys and gliders at four OOI Global Arrays, to address planetary-scale issues in critical high-latitude locations in the Northern and Southern hemispheres.

Additionally, the WHOI team led the design and deployment of buoys and gliders at the Coastal Pioneer Array off the coast of New England. EOM's



John Kemp Recovering an OOI Offshore Surface Mooring at the Pioneer Array.

Credit image – photo by Paul Matthias

Electromechanical Stretch Hoses are employed in these moorings, ensuring the reliable flow of real-time data.

The design of the Coastal Surface Moorings includes a fully electromechanical mooring riser to collect oceanographic data from the surface all the way to the seafloor. The design also makes use of specialised interface components such as EOM Mooring Universal Joints and EOM Electromechanical Mooring Chains.

Coastal Profiler Moorings provide real-time telemetry from wire-following profilers sampling the water column. A large subsurface sphere is positioned to maintain a taut cable for the wire-following profiler to track along, while the Mooring Stretch Hose provides a compliant electromechanical connection between the subsurface sphere and the small surface telemetry buoy.

The OOI programme is designed to provide consistent and accurate data as a resource for scientists working on critical issues and the EOM mooring components are playing an important role in ensuring the accurate and continuous real-time transmission of data to shore from instruments and sensors in the ocean.

## ACOUSTIC MONITORING

EOM's Passive Acoustic Moorings enable detection of marine mammal vocalisations with real-time telemetry and are currently being used to aid the endangered North Atlantic right whale. Feeding while drifting at the surface, right whales frequently can get hit by passing ships causing severe injury or death. The whales communicate actively underwater with low frequency moaning sound bursts. Listening from shore to the right



Credit image – photo by Tom Kleindinst

Chris Hines (EOM Offshore) helping to prepare the Environmental Sample Processor (ESP) which utilises the EOM stretch hose.

whales' vocalisation from Passive Acoustic Moorings, researchers and observers are able to monitor the presence and location of these animals. With this information, vessels could be warned to change their course, lower their speed, and look out for whales in their paths, reducing the risk of collisions.

Passive Acoustic Moorings have been deployed near New York, Massachusetts, and Maine, in and around busy shipping lanes, relaying information on whale presence and location in near real-time to prevent ship strikes. These innovative stretch hose moorings, supporting a hydrophone, can detect and relay underwater sounds in all sea state and weather conditions.

Traditional surface moorings include slack to accommodate buoy movement in storm conditions, resulting in flow noise that masks underwater sound signals

and makes acoustic detection impossible in anything other than calm conditions. The EOM stretch hose enables real time data to be collected in all conditions, with minimal flow noise due to hydrophone movement.

## LOOKING FORWARD

WHOI and EOM are in the process of extending the power-handling capabilities of the stretch hose to encompass the high voltage and current required by floating offshore power-generating installations. All floating power generating technology is faced with significant wave & tidal action- induced fatigue of the cables used to conduct the generated power to the sea floor distribution network. These power cables are subjected to continuous cyclical bending and fatigue between the platform and the ocean floor, resulting in costly

failures. Electromechanical Stretch Hoses, engineered for toughness, long-life, and fatigue resistance, offer unprecedented reliability in these applications.

Development partners are being sought to join a WHOI/EOM venture to develop working prototypes for high-power stretch hoses. Stretch hose technology is currently covered by two issued and one pending US patent.

## Woods Hole Oceanographic Institution EOM Offshore



# 3G IS STILL FIT-FOR-PURPOSE

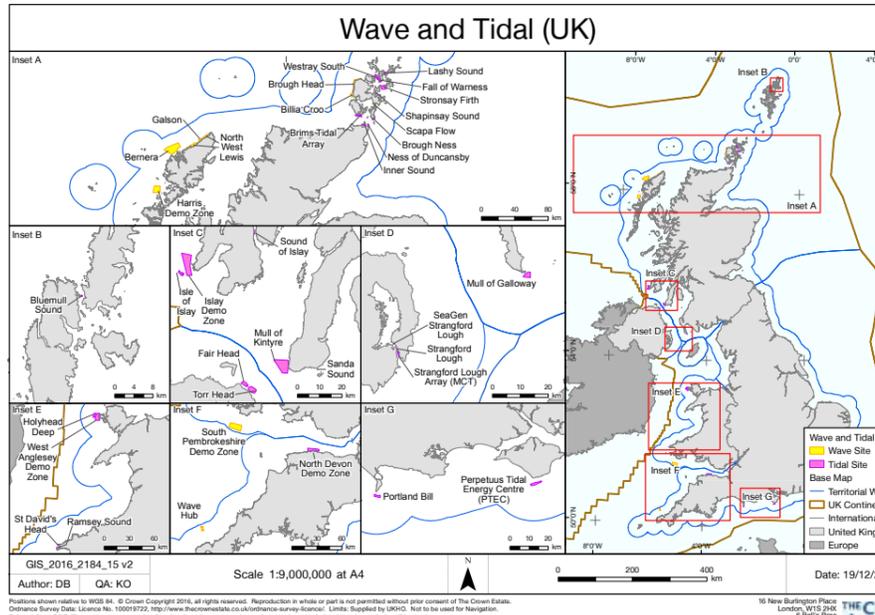
By any standards, 2016 proved to be an interesting year with Brexit, the US elections and global geo-political instability all influencing energy and commodity prices.

Moving into 2017, many uncertainties continue and despite significant ratification of the Paris Agreement, it remains unclear how governments and consequently, the renewables industry, will respond. Investment in marine renewables will invariably be affected, with budgets being will be closely scrutinised. All stakeholders will continue seeking ways to reduce costs and optimise efficiencies in delivering their technologies and energy.

## UTILISING BUDGETS EFFECTIVELY AND EFFICIENTLY

Foundation solutions, whether anchored, moored or static remain a significant cost for any marine renewable project. However, there remain a number of possible mitigations to utilise budgets effectively and efficiently, perhaps the most significant being to adhering to the '3G's' – Geoscience, Geotechnics and GIS. Investing in an intelligent and integrated geoscientific data acquisition programme enables a site to be appropriately characterised in relation to the proposed energy converter load case, design and installation. Geophysical and geotechnical site surveys typically consume 5-10% of any project's overall budget so it is wise to optimise data acquisition, designs and methodologies as early in the project life cycle as possible, reducing subsequent costs, risks and rework.

The Crown Estate's Wave & Tidal (UK) 2016 Chart depicts current UK wave & tidal interests, which by their very nature, are challenging sites in terms of physical environments, metocean and subsea geology. As wave & tidal converters exhibit considerable diversity in concept and design (e.g. wave 'bobbers' and 'flappers'; vertical and horizontal axis tidal turbines), it should follow that different considerations invariably prevail at these disparate geographical locations.



## ACQUISITION PLAN

Geoscientists have long since emphasised the value of obtaining key geoscientific parameters, particularly geotechnical, to assist with load case versus design optimisation, as encapsulated in a six-point data acquisition plan...

1. Detailed desktop study
2. Shore site walkover, if applicable
3. Geophysical, and possibly visual, surveys
4. Shallow geotechnical surveys and/or drillings
5. Onshore geotechnical drillings (if applicable)
6. Integrated Report

## FURTHER UTILISATION

We would propose additional feedback loops after the Integrated Reporting phase to enable all relevant stake holders to further utilise the presented data via GIS. This provides a unified, flexible and interactive medium to further validate ground models, optimise design, assist with subsea infrastructure installation, verify and certify.

“ALL STAKEHOLDERS WILL CONTINUE SEEKING WAYS TO REDUCE COSTS AND OPTIMISE EFFICIENCIES IN DELIVERING THEIR TECHNOLOGIES AND ENERGY”

These GIS libraries should be updated and iterated, due to the dynamic nature of the operating environments, to provide data and bench-marking from inception through to final ecommissioning.

## RETURN ON INVESTMENT

In short, a robust geoscientific data base is a critical and key success factor throughout a project life cycle. The initial investments will almost certainly pay-off in the long run.

**Peter Larkin and Hardeep Sidhu**  
Independent offshore energy consultants  
Cetus Innovate Limited

# LEADING THE WAY IN DYNAMIC MOORING TETHERS

Irish SME, Tfi Marine, is supplying its mooring spring components as part of a project to drive down the cost of ScotRenewables' tidal energy platform.

Mooring systems for floating tidal platforms are stretched taut by the turbine thrust load with no give to absorb wave loadings above this. Now TFI Marine components can be added to the mooring to absorb these wave loads. These components, capable of managing loads up to 300 tonnes will be deployed on the moorings of the new ScotRenewables' 65m long floating tidal turbine, at EMEC in 2017.

Wave and floating tidal energy devices need to be kept in position to both produce power and to ensure their survivability. The moorings also need to minimise the impact of wind, current and wave loads on the structure, along with being able to facilitate the dynamic movement (or lack of) required for optimal energy production. These are very difficult challenges for traditional moorings.



## CUSTOMISABLE

Developed with these requirements in mind, the company is offering developers polymer tethers; combinations of elastomers and thermoplastic springs; each customised for wave, floating tidal and floating wind devices and the associated environmental conditions.

For wave energy devices that require station keeping while moving freely in the waves, TFI can offer a tether with low stiffness response in normal load conditions and high stiffness response in extreme weather conditions; reducing peak loads by up to 70% and eliminating shock loads.



For rigid station keeping they deliver very stiff response in operating conditions with low stiffness response in survival conditions; with no change in motion in operating conditions but freedom of motion in extreme conditions to ensure survivability.

For floating tidal devices, they deliver a very stiff response up to the thrust loads and low stiffness response above that.

## SCALABLE

They are fully scalable up to multi-MN loads and offer developers the potential to operate in conditions and locations previously unachievable, enabling increased power production along with substantial capital and operational cost reductions.

## TFI Marine

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# DEVELOPING REVOLUTIONARY TECHNOLOGY

Marine Power Systems (MPS), a Swansea-based company that is developing revolutionary technology designed to harness wave energy, has reached an important stage of the development of the device, with the manufacture and assembly of WaveSub significantly underway.

### WAVESUB WAVE ENERGY CONVERTER

The revolutionary WaveSub Wave Energy Converter developed by the company is a unique, patent protected, award winning device. The WaveSub solves the four main challenges facing all developers looking to capture wave energy.

1. Developing efficient energy capture in any sea condition
2. Securing the technology's long-term survivability in a harsh environment
3. Ensuring the devices are easy to deploy, recover and service
4. Guaranteeing they are cost efficient to build in relation to the power they produce

### RELIABLE RENEWABLE ENERGY SOURCE

The WaveSub will provide a reliable renewable energy source through harnessing the energy from ocean waves. The technology being developed by MPS has huge potential to contribute to energy security targets and will reduce reliance on unpredictable and non-renewable energy supplies.

The fabrication of the 1:4 scale WaveSub is an important step in the journey towards commercialisation of the project. The device is 15metres long, 10metres wide and 2.5metres tall. A full scale, single device will be 40metres long, showing the scale of the technology being developed.

### TESTING

Ahead of testing at FaBTest, Falmouth MPS carried our detailed testing and analysis of seabed sediment. This was completed in order to gain a full understanding of the site where the anchors of the WaveSub device will be placed, and to inform the final anchoring specification for the WaveSub.

### INNOVATIVE SURVIVABILITY MECHANISM

Due to WaveSub's innovative survivability mechanism, the loads transmitted to the mooring system are significantly reduced, allowing the company to achieve a highly cost effective solution in terms of all mooring system components. This plays a key part in contributing to a low Levelised Cost of Energy, which is vital to reaching commercialisation.

“HUGE POTENTIAL TO CONTRIBUTE TO ENERGY SECURITY TARGETS”

### FUNDING

MPS' WaveSub project has been part-funded by the European Regional Development Fund through the Welsh Government, with MPS receiving a £2 million grant in October 2015.

### Marine Power Systems

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# DEEP GREEN'S DETACHABLE DESIGN DRIVES DOWN COSTS

Minesto develops a unique tidal energy technology called Deep Green. The device is the only known and verified technology to cost-effectively produce electricity from slow tidal streams below 2.5 m/s in speed.

## HOW IT WORKS

This is made possible by "flying" a subsea kite, consisting of a small turbine attached underneath a 12-metre wing, under the water. Using the tidal currents lifting force on the wing, the Deep Green power plant is steered by rudders in a predetermined eight-shaped trajectory. By doing so, the power plant pushes the turbine through the water at a speed several times higher than the actual velocity of the current it operates in.



seabed foundation via a 100-metre-long tether. This means that the device operates in the higher pillars of the water column, where most of the energy is. It also means that the wing and turbine can be detached from the tether at a top joint.

As a result, small vessels are needed also in operations and maintenance for handling of the wing, turbine and struts. But the truly incremental cost driver is that the device allows a launch and recovery system that minimises the need for subsea operations. After securing the detached tether to a buoy, Deep Green can be transported to onshore facilities for cost-effective service and maintenance.

Minesto

## COMPETITIVE ADVANTAGE

One of the major competitive advantages of the technology is that the concept enables offshore operations that are relatively low-cost. The small and lightweight design (the power plant in commercial-scale will have a dry weight of approx. 10 tonnes) means that smaller, less expensive vessels are needed for installation.

## DETACHABLE DESIGN CONCEPT

Another important aspect is Deep Green's detachable design concept. The power plant is moored to a bottom joint at the



## REDUCING STRUCTURAL COSTS AND DEVELOPING DURABLE

One of the biggest obstacles to the commercial use of wave energy today is cost and complexity. From mooring, anchoring and structural costs through to grid connection and deployment, wave energy costs remain high compared to other renewables.

### FLEXIBLE TECHNOLOGY

Danish company Waveston is developing an innovative, flexible wave power technology in partnership with Vryhof, a leader in offshore mooring and anchoring, the Technical University of Denmark (who have developed hydrodynamic model to test the new system) and hydraulic pump specialists, Fiellberg.

### TECHNOLOGY AND DESIGN PRINCIPLES

The technology and design principles are based on a slim, light and cost-effective wave structure, consisting of a horizontal cable – anchored at each end – on which vertical energy collector (ECs) are mounted like a string of pearls.

Due to the string's length and the oscillating waves, these ECs will face forces in opposing directions, cancelling each other out and creating a stable structure where relatively small forces can anchor the cable. The moving ECs then pump seawater into the pipes with the pressurised water powering a turbine.

### EXPERTISE

Vryhof, which has considerable marine renewable energy sector expertise as well as in oil & gas, designed the offshore structure, providing mooring expertise and the installation of just two Stevpris Mk6 anchors.

The anchors have an extremely high weight/strength ratio with their enlarged surface delivering holding power up to 30% higher than other drag anchors.



### REDUCING MOORING AND STRUCTURAL COSTS

Michael Henriksen, Waveston CEO explained: *"With reduced mooring and structural costs central to making our new technology commercially viable, it was essential that we partnered with a global offshore leader with experience in renewables. Vryhof met this criteria."*

### SUCCESSFUL TRIALS

The Waveston technology has undergone a number of successful trials, including in a closed bay in 2013 and - more recently - three kilometres offshore of Hantsholm in Northern Denmark where wave height can be up to nine metres. Next steps include the scaling up of the ECs with commercial roll out expected by 2020.

### WIDER INDUSTRIAL APPLICATIONS

Michael concluded: *"We have a number of interested local islands and communities, currently dependent on diesel generators, and we then plan to deploy in wider industrial applications. Reliable, clean and cheap wave power is now much closer to being achieved."*

Vryhof

# ENGINEERING SUCCESS

We introduce Parker Hannifin a Fortune 250 global leader in motion and control technologies. For 100 years the company has engineered the success of its customers in the mobile, industrial and aerospace markets.

They now bring that engineering expertise to the ocean power market. We hope you enjoy reading about a specific tidal turbine and its foreseen benefits to the industry.

## THE ATLANTIS TIDAL TURBINE AR1500

The ocean power market and specifically the tidal energy market segment is one of the the most promising emerging renewable energy segments and in contradiction to the leading and more well-known renewable energy sources of wind and solar power, tidal power has the quality of widespread predictability!

## VARYING ENERGY TECHNOLOGIES

An unusual aspect of ocean energy is the approach of the market’s technology developers to capture the power of the ocean – there is not, as yet, a standard approach as we see in mainstream wind and solar industries. Some technology developers are aiming to convert wave motion into electrical power and connect to the grid, where others are looking to supply off-grid smaller amounts of electrical power. Yet more are using the water’s movement to pump water back to shore for water processing purposes (reverse osmosis for drinking water).

The tidal segment of the ocean power industry, because of its predictability, is ideal to provide electrical power to the grid. However even here we see numerous approaches and device designs being utilised to accomplish this.

## COMMON FACTORS

Three common factors are: the need for financial investment, the massive dedication by the technology developers needed to bring the technology to prototype phase and the milestone of launching a full scale device into the water.

This milestone is now imminent with the launch one of the industry’s leading technology developers with their latest tidal turbine, the Atlantis Resource’s AR1500 tidal turbine!  
The AR1500 turbine is a 3 bladed, seabed mounted device with a rated capacity of 1.5MW at 3.0 m/s tidal flow. It is designed to withstand the extreme environmental conditions expected in the Pentland Firth in Scotland and the Bay of Fundy in Canada.

## TURBINE FEATURES

This turbine exhibits best in class design, with features such as...

- Variable pitch rotor blades for maximum energy capture
- Integrated gearbox and bearing-less permanent magnet generator
- Fast deployment and connection system; nacelle deployment less than 90 minutes
- 360 degree yaw capacity and survival lock system
- Multiple, fully redundant electrical systems for long term subsea operation

## LOCKHEED MARTIN

Lockheed Martin Corporation completed the detailed design of this cutting edge turbine in the USA. The corporation is an investor of Atlantis Resources, who have a design and build contract for the yaw drive, the variable pitch system, the manufacture of the steel turbine housing and the assembly of all the turbine modules (including the gearbox and generator). The contract also includes the systems integration and quality assurance of the overall turbine delivery programme. The current scope of the contract is an extension of the original contract dating back to 2013.

In conjunction with the design and build of the variable pitch system, the yaw drive and the lubrication oil filtration system on the gearbox, Lockheed reached out to industry leader in the motion and control space, Parker Hannifin.

## PARKER HANNIFIN – PROJECT CONTRIBUTION

Although typically not direct financial investors into the technology developers of the tidal energy capture devices, all supply chain companies involved in tidal projects make a significant investment in respect of time and resources.

They accept the risk of device/project failure, in order to assure the right products are chosen and implemented that allow maximum performance and ultimately to secure future sales.

## INVESTMENT

Parker have been investing in the wave & tidal industry for many years and have built or supplied product for many of the devices on sea trials. Atlantis, who have already seen successful sea trials with their previous tidal turbine are a natural candidate for Parker to support and supply components and systems.

## MULTI-COMPETENCE TEAM

Forming a multi-competence team spreading over the Atlantic, Lockheed initially worked with Parker’s Hydraulic Sales Engineer for north east region of the United States, Dave Hamby, to specify the correct hydraulic products for the variable pitch rotor blade system. This system is one of the turbine’s most essential systems as the blade pitch angle not only controls the speed of the turbine’s rotation (energy capture) but also functions as the primary brake.





Gearbox with Lubrication Oil Filtration system



**TECHNICAL DETAIL**

Pitching the blades into the flow increases the torque applied to the transmission shaft and drives the rotation. Oppositely, pitching the blades out of the flow, decreases torque and the turbine slows. In fully feathered position the blades are idled, the nose slows and the system can be brought to rest by the shaft brake.

**INTERNATIONAL COLLABORATION**

As the concept design approached completion the decision was made by Lockheed to have the turbine manufactured in Germany by a specialist company in the marine industry. At this moment the project became international and an ideal fit for coordination by Parker’s Global Energy Team’s Business

Development Managers on both sides of the Atlantic, Rob Salzer coordinating in the USA and Calum McConnell coordinating and accompanying the project in all phases in Europe.

Over a period of 18 months the Parker team worked closely with the Engineers in Lockheed and at the build company in Germany to specify the final Bill of Materials and final hydraulic circuitry. At this stage the variable pitch rotor blades project adopted products from across two continents, 6 countries and 10 Parker manufacturing divisions supplied via Parker sales organisations in Germany and the USA.

**PROGRESS**

In the summer the variable pitch rotor blades system within the nose of the turbine, moved into the final build phase

– the assembly and piping up of the hydraulic system components. Most of the pipes were produced and supplied as pre-fabricated pipe assemblies, but to offer maximum flexibility in the prototype phase it was decided to produce the hoses on-site using one of Parker’s German Technical Service Engineers; Wolfgang Fey.

Together with support from the local German Account Manager - Stefan Schlienz-Bouman, the nose section hydraulics for the variable pitch rotor blades system was completed and the system moved into the factory test phase, an exciting and tense phase for any new device!

Thanks to the massive dedication of all concerned, as well as technical support from various Parker divisions, the factory test phase finished and the turbine shipped to Scotland for final testing.

**GEARBOX**

Parallel to all of the activities for the variable pitch rotor blades system, Parker’s full line distribution partner, RG Group in the USA supplied Lockheed with hydraulic and fluid connector components for the yaw drive system and Parker Filtration division Europe designed, built and supplied the gearbox Lubrication Oil Filtration system, via Parker UK Sales, to Atlantis’s gearbox supplier Involution Technologies.

The commissioning stage of the gearbox with Atlantis and Involution engineers on site at the UK Catapult Offshore Renewable Energy site in Blyth was also supported by Parker engineers.

Involution’s Managing Director Mark Cunliffe told us *“Involution’s Engineers in the course of their careers have been involved in three of the world’s leading*

*tidal projects to date and it was with great pride that we were asked to take part in the Atlantis project to finally realise our ambition of seeing our class leading technology applied to a full scale array of tidal turbines having first started in tidal in 2006”.*

**DEDICATION AND FUTURE CONFIDENCE**

As Parker’s overall Project Manager Calum McConnell said: *“This project was indeed a serious investment of resource, but Atlantis’s technology, dedication, plan to market as well as their investor pool and the fact that they own the Meygen site, indicate strongly that although the tidal market does represent investor risk, they are one of the strongest candidates in the market space and highly likely to*

*be successful in their bid to produce hundreds of megawatts of grid connected power.*

*“The resource investment is large, as are the potential gains. We look forward to tomorrow, working closely with Lockheed and Atlantis and the next stages of the project!”*

**Parker Hannifin**





The challenge

Harvesting energy safely and efficiently

## 2016 – THE MOST INTERESTING YEAR IN THE HISTORY OF THE INDUSTRY

As Atlantis Resources' Tim Cornelius commented at last year's Scottish Renewables' Marine Conference in Inverness "The most interesting year in the history of the industry."

### MEYGEN PROJECT

Atlantis's MeyGen project, the world's largest tidal energy scheme, launched just prior to the conference. Tim told the gathering how he believes the project's eventual need for 200+ turbines represents "an unprecedented opportunity for turbine suppliers."

### CHALLENGE

This is a challenge for the company that will be addressed by diversification across the supply chain. More pressingly, the current uncertainty around securing a route to market through the CfD mechanism "Will be solved" with Tim saying: "There are very clever people working on [this issue] and I am confident there will be a solution."

### MILESTONES

Nova Innovation, Scotrenewables and Sustainable Marine Energy celebrated well-reported milestones in 2016, and Albatern's unique work with aquaculture business Marine Harvest Scotland is progressing well. Technology readiness levels are rising, and upcoming calls from Wave Energy Scotland give further cause for optimism in the sector.



As ever, though, two issues – access to finance and grid connections – were described as critical by speakers at the conference.

### FINANCE

Tim Sawyer of Carnegie Wave Energy UK told the event's final industry leaders' session: "We are working off chicken feed to develop game-changing technology, but despite that we have created amazing things."

### GRID ISSUES

It was Ronnie Quinn, General Manager of The Crown Estate's Scotland Portfolio, who summed up the grid issue. He said: "We suffered from the illusion that if we build it the grid would come, but that hasn't been the case: National Grid does not invest speculatively."

That grid remains such a key challenge is predictable for sectors whose resource is predominantly located far from our towns and cities.

### INNOVATIVE SOLUTIONS

But innovative solutions are starting to emerge, such as MeyGen's joint use of a community windfarm's grid connection, which Atlantis' Tim hailed as a huge step forward.

## SUPERVISORY CONTROL AND DATA ACQUISITION APPLICATION

MeyGen is the world's largest tidal stream project, located in the Inner Sound of the Pentland Firth, between the north Scottish mainland and Stroma Island. Atlantis Resources Ltd is supplying their 1.5MW AR1500 tidal turbine to the project.

Atlantis Resources Ltd has over a decade of experience in tidal power technology, culminating in the AR series of turbines for high energy open ocean environments. The AR1500 has active pitch, full yaw capability and an 18-metre rotor diameter. Each 150 tonne turbine nacelle is approximately 11 metres in length and has a design life of 25 years.

### DESIGN AND DEVELOPMENT

The product supplied by Atlantis Resources Ltd includes a PLC-based control system for the turbine and Cougar Automation Ltd designed and developed a Supervisory Control And Data Acquisition (SCADA) application to allow the remote monitoring and control of this turbine.

### KEY FEATURES

The key features of this web-based application, developed using Iconics Genesis64 are...

- Acquisition of live turbine data from the PLC using OPC UA protocol
- User-friendly graphical interface for data presentation and turbine control
- Full real-time and historical alarm management system
- Collection, logging and display of turbine data using a high-speed, mission critical historian
- Distributed software architecture allowing scalability and process-related asset trees

It was no surprise that the conference, well-attended as it was by smaller developers, supply chain and professional services, was dominated by the huge success of MeyGen. The optimism that this clearly produced in through sectors so used to overcoming adversity was palpable.

And in the final session OpenHydro's Sue Barr perfectly summed up the determination of the marine energy industry to succeed, saying: "Reverse engineer a challenge and you get an opportunity."

Lindsay Roberts  
Senior Policy Manager  
**Scottish Renewables**



### CONTROL SYSTEMS INTEGRATOR

Cougar Automation Ltd is a Control Systems Integrator with a 25-year pedigree, 100 staff and 6 UK offices. As one of the largest independent SI's in the UK, it has all of the business systems, accreditations and financial strength demanded by their clients, as well as experience with all the major SCADA and PLC platforms and many more specialist technologies.

### TEAM SPIRIT AND COMMITMENT

Their work is delivered by people who work in small fixed project teams and look after the same clients. The team spirit and commitment which this fosters delivers a superior customer service – borne out by the very positive feedback that they systematically gather for every project.

This unique combination means Cougar Automation Ltd can offer the capacity and professionalism of a large contractor whilst giving you the service and flexibility of your local independent.

### TESTIMONIAL

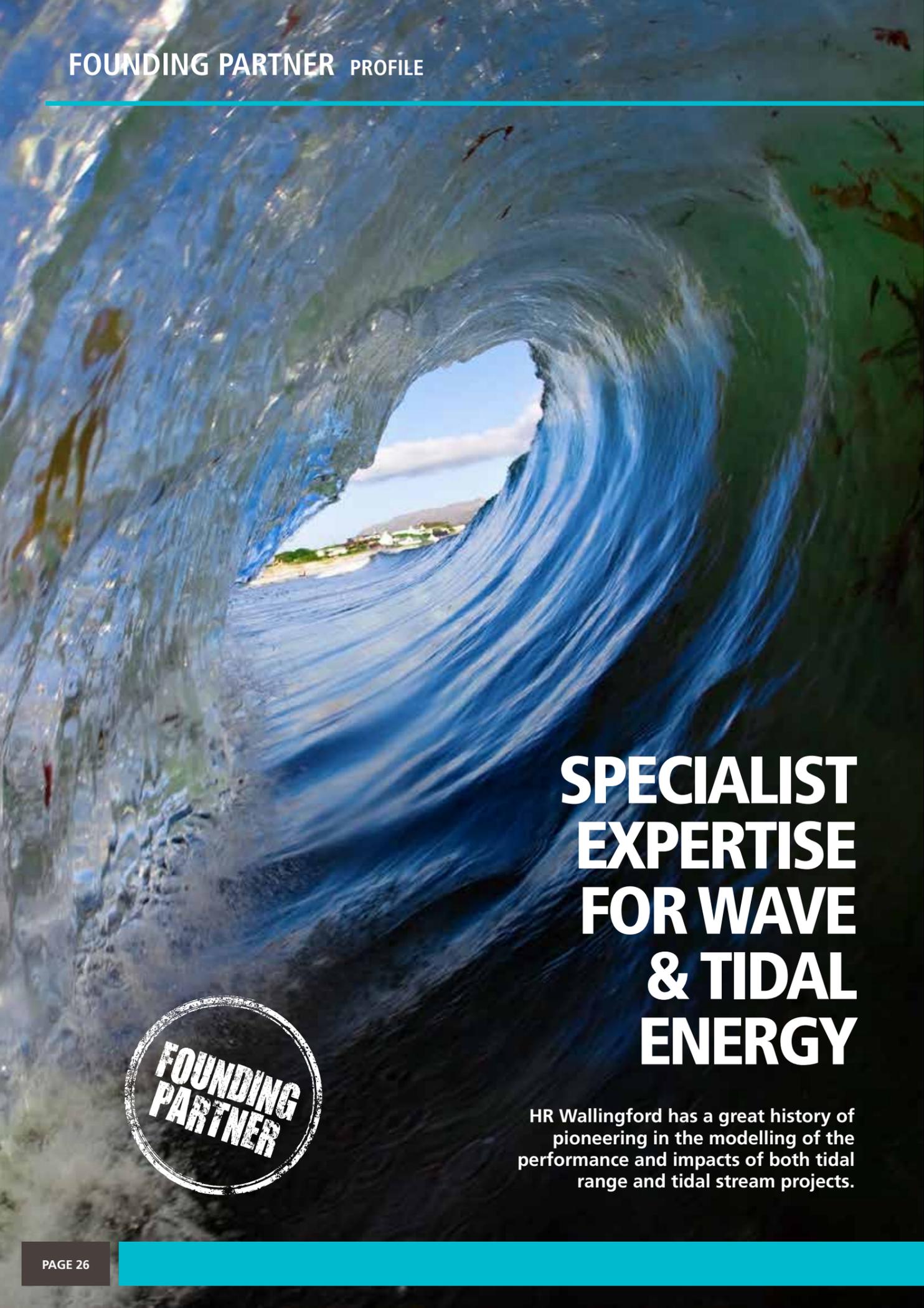
"We've had a great experience working with Cougar Automation. We have a demanding application and Cougar stepped up to the challenge and have delivered everything that we asked them for and more." Project and Systems Manager, Atlantis Resources Ltd.

**Cougar Automation Ltd**



ENGINEERING YOUR SUCCESS.

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# SPECIALIST EXPERTISE FOR WAVE & TIDAL ENERGY

HR Wallingford has a great history of pioneering in the modelling of the performance and impacts of both tidal range and tidal stream projects.



Based in Oxfordshire, HR Wallingford has state-of-the-art facilities for numerical and physical modelling, along with a team of over 200 expert staff who have an extensive track record of undertaking renewable energy work in the UK, Europe and globally.

**SAMANTHA DAWSON**, Sector Lead for Renewables commented *"In 2015 SMARTtide was awarded 'Most Promising New Tool to Support Developers and OEMs' at the International Tidal Energy Awards and has been used successfully to provide a review of energy yield calculations for tidal lagoon developments around the UK. This is an exciting time for tidal energy and we look forward to seeing the progression of tidal arrays and lagoons in the water."*

## SERVICES

HR Wallingford's portfolio of services to the renewable energy industry includes support of site selection through energy resource modelling and understanding of local environmental conditions (metocean) assessment through numerical and physical modelling. This includes data collection of the environmental effects of proposed schemes, for example, on tidal flows, water levels, sedimentation, underwater noise, fish as well as scheme optimisation for towing installation and maintenance operations.

## RESEARCH AND DEVELOPMENT

Commercial services to the tidal energy and barrage industry are backed up by extensive investment in research and development. HR Wallingford has worked with a wide range of government agencies and departments in supporting the development of this sector over the last 20 years. As well as headquarters in the UK, a network of offices around the world are well placed to support the renewable energy industry across the globe.

## VITAL TOOLS FOR THE TIDAL ENERGY INDUSTRY

### Advancing tidal resource modelling

HR Wallingford developed SMARTtide (Simulated Marine Array Resource Testing), a unique suite of two dimensional (2D) hydrodynamic models of the UK's continental shelf, including the North West European coastline. The model was commissioned and funded by the Energy Technologies Institute (ETI) with the purpose of creating a valuable tool in site selection, layout design and development, as it assesses the interactions between tidal energy systems (tidal stream and tidal range) at high resolution.

## UNDERPINNING CONSENT WITH SOUND VALIDATED MODELLING

HR Wallingford has also developed a hydro-acoustic model for mitigation and ecological response (HAMMER toolkit), for use in marine environmental impact assessments. It is compliant with the most recent guidance on underwater sound measurement and modelling and has been peer reviewed, validated and benchmarked against collected data and other models. The HAMMER toolkit combines UnaCorda, a predictive acoustic propagation model (incorporating seabed bathymetry, sediment type, hydrodynamics, salinity and temperature gradients) developed in conjunction with Loughborough University, with HR Wallingford's unique ecological response models for individual marine species (HydroBoids).

Using individual/agent based modelling (I/ABM) techniques, developed and validated with the University of Exeter, the HAMMER toolkit is able to predict the response of a target species to underwater sound during the initial stages of a project. This early consideration allows appropriate management and mitigation measures to be identified, and provides clients with a compliant and robust plan in order to minimise and where possible, remove these impacts.

## LAGOON POWER

HR Wallingford has assessed, through modelling, the energy yield potential for more than thirty tidal lagoons. Assessment has involved working with developers, regulators, potential investors, and turbine manufacturers, bringing the skills of computational modelling and civil engineering to develop costs,

power generation, environmental impacts (hydrodynamics, sedimentation, water quality, fish through turbines, etc.), and feasibility studies for different projects. Specific projects have included Tidal Lagoon Power (Swansea), DECC 2009 Tidal barrage and lagoon studies, as well as a considerable number of confidential projects.

## FAST FLOW FACILITY

The Fast Flow Facility is one of the world's largest marine test facilities. This unique, dual channel flume delivers a world-leading capability in wave, fast tidal current and sediment modelling.

Understanding the complex way waves, currents and sediments interact is vital to the successful delivery of projects in the marine environment. The Fast Flow Facility allows the company's scientists and engineers to examine these interactions at a larger scale, and in more detail, than has previously been possible, helping to more effectively optimise designs for clients, and minimising the water-based risks for these projects.

## TRAINING UP THE NEXT GENERATION

HR Wallingford together with the Universities of Edinburgh, Strathclyde and Exeter, and the Scottish Association for Marine Science form a partnership to deliver the EPSRC/Energy Technologies Institute (ETI) funded Industrial Doctorate Centre in Offshore Renewable Energy (IDCORE).

The HR Wallingford IDCORE Summer School programme provides both IDCORE students and professionals with an industrial and commercial perspective regarding the issues involved in the development of offshore renewables. The innovative programme aids to develop and strengthen the supply chain by providing the next generation of post doctorate engineers and scientists with a hands-on, industry-focused course supported by cutting edge research and technology.

## HR Wallingford Ltd



# OCEAN RENEWABLE ENERGY DEVELOPMENT PLAN

Ireland's western coastline is a spectacular landscape of splintered rock and weathered cliff faces, a coastline that for millennia has borne the brunt of the abundant energy which has rolled across the North Atlantic Ocean to converge on Irish shores. This abundant natural resource, combined with proximity to European markets and a committed policy-backed drive, mean Ireland has become a hub of activity and development for the ocean energy industry.

## Strategy for development

The Ocean Renewable Energy Development Plan, published in February 2014, sets out the Irish Government's strategy for development of an indigenous offshore renewables industry; promoting job growth, economic development, and increased energy security in an environmentally sustainable manner. High level ambitions are supported by a robust governance structure, which is critical for effectively achieving the goals set out in the strategy.

## Working together

The Sustainable Energy Authority of Ireland (SEAI) has worked with fellow industry partners to fund and develop an impressive testing infrastructure to facilitate the early stage development of ocean energy devices. 2015 saw the completion of the Beaufort Building in Cork, which houses the state-of-the-art Lir National Ocean Test Facility, an internationally recognised centre of excellence for the testing of early ocean energy concepts using various simulation facilities.

## MaREI Centre

The Beaufort Building also accommodates the MaREI Centre, a team of dedicated researchers with over 30 years' relevant expertise who provide technical support for developers using the testing facility. The Galway Bay Marine and Renewable Energy Test Site provides ideal quarter-scaled, real-sea conditions to developers wishing to test more advanced prototypes in a representative environment. The SeaPower

device, pictured, was successfully deployed at the site in November 2016 and continues to collect data.

## Atlantic Marine Energy Renewable Test Site

The Atlantic Marine Energy Renewable Test Site is a full-scale test site currently being developed by SEAI near Belmullet, Co. Mayo. Wave conditions at this site are particularly energetic, with an annual average wave power resource of 70 kW/m, while waves of up to 23m have been recorded by buoys on the site. The foreshore licence for the facility was awarded in 2015 and Mayo County Council are currently upgrading port facilities in the area, ensuring ease of access for both local fishermen and developers.

Work on the onshore substation is expected to commence in 2017. In addition to high quality infrastructure, high quality information and data is provided to those interested in Ireland's ocean energy industry via the Ocean Energy Ireland portal.

## Ocean Energy Ireland portal

The portal, designed by SEAI and the Marine Institute with input from numerous other groups, is a sign-post to the supports available in Ireland for the development of the marine renewable energy sector. There is information on marine data, maps, tools, funding and information relevant to renewable energy site assessment, development and management.

The Marine Renewable Energy Atlas, an interactive GIS map of Ireland and its waters, was updated last year to include the most relevant, high quality and downloadable ocean energy data available. A new inventory for environmental planning was added to help developers researching testing and deployment in Ireland.

The updated Ocean Energy Supply Chain Database was published in the summer, and now features 120 businesses searchable by either energy type (wind, wave or tidal), or business type (business support services, consultancy services, device developers etc.).



## Environmental guidance documents

2016 also saw two draft environmental guidance documents for the offshore renewable energy industry released for public consultation. These documents, one on the preparation of both Environmental and Natura Impact Statements for offshore renewable energy projects, and the other on Marine Baseline Assessments and Monitoring Activities, will ensure there is clear guidance for developers on statements, data, and monitoring necessary for deploying in Ireland's oceans. This will ensure best practice is adopted in order to develop the industry in an environmentally friendly manner.

## Ocean Energy Prototype Development fund

SEAI's Ocean Energy Prototype Development fund supports the research, development, testing and deployment of ocean energy devices. To date, a total 85 projects have now been awarded a combined sum of over €13 million. Last year saw an increase in the number of projects awarded grants on the previous year, and this trend is expected to continue in 2017.

“IRELAND'S WESTERN COASTLINE IS A SPECTACULAR LANDSCAPE OF SPLINTERED ROCK AND WEATHERED CLIFF FACES”



## International collaboration

International collaboration is an important aspect of developing Ireland's ocean energy industry, and SEAI have fostered many relationships with international counterparts in the UK, USA and Europe. The Ocean Power Innovation Network is a collaborative network between Ireland, Northern Ireland and Scotland. The network's mission is to advance innovation by learning from experts in other industries, to push the boundaries of what's possible in ocean energy, and progress innovative ocean projects in a coordinated way.

## Workshops

To date the network has facilitated two workshops, held in Dublin and Edinburgh, which have demonstrated to attendees the benefits of open innovation, highlighted opportunities for learning and technology transfer from other sectors such as offshore oil & gas, and encouraged valuable industry collaboration.

## Open for business

Like the waves off the coast of Mayo, momentum for Ireland's ocean energy industry is building. 2017 looks set to be another successful year, proving once again that Ireland is open for business.

## Sustainable Energy Authority of Ireland (SEAI)

<p>SCAN/CLICK</p> <p>WEBSITE</p>	<p>SCAN/CLICK</p> <p>MORE INFO</p>	<p>SCAN/CLICK</p> <p>LINKEDIN</p>	<p>SCAN/CLICK</p> <p>TWITTER</p>
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# CENTRE FOR MARINE AND RENEWABLE ENERGY IRELAND (MAREI)

MaREI is a research, development and innovation Centre, supported by Science Foundation Ireland, that operates across the fields of marine and renewable energy. In addition to fundamental scientific research, the centre provides targeted research and expert consulting services to a wide range of companies, which has established the centre as a strategic research and development partner for both academic and industry partners worldwide.

## STRENGTHS – SHARING KNOWLEDGE

MaREI's strengths lie in the multi- and trans-disciplinary nature of its research teams, allowing it to combine insights across areas such as Marine Renewable Energy (MRE) Technologies, Materials and Structures, Observation and Operations, Coastal and Marine Systems, Bioenergy, Energy Policy and Modelling, and Energy Management. MaREI also offers world-class infrastructure and testing facilities, including the LIR National Ocean Test Facility, that allow the systematic identification and reduction of development risks through a structured 'Technology Readiness Level' (TRL) development cycle.

## TECHNOLOGY DEVELOPMENT EXPERTISE

MaREI's technology development expertise covers the wave, tidal and offshore wind energy sectors, as well as complementary terrestrial applications such as onshore wind. Capabilities include aspects such as hydrodynamic and numerical modelling, power take-off and electrical control, and also extends to areas such as the design of mooring systems and array optimisation for the deployment of multiple devices.

## FUNDAMENTAL UNDERSTANDING

Physical and hydrodynamic models are fundamental to the understanding of device behaviour and response in typical wave climates, and allow key parameters to be determined, including maximum device loading (dissipation, diffraction, radiation, large motions and structural interaction), and the calculation of power conversion capabilities, providing the basis for control and forecasting algorithms.

## TESTING

Physical testing of prototype devices is facilitated through infrastructure available at Lir-National Ocean Test Facility, supported by the Sustainable Energy Authority of Ireland, and Limerick Docks tidal tow-testing facility.

## MaREI

**MaREI**  
Centre for Marine and Renewable Energy

- 180 researchers across 6 academic institutions working with 46 industry partners
- Technology development expertise covering the wave, tidal and offshore wind energy sectors
- World-class MRE testing infrastructure including the Lir National Ocean Test Facility

[www.marei.ie](http://www.marei.ie) Tel: +353 21 4864300

# RENEWABLE ENERGY

## Moving forward

In 2015 147 GW was added to renewable power generating capacity with a spend of \$286 Bn. This was made up of mostly onshore wind, solar PV, bio energy and some offshore wind. Wave & tidal is falling behind with the emphasis remaining on its potential rather than its actual contribution.

### HOW DO WE GET BOTH WAVE & TIDAL ENERGY TO COMMERCIAL REALITY?

The answer according to Exceedence CEO, Ray Alcorn, is to understand the composition of your energy cost and how each factor interrelates. Only then, can you make decisions on your development steps with measurable bottom line energy costs in mind. At that stage, you can demonstrate that you are credible, competitive and attractive for investment and project finance.

### DOING THE MATHS

Ray asks us to think of the usual pie chart with lots of slices for each cost. This can apply to devices or to projects big or small. The problem is that reducing the size of one slice may make another disproportionately bigger. For example, saving CAPEX on a small machine part may cost much more on unplanned Maintenance. What we are trying to achieve overall is a smaller pie and then we can sell many more pies.

The only way to understand is to build a techno-financial model of your device and of your projects. Current approaches for financial modelling in renewables projects tend to be costly, and they do not effectively accommodate the 'big picture' of the plan. Planning a renewables project – perhaps a new windfarm or wave-energy initiative – often involves hiring someone to carry out financial modelling, or consulting a large management company at a considerable cost.



## SOFTWARE SOLUTION

Exceedence have created software for this. It allows transparent input across the supply chain and a 'helicopter view' of the model. The tool, which uses international standards, allows projects to be more thoroughly analysed – it means risks can be more effectively identified and addressed and it means projects can be optimised at a fraction of the cost of traditional methods.

This software has been used by technology developers to select materials, PTO and O&M strategies by project developers for prospecting sites and technologies and by investors to compare projects. The company have published a number of study cases that show the efficiency of the method across the entire renewable energy supply chain.

## IN ADDITION

Another use for the technology has been by those making funding applications. Exceedence is used to show the initial levelised cost of energy and how it will decrease throughout the lifetime of the project.

## ORIGINATION

Exceedence was spun out of University College Cork in 2016 and funded by NDRC and Enterprise Ireland. The company is currently working with

Microsoft and the Open Data Incubator to further develop the software and data offering.

Currently the software is commercially available in desktop form. In February, a teaser of the cloud based version of the software that we are currently developing will be available. People who have registered will be able to have access to all the updates on our development (software features and datasets included) through their newly launched Forum (see link at end of this article).

## NO TIME TO LOSE

Formerly the head of an ocean energy research centre in University College Cork, Alcorn believes that urgency is required to realise the wave & tidal energy technology arguing that *"We must see that we are in a race and while we are reducing our costs, other renewables have the same trajectory. We don't have forever to get this right and we don't want to be cornered as a niche energy supplier when there are USPs for both wave & tidal."*

## Exceedence



# SEAPOW TEST PROTOTYPE AT SMARTBAY

Irish SME SeaPower is currently testing its prototype wave energy device at SmartBay. The site at Galway Bay is Ireland's consented site for testing wave energy converters at quarter scale and has been operating for the last ten years.

SeaPower successfully deployed its quarter-scale device at the test site during Autumn 2016. This deployment followed a rigorous development programme spanning almost 8 years, which involved small scale tests and continuous developments.

### THIRD PARTY VERIFICATION

Prior to deployment an independent third party verification of the design, construction and deployment of the device was undertaken by Wood Group Kenny in Galway. The device was manufactured by Foynes Engineering Ltd in Limerick and was towed by sea to the SmartBay test site in Galway Bay. Atlantic Towing Ltd were responsible for successfully installing the moorings and the device at the test site.

The device will be deployed at SmartBay until March 2017, during which time its performance will be validated against a wide range of wave heights and wave periods from a range of directions. The project has been supported with a grant of over €1m through the Sustainable Energy Authority of Ireland's (SEAI) Ocean Energy Prototype Development fund.

### TEST SITE DETAILS

Speaking on the test site, John Breslin, General Manager SmartBay said: *"The SmartBay test site provides developers with the opportunity to undertake their first sea trials in an environment where wave conditions are approximately 1/4 of those found in*

*further offshore locations off Ireland's west coast. This allows developers to keep manufacture and deployment costs to a minimum by building and deploying smaller scale devices.*

*The SmartBay test site facilitates iterative deployments to be undertaken before developers incur the significantly higher costs associated with deploying larger full-scale devices."*

### DEVELOPING NOVEL TECHNOLOGY

Peter Heffernan, Marine Institute CEO said: *"Sea Power Ltd is a great example of an indigenous Irish company developing novel technology to harness the power of the ocean. Having brought their device through various small scale prototypes, it is exciting to see this new technology being prepared for testing in the sea at quarter scale.*

*"We are delighted to be working with our partners SEAI and Seapower to make a significant contribution in the evolution of ocean energy as an environmentally friendly and cost effective source of power for Ireland."*

### ACCREDITATION

SmartBay Ireland successfully passed its ISO surveillance audits and has successfully continued its accreditation under ISO 9001:2008, ISO 14001:2004 and OHSAS 18001:2008.

Speaking following the announcement John Breslin, Smartbay General Manager said *"The fact that the surveillance audit was passed without incurring any non-conformances demonstrates SmartBay's continued commitment to the health & safety of our employees, the quality of our work and the impact of our activities on the environment."*

### BRINGING OFFSHORE RENEWABLE ENERGY TECHNOLOGIES TO MARKET

FORESEA's Interreg Project is an €11m project which helps to bring offshore renewable energy technologies to market by providing free access to a world-leading network of test centres – EMEC (UK), SEM-REV (France), SmartBay (Ireland) and Stichting Tidal Testing Centre (Netherlands). The test centres are supported by European industry group Ocean Energy Europe, based in Brussels.

Through the project, the performance of ocean renewable energy technologies will be demonstrated and validated in real sea conditions, helping to leverage the investment needed to take these new products to market.

### CLEAR GLOBAL LEADERS

European technologies are the clear global leader in ocean energy. To translate this leadership into a new industrial sector, it is essential that a critical mass of technologies receive enough private investment to take them to the marketplace.



“A RIGOROUS DEVELOPMENT PROGRAMME SPANNING ALMOST 8 YEARS”

The FORESEA programme will encourage longer term testing and technology de-risking to leverage further investment and enable progression towards the marketplace. The second call for applications was formally launched at a reception during the Ocean Energy Europe 2016 Conference & Exhibition.

### SmartBay



# DEVELOPING POWER TAKE OFF FOR WAVE ENERGY CONVERTORS

Blue Power Energy is an Irish based ocean energy technology development company founded in 2008 who are in the business of developing and commercialising a novel Power Take Off for wave energy convertors.



Image – BPE PTO7 having characterisation/endurance testing at ETC, Glasgow

Blue Power's Power Take Off (PTO) is an innovative direct drive PTO that uses a ball screw to convert linear motion as the prime mover into a rotary motion, suitable for operating conventional generators or water pumps. It is compatible with attenuator, point absorber and oscillating wave surge convertors.

## HIGHLY RELIABLE TECHNOLOGY

Ball screw technology is well developed and utilised within the industrial and aerospace sectors, so Blue Power have

transferred this highly reliable technology across to the wave industry. The PTO uses off the shelf components with few special parts. It is suited to wave harnessing because it can take the high force and low speed input and convert it into high RPM output without the requirement for a gearbox resulting in losses.

## PROTOTYPES

Blue Power have built 7 prototypes to date that have been tested at various sites. The most recent prototype (PTO7),

was funded by the Wave Energy Scotland PTO stage 2 programme where a contract of £306,530 was awarded to further develop and optimise the PTO.

As part of this project the company built and tested a 5kW PTO with a control system to maximise efficiency. A kinematics model was developed for load prediction under various conditions.

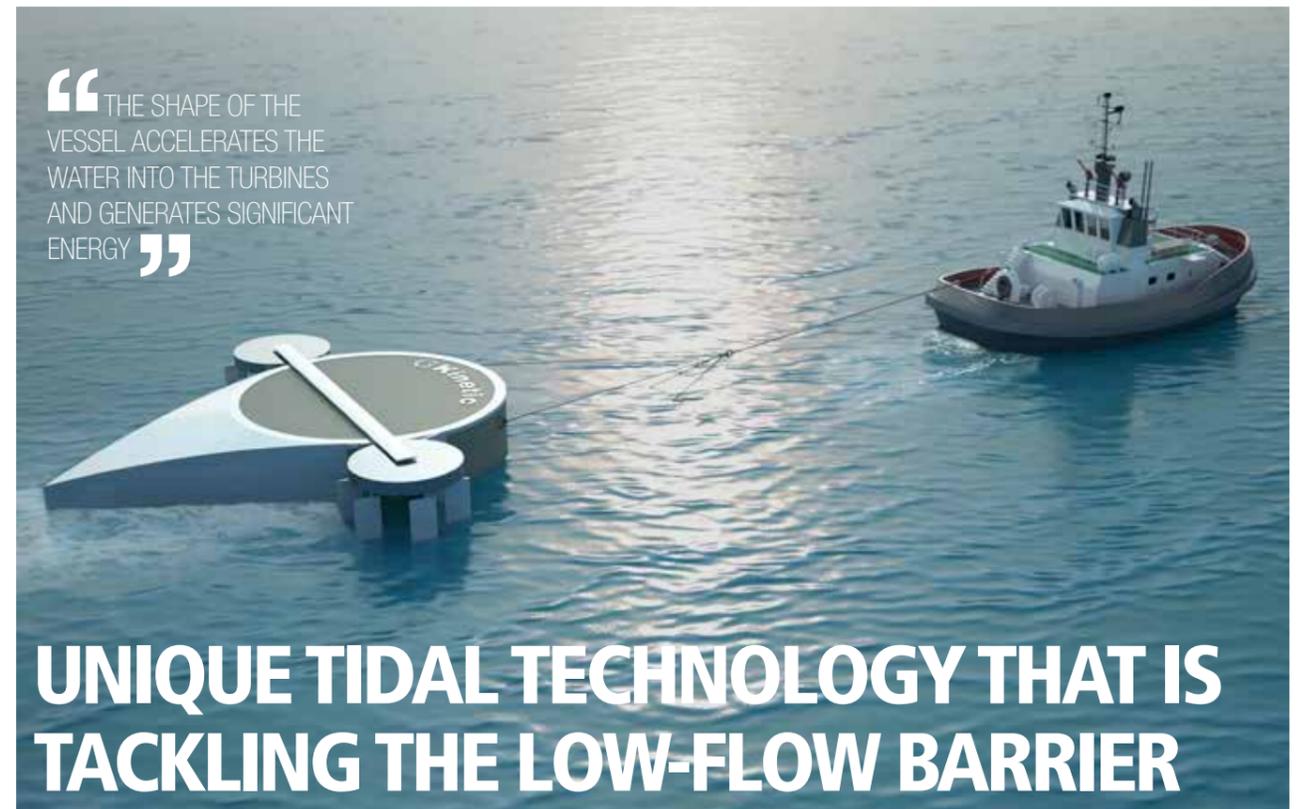
“IT CAN TAKE THE HIGH FORCE AND LOW SPEED INPUT AND CONVERT IT INTO HIGH RPM OUTPUT”

## STAGE 3 PROJECT

Blue Power Energy are currently making an application to progress to Wave Energy Scotland's stage 3 project which will be a 2 year programme and advance our technology to TRL 5-6. The purpose of this project will be threefold...

1. To carry out additional exploratory and endurance bench testing on the main sub component (ballscrew) that was identified as been required during the WES stage 2 project work
2. To integrate our PTO and control system into a reputable WEC and both tank and sea test at appropriate scales
3. To build a commercial scale PTO and both marinise it and fit a torque limiter and bench test it

Blue Power Energy



“THE SHAPE OF THE VESSEL ACCELERATES THE WATER INTO THE TURBINES AND GENERATES SIGNIFICANT ENERGY”

## UNIQUE TIDAL TECHNOLOGY THAT IS TACKLING THE LOW-FLOW BARRIER

GKinetic Energy was founded in 2014 and is based in County Limerick, Ireland. The company is developing a range of hydrokinetic turbines for both river and tidal flows. The device involves two vertical axis turbines placed on either side of a buoyant vessel.

The shape of the vessel accelerates the water into the turbines and generates significant energy in low flow speeds, removing the need for a head of water and expensive civil works. To date, the company has secured private investment and SEAI prototype development match funding. Efficient use of this finance has enabled rapid and cost effective movement through TRL levels.

## COLLABORATION

The company continue to achieve milestones by identifying strategic partners and taking a collaborative approach to the Research & Development of their technology. In 2014, the device operated at an impressive 41% efficiency compared to the 32% industry standard at IFREMER in Boulogne-Sur-Mer, France and in 2015, GKinetic were named winners of the SEAI Design Award. Aiming to commercialise small scale river devices, machine build partners, DesignPro Ltd secured Horizon 2020 Phase 1 Funding and are now working on the Phase 2 application.

## DEPLOYMENT AND TESTING

In October 2015, the company successfully deployed and tested a 10kW device at the Limerick Docks, a custom designed test facility set up through collaboration with Shannon Foynes Port Company. This demonstration validated ease of deployment, mooring costs, blade pitch control system and wireless communication systems. In 2017,

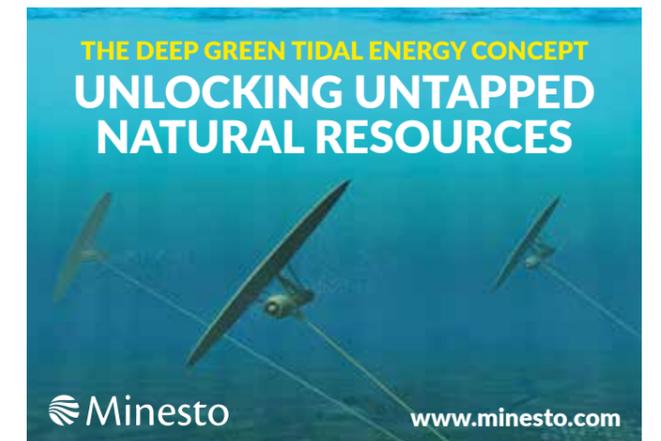
they will deploy a 25kW machine on the river Garonne in France for further studies including an environmental impact analysis.

## FUTURE

GKinetic are working toward the build & deployment of a 250kW prototype device in 2018. Collaboration with entities such as Numerics Warehouse, NUI Galway, MaREI, Shannon Foynes Port Company and UCC will be instrumental during this project.

The company aims to continue to prove their technology at different scales and demonstrate their novel solution for flow acceleration and tidal energy extraction.

## GKinetic Energy Ltd



# THE ENTREPRENEUR SHIP

## World's First Maritime Incubation Hub

The beautiful Cork Harbour in the south of Ireland has several geographical and historical claims to fame. It is the second largest navigable natural harbour in the world: in the 1700s it was home to the largest butter market in the world and at the beginning of the twentieth century it was the last stopping point for the Titanic before its ill-fated trip across the Atlantic.

For hundreds of thousands of Irish emigrants it was the provided their last moments on home soil before they set sail in search of a new life in America, Australia, New Zealand and beyond.

### PORTAL TO THE WORLD

The idea of Cork Harbour as a portal to the world has taken on a whole new meaning recently with the emergence of a maritime hub of real global significance. A critical part of this is the establishment of the world's first incubator for marine and energy companies, The Entrepreneur Ship.

Companies that locate in The Entrepreneur Ship are part of a thoroughly unique centre with wind, wave & tidal technologies being developed alongside other products such as drones, earth observation and software that derisks investment in renewables.

### LEARNING FROM EACH OTHER

What is wonderful about the centre is how companies complement and learn from one another as they go from start-up to scale-up. This is underpinned by a group of prestigious mentors who provide business advice and the benefit of their network as well as a range of events designed to promote networking and develop business skills.

Nested alongside the National Maritime College of Ireland and University College Cork's Marine and Renewable Energy Centre (MaREI) as well as the Headquarters of the Irish Naval Service, companies in The Entrepreneur Ship are treated to an eco-system of research excellence, world class training and naval test bed facilities.



### ADVANTAGES THROUGH COLOCATION

Ray Alcorn, CEO of Exceedence, a company with a techno-financial modelling software for renewables emphasises this saying, *"The advantages here are through colocation. We already have projects that we worked on with the National Maritime College and with MaREI. In fact some of our staff are ex MaREI employees as well, including myself. The mentorship network is very good and you are also a relatively big fish in a small pond which is nice because we are very focused on what we do here and we are part of a cluster. We share funding programmes, we tell people what else is coming up and we invite people to various workshops and we try and learn from each other."*

“THIS IS UNDERPINNED BY A GROUP OF PRESTIGIOUS MENTORS WHO PROVIDE BUSINESS ADVICE”

### DYNAMIC AND SUPPORTIVE ENVIRONMENT

On top of this, the Irish state has created a dynamic and supportive environment for business with agencies such as the IDA, Enterprise Ireland and the Sustainable Energy Authority of Ireland providing access to a range of supports.

So if you have an idea for a startup, take a look at The Entrepreneur Ship.

### Irish Marine Energy Resource Cluster (IMERC)



Image – TAOIDE kick-off meeting at UCC's new Lir National Ocean Test Facility in Ringaskiddy Co. Cork, from left are Donal Murray (UCC); Gianluca Tondi (European Commission); Matthias Wecker and Martin Shan (Fraunhofer Gesellschaft); John Doran (LYIT); Kevin Leyne and Annette Matthys (UCC); Jarlath McEntee, James Donegan, and Milo Feinberg (ORPC); and Michael Baumann (SKF)

## GLOBAL LEADER IN HYDROKINETIC POWER SYSTEM

ORPC Ireland, a wholly owned subsidiary of Ocean Renewable Power Company, a global leader in hydrokinetic power system technology and project solutions, along with its project partners, has kicked-off of a 3.2 million euro technology development project for which it is the technical lead.

### INTERNATIONAL CONSORTIUM

The official start date was November 1, 2016. Funded by the EU's Horizon 2020 Programme, University College Cork (UCC), Ireland, is project coordinator and along with ORPC Ireland, is joined in a strong consortium with Letterkenny Institute of Technology (Ireland), Fraunhofer-Gesellschaft (Germany) and SKF (U.K.) Limited.

### IMPROVING SYSTEM RELIABILITY

'Technology Advancement of Ocean Energy Devices through Innovative Development of Electrical Systems to Increase Performance and Reliability', or TAOIDE for short, is aimed at radically improving system reliability by developing a more robust power transfer system from prime mover to electric grid, specifically, a direct drive permanent magnet generator capable of operating in a fully flooded condition. In addition to ORPC benefitting from this innovation, colleague companies in Europe and worldwide will be helped.

### 3 YEAR PROJECT

Year 1 of the 3 year project is focused on design work, year 2 on subsystem testing and year 3 on full system testing at UCC to validate system improvements to a full-scale ORPC hydrokinetic turbine and associated economics at UCC's Lir National Ocean Test Facility.

### MAJOR DEVELOPMENT

*"Proving the functionality of a wet-gap generator will be a major development for the ocean energy industry", commented ORPC President & CEO, Chris Sauer, "and will make our marine renewable energy systems more competitive with other renewable energy options. We look forward to working with our dedicated partners in Ireland and the EU to significantly advance ocean energy technologies and help secure Europe's global competitiveness."*

### WORKING TOGETHER

Dr. Jimmy Murphy, Lir National Ocean Test Facility Manager noted, *"I am delighted with the opportunity to work with ORPC Ireland and the other partners on this exciting major project over the next three years."*

### ORPC Ireland

# MERGING MODELS AND SATELLITES FOR MORE ACCURATE WAVE HINDCASTS

TechWorks Marine is well known in the marine renewable sphere for its expertise in delivering in-situ wave and tidal resource assessment and monitoring. Their latest offering for those interested in wave resources uses satellite data and numerical modelling to produce global, long-term wave statistics to complement our in situ measurements.

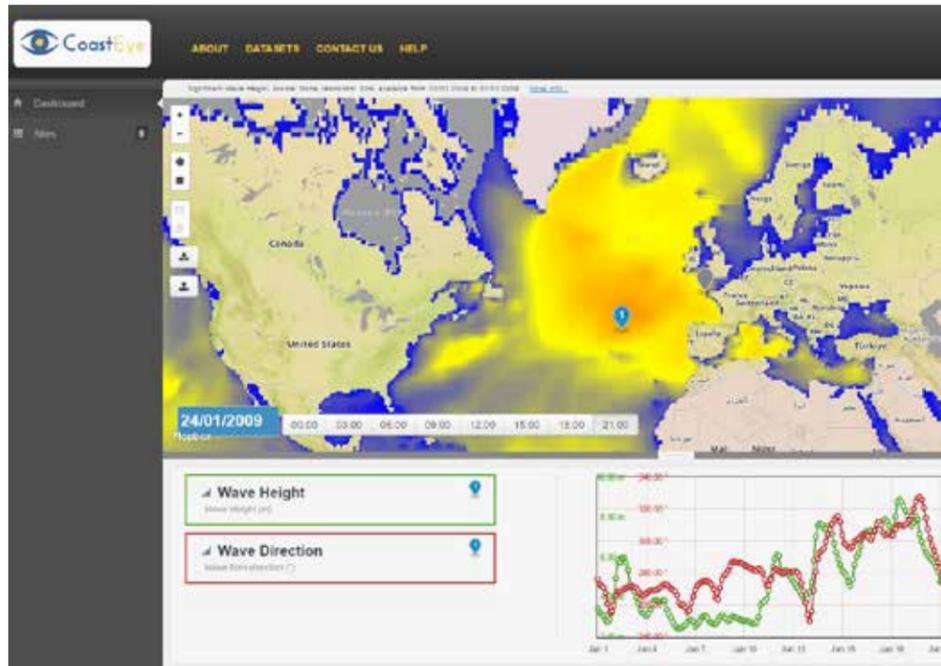
## RESOURCE ASSESSMENT SURVEYS

Over the last decade TechWorks Marine has been working with a number of agencies, developers and utilities carrying out resource assessment surveys at various sites across Europe. At the Raz De Blanchard site in France, TechWorks has deployed numerous ADCP (Acoustic Doppler Current Profiler) seabed frames for both OpenHydro and Engie/Futures Energies to gather high precision current and wave information, for both resource assessment and also turbine characterisation.

Similar surveys were conducted in the Channel Islands, Northern Ireland, Ireland and Scotland for a range of clients ranging from Tocardo BV and DP Energy to SEAI (The Sustainable Energy Authority of Ireland). Over the last decade the company has become a leader in marine renewable energy resource assessment, and have developed methodologies to ensure quality data return.

## INTERNATIONAL BEST PRACTICE

TechWorks Marine are not just aware of international best practice, they have written the book on it as well as contributing to the IEC Technical Committee 114 – Marine Energy since 2011. They also played an active role in the development of the Technical Standards for both wave and tidal resource assessment and continue



to monitor developments for the IEC committee to incorporate updates from our experience in a still-developing field.

## LATEST DEVELOPMENT

The company's latest development in the marine resource assessment sector combines satellite wave data from the last twenty years with the most up to date wave model and wind fields to create a global wave database. Available since 1993, satellite altimeter measurements have become increasingly important as global observations of sea state.

Currently available wave databases do not include these data at the modelling stage, even though they increase the accuracy of the model output. During a project funded by the European Space Agency to optimise the use of satellite data in the marine renewable sector, an assimilation scheme for satellite altimetry data was developed for input to the WAVEWATCH III model.

## GENERATION OF GLOBAL WAVE STATISTICS

Use of the Irish Centre for High-End Computing parallel processing system allowed the generation of global wave statistics from this model, along with high resolution spectral wave data around Europe. The wave climate at a particular location, such as its variation with the seasons and from year to year have been calculated from this database. The hindcast was developed for marine renewable energy resource assessment applications and allows developers rapid online access to accurate wave statistics for sites of interest.

The database is due for release later in 2017.

## TechWorks Marine

# CONTRIBUTE TO THE NEXT EDITION OF WAVETIDAL ENERGY NETWORK MAGAZINE



We would like to invite you to contribute to the next edition of WaveTidal Energy Network magazine. We don't charge for editorial as it brings our 5,400 senior decision making readers interesting and thought provoking stories from experts like yourselves in the industry. Editorial forms a great way for your company to get some publicity too. The following are the options for involvement:

- **UNSOLICITED PRESS RELEASE** – we get literally hundreds of these general editorials. As we can only fit editorial into the features we are running and prefer items written for us, the chances of this appearing is slim.
- **350 WORD EDITORIAL** - contribution to one of our Forthcoming Features plus high res image – good chance of being included. No charge for this at all.
- **EDITORIAL WITH INTERACTIVE LINKS** - We add up to three links at the end of your 350 word editorial to bring additional information relevant to our readership in the wave & tidal industry – such as fuller, much longer article/brochure/tech spec/video/links to your website etc. Guaranteed to appear as they make the magazine more interesting for our readers. Cost for this £330 + vat per edition
- **SPONSORSHIP OF A FEATURE** - High impact with the opening double page of the feature – 850 word editorial. We also add your branding to each page of the feature in the header bar. More information about sponsorship on the next page
- We also run **STAND-ALONE ARTICLES** and conduct interviews too. These are all by arrangement and normally as part of a marketing plan

## FEATURES TO APPEAR IN THE SPRING EDITION – ISSUE 10

1. **INDUSTRY UPDATE – NEWS & EVENTS**
2. **INNOVATIONS & USING NEW TECHNOLOGY \*\*\*\***
3. **CABLE PROTECTION/SCOUR MITIGATION**
4. **TIDAL TEST FACILITIES \*\*\*\***
5. **SPOTLIGHT ON CORNWALL & SOUTH WEST**
6. **UPDATE ON SWANSEA BAY TIDAL LAGOON \*\*\*\***
7. **PROJECT FUNDING \*\*\*\***
8. **MARINE ECOLOGY \*\*\*\***

Those features with \*\*\*\* are still available to sponsor if you would like to take the lead.

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