Magellanes Turbine

Figure 1. Magellanes turbines

Summary description

This case study consists in the installation of the Magallanes Turbine prototype in the European Marine Energy Centre (EMEC, a test site in the Orkneys, Scotland, that provides to ocean energy developers the opportunity to test full scale grid connected prototype devices in unrivaled wave and tidal conditions).
The floating system developed by the Magallanes Project is based on building an artefact (a steel-built trimaran), which incorporates a submerged part where the hydrogenerators are fitted. This platform is anchored to the sea bottom by two mooring lines, to the bow and stern.
The Magallanes Project sets out to develop and construct, in Galicia, the technology required to win the race for harnessing power from tides, by generating patents, expert teams, the electrical components and shipbuilding industries for floating platforms.
Previous tests in the EMEC at a scale of 1:10 have proven the capabilities of the device to produce energy. On this sense, the full scale model will have a nominal power of 2 MW.
This project is supported by the European Union by means of a Fast Track to Innovation Project and the Regional Government of Galicia (Xunta de Galicia), in the Galician R&D Plan. Forty researchers from universities and technological centres have taken part in developing the model.

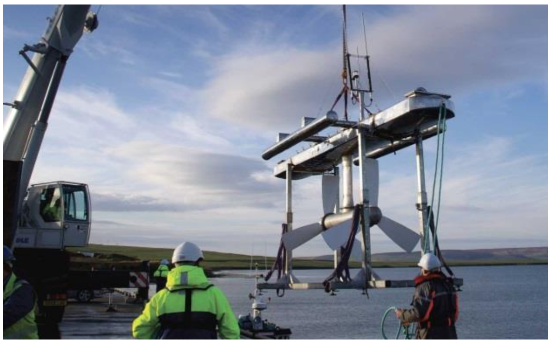

Figure 2. Magallanes Project turbine installation

Figure 3. Installed and submerged tidal turbine

Reason of interest for MAESTRALE

The Magallanes Project produces its energy form the flow of water in tides with the aid of water turbines. It is a project which has a quite moderate power generation and a very low cost as it does not require huge constructions such as breakwaters being a modular structure which can easily be scaled according to different locations and situations. It is interesting the fact that it is completely built onshore which reduces construction costs and its floating platform concept reduces its environmental impacts.

GENERAL INFORMATION	
Type of Blue energy source	**Tidal stream energy**
Type of energy output	**Electricity**
Type of project/plant	**Prototype**
Status	**Under realization**
Location	***59.009N , -2.877E*** ***Atlantic Ocean*** ***Scotland, Orkney***
Involved actors	***Magallanes Renovables - Developer and designer*** ***EMEC - Offerer of demonstration facilities***

	Sagres SL - Technical clothing for security corps and forces *IM Future - Maintenance, operation and management* *Leask Marine - Marine Operations*
Nominal power	*2 MW of nominal power, in terms of energy 17520 MWh/year*
Annual productivity	*n/a*
Size	*0.270 km2*
Year	*2016 – End testing model scaled 1:10 at the EMEC* *2017 – Construction of the full prototype in Vigo* *2018 – Deployment full scale in Scotland*
Implementation cost	*1.9M € for the construction & design of the full prototype (Fast Track Project)*
Payback period	*Not applicable for this project, but for any offshore project around a decade is foreseen*
Key words	*Tidal energy, tidal energy platform, floating platform, orientated blades, prototype, EMEC, currents hydrogenerators*
Web link	http://www.magallanesrenovables.com/en/proyecto

6.2.1 BACKGROUND

Energy policies framework

Integrated Maritime Policy
Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - An Integrated Maritime Policy for the European Union. The Integrated Maritime Policy seeks to provide a more coherent approach to maritime issues, with increased coordination between different policy area
Blue Growth
Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - Blue Growth opportunities for marine and maritime sustainable growth. Blue Growth is the long term strategy to support sustainable growth in the marine and maritime sectors as a whole. Seas and oceans are drivers for the European economy and have great potential for innovation and growth. It is the maritime contribution to achieving the goals of the Europe 2020 strategy for smart, sustainable and inclusive growth.

Blue Energy
Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - Blue Energy Action needed to deliver on the potential of ocean energy in European seas and oceans by 2020 and beyond. On 20 January 2014, the Commission set out an action plan to support the development of ocean energy, including that generated by waves, tidal power, thermal energy conversion and salinity gradient power in its communication entitled 'Blue Energy: Action needed to deliver on the potential of ocean energy in European seas and oceans by 2020 and beyond'.

Legal and administrative background

Recommendations
DNV-OSS-312 Offshore service specification: Certification of Tidal and Wave Energy Converters

EU Legislation
*** Regulation (EU) No 1255/2011 of the European Parliament and of the Council of 30 November 2011 establishing a Program to support the further development of an Integrated Maritime Policy**
*** Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. It seeks to contribute to ensuring biodiversity in the European Union by the conservation of natural habitats, and wild fauna and flora species.**

Links with spatial planning instrument

Maritime Spatial Planning
Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014 establishing a framework for maritime spatial planning
Competition for maritime space – for renewable energy equipment, aquaculture and other uses – has highlighted the need to manage our waters more coherently. Maritime spatial planning (MSP) works across borders and sectors to ensure human activities at sea take place in an efficient, safe and sustainable way. That is why the European Parliament and the Council have adopted legislation to create a common framework for maritime spatial planning in Europe.

This case study is a research project so just a device was deployed for its development, and therefore not a significant impact was found on the maritime spatial planning. If a full plant is installed, the definition of the deployment area must be agreed with the key players of the Mediterranean Sea, e.g. tranport companies, main sea routes; so as to reduce the impact on other sectors.

6.2.2 TECHNOLOGICAL ISSUES

Applied technology

The floating system developed by the Magallanes Project is based on building an artefact (a steel-built trimaran), which incorporates a submerged part where the hydrogenerators are fitted. This platform is anchored to the sea bottom by two mooring lines, to the bow and stern. It harnesses the ocean currents to move the turbine and produce electricity.

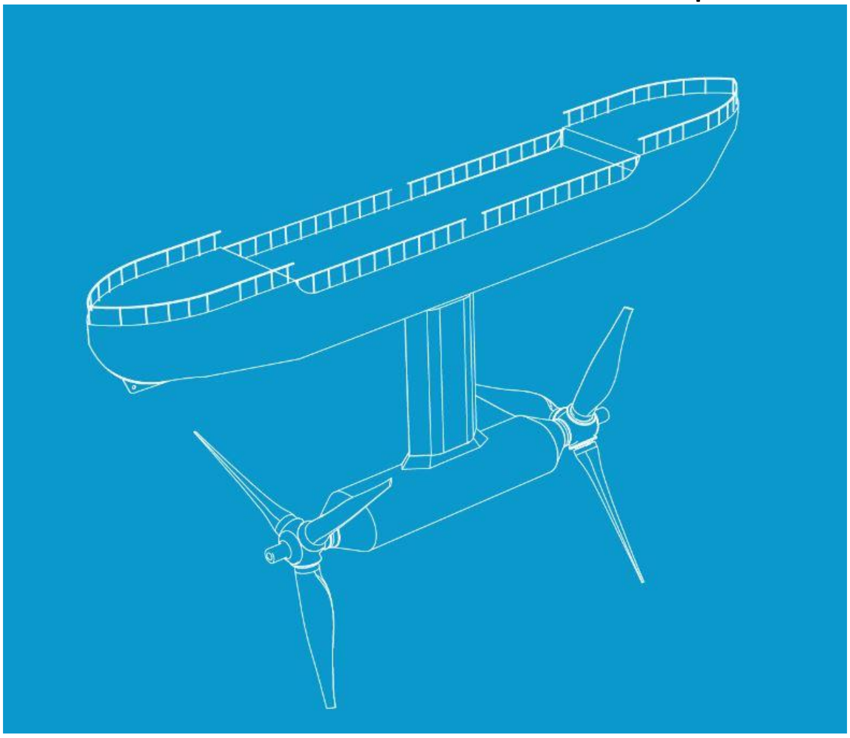

Figure 4. Magellanes floating tidal turbine

Innovation aspects

Its considerable advantages are: low maintenance, because it has an accessible engine room, a lower installation cost, and a higher degree of efficiency. Since they are floating facilities, they are adaptable to all sea environments with a low environmental impact.

Quantitative information

TIDAL ENERGY PLATFORM
Weight: 350 mt
Draft: 25 m
Overall length: 45 m
Breadth: 6 m
Power rating: 2 MW
2 oriented blades: 19 m diameter

Background information

Based in Orkney, Scotland, the European Marine Energy Centre (EMEC) has supported the deployment of more wave and tidal energy devices than at any other single site in the world. EMEC provides a variety of test sites in real sea conditions. It's grid connected tidal test site is located at the Fall of Warness, off the island of Eday, in a narrow channel which concentrates the tide as it flows between the Atlantic Ocean and North Sea. This area has a very strong tidal current, which can travel up to 4 m/s (8 knots) in spring tides. Tidal energy developers currently testing at the site include Alstom (formerly Tidal Generation Ltd), ANDRITZ HYDRO Hammerfest, OpenHydro, Scotrenewables Tidal Power, and Voith
Therefore, similar conditions are foreseen to guarantee the viability of this type of renewable energy.

Assessment tools & methods

As this was a research project that was installed for a year, it was not necessary to conduct such studies. However, the potential impacts on the environment brought about by the device were considered and mitigated, as will be described in the following section.

Environmental & Landscape impacts

The main environmental concern with tidal energy is associated with blade strike and entanglement of marine organisms as high speed water increases the risk of organisms being pushed near or through these devices. As with all offshore renewable energies, there is also a concern about how the creation of EMF and acoustic outputs may affect marine organisms.
Tidal energy removal can also cause environmental concerns such as degrading farfield water quality and disrupting sediment processes, however as this technology is a floating platform this affection on the environment would be less than anchored projects.

Socio-economic impacts

The technology would positive contribute to the decarbonisation goals of the country.
Local economic regeneration would improve.
Spanish economic opportunity where its technology could become worldwide known and expanded
Construction and manufacturing jobs sustained by the project.
Power over 1200 homes.

6.2.3 IMPLEMENTATION ISSUES

Implementation cost

The funds granted by CE were 1.9 million €, for the testing EMEC phase.

Financial sources

This case study has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement Nº730628. In addition, funds from the Regional Government of Galicia (Xunta de Galicia) has also supported the project under the Galician R&D Plan

Problems and obstacles

In this type of projects the main problem relies of the difficulty of its maintenance due to its offshore installation and submerged structure. However the Magallanes project has been able to reduce the maintenance costs designing a boat-like deck which enables a direct access to machinary through it with avoiding the need of complex offshore structures to controlo and maintain the prototype.
Further problems concern corrosion due to the saltwater particles on the blades of turbines. Possible navigation problems could appear as its large size may cause obstruction in shipping lanes.

Success factors

The project is based on achieving the most efficient, profitable method possible to obtain tidal energy:
-a sturdily-built
-simple installation
-capable of producing electricity in any area in the world
-with the easiest maintenance system.

Transferability in the MAESTRALE area

Tidal movement generates currents which, in some areas of the world, surpass 9 metres per second in intensity. The estimates by the International Energy Agency estimate that tides could obtain at least 1.2 million MWh per annum, meaning 7.5% of all the energy worldwide. This is not the case in the Mediterranean Sea as current are not as intense due to its low tidal ranges between 0 and 1 m. However, Gibraltar (Spain) could be a suitable location as tidal currents of 2.1 m/s have been registered, involving the necessary driving force.

Notes/Comments

1) **http://www.magallanesrenovables.com/en/proyecto**
2) **http://www.emec.org.uk/about-us/our-tidal-clients/magallanes/**
3) **http://www.emec.org.uk/press-release-magallanes-successfully-install-floating-tidal-turbine-at-emec-2/magallanes/**
4) **http://www.bbc.com/news/uk-scotland-scotland-business-30250329**
5) **http://www.offshorewind.biz/tag/magallanes/**
6) **http://tidalenergytoday.com/2014/11/28/magallanes-deploys-floating-tidal-turbine-at-emec/**
7) **https://vimeo.com/216471855**
8) **Sleiti, A. K. (2017). Tidal power technology review with potential applications in Gulf Stream. Renewable and Sustainable Energy Reviews, 69, 435-441.**