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ISSUE 7 | SPRING 2016

SEA OF OPPORTUNITY: A MARINE ENERGY EDITION

FEATURES

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WELCOME

OUR FOCUS THIS ISSUE IS ON THE UK'S MARINE ENERGY SECTOR, ITS CHALLENGES AND INNOVATION PRIORITIES

Andrew Jamieson
CEO

There has been much coverage of the woes of the sector, but there is also considerable progress being made in key areas and the potential opportunities remain well worth the pursuit as will be highlighted at February's International Conference on Ocean Energy (ICOE) in Edinburgh.

We are confident tidal stream energy can achieve commercialisation, and are excited to see further testing of the Atlantis AR1500 tidal turbine in the near future at our National Renewable Energy Centre in Blyth, ahead of deployment in the MeyGen development in the Pentland Firth.

However, we believe that tidal energy will require upward of £100m to get the first arrays of c.10MW to financial close. Greater investor confidence is vital and we believe that, in part, this will be achieved by technologies undergoing a stage-gating process to confirm their maturity against Technology Readiness Levels (TRLs).

Wave energy is still in early stage development. New, innovative solutions are required that challenge the current range of wave energy designs to enable the sector to become commercially viable.

A vital aspect of the various marine energy technologies is the truly UK-wide economic growth opportunity that they present. Major projects are well established in England, Wales, Scotland and Northern Ireland, with both national and regional government support.

At the Catapult, we are working in close collaboration with local partners across the UK to identify and accelerate the technologies that will deliver the potential of these projects.

There remains a way to go before the UK's plentiful marine energy makes a significant contribution to our sustainable, secure energy mix, but positive steps are being made in challenging times, and we remain confident that the goal is achievable.

CONTENTS

MARINE SECTOR TRENDS

SECTOR LEAD FOR WAVE AND TIDAL ENERGY, SIMON CHEESEMAN, EXAMINES SOME OF THE KEY ISSUES FACING TODAY'S MARINE ENERGY INDUSTRY, AND HOW ORE CATAPULT IS SUPPORTING THE SECTOR, ENSURING IT IS A UK ECONOMIC SUCCESS STORY

The economic and environmental arguments to support the on-going development of a vibrant UK marine renewables energy sector are difficult to ignore. With a global market worth £76 billion across 50 countries, it's estimated that wave and tidal energy could contribute about £4 billion to UK GDP by 2050, offering strong export opportunities and the potential to increase the number of skilled jobs from the current 1,700 to around 20,000 in the next decade. The installation of man-made structures in our oceans will also create new habitats for thriving communities of marine species.

UK waters have some of the best marine resources in the world and we are well placed to exploit them. There is good, continuous tidal flow between the Atlantic and the North Sea, and large wave fetch created by the Atlantic winds. Whilst our ability to extract energy from tides is more advanced than from waves, both industries are still at the early stages of technology development, but have the potential to supply about 20% of the UK's electricity which would offset approximately 30 million tonnes of CO_2 emissions each year.

So, the challenge we face is to develop our ability to extract that energy economically, and cost competitively compared to other sources of energy generation, whilst at the same time balancing the needs of the marine community. We must make marine energy extraction a viable and established industry, and we can achieve that by working collaboratively with industry and academia to focus on the sector's main technology challenges, managing risk, and supporting the growth and productivity of the UK supply chain.

Collaboration, research and development

Just as the offshore wind industry has, the marine energy industry is recognising the need for a greater degree of collaboration in tackling some of the industry's key challenges. European Union funding is readily available for international, collaborative initiatives that bring together industry and academia to solve generic industry challenges, on the understanding that data and knowledge gained from the projects is shared for the benefit of the wider sector.

At the Catapult, we convene joint industry programmes and issue innovation challenges to industry, and we keep these updated as new work allows us to get more precise around the opportunity or problem out there. We want industry, large and small, to come forward with ideas to address these challenges, and work collaboratively with our own team of technical experts and test and demonstration assets to develop them into market-ready technology. For example, our Tidal Turbine Drivetrain Reliability and Simulation project, TiPTORS, which in collaboration with tidal turbine developers is looking at the physics of failure, will test advanced sensor techniques using our 3MW drivetrain test rig and collect real data from developers for validation and cost of energy assessment.

Using our industry expertise and testing facilities, we aim to bridge the gap between academic research and industry need, undertaking applied high level research ourselves in areas such as blades and drive trains. We actively support a number of Knowledge Exchange Fellowships and PhD opportunities and have reciprocal agreements in place with academia to share knowledge and expertise.

Managing technology risk

Globally we are in an economic downturn, with new prototype developments and first array deployments being more difficult to fund and taking longer to implement. Challenges in developing technology that operates cost effectively in a harsh environment remain. All this means project investment is scarce and difficult to source. Many investors just aren't prepared to take the risk of investing in new, un-proven technology, and are mainly interested in relatively short term returns on investment. ORE Catapult's own financial analysis indicates that the tidal industry, for example, will need upwards of £100 million to get the first arrays of c. 10MW to financial close, and much of this cost will need to be directed towards technology innovation.

As one of the leading nations in ocean energy development, we believe that the UK must lead the way in enforcing a strict "end to end" technology development regime that not only offers clear benefits to technology developers, but would also be approved and adopted by all UK test facilities and endorsed by public funding and accreditation bodies. Such an approach would enable unfettered data exchange, encourage learning and most importantly provide the only route to access public funding. To that end, we have launched our Technology Assessment Process (TAP) where we will work with developers through a structured technology development journey, aiming to significantly de-risk their technology before it reaches prototype testing stage. We are also leading discussions with public funding bodies, academia and developers to discuss the introduction of a more controlled method of funding technology development. TAP will provide independent assessment of concept proving, testing results and performance improvement towards commercialisation, building up an evidence-based dossier throughout the process that can be used to provide confidence to investors, technology partners and funders that a technology will mature as predicted.

Supporting the UK supply chain

A successful industry will be built on a solid, growing and productive UK supply chain. We work across the UK in regions with a strong marine focus, helping to align aspirations and activities with national policy and requirements, leading to growth and job creation for UK SMEs.

Our vision is of a marine energy industry operating in a virtual trading space where market opportunities are clearly visible; where the supply chain capabilities are clearly understood and diversification and cross sector technology pull-through is second nature. We want technology developers to be able to articulate the innovation challenges they face, and for the market to be able to respond instantly with solutions.

image left
Simon Cheeseman - Sector Lead, Wave and Tidal Energy

image below
3MW tidal turbine drive train test rig at ORE Catapult, Blyth

image right
Floating tidal stream turbine, Scotrenewables Tidal Power Ltd

image above
Evopod, Sanda Sound
Image courtesy of Oceanflow Energy

ORE Catapult has developed the UK Marine Energy Supply Chain Gateway (MESCG) website in order to facilitate better engagement between buyers and sellers. The aim is to put buyers in touch with sellers; making sure that organisations that need products and services can find the organisations that can provide them. The system will also form part of an information source that will help users understand the nature of the wave and tidal industries, and how they can become part of the supply chain.

Future success

For the marine sector to be a success, the levelised cost of wave and tidal energy must reduce significantly in a time frame similar to targets already set for offshore wind. To do this, we need device developers to focus on improving affordability, performance, reliability, and survivability. The Catapult's role is to work with them and others, particularly academia, to focus research priorities around wider critical path components which have less to do with a developer's intellectual property, and more to do with product assurance and issues around reliability, health and safety, installation methodology, and optimisation of operations and maintenance. Projects such as our marine energy component testing, which analyses failed components, helps us to do that and our studies looking at tidal turbine blade collision, tidal turbulence and biofoul prevention, are all helping to de-risk the sector.

Ultimately, we need to see arrays in the water, and a lot of them. Our aim, as a nation, should be to encourage and help establish first arrays, such as the MeyGen deployment in the Scottish Pentland Firth. For all new technologies, this is a necessary step to prove the technology works and showcase the route to full commercial viability. The more you can resolve some of the basic issues that developers come up against time and time again, the less risky and more attractive marine projects will become to investors and this is where the Offshore Renewable Energy Catapult is playing a vital role – in ensuring that the UK's marine energy industry is a UK economic success story.

CATAPULT
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The Tidal Exchange

Accelerated life tests in our 3MW capacity nacelle test facility compress many months of tidal exchanges into days of testing to give tidal turbine developers a real edge for commercialising marine renewables.

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MARINE R&D FOCUS

BY WORKING ACROSS ALL STAGES OF TECHNOLOGY DEVELOPMENT, ORE CATAPULT IS PLAYING AN ACTIVE ROLL IN MOVING THE INDUSTRY EVER CLOSER TOWARDS FULL SCALE COMMERCIALLY VIABLE MARINE ENERGY

Wave and tidal technology developers face a difficult trade-off between incremental technology development, where small-scale pilot projects demonstrate and prove their performance, versus the need to secure private capital where the emphasis is to upscale and generate bankable technology as quickly as possible. With this in mind, ORE Catapult has established a cross-cutting marine portfolio which focuses on various levels of technology readiness, and concentrates on marine technology demonstration activities, optimisation and cost reduction projects to address this challenge and accelerate the technology development cycle and full-scale commercial viability.

Working collaboratively with the European Marine Energy Centre (EMEC) and SP Technical Research Institute of Sweden, ORE Catapult is engaged in an early stage OCEANERA-NET project (RiaSoR) to establish industry best practice and methodologies in reliability testing for wave and tidal devices.

The project will look at methods to analyse risk of failure in power conversion and mooring systems to improve engineering design and gain a better understanding of where failure may occur in the design process in order to develop more reliable marine technology. This reliability methodology is ultimately aimed at reducing Health, Safety and Environmental (HSE) risks, technological risks, and Operations and Maintenance (O&M) costs which will lower the Levelised Cost of Energy (LCoE) for the sector.

The Catapult is also working on another OCEANERA-NET project (RECODE), in collaboration with partners Tecnalia, Zunibal, Ditrel, WavEC and Smartbay. The project aims to identify common components as well as improve inter-connectivity in ocean energy technologies by developing a set of industry-enabling cost effective components, specifically designed for reliable and sustainable delivery of ocean energy. These components comprise a safety monitoring and control device, a wave measurement buoy, an umbilical cable monitoring device and an underwater device-to-cable connector for a floating energy converter. Identifying these common components will help to reduce costs by driving down CAPEX and OPEX and allow the ramping up of volume manufacturing. Delivering reliable, cost-effective technologies as well as developing industry best practice and methodologies is paramount to the ultimate commercial success of Europe's ocean energy industry and drive to reduce costs.

Moving along the technology readiness scale, the Catapult has been involved in the European funded Marine Renewables Infrastructure Network (MARINET) project, providing funded access to its world-class marine R&D facilities and technical experts. The transnational project has conducted joint activities to standardise testing, improve testing capabilities and knowledge to accelerate the development of marine renewable energy technologies and enhance the integration and utilisation of European marine renewable energy research infrastructures and expertise. To progress this work, and enable developers to offset their development costs by accessing facilities to allow the advancement of technologies, the Catapult is pursuing similar opportunities in the next round of Horizon2020 funding calls.

image right
Test set-up for Quiet Pile Ltd

image below
AR1500
Image courtesy of Atlantis Resources Ltd

At demonstration scale, the Catapult has been working with Quiet Pile Ltd on their novel design concept intended to mitigate acoustic noise caused by offshore piling operations and reduce the impact of piling on marine life. The concept deviates from the majority of systems currently in use or in development in that it reduces the sound at source by damping pile vibrations. During certain times of the year, piling restrictions are placed on offshore construction projects and as current noise mitigation technologies in the market can be expensive to deploy, increases in project costs are not uncommon. This technology could therefore play an important role in reducing offshore installation risk, as well as creating both positive economic and environmental impact.

At the other end of the technology development spectrum, early in 2016, ORE Catapult's National Renewable Energy Centre will work with tidal energy developer, Atlantis Resources Ltd, to test their full-scale next generation 1.5MW tidal turbine, the AR1500. The Catapult's 3MW power train test rig will be used to simulate the dynamic forces the turbine will experience during operation. The tests aim to de-risk the AR1500's deployment by proving the reliability and validating the performance of its power train system.

ORE Catapult is working with Atlantis Resources on the €1.3m Eurostars funded project to drive forward the development and deployment of the AR1500 tidal turbine, the series which is to be installed at MeyGen, the UK's first tidal array, in the Pentland Firth off the Scottish coast. The tests are the critical final stage of development that will give Atlantis, MeyGen and their investors the confidence that the turbine is ready to be deployed and to start generating electricity.

It's undeniable that it has been a turbulent year for the UK's marine energy sector, but the industry has made some enormous achievements. Through the work which the Catapult is involved in, there are some promising developments ahead at all stages of technology maturity as we move ever closer to delivering commercially viable marine energy.

THE SECRET SEA

AN UNUSUAL NEW PROJECT TO TAKE A CLOSE UP LOOK AT A CLUTCH OF CLINGY CREATURES COULD SHED NEW LIGHT ON THE SECRET LIFE OF THE UK'S SEAS

The overall aim of the ORE Catapult led project is to map, for the first time, how communities of attaching, or 'sessile', creatures vary around the UK's coast and to develop a sensor to measure their growth rates, charting in detail the potential impact they have on subsea equipment and their effect on functionality.

The project could ultimately see the creation of a detailed map to identify the type, speed of growth and prevalence of these attaching species – a process known as 'biofouling' - with the aim of better informing the operation and maintenance of subsea equipment.

Leading the project is Vicky Coy, ORE Catapult project manager, working with partners including the commercial arms of the Scottish Association for Marine Science, SRSL Ltd, and Plymouth Marine Laboratory, PML Applications Ltd, as well as international paint manufacturer AkzoNobel.

Vicky said: "Biofouling is a huge issue both in the UK and across the world. We work closely with offshore renewable energy technology developers and biofouling is repeatedly highlighted to us as a potential challenge for the renewables industry and related sectors.

"These organisms often attach in large numbers, creating particular problems for offshore renewables structures and the associated operational activities, adding weight, clogging machinery and accelerating deterioration.

image above
Dr Raeanne Miller and Vicky Coy in the SAMS lab
Image courtesy of SAMS

image far left
Goose barnacle growth

image left
Investigating bioufouling
Image courtesy of Adrian Macleod, SRSL Ltd

"While much is known about these communities, this is the first time they have been looked at in this way, including the way growth patterns vary around the UK's waters, and the impact they could have on renewables installations such as offshore wind and subsea tidal turbines, wave energy devices and their connected infrastructure.

"The project outcomes will also support greater understanding of the evolving bio-diversity of our seas."

Many industries, including renewables, shipping and telecommunications, rely on subsea equipment for their day to day operations, however the growth of sessile organisms can have a detrimental effect on electricity production, maintenance operations, repairs and ultimately costs.

The project will also look at the potential for developing sensors to monitor the type of biofouling occurring on subsea surfaces, measuring the type of growth, depth of growth and speed of fouling.
Vicky continued: "We are working on a feasibility study to establish a unique mapping tool that will indicate the likely species to be encountered in the UK's waters, including the rates of growth and their thicknesses, as these vary greatly around our diverse coastline. Using this information, we plan to develop a sensor that can measure the real-time growth of these communities, giving industry insight into the impacts on their infrastructure.

Dr Raeanne Miller is a marine scientist at Oban's SAMS Research Services Ltd. She said: "The type of biofouling around UK waters varies greatly. Biologists already have some tools and datasets to predict the type of biofouling which may develop on subsea structures and more data will continue to support the assessment of forthcoming sites for development and the planning for accurate maintenance and cleaning levels. Mapping these habitats won't just be useful for industry, it could be a hugely important tool to help preserve indigenous species and protect our seabeds."

The first outputs from the project will be published in February 2016.

TECHNOLOGY ASSESSMENT PROCESS

CATAPULT 'TAPS' INTO THE MARINE TECHNOLOGY DEVELOPMENT JOURNEY, CREATING A METHODOLOGY TO TAKE IDEAS FROM CONCEPT TO DEPLOYMENT

A successful wave and tidal sector in the UK – contributing thousands of jobs and millions of pounds to the UK economy – will be underpinned by a well-conceived and managed approach to technology development that allows the industry to move down the cost curve, ultimately reducing the levelised cost of marine energy (LCoE) to levels comparable with other sources of electricity.

Until now technology development, particularly in the tidal and wave sectors, has been characterised by a rush to get full-scale prototypes into the water as soon as possible to satisfy investor aspirations. This has meant not always focusing on proving the engineering principles, refining and de-risking the concept design at the earliest stages. With wave energy technologies in particular, there has been very little technical convergence to date and the sector is struggling to identify the most promising innovations on which to concentrate.

As a leader in ocean energy development, and recognising that only those technologies and innovations which best contribute to reducing LCoE will ultimately survive in the market, the UK must be at the forefront of introducing a new, more disciplined approach to marine renewables sector technology development. An "end to end" technology development regime is needed, that not only offers clear benefits to technology developers and their investors, but would also be recognised and adopted by all UK test facilities and endorsed by public funding and accreditation bodies.

ORE Catapult has therefore launched its Technology Assessment Process (TAP), intended to guide the assessment of new and developing technologies in a consistent, objective, proportionate and structured manner. The Catapult will work with developers to map out and follow

image left
Fundamentals of TAP

image below
Wave energy devices at EMEC Billia Croo test site
Image courtesy of Colin Keldie

a structured technology development journey, aiming to significantly de-risk technology before it reaches prototype testing stage, resulting in a less expensive, faster and more certain development pathway.

The TAP methodology is designed to track progress, and build evidence of performance as technological ideas move from one stage of development to another. These principles of early refinement of fundamentals and of steady building of design confidence may seem obvious, but they are characteristics that have been largely absent from the marine energy sector in recent years.

Working with our delivery partners the European Marine Energy Centre (EMEC) in Orkney, we will support technology developers, guiding them through a more structured approach to developing their technologies, from concept development, through to laboratory and analytical testing, prototype proving at a test site, single device deployment and preparations for first arrays.

They will also benefit from an evidence-based dossier, known as a 'Technology Passport', which will help prove the credibility of the technology and contain evidence such as engineering logs, test tank results, and test facility reports. ORE Catapult will help to map the developer's journey through the development process, identifying milestones that still need to be undertaken towards technology commercialisation and identifying appropriate development support opportunities. Discussions are also ongoing with public funding bodies, academia, developers and industry bodies to agree how the TAP process will enable a more controlled method of unlocking funding for technology development.

The underlying, core principles of TAP are:
1.The fundamentals of a technology must be sound and innovative.

2.A focus must be kept on the end stage of commercial affordability at every stage of the development process, and each step in the journey must represent progress towards that objective.

3.A stage gate approach to the development of the technology must be established, with clear stage targets. Successful outcomes must be achieved efficiently and effectively in terms of cost, time and risk awareness with progress proven against sound core metrics.

The benefits of the TAP approach are clear, both economically and in meeting stakeholders needs. Developers can improve understanding and validate the competitive prospects for their innovations. Capital investment can be matched to strong, feasible technical ideas, rather than those ideas that have benefited from the greatest marketing exposure, with solid economic justifications for capital investment underpinning each stage of the development journey.

Investors and sponsors will benefit from early and ongoing independent review, giving a greater level of confidence in the technology being developed, leading to better informed investment decisions, improved confidence and reduced risk. Developers will be able to offer grant awarding bodies visibility of TAP assessment reports to assist in evaluating competing ideas seeking funding, with Government and other public agencies able to use the process to help benchmark and understand the progress the sector is making in reducing costs.

It is widely accepted that technology demonstration at full scale is more expensive, more time consuming and less technically flexible than ironing out design flaws at the laboratory and analytical stage. Therefore, it follows that fundamentals should be thoroughly researched and developed in the early stages (to change fundamentals at a later stage will be expensive, slow and awkward), with the latter stages devoted to dealing with challenges of engineering implementation not of technical concept. Overall, TAP will lead to improved focus and economic risk management in technology development and an acceleration of the sector down the cost curve and towards affordability, so it is considered vital for a successful marine energy sector. TAP will also be of great benefit to more mature designs by assessing integration and array design issues.

For more information on ORE Catapult's Technology Assessment Process, please contact Simon Cheeseman.
simon.cheeseman@ore.catapult.org.uk

OUR SUBSEA DOCKS

EXECUTING A COMPONENT TRIAL TO PROVE THE PERFORMANCE OF AN EDUCTOR SYSTEM FOR IHC EB AS PART OF THEIR HI-TRAQ TRENCHER

The Catapult's National Renewable Energy Centre in Blyth has been undertaking research and development, and conducting testing and demonstration activity on innovative marine energy technologies, since 2002. The marine related assets include a 3MW drive train test facility, a shallow water test facility comprising two still water docks and a simulated seabed, and the UK's only accredited electrical and materials laboratory.

The site, an ex-shipyard, has adapted three dis-used dry docks to create a real-life testing ground for trialling new technologies in a controlled saltwater environment. The facility is used to perform equipment trials, prove installation techniques, and conduct performance verification and witness tests for the offshore energy sector. The simulated seabed has enabled ORE Catapult to play an instrumental role in the testing and trialling of novel cutting devices for trenching equipment, such as IHC Engineering Business Ltd's (IHC EB) Hi-Traq ROV trenching technology, and the still water docks are used to carry out submerged testing of ROVs and cable protection system trials for offshore wind projects. Other projects have included the development of power take-off systems for marine renewable devices, cable joint integrity tests, as well as novel pipeline and cable infrastructure installations, helping to reduce the risk of failure offshore and accelerate the marine energy technology development cycle.

image above
Shallow water test facilities at ORE Catapult, Blyth

image far left
Eductor system undergoing submerged testing

image left
Eductor system test for IHC EB

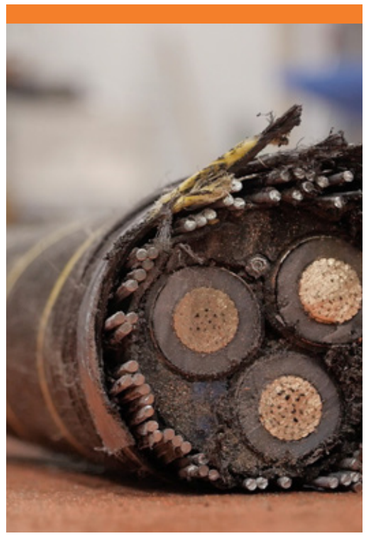
Most recently, the shallow water test ground was used to trial a prototype annular eductor system, developed as an application for the Hi-Traq trenching vehicle. The eductor system is utilised for spoil removal and chain cleaning operations during trenching and larger iterations of the eductor can be used to perform seabed excavation activities for operations and maintenance (O&M).

The full scale test was undertaken to demonstrate the capabilities of the eductor system in a controlled saltwater environment in order to recreate the operating conditions it will experience offshore and prove the performance of the system. During the eight day programme, the eductor underwent a series of fully submerged trials in the large stillwater tank to assess its performance characteristics. The test results have been utilised as a basis for further development and provide empirical data to establish performance models for a range of eductor sizes.

Denis Vasiljev, Mechanical Design Engineer at IHC EB, commented: "We were really pleased with how the eductor performed during the trials. Having access to Catapult's controlled onshore testing facility is ideal, it allows us to quickly and effectively test and prove key components and ultimately meet our product development timeframes."

2016 promises to be an exciting year for the Catapult, particularly in the area of marine energy projects. Forthcoming tests include a full system test of Atlantis Resources' AR1500 tidal turbine and testing the entire power take-off system of Tocardo's T2 turbine. The T2 test is part of a €1.3million EU FP7 funded project - TIDAL-EC - involving seven consortium partners from five European countries. It aims to determine the optimum design of a tidal energy converter power take-off system and permanent magnet generator, developing an optimised system that will improve reliability, increase power conversion efficiency and facilitate reduction in the cost of tidal power.

PROJECT SNAPSHOTS



RECODE

The RECODE OCEANERA-NET project, in collaboration with project partners Tecnalia, Zunibal, Ditrel, WavEC and Smartbay aims to answer the challenge of identifying common components in ocean energy technologies by developing a set of industry-enabling cost effective components, specifically designed for reliable and sustainable delivery of ocean energy. These components comprise a safety monitoring and control device, a wave measurement buoy, an umbilical cable monitoring device and an underwater device-to-cable connector for a floating energy converter.

Delivering reliable and cost-effective technologies is paramount to the ultimate commercial success of Europe's ocean energy industry and therefore identifying common components will help reduce costs by driving down both CAPEX and OPEX, and ramping up volume manufacturing.

Project outputs expected 2017.

RiaSoR

ORE Catapult is working with the European Marine Energy Centre (EMEC) and SP Technical Research Institute of Sweden in the Reliability in a Sea of Risk (RiaSoR) OCEANERA-NET project. The project will establish industry best practice in reliability testing for wave and tidal devices through improved load measurements and verification; standardised design guidelines for marine energy systems; and increased safety in marine energy operations. Our role involves modelling systems and developing enhanced condition monitoring methodologies to improve the reliability and availability of electrical power conversion.

The impact from RiaSoR on the wave and tidal energy industry will be to demonstrate innovative reliability analysis by learning from the physical interactions between the device and its environment, while embedding this understanding and building robustness into marine energy technology designs. This reliability methodology is ultimately aimed at reducing Health, Safety and Environmental (HSE) risks, technological risks, and Operations and Maintenance (O&M) costs which will lower the Levelised Cost of Energy (LCoE) for the sector.

Project outputs expected end of 2016.

Energy Yield Assessments

Frazer-Nash and ORE Catapult have produced a standardised approach to assessing and reducing uncertainty associated with energy yield assessment related to wave and tidal energy projects. Until now, there has been no standardised methodology or common terminology for energy yield and uncertainty assessments. The approach will help to identify key uncertainties in wave and tidal energy yield simply and systematically, provide a common language and standardised approach to assessing and reducing uncertainty, and allow projects to be compared on a like-for-like basis. Ultimately it will help to reduce risk and make wave and tidal energy projects more attractive to investors.

These reports are available to download from the ORE Catapult website.

Knowledge | Collaboration | Innovation

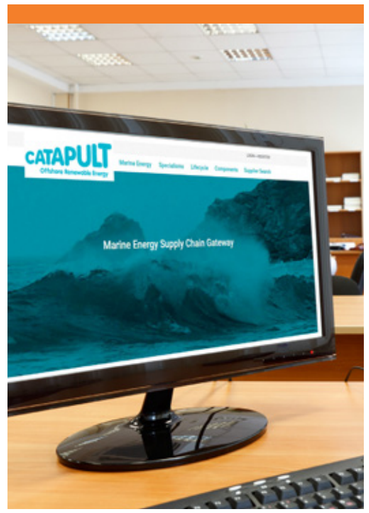
HIGHROC

ORE Catapult's offshore wind anemometry platform, located three nautical miles off the coast of Blyth, Northumberland, has been fitted with an Aeronet-OC water colour monitor to measure water luminance (Lw) as part of a €2.5m European funded FP7 project - HIGHROC (HIGH spatial and temporal Resolution Ocean Colour). The project aims to carry out research and development necessary for the next generation of coastal water products and services from ocean colour space-borne data by providing an order of magnitude improvement in both temporal and spatial resolution.

The measurements from the Aeronet-OC water colour monitor can be used to determine the turbidity and chlorophyll levels of the water, which are required as part of offshore site Environmental Impact Assessments (EIA). The instrument will collect data every 30 minutes, and be used to calibrate and validate HIGHROC algorithms. The Aeronet-OC instrument was successfully installed on the platform in Autumn 2015 and will begin collecting data in Spring 2016.

Suscable 2

We are collaborating with GnoSys Global Ltd and other partners in supporting the development of new insulation materials for power cables which can accommodate a variable loading profile. These cables which regularly operate under a dynamic (varying) load are used within the onshore and offshore renewable energy industries. The development of new insulation materials will result in the enhancement of the thermal performance of the power cables. This in turn should extend their operational life and thus drive down whole-life costs. In addition to ORE Catapult, partners involved in developing SUSCABLE include National Grid and Scottish Power Energy Networks as technology users, leading cable manufacturers, and the University of Southampton and GnoSys Global as research providers.



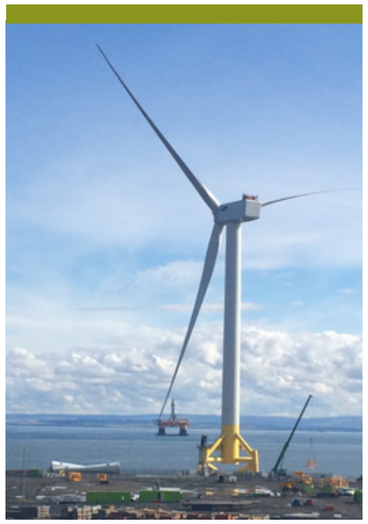
Marine Energy Supply Chain Gateway

Effective knowledge management solutions and the ability to access valid, well-maintained and relevant information will support the successful development of an effective supply chain.

Using insights gathered from data suppliers, owners and users across the sector and building key partnerships with UK trade organisations, ORE Catapult has constructed an interactive online knowledge portal - Marine Energy Supply Chain Gateway.

The supply chain portal received funding support from Scottish Enterprise and RenewableUK, and was developed in collaboration with RegenSW, The Welsh Government, Highlands & Islands Enterprise, Invest Northern Ireland and Scottish Renewables. It provides a searchable resource for buyers seeking UK partners and products and is an easy interface for new market entrants.

NEWS ROUND UP



ORE Catapult completes acquisition of Samsung's 7MW demonstration offshore wind turbine

ORE Catapult has completed the acquisition of the Levenmouth 7MW demonstration offshore wind turbine, located off the East Fife coast, from Samsung Heavy Industries (SHI).

The turbine becomes the world's most advanced, open access, offshore wind turbine dedicated to research, and offers opportunities for considerable training and development of skills vital for the future of the offshore wind industry. The turbine offers UK industry and academia an unrivalled opportunity to develop a deeper understanding of a wide range of technologies as well as the operations and maintenance aspects of offshore wind turbines, and thus drive down the cost of delivering clean energy from offshore wind.

The Catapult will now undertake a planned period of operation and familiarisation of the turbine alongside SHI, whilst continuing to develop research and development activities covering multiple areas of offshore wind operations.

ORE Catapult and Atlantis Resources announce testing of tidal turbine power train destined for MeyGen

Tidal turbine developer, Atlantis Resources, will test its next generation 1.5MW tidal turbine, the AR1500, at the National Renewable Energy Centre in Blyth as part a six week test programme. The tests aim to de-risk the AR1500's deployment by proving the reliability and validating the performance of its power train system.

ORE Catapult is working with Atlantis Resources on the €1.3m Eurostars project to drive forward the development and deployment of the AR1500 tidal turbine, the series which is to be installed at MeyGen, the UK's first tidal array, in the Pentland Firth off the Scottish coast. The tests are the critical final stage of development that will give Atlantis, MeyGen and their investors the confidence that the turbine is ready to be deployed and to start generating electricity.

The Catapult's 3MW power train test rig will be used to simulate the dynamic forces the turbine will experience during operation. This type of testing is critical to ensuring that any technical issues are resolved prior to deployment, minimising the risk of early complications and unplanned maintenance.

Cutting edge lab upgrade increases 66kV deployment potential

The Catapult has upgraded its UKAS accredited high voltage electrical laboratory, providing enhanced testing capability unique in the UK and paving the way for an industry shift from 33 to 66kV for future offshore wind inter-array electrical systems.

The upgrade to the adjustable HV reactor involved introducing an automated control system and increasing the testing capability of the 600kV resonant transformer, on long-term loan from Doble Powertest, to 150kW of power. This now means that the reactor has both the required high voltage and high current capacity to carry out automated step-breakdown testing of 66kV cable systems using water terminations.

Stepping up array systems in offshore wind farms to 66kV will have a dramatic impact on the sector, and result in higher offshore power density, lower operational losses, fewer offshore collector substations and the resultant reduction in the levelised cost of energy. Ultimately, this move is essential for the development of larger offshore wind power parks which will use larger capacity offshore wind turbines.

Latest news and developments

LM Wind Power and ORE Catapult collaborate on an innovative blade testing method

Global wind turbine blade manufacturer LM Wind Power and the Catapult are involved in a strategic collaboration, to develop an innovative blade test method that could help to reduce overall blade test times by up to 25% and potentially almost halve the time for the fatigue-testing alone.

LM Wind Power together with ORE Catapult have embarked on an innovative partnership aiming to develop shorter and more cost effective blade tests. The project initiated by the Catapult set out to optimise the test design and develop a faster and even more precise method for conducting the flapwise and edgewise fatigue testing simultaneously on the same blade.

This new test method will also have significant benefits in terms of time reductions and cost advantages, not least for the larger blades for offshore. The fatigue analysis software, developed by ORE Catapult in collaboration with Durham University and utilising extensive data from LM Wind Power, has been certified by DNV GL.

The programme is now moving into the testing phase, for which LM Wind Power has delivered the 40.3 meter blade that will undergo full-scale testing using the bi-axial testing technology at the Catapult's facility in Blyth, Northumberland.

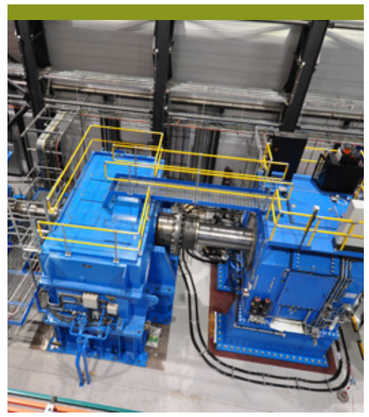
Catapult's Ignacio Marti elected as new Chairman of IEA Wind

The International Energy Agency Wind Energy Group (IEA Wind) has elected ORE Catapult's Innovation & Research Director, Ignacio Marti, as the Chair of the Executive Committee.

IEA Wind is a global network of researchers and policy experts focused on advancing wind energy development within the 24 member countries. The member countries of the IEA Wind Energy Group are world leaders in wind deployment and represent 85% of the world's installed wind capacity. R&D collaboration among IEA Wind member countries has played a major role in addressing the most difficult to solve wind technology challenges; and collaboration will continue to be important as future challenges are identified and addressed.

Ignacio Marti said: "I look forward to taking up my Chairmanship and continuing the significant research and innovation contributions that IEA Wind's activities have made in furthering the global wind industry."

Organisations wishing to engage in IEA Wind research activities should contact Patricia Weis-Taylor, Secretariat for IEA Wind (secretariat@ieawind.org), or any IEA Wind Executive Committee member for further information (www.ieawind.org).



TiPTORs project delivers improved design processes for tidal turbines

The first phase of the Tidal Turbine Powertrain Reliability Project (TiPTORs), led by the Catapult, has delivered a 'Design for Reliability' (DfR) methodology.

The methodology, developed in partnership with Ricardo and DNV GL, provides a systematic approach, allowing designers to understand and control the factors influencing product reliability and hence operational performance, improving the detection of weak links early at the design phase.

Alongside the DfR methodology, specifications for both a reliability simulation tool and a component database have been produced in preparation for the next phase of the project, which will focus on accurately modelling components, allowing for better component and system selection.

Together, the DfR process and simulation tool will enable turbine designers to better predict reliability, degradation and pinpoint potential failure, providing confidence that the turbine will operate within required parameters delivering the predicted LCoE.

More information on this project is available on the ORE Catapult website.

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