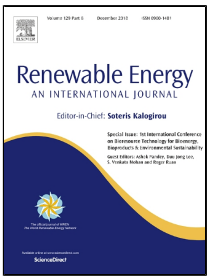
Accepted Manuscript



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PII:	S0960-1481(18)31033-4
DOI:	10.1016/j.renene.2018.08.083
Reference:	RENE 10510
To appear in:	*Renewable Energy*
Received Date:	04 November 2017
Accepted Date:	26 August 2018

Please cite this article as: Ijaz Fazil Syed Ahmed Kabir, E.Y.K. Ng, Effect of different atmospheric boundary layers on the wake characteristics of NREL Phase VI Wind Turbine, *Renewable Energy* (2018), doi: 10.1016/j.renene.2018.08.083

Effect of different atmospheric boundary layers on the wake characteristics of NREL Phase VI Wind Turbine

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Abstract

In this study, the interaction of horizontal axis wind turbine (HAWT) with neutrally stratified atmospheric boundary layer (ABL) and its wake characteristics are investigated. Important wake characteristics of wind turbine such as velocity deficit and turbulence level are analyzed. For this purpose, Unsteady Reynolds-Averaged Navier-Stokes (URANS) using k-ε turbulence closure models are performed using commercial Computational Fluid Dynamics (CFD) software called ANSYS FLUENT. Full rotor CFD simulations of the NREL Phase VI wind turbine by virtually placing on a flat surface with different aerodynamic roughness lengths are performed. Discussions on effective modelling of horizontal homogeneity for the undisturbed ABL is included. The influence of inflow ABL's turbulence level in the wake velocity recovery and the ground effect on the wake turbulence intensity (TI) is analyzed. In addition, comparison of rotor aerodynamics of wind turbine in different terrains is performed using pressure coefficient distributions. Finally, the necessity of inclusion of TI recovery in addition to velocity recovery in the wake for the wind farm alignment is discussed.

Highlights

- Full rotor CFD simulations of wind turbine in ground surface with different aerodynamic roughness lengths was done.
- Study on rotor aerodynamics of the same wind turbine in different terrains were discussed.
- Importance of TI of the ABL in the wake recovery was discussed.
- Comparison of effect of wind shear in the ABL on wind turbine wake recovery with the analyses of uniform inflow by CFD were also performed.
- Ground effect on the turbulence intensity in the wake were also briefed.

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