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Innovative wave energy device applied to coastal observatory systems

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Marine environment is one of the most promising sources of renewable energy, whose exploitation could have an effect on several application fields. This work presents the design of an innovative device based on the Oscillating Water Column (OWC), that allows to convert wave energy into electricity, suitable for the typical Mediterranean wave climate. The flexibility of the device permits its installation either in deep or shallow waters, with reduced costs of deployment, maintenance and connection to the grid. Furthermore, the replicability of the design allows the device to be installed in array of several number of similar units.
The technical concept is to convey the sea water within a vertical pipe, in which the water movements activate a rotor connected to a generator that transforms the energy of the water motion into electricity. The hydrodynamic design of the pipe is built to minimize the losses due to friction and turbulence and to exploit the maximum possible energy from wave motion. The wave energy is directly absorbed by the rotational movement of the turbine blades located in the water itself allowing a further reduction of the energy losses associated with the transformation of the linear water motion into electrical generation in the air phase (typical configuration of the OWC devices).
In this work the device components are described considering two possible configurations that use a Wells turbine or a Bulb type turbine.
The system can be realized at a low cost, because of the modularity of the device project, which allows large freedom of sizes and placements, being able to be installed both individually and in arrays. The modularity, associated with the fact that the main elements of the system are available on the market, makes the device particularly attractive from the economic point of view. Finally, it is realized with a high constructive flexibility: the proposed system can be transported floating and moored to existing coastal structures or anchored to a dead body on the seabed, with consequent simplifications from the point of view of deployment and maintenance, resulting in further cost reduction, compared to existing systems.
At last but not less important, this device produces low impacts on marine environment according to the monitoring techniques identified in the frame of the european project “Marine Renewables Infrastructure Network for Emerging Energy Technologies” (Marinet – FP7). Within this context the device finds an excellent application field in the low consumption monitoring systems which can be located near the priority habitats to analyse the impacts due to coastal anthropic pressures. Civitavecchia coastal zone is suitable to be used as the test site for this new device as it includes the observing system C-CEMS (Bonamano et al. 2016), composed by three water quality fixed stations that continuously measure the physical, chemical and biological parameters of the water column, and Sites of Community Importance (SCI) where effective and urgent management measures were requested by the EC to protect the Posidonia oceanica meadows.