Portuguese Grid Connected OWC Power Plant: Monitoring Report

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ABSTRACT

Fifteen years ago the European OWC pilot plant was built on the Island of Pico (Azores). Because both the structure and the turbo-generator unit survived to extreme storm conditions and thanks to the development of a maintenance program (non-existing), the technical plant availability achieved to date allows a new phase of systematic testing since 2005. The recent testing program (2007-2009) and achieved functional improvements will be reviewed. An interim evaluation of the plant performance will also be presented and the monitoring plan developed for full plant functionality will be discussed.

KEY WORDS: Pico plant; wave energy; oscillating water column; monitoring plan; performance assessment.

INTRODUCTION

After being unproductive for several years the Pico plant was reactivated in 2005 and has now operated for 5 years connected to the local grid of EDA (Regional Utility). Simultaneously the pilot plant has been used for testing instrumentation or development of control strategies. Besides from being built with technology that today is not considered cutting edge, the Pico OWC is presently one of the very few operational wave power plants world-wide that has gathered a significant record of real-sea testing.

This paper aims at presenting relevant activities since the 2005 recovery works, most of which are still in progress. The plant maintenance plan and achieved improvements will be first reviewed. By assessing the various stages of power along the conversion chain, wave to wire models developed in the past can be verified step by step and a comprehensive monitoring plan can be implemented as presented in a second part of the paper. An updated evaluation of the plant performance is further presented.

One of WavEC’s focus has been to compare in-situ behavior with former mathematical simulations and experimental results. The status of this work will be presented, discussing the remaining difficulties in achieving adequate measurements at each stage of the conversion chain.

PLANT DESCRIPTION

Fig. 1: Essential components of Pico plant.

The operation principle and location of the sensors of the Pico OWC is presented in Fig. 1. The oscillation water column inside the chamber is excited by the incident waves, ideally with periods close to the resonance period of the chamber, and forces air alternately to and from the atmosphere, via a Wells turbine with symmetric blades and rotational speed in the range 750-1450 rpm.

On each side of the rotor, a guide vane stator carrying fixed steel vanes is installed, in order to increase the aerodynamic performance of the turbine. The distinct characteristics of a “classical” Wells turbine are the symmetrical blades with fixed pitch for bi-directional flow.

To avoid over-pressure and stall conditions, a slow acting relief valve exists which can be opened from 0% to 100%, according to the incident sea-state. The safety of the turbo-generation group is provided by redundancy in the closure mechanism of the air duct: a slow-acting guillotine-type isolation valve is shut whenever the plant is non-operational over a longer period, whereas the fast-acting variable-pitch-blade maneuver valve can be efficiently operated during test periods.