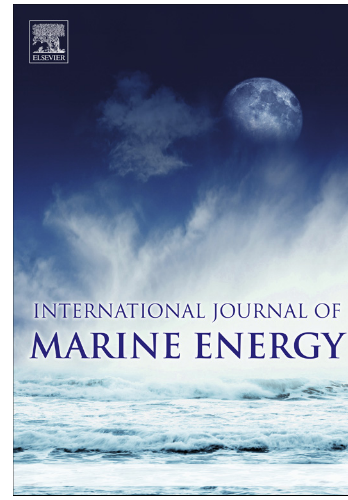

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Experimental investigation of the near wake of a horizontal axis tidal current turbine

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ABSTRACT

A scaled-model of an HATCT (*Horizontal Axis Tidal Current Turbine*) was tested in the CNR-INSEAN Circulating Water Channel. Two different analyses were performed during the experiments: preliminary investigation of the performances of the turbine in different working conditions and LDV (*Laser Doppler Velocimetry*) measurements in the near wake. Velocity measurements are performed in phase locking to the rotor, in order to resolve the blade wake structure at different working regimes. Indeed, the knowledge of all three velocity components (tangential, axial, radial) allows to evaluate through energy balance concerns, the transfer of inflow kinetic energy into mechanical work of the rotor and into different energy contributions in the wake. The LDV analysis of the near wake also contributes to understand some of the most important fluid dynamics aspects related to the design of the rotor and to the different working conditions, and can be used as a preliminary study for understanding the wake evolution and the interaction between two or more turbines in a farm.

1. INTRODUCTION

Tidal current energy is one of the most interesting renewable and clean energy resources for electricity generation which is expected to spread more and more in the near future by offering distinct advantages over other renewable energy sources due to its regular and predictable nature. Tidal streams are created by the constant periodic motion of the waters of the sea due to changes in the attractive forces of the Moon and Sun upon the rotating Earth. This resource is entirely predictable and, for a given stream velocity, the theoretical power per square meter that can be extracted using available technology is quite large, due to the high density of the water. In order to maximize energy extraction, the installation of multiple devices within tidal farms is devised. Consequently, a detailed understanding of the flow field downstream of a single device is a fundamental first step towards the design of tidal farms which are both spatially efficient and sustainable. Extensive literature on wind turbine wakes is available and can be applied to marine tidal turbines. Nevertheless a major difference arises for the latter, *i.e.* the interaction with the free surface and the sea bed. For example, regarding the second aspect, the presence of strong vortical structures in the wake of the rotor could cause erosion and interfere with the sediment transport mechanism of the marine currents in the installation site. The analysis of the wake of a tidal turbines was already addressed in previous studies focusing on the far wake and rotor interaction in farm installation Mycek et al. [1],[2], Stallard et al. [3]. Maganga et al. [4], [5] performed the study of a 3 blade tidal turbine by using laser Doppler Velocimetry (LDV) focusing on the effect of the inflow properties (turbulence, yaw angle) on the mean and turbulent flow characteristics of the rotor wake. Myers et al.