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外罩式風力發電機利用風門控制發電量的研究 Ducted Wind Turbine Power Output Control Using Airflow Deflector

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摘要

小型風力發電機的限速保護是安全操作很重要的一環，過去常用的方法包含電磁短路煞車、偏航、離心錘變矩、失速保護等，但各有其優缺點。本研究的目的是在探討一個有外罩設計的風力發電機，利用其獨特外罩導管，設計風門結構控制流量，量測比對發電功率的差異，使風力發電機能夠有效的在高風速下達到限速保護作用。試驗方法是將風力發電機置放在風洞中測試，分別在風力發電機入風口位置及出風口位置設計安裝風門結構，角度變換設定由90度至0度遞減，量測輸出電壓、電流後，統計數據轉換成功率來比對差異。試驗結果發現風門確實可以針對外罩式風力發電機限速保護達到一定的功效，且入風口的風門控制效果優於出風口的風門限制。

關鍵詞：外罩式風力發電機、限速保護、風洞測試、風門。

Abstract

Over speed protection is very important for small wind turbines to operate in a safe way. There are many methods, including electromagnetic braking, yawing, centrifugal pitch control, and stall, etc., that are commonly used and have their advantages and disadvantages. The purpose of the study is to design and test airflow deflectors added to a ducted wind turbine to see the effectiveness in regulating the airflow and thus control the power output for wind turbine safety operation at high wind speed conditions. The test was performed at a wind tunnel facility. Two types of deflectors were designed and installed at the turbine inlet and outlet. Quantitative data in power generation was measured and discussed when the deflectors were applied at different angles, from 90 degrees fully opened, and progressively decreasing to 0 degrees fully closed. The generator output voltage, current, and their associated power were measured. The test results indicated both the inlet and outlet deflectors can effectively reduce the power output and protect the turbine when the wind speed is high. The inlet deflectors were found to be more effective than the outlet deflectors because of more effective airflow control.

Keywords: Diffuser Augmented Wind Turbine, Over Speed Protection, Wind Tunnel Test, Deflector.