CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Andrew A. Asper

Project Number
J0101

Project Title
Watts Up with Fairings? A Technological Breakthrough, Phase II

Abstract

Objectives/Goals
My objective: To determine if teardrop shaped fairings added to the 12 blade-to-strut joints of my innovative Vertical Axis Wind Turbine design, which I constructed in Phase I of this project, will provide more power output as measured in Watts, and increase the actual turbine performance more than my VAWT without fairings. The experimental measurement Power coefficient versus tip-speed ratio will be used to determine the turbine's performance.

Methods/Materials
1)Design and build a wind tunnel with diffuser 2)Design and make a circuit board 3)Test VAWT without fairings at a wind speed of 3.5m/s and again at 2.5m/s-20 trials and record Watts 4)Design and make outside fairings and apply to outside of 12 blade-to-strut joints 5)Design and make inside fairings and apply to inside of joints making a teardrop shape 6)Test VAWT with fairings at same 2 wind speeds-20 trials and record Watts 7) Use mathematical formulas that incorporate Power, air denstiy, swept area of rotor, RPM and wind speed to calculate power coefficient versus tip-speed ratio for all trials and means, with and without fairings to show turbine's overall performance.

Results
After 40 trials, the results showed that my hypothesis was correct. At both wind speeds the fairings improved the power output as measured in Watts, showing that the turbine with fairings produced more power. They also made the output more consistant. The power coefficient vs tip-speed ratio increased at both wind speeds. At a wind speed of 2.5m/s the power coefficient vs tip-speed ratio increased significantly more with fairings than without because the lower wind speed sees a larger increase in tip-speed since the fairings helped decrease the drag in the blade-to-strut joint area.

Conclusions/Discussion
It is interesting to note that the power coefficient vs tip-speed ratio increased more at the lower wind speed - the turbine with fairings was able to capture more power available in the wind because the tip-speed ratio increased more due to less separation and a decrease in drag. Overall, the fairings did improve the turbine's performance because they smoothed out the flow in the blade-to-strut joints, eliminating the vorticies that create extra drag and performance loss. Another benefit of the fairings was that they made the blade-to-strut joints stronger which adds more durability. I plan to pursue the possibility of obtaining a patent for my innovative VAWT design.

Summary Statement
My project is about determining if teardrop shaped fairings added to the 12 blade-to-strut joints of my VAWT will provide more power output as well as increasing the turbine's performance measured as power coefficient vs tip-speed ratio.

Help Received
Mentor-Dr. Dale Berg scientist from Sandia, John Loth-Engineering Professor, dad helped with equipment, Dr. Olson science teacher helped with circuit board.