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On the Absorption of Wave Power Using Ship Like Structures

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ABSTRACT

This paper presents a conceptual study of a wave farm based on ship-like structures being developed under the acronym KNSWING. These are attenuator Wave Energy Converters (WEC) integrating Oscillating Water Columns (OWC) with side openings in the hull. This leads to important advantages compared to solutions based on Point Absorbers as described in (K. Nielsen, 2004) such as: large modular structures with redundant PTO systems, simplicity with few moving parts, less electrical equipment on the seabed and lower grid connection costs, a main structural frame suited for mass production, high energy absorption from waves, low mooring forces, low cost concerning tow out for installation, and easy access to mechanical equipment which are all located above water.

KEY WORDS: Wave energy; cost of energy; Wave Energy Converter WEC; Attenuator OWC; Experimental performance assessment; Marinet experiments; Numerical Modelling; Mooring Loads; North Sea; Conceptual design; Technology Performance Level TPL, Concrete structures; Cost of energy LCOE.

INTRODUCTION

The objective of this paper is to present a conceptual study of the design of a wave farm composed of a large number of serially produced Wave Energy Converters (WECs) and the experimental and theoretical results related to the development of a ship-like structure to absorb wave energy. The concept was first investigated following the energy crises in 1973, when the UK set out research to develop alternative energy solutions converting wave energy to electricity to meet part of the UK electricity demand. A wide range of WEC's resulted from this R&D programme presented at the first international conference of Wave Energy in 1979 in Gothenburg. Among these ideas was a ship-like concept the I-beam OWC attenuator concept (Moody, 1979), which had been tested at University of Edinburg by Stephen Salter, but also the Kaimai an 80 meter long ship with OWC chambers which had been tested in real seas in Japan was presented.

The attenuator principle is one of three main WEC configurations as shown on Fig.1. Compared to point absorbers and terminators the attenuators face the waves with their bow and span several wave lengths which provide a stable reference with minimal drag and mooring forces.

In recent paper on attenuators, Stansell and Pizer (2013) describe how additional length would provide additional power in relation to swept volume. This inspired the main author of this paper to reinvestigate the power absorption, design and survivability of ship-like structures and apply to the EU Marinet test programme together with DTU.

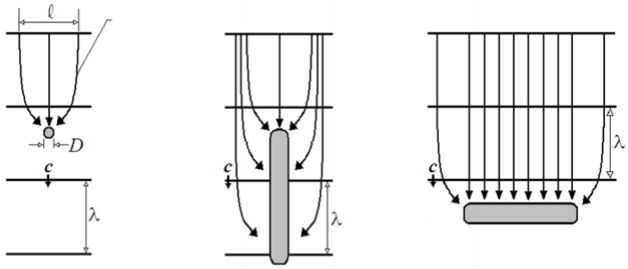

Figure 1 Typical Wave Energy Converter configurations

The experimental investigation of the wave energy converters was carried out at HMRC at UCC in Ireland, followed by additional Marinet experiments in Portaferry QUEB in combination with two student projects at DTU. Based on the results from the experiments and