Wave Tidal
ENERGY NETWORK
Winter 2018 ISSUE 14 | £7.50

COMMUNICATION HUB FOR THE WAVE & TIDAL ENERGY INDUSTRY



SPOTLIGHT ON THE BASQUE COUNTRY
ENERGY FUTURE-PROOFING

SPECIALIST COATINGS
PROTECTING YOUR ASSETS

THE SCIENCE OF SEALING
A SCIENCE NOT AN ART

Image courtesy of: BiMEP
(Biscay Marine Energy Platform)

BASQUE COUNTRY: INDUSTRY FOR A WAVE FUTURE

Located in the north of Spain, the Basque Country represents one of the largest industrial concentrations in Europe and is the region with the highest R&D intensity in the country

This industrial and technological positioning has allowed the region to become a worldwide reference in driving the wave energy alternative, both having a complete value chain led by several converter developers and a unique set of R&D infrastructures for testing and validation of marine energy components and systems.

BASQUE COUNTRY: PUBLIC-PRIVATE COLLABORATION BETTING ON MARINE ENERGY

The diversity of stakeholders that are present in the value chain as well as the energy potential of the Basque coast make marine energy a strategic bet of the Basque Country. In fact, the Basque Energy Technological and Industrial Development Strategy (energiBasque), developed in collaboration between the Basque Government and over 130 organisations, consider wave energy as one of its prime commitments.

Within its 150km of total coast length, the Basque coast is in a unique position to benefit from wave energy and to develop and test wave power generating devices. Moreover, the available medium-high level resource facilitates testing in a less aggressive environment than other locations.

This is complemented by the regional existing expertise in marine renewable energy technologies, based on a tradition for collaboration and the support of relevant entities such as EVE (Basque Energy Agency), SPRI (Business Development Agency of the Basque Government) and the Basque Energy Cluster, which currently coordinates ELBE (Europe Leading Blue Energy), an internationalisation project funded by the European Commission through the COSME Go International programme, partnering with clusters from Denmark, Sweden, Scotland and Belgium.

UNIQUE TEST-SITES

Two world reference infrastructures have been boosted by EVE in the field of wave energy, Mutriku OWC plant and BiMEP, in order to develop a scientific-technological offer and position the Basque Country as an international benchmark in wave energy. Mutriku OWC is the first grid-connected wave energy plant in Europe (mainland) and an up-and-running test site for new concepts. The facility opened in July 2011 and all the power generated is fed into the grid for general consumption.

On the other hand, the Biscay Marine Energy Platform (BiMEP) is a singular platform for real-scale testing and validation of marine energy components and systems. The purpose of the platform is to demonstrate the technical and economic viability and safety of the converters before they are rolled out on a large-scale commercial level. BiMEP is located off the coast at Armintza and with a capacity of 20MW it offers a complete portfolio of services for speeding up development of marine energy technologies.



Mutriku Wave Power Plant
Credit: EVE – Basque Energy Agency

SETTING THE PACE IN R&D

Alignment among business, research centres, testing sites and government translates into intense collaboration in R&D projects in which the Basque value chain has a strong involvement. Currently, there are two emblematic projects under way connected to these infrastructures, HARSH and OPERA.

HARSH is a strategic project funded by the Basque Government with the underlying objective of carrying out industrial research in the search for solutions to common problems (corrosion, fouling, etc.) faced by companies in the development of their products for energy applications in harsh marine environments.

Regarding OPERA, it is a European distinctive project funded by the H2020 programme led by TECNALIA and with the participation, among others, of four other Basque organisations, such as Iberdrola, Oceantec, BiMEP and EVE. Its main objective is to reduce the cost of wave energy by 50% and, for the first time, to provide open access to high-quality open-sea operating data to the wave energy development community.

A COMPLETE VALUE CHAIN WITH INTERNATIONAL ACKNOWLEDGEMENT

Many initiatives have been launched which have positioned the Basque value chain as an international reference point. The region has a strong business fabric operating in both energy and shipbuilding sectors, with more than 70 Basque companies who have developed a specific offer for wave energy, including WEC components, equipment and auxiliary wave farm services (such as connection solutions, moorings, buoys, power electronics, etc.).

One of the most representative cases is Oceantec, the first Spanish company to connect its own WEC to the grid. This pioneer enterprise commissioned its low power OWC prototype, the MARMOK-A-5, at BiMEP in 2016, surviving two winters in open Atlantic waters and currently continues supplying electricity. It also participates in OPERA, providing operational data.

Two other enterprises are currently working on the development of converters, Arrecife Energy Systems and Sener. The Arrecife start-up, which has obtained funding from the SME instrument and the Seal of Excellence from the European Commission, is growing by leaps and bounds. Its converter simulates a coral reef that opposes the strength of the waves to create resistance and absorb much of its energy and it is currently in the stage of funding a prototype on a real scale. On the other hand, the internationally recognised engineering company Sener also has its own patented wave energy converter design, based on the principle of the OWC.

R&D AGENTS THAT MAKE A DIFFERENCE

In close cooperation with these companies, the Basque Country hosts a network of R&D organisations and highly experienced research groups, that are referenced in wave energy projects within the EU framework programme such as TECNALIA, which until recently chaired the international Ocean Energy Systems association.

Other Basque research centres and universities, such as Azti TECNALIA, IK4 research alliance, Mondragón Unibertsitatea and UPV/EHU, also work together developing specialised, world-class and market-oriented research that covers a wide range of marine energy activities from environmental monitoring and EIA studies to the designing of marine farms.

Basque Energy Cluster

SCAN/CLICK
WEBSITE
VIDEO

HARNESSING WAVE POWER POTENTIAL

Nature is inspirational – traditionally, inventors have stared at it and analysed its patterns and that has been the source of many great ideas

Observation is also Arrecife Energy System's key to success. By imitating the behaviour of coral reefs, this Spanish based company wants to make a difference in marine energy. Their founders have designed the first operating system through turbines which, like corals, function as a natural barrier against waves and opposes them. The result? Absorbing more energy than any other technology and producing electricity continuously.

UNIQUE AND ENVIRONMENTALLY FRIENDLY

Arrecife's system provides cross flow turbines that are activated by waves. When they rotate, generators transform the movement into electricity. Not only that, but Arrecife's device is the only one that captures energy from all the sea's sources: wave, current and tidal.

Surviving storms is another of its strengths. An immersion system enables the system to avoid damage from heavy seas. Natural sea life is safe thanks to non-cutting turbine blades designed by José Javier Doria from the Basque Country University.

A BRIGHT FUTURE

Since its founding in 2016, Arrecife's potential is being recognised worldwide. Currently seeking funding to build the full-scale prototype, the company has qualified for numerous innovation projects and are finalists in Cleantech Open Northeast, South Summit and Shell New Energy Challenge amongst others.

The European Commission granted Arrecife the Seal of Excellence and the H2020 SME Phase 1 subsidy and the scaled version system was recently tested in a natural sea environment successfully. The company expects to test its full-scale device during 2018.

The global resource of wave energy has been estimated to be greater than 2TW and the possibilities it offers are substantial.

Arrecife Energy System





TEST FACILITIES FOR FLOATING OFFSHORE ENERGY DEVELOPERS

BiMEP (Biscay Marine Energy Platform) provides research, testing and demonstration facilities for developers working in the field of ocean and floating offshore wind energy

The test facilities are located in two different sites: BiMEP itself, in the village of Armintza and the other in the town of Mutriku.

The privileged location of BiMEP offers excellent access from all areas of Europe, a highly developed technological support network and favourable wave and wind conditions for testing. These facilities are a clear example of the commitment of the Basque Government to develop marine energy through the efforts of the Basque Energy Agency (EVE).

BIMEP SITE

BiMEP is an open sea test area located off the coast of Armintza, in the province of Bizkaia. Operating since June 2015, BiMEP offers technology developers an offshore area with suitable wave and wind resources, thereby enabling the demonstration and validation of the technical and economic viability of different concepts of energy converters, equipment and materials prior to commercial development.

The test area is connected to an onshore substation via four 5MW subsea cables and data collection is made possible through a remote monitoring and control system set up in a nearby dedicated facility.

MUTRIKU SITE

The Mutriku facility is located inside the Mutriku wave power plant, in the province of Gipuzkoa. Inaugurated in 2011, this commercial power plant uses oscillating water column technology to harness wave energy. The plant, built into a breakwater and with a capacity of 296KW, has been in constant operation, supplying more than 1,400,000kWh to the grid.

Today, two chambers of the power plant have been equipped with sensors and power electronics to offer technology developers the possibility of testing new concepts of air turbines, generators, control strategies and auxiliary equipment in real sea conditions.

KEY INITIATIVE

As a key initiative within the Basque strategy on ocean energy, BiMEP is designed to promote the development of business activities in new and emerging areas, thereby helping to provide the Basque industrial fabric and scientific and technological players with a sound technological base and starting point for the development of the ocean energy sector.

BiMEP



NEW SUBSEA CONNECTION SOLUTION

BiMEP (Biscay Marine Energy Platform) provides research, testing and demonstration facilities for developers working in the field of ocean and floating offshore wind energy

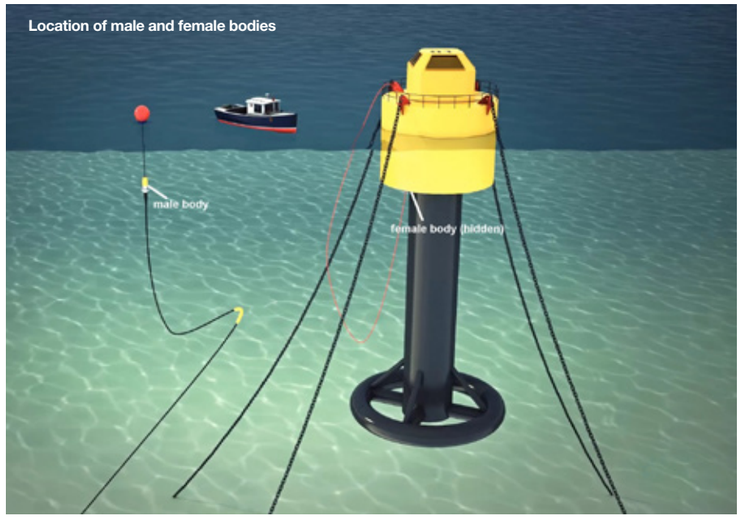
Sometimes this challenge has been addressed by acquiring electrical connectors from other sectors that are oversized and expensive. The presented solution is named KONEKTA2 and it has been developed by Ditrel Industrial with the objective of simplifying the connection/disconnection operations and reducing costs and time by avoiding the use of expensive marine equipment.

DESCRIPTION

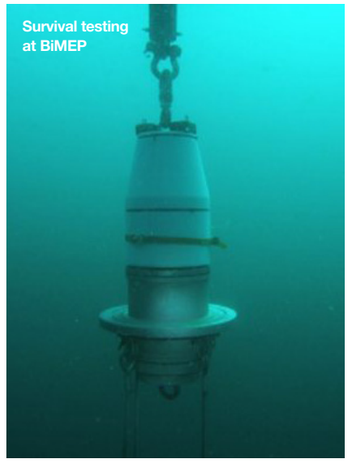
The solution consists of a male/female connection, performed on the surface from inside the energy converter. This means that there is no need for using large vessels, cranes or ROVs. On the one hand the male body can stand by floating and is linked permanently to the subsea umbilical cable ready for the connection to the converter. On the other, the female body is welded to the hull of the converter. Once the converter is towed from the seaport to the generation location, the connection can be performed using a normal sized vessel.

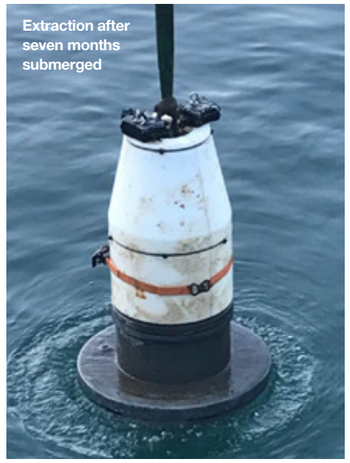
MAIN FEATURES

- Up to 20kV (nominal voltage), 66kV under development
- Triphasic connector for medium voltage, fibre optics and auxiliary supply
- Low manufacturing and positional costs
- Tested and validated in BiMEP
- AIP Certificate from Bureau Veritas
- Protected with patent EP 2 784 364 B1



Location of male and female bodies


Survival testing at BiMEP


Extraction after seven months submerged

PROJECT MILESTONES

- April 2014 – KONEKTA2 project begins
- August 2015 – participation in 'RECODE' consortium project selected by the OCEANERA-NET Joint Call Committee
- March 2016 – participation in the 'HARSH' consortium project for designing, manufacturing and validating different components for the Offshore Energy Sector
- September 2016 – real sized prototype is manufactured
- December 2016 – onshore performance testing
- March to November 2017 – survival testing in BiMEP
- June 2017 – KONEKTA2 obtains AIP certificate from Bureau Veritas

Ditrel Industrial

The HARSH project

Technologies for the design, advanced manufacturing and validation of components for power installations in offshore environments

HARSH is a strategic project that aims to address several common challenges of the harsh marine environments.

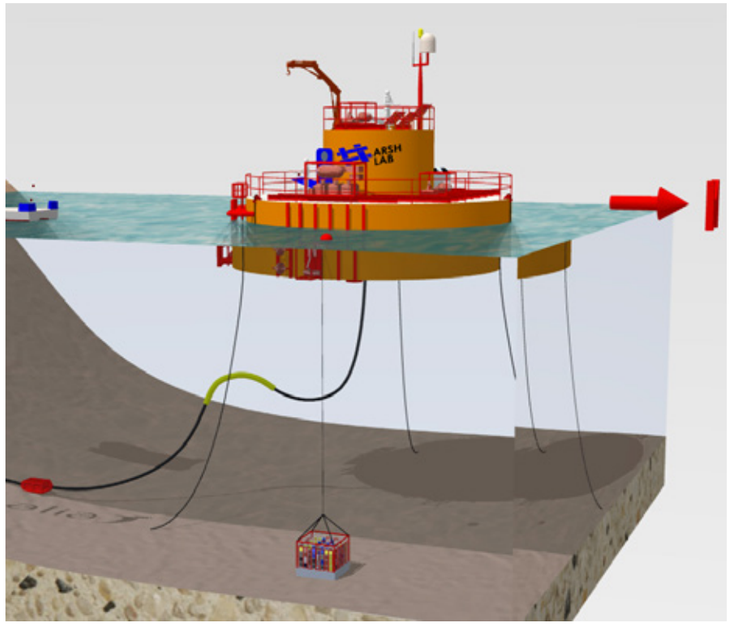
There are three functional pillars to face the marinisation challenge:

1. **Materials and solutions to protect against corrosion and fouling: to secure the survival of the devices and components in hostile environments and reliability of the continued functioning and generation**
2. **O&M: enabling accessibility to the devices for their proper maintenance and predictability of the resource, securing the operation in adverse conditions of the environment and instability of the associated devices and equipment**
3. **Competitive production costs**

The project addresses these aspects with the objective of developing new products, such as: risers, fixings, hydraulic systems, submarine electric connectors, submarine handlers, hydraulic systems, protective coatings against corrosion and fouling, anchoring lines, welding processes, software platform for advanced logistics simulation and access to floating assets for operation & maintenance.

CONSORTIUM

HARSH consortium brings together companies that produce different components and solutions for a technologically innovative sector such as offshore energy (oil & gas and renewable), which will enable them to offer a higher quality joint and coordinated service in the supply of key elements for large oil companies and manufacturers of components and windfarm operators. The participating companies are: Erreka, Credeblug, Ditrel, Glual, Hine, Navacel, Nem Solutions, Sasyma, Tubacex, Vicinay Cadenas, Vicinay Sestao, Cluster de Energía and Foro Maritimo Vasco.



LABORATORY

HARSHLAB: in the case of offshore environments, much of the R&D&I must be carried out in the real environment. Therefore, the HARSH consortium will develop the HARSHLAB laboratory (permanently anchored at BiMEP) under the leadership of TECNALIA.

> "HARSH consortium brings together companies that produce different components and solutions..."

TECNALIA is a unique infrastructure worldwide which will enable components and subsystems to be tested and validated in a real marine environment, enabling the possibility of integrating diverse active and passive tests as well as staff training in an offshore working environment, with significant economic conditions and professional projection.

UNIQUE

There is no other worldwide offshore laboratory that integrates the versatility and huge range of testing that is proposed which will furthermore enable BiMEP to offer a greater variety of testing services, increasing its workload.

HARSH

wave energy

BASQUE COUNTRY

POWERED BY THE BASQUE ENERGY CLUSTER

WAVE ENERGY BASQUE COUNTRY brings together leading Basque companies that have business objectives in the marine renewable energy.

COMPANIES IN THE VALUE CHAIN



WWW.WAVEENERGYBASQUECOUNTRY.COM

NOT YOUR AVERAGE TYPE OF EXPERT

By means of smart tooling Kimua aims to improve assembly, transport and installation of marine energy systems

SYNERGIES

Founded in 2011 and growing steadily since then, the company wants to bring its experiences made in the offshore wind industry to the marine energy market. Kimua developed a lot of special tools in previous years for pioneering projects in the offshore wind sector. All this knowledge can be applied for faster and effective industrialisation in the marine energy industry.

INTELLIGENT DESIGN

The engineering team always considers the whole workflow of a product when designing specific solutions, so that your production line or installation setup is working smoothly from start to finish, especially in rough offshore conditions; and when dealing with large and heavy components, ergonomic design is a key factor for a safe operation.

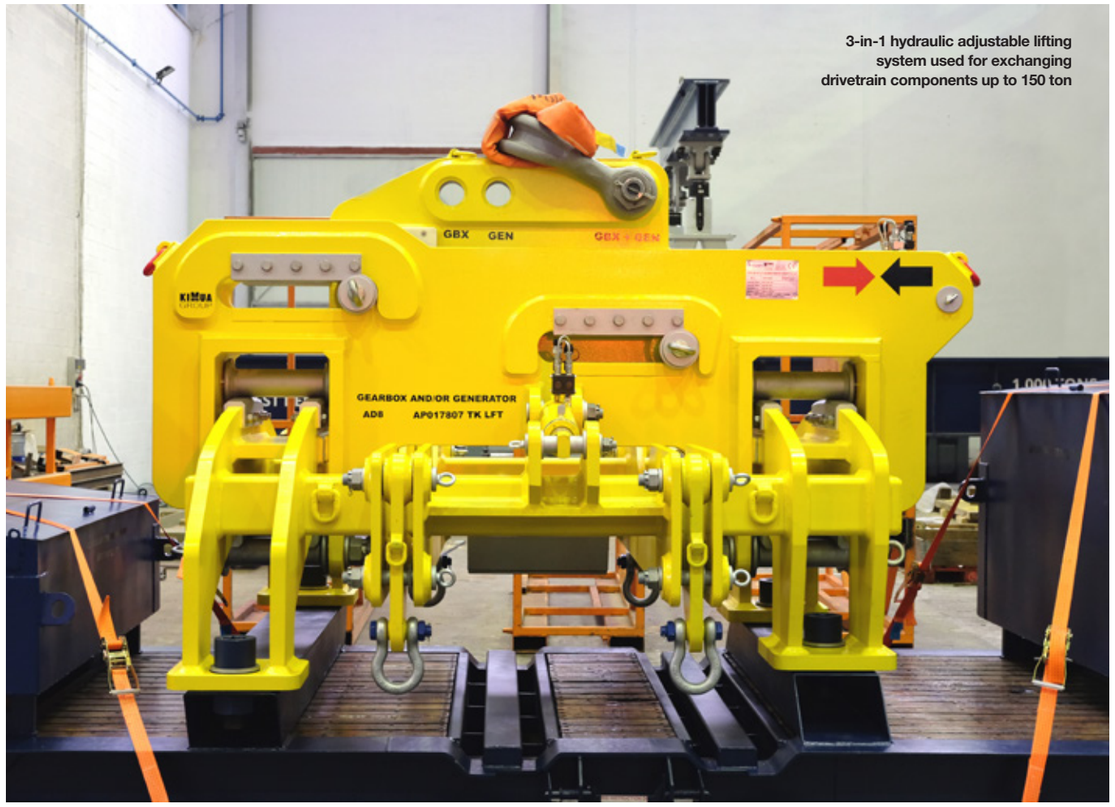
CREATIVITY

Kimua often defines solutions for problems that have never been faced before. Therefore the combination of creativity, experience and professional engineering is their foundation. For example, in some cases Kimua has combined different tools into one, saving cost and time during manufacturing, operation and storage. This is only possible by stepping back and looking at the whole picture, working on ideas even if they sound crazy and impossible. This is Kimua's way to propose better and safe solutions for complex problems.

QUALITY

Good ideas are worth being manufactured in high quality and with passion. Skilled and motivated hands in the workshop as well as a full quality documentation back to the heat is the basis for this. EN 1090 EXC3 and DNV GL certified tools are the proof. From cutting to coating, Kimua has a critical eye on all steps during manufacturing to ensure that all tools are working reliably, safely and for years to come under harsh conditions..

Kimua



3-in-1 hydraulic adjustable lifting system used for exchanging drivetrain components up to 150 ton

ONE YEAR SUPPLYING ELECTRICITY TO THE GRID

On 13th December 2017 the Oceantec's Wave Energy Converter (WEC) MARMOK-A-5 celebrated its first anniversary supplying electricity to the Spanish grid

The MARMOK-A-5 is a low power prototype of 5m diameter and 42m long based on Oscillating Water Column (OWC) technology. The MARMOK-A-5 is installed in the Biscay Marine Energy Platform (BiMEP), located 4km off Armintza (Spain) and is the result of a pre-commercial procurement contract by the Basque Energy Agency (EVE).

PROMISING RESULTS

During this first year of operation results are extremely positive…

- The prototype has survived a winter in open waters of the Bay of Biscay, with wave heights larger than 12m, without suffering any notable damage. This confirms the survival capacity of the device in extreme sea conditions for which it has been designed
- The project has been completed within a closed budget, in which there has not been any unexpected significant cost overrun. This shows the high degree of Oceantec´s knowledge about all subsystems and their operation
- The availability of the prototype is close to 90% which confirms the ease and low cost of maintenance
- The data collected both from the power performance and the dynamic behaviour of the MARMOK-A-5, has given confidence on the numerical models which will be the basis for the next steps of technology development.

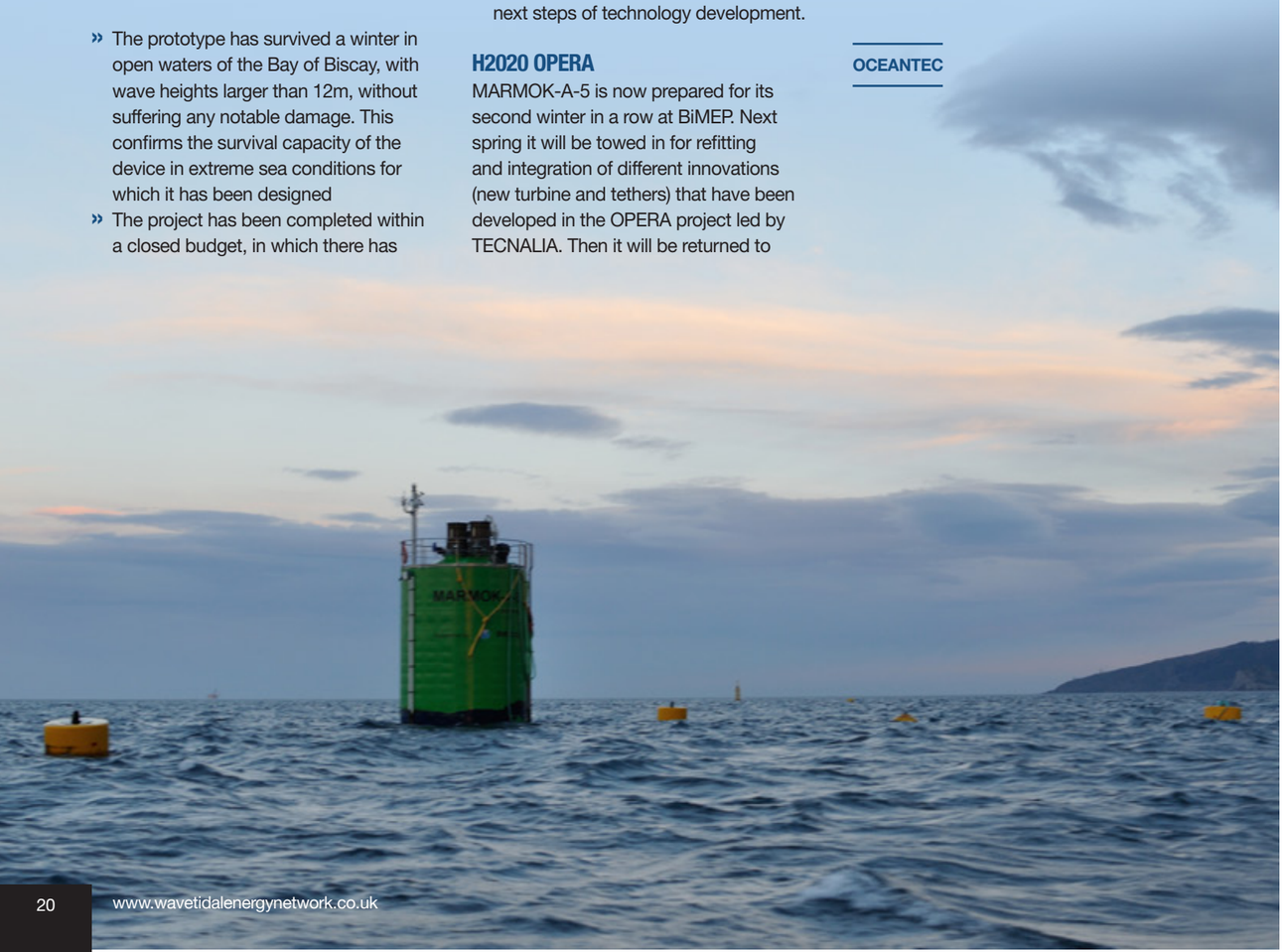
H2020 OPERA

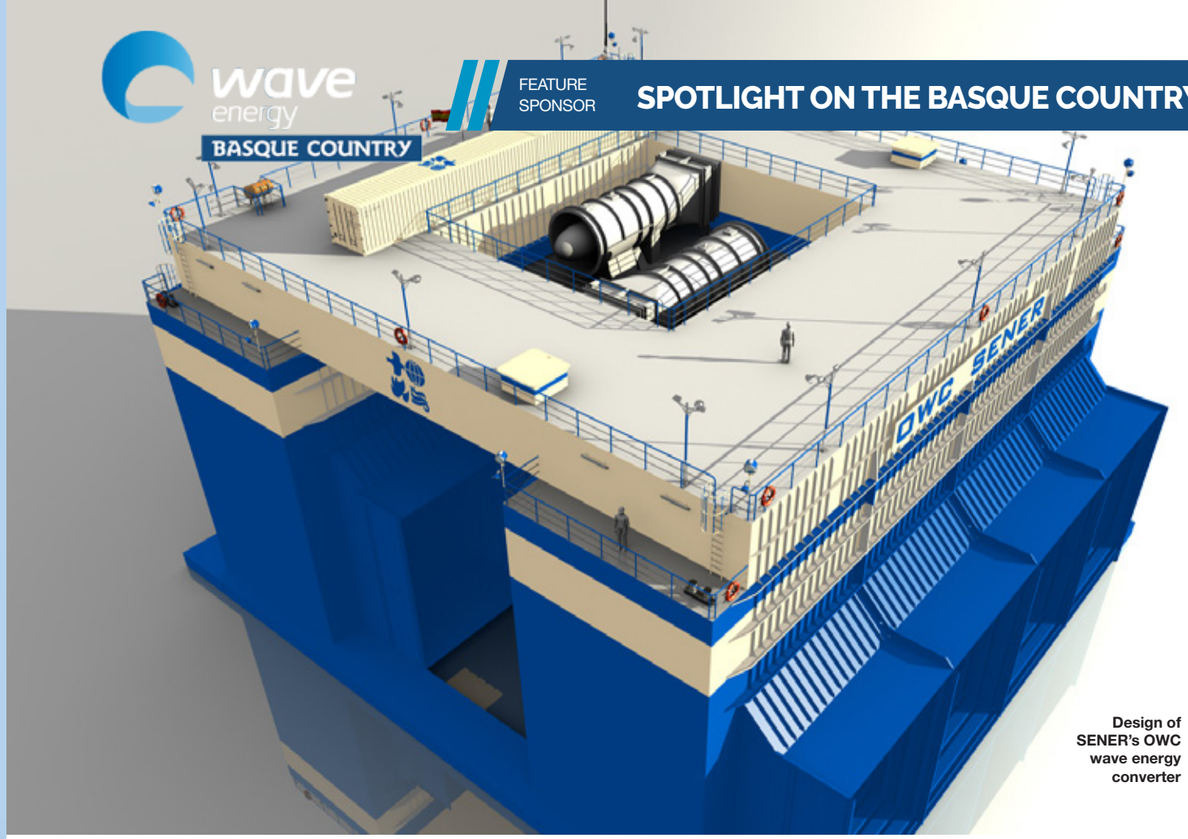
MARMOK-A-5 is now prepared for its second winter in a row at BiMEP. Next spring it will be towed in for refitting and integration of different innovations (new turbine and tethers) that have been developed in the OPERA project led by TECNALIA. Then it will be returned to its mooring site to collect more data for benchmarking.

NEXT STEP

Oceantec's next step is to design, build and operate a commercial size WEC. In this new prototype Oceantec will exploit the experience obtained in the MARMOK-A-5, as well as new technological improvements, which will greatly move the technology close to a commercial product able to compete in the renewable energy sector.

OCEANTEC





Design of SENER's OWC wave energy converter

PIONEER IN THE RENEWABLE ENERGY SECTOR

SENER is a private engineering and technology group present in the fields of renewables, power, oil & gas; aerospace; infrastructure and transport; and marine

On the premise of efficient energy use, SENER has always stood out as a pioneering company in the field of renewable energies through investment and development of technologies in several fields.

SUPPORT

Regarding marine energy, they have participated as an engineering company supporting the Biscay Marine Energy Platform (BiMEP), for the Basque Energy Agency, carrying out the following…

- Writing/supervision of technical and administrative specification for the public work packages (subsea cable, connector, substation and marine aids to navigation).
- Bidders evaluation and awardee selection of differing work packages
- Supplier supervision
- Project construction management

The company has also taken part in other projects such as OCEANLIDER and EMERGE projects for Iberdrola Renewables, or the Offshore Wind Accelerator (OWA) Contest for the Carbon Trust.

EXPERTISE AND EXPERIENCE

It also highlights the experience in studies of marine and coastal resources, as well as in the study of marine energy converters with SENERWave, a software designed internally to simulate floating and fixed devices in sea conditions. All this expertise, added to their capacity for carrying out multidisciplinary EPC projects, allowing them not only to analyse the feasibility of marine renewable projects but also to accomplish the design, construction and commissioning of them.

DEVELOPMENT

SENER has also developed and patented its own Wave Energy Converter based on the Oscillating Water Column (OWC) principle and has developed two devices for deep and shallow waters. In addition, they patented, designed and tested the main equipment of the technology: a high-efficiency unidirectional air turbine and air check valves.

Founded in 1956, the company's aim is to offer its clients the most advanced technological solutions and to achieve international recognition based on its independence and commitment to innovation and quality.

SENER

PRIVATELY FUNDED LEADING RESEARCH CENTRE

TECNALIA is the first privately funded applied research centre in Spain and one of the leading such centres in Europe – their mission is to transform technology into GDP

The research centre is committed to renewable sources of energy from the marine environment as a promising sector, which will contribute towards sustainable economic growth and stable job creation. They believe that research, development and innovation will play a key role in creating cost competitive technologies in the sector.

KNOWLEDGE AND EXPERTISE

The centre offers its knowledge and expertise to companies interested in offshore renewable energy in areas such as modelling and analysis of offshore structures (including mooring systems and foundations); electric transmission; materials (testing and failure analysis, corrosion monitoring, fatigue, bio-fouling…) and O&M strategies definition.

The centre applies this knowledge using a coordinated and holistic approach, focusing on the development of cost effective technologies to harness offshore renewable sources throughout their life cycle.

EXPERIENCE

TECNALIA has more than 12 years of experience in the marine energy sector, totalling €35m worth of R&D. Some of the most exciting achievements include creating two technology-based companies (Oceantec Energias Marinas and Nautilus Floating Solutions), transferring four patents to industry (including two SMEs) and open-sea testing several wave energy devices and subsystems.

The centre has participated in 12 European research projects on offshore renewable energy worth more than €5m in funding. Among them it is worth mentioning the ongoing OPERA project. Led by the centre, a consortium of 12 academic and industrial partners will deliver for the first time, open access, high-quality open-sea operating data and experience to the wave energy development community, thus contributing to identifying and quantifying the challenges experienced at-sea as well as to prioritising the development and innovation effort required for solving them.

PROJECT AIMS

The project aims to develop and de-risk technologies that will reduce the cost of operating wave energy devices



at sea by 50% in the long-term and subsequently accelerate the roll out of marine renewable energy.

COLLABORATION

Last but not least, TECNALIA has collaborated with the local government on the definition of a marine energy strategy, organised international and national events, including ICOE2010 and is contributing to numerous international committees and advisory groups (OES, OEE, EERA, ETIP-Ocean, IEC/T114 among others).

TECNALIA



HELPING OCEAN ENERGY BECOME A REALITY

The climate change forecasts are leading to a change in the power production model, promoting ocean energy - and in particular wave & tidal energies – however it needs to lower costs in order to achieve a commercially competitive LCoE

AN OPPORTUNITY

Tidal and especially wave energy are nowadays at an initial development stage. This represents a great opportunity for researchers and developers to improve and implement a technology of future.

PERFORMANCE TROUGH CONTROL

This technology is mainly based in turbo-generator modules that must be adequately controlled, not only to increase the efficiency, but also to provide reliable operation and ensure the protection of the plant.

UPV/EHU CAPABILITIES

In this context, the Automatic Control Group of the UPV/EHU is a pioneer in the control of marine power plants, with collaborations with main key players, a strong support from the administration as, for example, the Basque Energy Agency responsible for leading projects such as the Mutriku's MOWC plant or BIMEP- and a longstanding history developing control strategies to contribute bringing Ocean Energy to the market.

NEW INTERNATIONAL MASTER'S DEGREE

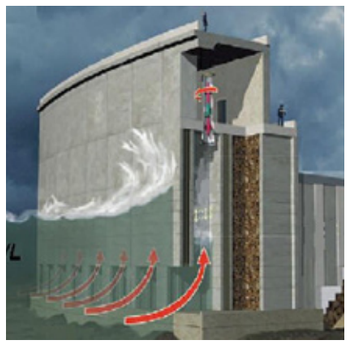
At the beginning of 2014, the UPV/EHU proposed the creation of a European master's degree in marine offshore energy, due to the concerns of many companies and both public and private institutions in this sector that expressed the need for the implementation of this type of training based on specific needs.

Their aim is closing the training cycle of specialists with specific knowledge about offshore renewable energy, such as: training in aerodynamics and hydrodynamics with mechanical and electrical principles applied to the marine environment, composites, lamination structures, injection, corrosion, biofouling, coatings, safety in the marine environment, installation services, repair and maintenance, economic and legal aspects of park implementations, etc.

STRUCTURED TECHNICAL CONTENTS

After several years of exhaustive analysis of offering masters in these subjects in Europe, they combine the participation of several partners that complement the training to meet this lack of specific training. The technical contents are structured in six major blocks…

1. Resource and marine environment
2. Theoretical foundations
3. Connection and integration to the electricity grid
4. Engineering, development and management of offshore parks
5. Conversion technologies
6. Environmental, economic and legal aspects of marine renewable energy



COMMITMENT

The commitment to renewable energy offshore in the Basque Country is already a reality awaiting a promising future that continues to grow and it is supported by three main pillars: infrastructure, research and training, which walk together on a sustainable bet in this changing energy future.

UPV





MAKING MARINE DATA COLLECTION EASIER

Zunibal, S.L., a Spain-based bespoke marine technology and communications company, in order to meet market needs, has developed an innovative wave measurement system, Anteia Wave Buoy

Thanks to close collaboration with Basque Energy Cluster and marine renewable actors, this innovative system can provide the decision maker with timely/accurate information to bring down the uncertainties and improve the efficiency of marine renewable energy devices.

REAL TIME KNOWLEDGE

Firstly having a real time knowledge of the sea state could increase the weather window to operate due to better understanding of the real-time meteorological conditions on site and reducing the risk of planning an operation based only on the weather forecast, resulting in a reduction in the total cost of the operation.

Secondly, the system can be used to optimise the energy conversion and as a protection system when the environmental conditions are hazardous for the energy converters.

SOLUTION

Zunibal's solution is using the Anteia Wave Buoy (measurement device), website and mobile friendly application to allow the data access from any place at any time including technical support.

Anteia Wave Buoy is a small and easy to deploy solution, weighing 26kg and measuring 0.6m diameter. The physical characteristics and materials used give many advantages, for example the use of small boats for deployment and recovery and the potential of deploying an array of buoys to cover as much area as possible, as well as opening the way to reducing the operational costs linked to buoy maintenance.

BESPOKE MOORING SYSTEM

Additionally, the buoy has a bespoke mooring system, allowing free movement for optimum wave parameters detection. This mooring is specially designed for the buoy and can be fitted to different depths and current conditions.

At this moment the system has been deployed for more than two years in BiMEP (Biscay Marine Energy Platform), and recently it has been deployed in PLOCAN test site (Canary Island). In these two experimental areas the data provided by the system is continuously analysed by experts to ensure the operational quality of the company's solution.

ZUNIBAL

OCEANS – THE KEY TO FUTURE ENERGY MIX

The worldwide increasing demand of energy is a fact, as well as the need to harness it from renewable sources in order to minimise the impacts on the environment

In this situation, the oceans become key in the future energy mix because of their huge energy potential within special outstanding coastal areas, where two thirds of the global population live.

TECHNICAL CHALLENGES

Nevertheless, the oceans also pose huge technical challenges because of the extreme requirements required in terms of wide load range, protection against environmental conditions, life cycle time, maintenance and availability together with the total cost of energy as a decisive factor for success. Therefore, deep understanding of these challenging requirements besides expertise on maritime applications become keys factors on any ocean energy system development.

HYDRAULICS TECHNOLOGY

There are currently many ocean energy generation concepts where Bosch Rexroth is involved as drive and control specialist on various technologies and it believes that hydraulics technology fits extraordinarily on the ocean energy challenges starting on the components level, which are already proving to be exceptionally robust and reliable in a variety of marine and offshore applications such as axial piston motors A4VSO or A4VSG, radial piston pump CBM together with motion logic control MLC within specific algorithms for the best in class hydraulic control.

SUPPORT

Bosch Rexroth supports, from the early phase, engineering efforts around the world with its cutting-edge technology and unique industry knowledge from the key components to complete modules and systems relating to the so called power-take-off (PTO), energy storage or auxiliary drives.

Bosch Rexroth

