Hydrodynamic Optimization of the UGEN - Wave Energy Converter with U-shaped Interior Oscillating Water Column

Two most important challenges of wave energy technology

1. To date there is still no solution to harvest energy from ocean waves that has proven to be commercially viable in comparison with other sources, and a couple of failures in the past affected the perception we have about reliability and survivability in extreme weather conditions of wave energy converters;

2. The need to develop new power generation technology, which must be well aligned with the European regulatory system in terms of 20% reduction of CO2 emissions by the year 2020, and improve energy security so that 18-20% of the consumed energy in countries such as Ireland, Portugal, Spain and the UK will be actually extracted from waves.

Solution for Reliable & Cost-Effective Wave Energy

The UGEN technology consists of an asymmetric floater with an interior U-tank filled with water and two lateral air chambers connected by a duct where a reversible air turbine is installed to absorb the wave energy.

1. The floater is kept in place with a slack mooring system and can be easily submerged under extreme weather conditions;

2. UGEN can oscillate in resonance with the incoming waves to increase power production;

3. The floater is kept in place with a slack mooring system and can be easily submerged under extreme weather conditions;

4. UGEN is the most cost effective wave power generation solution with a Levelized Cost of Electricity (LCOE) of 256 €/MWh.

Technological Development

We are currently at Technology Readiness Level (TRL) 5, which means the technology has been validated in an experimental facility and in 3 to 4 years we expect to be in the market, as shown in the Gantt chart below.

Following a preliminary experimental validation study conducted in 2010 at IFREMER’s wave basin (Brest, France) with a scaled model of the UGEN, Instituto Superior Técnico (IST)’s numerical model has been further developed until nowadays so that annual averaged power output scatter diagrams of the UGEN at the deployment location could be calculated for optimization design purposes. Also in 2010, IST sponsored the patent registration of the UGEN concept, which is a clear demonstration of novelty and originality of this particular concept.

A comprehensive research programme to improve the conversion efficiency of the UGEN by focusing effort on key techno-economic challenges and demonstrate both simplicity and the cost effective applicability of the concept was then conducted. Specifically, an optimization design procedure for oscillating water column (OWC) WECs was developed, where the geometry of the floater and OWC, and Power-Take-Off (PTO) characteristics were optimized to attain the most cost-effective power generation solution at a specific deployment location.

Year 2017 Year 2018 Year 2019 Year 2020

| TRL 5-9 | Scale model testing 1:10 |
| 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| Full-scale prototype @PilotZone & Class approval |
| 15 M Euros |

Hence, a significant numerical and experimental modelling has been performed by team members in the coupled process of an asymmetric floater with an internal U-tank to shorten the path to commercialisation of the UGEN.

More recently, the undesirable occurrence of certain WEC dynamic instabilities in waves, such as parametric rolling, has been also investigated by this same team at both numerical and experimental levels in order to anticipate and sort out major problems during operation and extreme conditions at the deployment site.

Market

According to the International Energy Agency’s “Blue Map” the market turnover for wave energy in Europe by the year 2020 will be 4.1 billion €.

High profit margin business for a capital intensive but also efficient development program to be conducted by a highly experienced team.

Are you willing to win the race to clean energy by 2020?

Then either become a partner or invest in UGEN technology and be the winner of the race of harvesting energy from ocean waves using a robust and safe wave energy converter that has proven commercial viability and fully compliant with the upcoming European regulatory system.