

833. Establishment and safety evaluation of a flexible test platform for the vertical-axis wind turbine

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Abstract. This work intends to construct and execute the safety evaluation of an test platform for the small vertical-axis wind turbine (VAWT), which is mounted on the rooftop of a 60 m-height building. The experiment platform designed here is flexible and suitable for carrying out the systematic performance evaluation on different types of VAWT. The wind turbine performance measurement is conducted by utilizing the data acquisition system. All environmental information and power data from sensors and generator on this platform are recorded and transferred to the computer automatically. Later, these analogy signals are transformed to digital format for transmitting into computer. Also, with the aids of a visual software programming within the framework of LabVIEW, the real-time monitoring on the input/output parameters of generator and the wind condition can be accomplished simultaneously. Afterwards the data processing and in-depth analysis on the experimental outcomes are carried out via the established computer program. Consequently, the on-site performance of the wind turbine generator system is attained in an automatic and systematic manner. Moreover, to ensure for providing sufficient data and its accuracy, statistic concept is enforced to judge whether the test data are qualified or not in the data-processing procedure. Regarding the safety evaluation of wind turbine on this test platform, the numerical models of wind turbine and platform are analyzed via ANSYS Workbench to obtain the forces exerting on the main shaft and blades. This force distribution can be analyzed for checking if they can stand and meet the safety criterion under various wind speeds. Furthermore, a 2 m-diameter, multi-blade vertical-axis wind turbine (MVAWT) is installed as a demonstrating case of the entire procedural test. Firstly atmospheric parameter, such as wind velocity, wind direction, air temperature, and air pressure is measured based on IEC 61400-12 standard on the rooftop of building for one year range measurement time. By collecting and observing the wind parameter data, such as mean wind velocity and wind direction distribution, the wind energy estimation of this MVAWT can be analyzed quantitatively. In summary, together with the data-acquisition software programmed under the framework of LabVIEW, this experimental system can provide the capability for monitoring, recording, and filtering these test data in an rigor manner, and is appropriate for executing the R&D and performance evaluation on different VAWTs.

Keywords: vertical-axis wind turbine, flexible, test platform, Labview, data acquisition system.

Introduction

Due to environmental concerns, the renewable energy industry is attracting more R&D attentions from researchers all over the world, especially in the wind energy development. It becomes one of the promising energy sources candidates in gaining zero carbon content for future applications. From the gigantic-size horizontal-axis wind turbine (HAWT) to small-size VAWT for home utility are offered by manufacturers to fulfill the alternative energy demand. Within this decade, due to the increasing demand, Taiwan's wind turbine industry is growing exponentially [1, 2], and several VAWT companies also are founded to intend filling the niche market of small size wind turbine. VAWT owns a great potential as an energy harvester since it is suitable in urban population city due to several considerations, such as an omni-directional wind turbine, rotating on low wind speed, unsteady wind conditions, low acoustic noise, and