OPTIMIZATION OF THE LAY-OUT OF A FARM OF WAVE DRAGON WAVE ENERGY CONVERTERS IN THE NORTH SEA

Beels Charlotte, Peter Troch and Julien De Rouck

Afdeling Weg- en Waterbouwkunde, Vakgroep Civiele Techniek, Universiteit Gent, Technologiepark, Zwijnaarde 904, 9052 Zwijnaarde, Belgium
E-mail: Charlotte.Beels@UGent.be

Wave energy is a renewable energy source that has the potential to contribute significantly to our renewable energy supply. In the last decade many concepts for wave power conversion have intensively been studied and developed, a.o. the Wave Dragon Wave Energy Converter (WD-WEC) (Kofoed *et al.*, 2006). The WD-WEC is a floating offshore converter of the overtopping type. Two wave reflectors focus the incident waves towards a ramp. The focussed waves run up the ramp and overtop in a basin above mean sea level. Power is produced when the stored water drains back to the sea through hydro turbines. The considered WD-WEC has a rated power of 2MW in a 12kW.m^{-1} wave climate. As the rated power of a single device is relatively small, several WD-WECs need to be installed in a geometric configuration or in a 'farm'.

WD-WECs in a farm are partly absorbing and partly redistributing the incident wave power. As a result a wake behind each WD-WEC is created. The power absorbed by each individual WD-WEC in a farm is affected by the wakes of its neighbouring WD-WECs. The wake effects in a farm and consequently the power absorbed by a farm, depend on the wave climate and on the lay-out of the farm. The farm lay-out does not only affect the amount of absorbed power but also modifies the cost of the farm. Mainly the cost of the electrical cables between the WECs in a farm is affected by the farm lay-out. The costs of installation, operation and maintenance are to a lesser degree dependent on the farm lay-out.

In this study, the lay-out of a farm of WD-WECs is optimized to decrease the cost per produced kWh. Therefore the power production of two different farm lay-outs of WD-WECs with a rated power of 198 MW (99 WD-WECs arranged (i) in a single line and (ii) in a staggered grid) in a near shore North Sea wave climate, has been assessed numerically using the time-dependent mild-slope equation model MILDwave, developed at Ghent University (Beels *et al.*, 2006). Furthermore, for each lay-out an optimal (low cost) submarine cable network has been designed.

The results, as presented in this poster, indicate that the investment cost of the submarine cable network is only a fraction of the total investment cost of the farm. Hence, when designing the lay-out of a farm of WD-WECs, mainly maximum power production should be aimed at. A single line of WD-WECs results in the highest power production and lowest cost of energy. On the other hand this lay-out requires a wide sea area.
The installation of a line of WD-WECs in front of a farm of wind turbines may be beneficial. In that case the WD-WECs may be connected to the transformer platform of the wind farm, which reduces the grid connection cost. Furthermore, the WD-WECs reduce the wave height in their lee, which makes maintenance of the farm of wind turbines easier and cheaper.

Acknowledgements
Research funded by Ph.D. grant of the Institute for the Promotion of Innovation through Science and Technology in Flanders (IWT-Vlaanderen), Belgium. Wave Dragon ApS. (WD-MW FP6 EU project) and Dong Energy are gratefully acknowledged for providing the data on which this study is based.

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