Advances In Small Turbine Design

PO.270

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Abstract

- Even in the 21st century more than 17% of world’s population is deprived of electricity.
- In order to overcome this issue the most important energy form is ‘Wind Energy’.
- Unfortunately wind turbines are still rare because of the variation in wind data, large sizes, and installation complexity.
- Another important factor is the high initial cost which is out of the reach of majorities.
- The abstract has incorporated most of the fundamental problems and advances with their exact solutions to bring drastic changes in quick tenure.

Objectives

- Spread awareness importance of wind energy
- Long term benefits of wind energy
- Inefficiencies of turbine and their solutions
- Research on the future advancements
- Modification of turbine designs

Methods

- Increasing diameter by 20% increases capture area by 44%
- HAWT and VAWT hybrid combining advantages of both
- Increase the blade width (tip area small)
- Double rotor hence double rate of magnetic flux
- Electromagnetic brake, pitch control & yawing mechanism
- Direct-drive synchronous generator
- Wind speed in urban areas 3-4 m/s
- Making use of ‘Wind -Corridors’
- Rotor with a ring covering the tip of blades
- Cover the returning part of VAWT
- Turbine efficiency close to Betz Limit
- Variable frequency alternator with a downstream inverter
- Optimum tip/speed ratio
- Location of smooth and laminar flow
- Offshore wind and wave hybrid turbines
- ‘Shroud’ with an active yawing mechanism
- Blade angle, θ=45°
- Lift / drag ratio maximum
- Rotor similar to disc to capture most air
- Fiberglass material for manufacturing

Results

- Betz Limit, η_{Betz} = 59.3%, efficiency is not as important for wind turbines as fuel is ‘free’.
- Using reinforced plastics can reduce the weight by 3-5 times and makes turbine to be mobile.
- Due to ring on the blades tip, noise pollution can be minimized and so the tip/speed ratio.
- The lift/drag ratio will increase and hence the conversion of K.E. of wind into electrical power.
- Electricity output of 50Hz AC due to integrated inverter which is suitable for most appliances.
- ‘Shroud’ will increase wind velocity depending on the nozzle angle. As we know doubling wind velocity can increase power up to 8 times.
- Regenerative braking system utilizes extra wind energy in case of strong wind conditions.

Conclusions

- Wind energy share in the global energy mix will increase.
- Common people around the globe will switch to renewable energy.
- Overall burden will decrease from the conventional thermal power plants
- Fossil fuel reserves can be saved for other usage.
- More research opportunities will evolve.
- Wind industry will experience a boom.
- A perfect wind turbine can serve as a solution of energy crisis especially in third world countries.
- The above mentioned advances will surely prove revolutionary for the entire world.

References