Using CFD to Predict the Performance of Innovative Wind Power Generators

Daryoush Allaei[1]

[1]Sheer Wind Inc., Chaska, MN, USA

Abstract

INVELOX is an innovative wind power generation system as shown in Figure 1. It is comprised of a wind capturing system that accelerates and delivers high kinetic energy wind to a power conversion system placed in the Venturi section of the INVELOX. The objective of this project is to build a full scale model to verify laboratory and field our test data and to utilize the validated model as an effective design tool for future development. Multiphysics simulation involving Computational Fluid Dynamics (CFD) has progressed significantly in the recent years so that predictions of flow around and inside complex geometries are now possible. In the present work, we will demonstrate how simulations can be used to evaluate a highly acclaimed innovative wind power generation system known as INVELOX. The model was developed using COMSOL package. The fluid dynamic modules were employed. The objective was to validate that this patented technology significantly outperforms traditional wind turbines and it delivers superior power output at reduced cost, and in the process, solves all the major issues that have so far undermined the wind industry, such as low turbine reliability, intermittency issues, and adverse environmental and radar impact. The fundamental innovation of the INVELOX system is that it eliminates the need for tower-mounted turbines while it capturers wind flow through an omnidirectional intake. Simulating the performance of this wind power generation system is quite challenging because it requires acceptable computational results that are used to design the INVELOX system with model predicted performance. The goals is to better model and understand the flow field inside the INVELOX where the actual wind turbine is located as well the external flow field which not only provides the intake flow but also has to match the exhaust flow of the system. The present computations involved cases with different incoming wind directions and changes in the intake geometry. The results also compared with those obtained by using another commercially available CFD package. Sample results are shown here. Velocity and pressure fields are compared in this analysis using the two models. It is shown (Figure 2) that it is possible to capture, accelerate, and concentrate wind in order to maximize the power output. Increased wind velocities result in significant improvement in the power output.

Reference

1. Yi Han and Yiannis Andreopoulos, "CFD STUDIES OF THE INVELOX TOWER", Interim Report Dated June 3 2012.
2. Daryoush Allaei, "Perfroamnce of INVELOX", Internal Report Dated May 30, 2012.

Figures used in the abstract

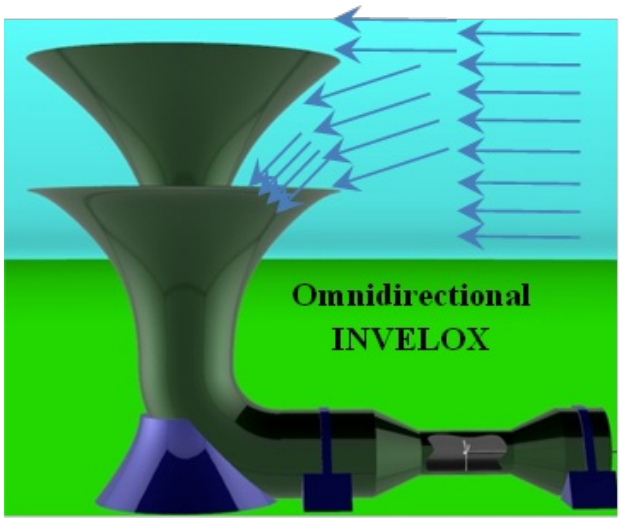

Figure 1: INVELOX wind power generation system.

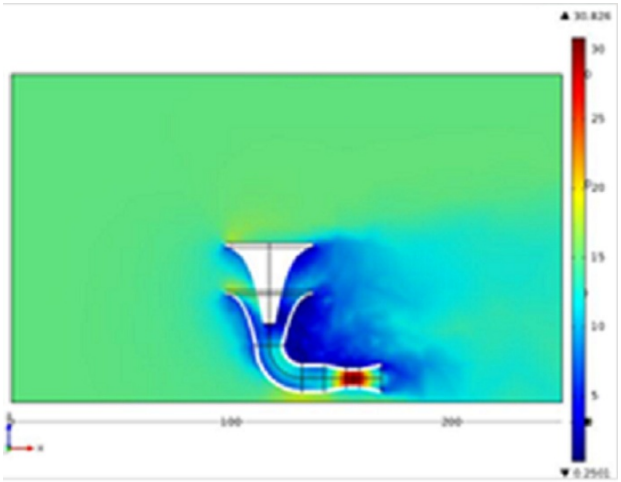

Figure 2: Sample velocity field generated by the COMSOL model.