

WIND TURBINE DIFFUSER AERODYNAMIC STUDY WITH OPENFOAM

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A flange attached at the exit of the diffuser shroud, increases the low pressure region behind the rotor, due to the strong vortex wake formation behind the flange. This region helps to draw a huge amount of mass flow inside the shrouded diffuser, accelerating the flow passing through the rotor. The flow around this flange diffusers has been studied experimentally and numerically by many researchers [1, 2]. Unfortunately, this flange configuration which is used for low energetic flows, generates a wide wake that compromises its implementation in wind farms.

Different configurations have been analyzed in the bibliography to try to achieve similar results as flange diffuser wind turbines. In [3], after their numerical simulations and wind tunnel experiments optimal open angles 10° and 12° , are suggested for flow at Reynolds number of 66500 (by referring to the diffuser inlet section), respectively for an empty diffuser and for a diffuser shrouding a small wind turbine.

In [4] shrouded wind turbine flowfields are examined in detail investigating several points: regions with flow separation, the development of velocity profiles, and the interaction between the turbine wake and shroud boundary layer.

A multi-element diffuser geometries generated with Salome and snappyHexMesh, are studied numerically with OpenFOAM to find the optimal configuration, maximum area expansion avoiding flow detachment, for different pressure drops of the actuator disc. Different geometry parameters (airfoil overlapping, aperture angles between airfoils, etc) are studied, in order to reduce the turbine wake keeping its efficiency.

References

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