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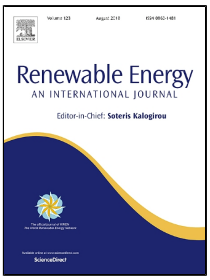

Chamber pressure skewness corrections using a passive relief valve system at the Pico oscillating water column wave energy plant

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Chamber pressure skewness corrections using a passive relief valve system at the Pico oscillating water column wave energy plant

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***Abstract* - Power production levels at the Pico plant fall significantly short of pre-project estimates. Poor turbine performance compared to expectations from scale model testing accounts for much of this shortfall. Unanticipated chamber pressure skewness is also found to contribute to the deficit. This skewness manifests from wave shoaling because of the shallow chamber water depth from boulder collection and is worsened by intermittent chamber pressure losses caused by chamber wall defects. A passive non-return by-pass relief valve system for partially counteracting chamber pressure skewness is investigated. This functions by venting more of the unconvertible pneumatic over-power during the more intense but shorter duration exhalation half-wave cycles. At the same time, it retains more of the convertible pneumatic under-power in the weaker but longer duration inhalation half-wave cycles. This method reduces the degree of pressure skewness, which improves the system performance in higher energy excitation conditions. The passive relief valve specifications are optimised with a time-domain wave to wire model which is also used to project the expected plant performance enhancement in a range of wave conditions. Simulation results are compared to limited field tests results using a simple prototype passive valve system and good agreement is found.**

***Keywords*— OWC, passive control, wave energy, Pico, by-pass relief valve, time domain modelling**

1. Introduction

The Pico plant is a full-scale shore-mounted oscillating water column (OWC) type wave energy converter (WEC) constructed in 1999 and located on the Portuguese island of Pico in the Azores archipelago [1]. The operating principle of the device is as follows. The device structure forms a plenum chamber with internal dimensions of 12(m) x 12(m) in the horizontal plane and a design depth of 8(m) at mean water level. A submerged entrance to the chamber permits wave energy flux with the ocean. Wave action inside the chamber drives an oscillation of the chamber water column that acts as a piston to compress and decompress the air pocket bound by the chamber walls. The resulting pressure head drives a reciprocating air mass flux through a self-rectifying Wells type turbine. The turbine is connected to a doubly fed asynchronous generator that takes electrical power off for processing and grid delivery. Fig. 1 shows the plant system configuration.