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(Autonomous Institution Affiliated to VTU, Belagavi)

A Project Report On

LOW COST VERTICAL AXIS DUAL WIND TURBINES FOR REMOTE VILLAGES

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ABSTRACT

It is estimated that the energy demand in India will reach 1640 billion units in 2020. Currently, 70% of India's energy needs are fulfilled through nonrenewable sources of energy which are rapidly depleting. Wind energy is one source of renewable energy, which can be harnessed through wind turbines. Vertical axis wind turbines offer a better alternative than horizontal axis wind turbines as they operate at low wind speeds and are ideally suited for rural areas where grid power is unavailable. A comprehensive literature review revealed that research efforts are primarily focused on improving the efficiency of Savonius type wind turbines which has self-starting characteristics. However, limited efforts have been made on aerodynamic coupling between two Savonius turbines. The objective of this work was to model twin Savonius wind turbines, working in tandem and placed in an array which can be installed in remote villages.

Simulations were performed on a Savonius turbine for different blade profiles, two and three bladed configurations, and for an array with two and three turbines using ANSYS Fluent 14.5. Five design variables namely the tip speed ratio, overlap ratio, rotor angle offset, angle between turbines and distance between turbines, were chosen and simulations were conducted using orthogonal array method to optimize the power coefficient (C_p). A regression relation was obtained using Minitab based on the simulation results.

The simulations showed that the circular blade profile had the highest dynamic torque coefficient of 0.19 compared to the other profiles. Also, the two bladed configuration had higher C_p of 0.251 than the three bladed configuration which had a C_p of 0.157. The array simulations also showed that the two turbine array was 12% more efficient than the three turbine configuration. Further, the twin turbine configuration yielded a higher C_p of 0.281 in comparison with an isolated turbine C_p of 0.251. Based on the simulation results, the turbine in the array was designed having a length of 720 mm and a diameter of 280 mm. Detailed fabrication drawings were prepared and the system was fabricated. The test results showed that each turbine of the array yielded more power than if operated in isolation.