

## WaveSAX device: design optimization through scale modelling and a PTO strategical control system

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WaveSAX is an innovative OWC (Oscillating Water Column) device for the generation of electricity from wave power, conceived to be installed in coastal marine structures, such as ports and harbours. The device - especially designed for the typical wave climate of Mediterranean Sea - is characterized by two important aspects: flexibility to fit in different structural configurations and replication in a large number of units.

A model of the WaveSAX device on a scale 1:5 has been built and tested in the ocean tank at Ecole Centrale de Nantes (France). The study aimed to analyse the behaviour of the device, including two Wells turbine configurations (with three and four blades), with regular and irregular wave conditions in the ocean wave tank. The model and the wave basin were equipped with a series of sensors which allowed to measure the following parameters during the tests: pressure in different points inside the device, the free water surface displacement inside and outside the device, the rotational velocity and the torque at the top of the axis. The tests had the objective to optimize the device design, especially as far as the characteristics of the rotor of the turbine is concern.

Although the performance of the WaveSAX has been satisfactory for regular wave conditions, the behaviour of the Wells turbines for irregular wave climate has shown limitations in terms of maintaining the capacity to transform hydraulics energy into mechanical power.

To optimize the efficiency of the turbine, an electronical system has been built on the basis of the ocean tank tests. It allows to continuously monitor and command the rotational speed and the torque of the rotor connected with the turbine, and to control in real time the electrical flow of a motor-generator, either absorbing energy as a generator, or providing power to the turbine working as an engine. Two strategies - based on the velocity and the torque control - have been investigate in the electronic test bench simulating four wave conditions previously tested in the ocean tank at the ECN (Nantes, France). The results showed a satisfactory behaviour of the system and allowed to define the optimal velocity and torque conditions to maximize the PTO.

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