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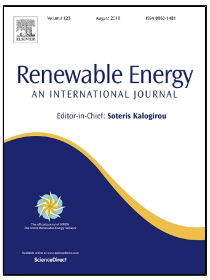

Full scale behavior of a small size vertical axis wind turbine

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Full scale behavior of a small size vertical axis wind turbine

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Abstract

This paper shows the on-going experimental campaign carried out over a small size vertical axis wind turbine in the facility of the Savona Harbor. Investigations mainly concern two issues: power production assessment and full-scale structural behavior. The first one highlights the importance of a deep knowledge of the local orography and of the wind characteristics (e.g., turbulence intensity); in the absence of reliable wind data it is impossible to properly estimate the performance of the system. The latter allows to identify the possible critical aspects of the structural system (e.g., in terms of resonance conditions) and to investigate the actual dynamic behavior (e.g., in terms of dissipative capacity), necessary for assessing the useful life. The paper points out how these two issues are closely related. Results obtained can provide indications suitable for improving future installations.

Keywords: *Damping ratio estimates; Experimental power curve; Small size wind turbines; Turbulence effects; Vertical axis wind turbine (VAWT); VAWT identification*

1 Introduction

The large interest attracted by the exploitation of wind energy [1] has brought into being an extensive scientific literature on large wind turbines based on a well consolidated technology (e.g., [2],[3]). Turbines having a rated power of 8 MW are now operational and the trend marks a steady growth in the size of the installations. At the same time, the increased attention in distributed power generation for smart cities as well as for green buildings has been accompanied by a large interest in micro and small wind turbines ([4],[5]). Being an appropriate tool for small-scale distributed power generation, they look very attractive either in standalone or grid connected configurations, integrated with other renewable sources (e.g., [6],[7]) or into the building design (e.g., [8],[9]). However, this interest has not been accompanied by adequate technological improvement, so that applications often do not prove effective in full scale conditions and are hardly competitive compared with other sources of green energy generators. In particular, the exploitation of small turbines usually faces several shortcomings concerning both the actual energy production and the structural safety. The former is often less than expected, as the definition of the technical data is usually obtained from wind tunnel tests carried out in smooth flow, which does not allow reproducing the actual behavior in atmospheric boundary layer during the operating conditions. Research on novel solutions seems promising for improving their starting features (see,