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To Study of Wind Energy Generation in Indian Tertiary

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ABSTRACT

Wind energy is most powerful source of energy without making any kind of pollution. In this article, wind power abstraction is focused by using various techniques and number of rotors is introduced for varying power capacity. So wind mill target is to achieve the power and reduce the noise impact to the nature and human kind. Maintenance of the wind mill is also tough when it is located to the remote area. Man power and technical team have to work hard for proper working of wind mill, so sometime automation and other fully automatic system is required while operation.

Power from the wind mill depends on the availability of force of wind, direction of wind, total weight of the blade etc. If the blade has higher weight then it will not rotate freely and less power may be generated. To full fill this condition the blade is made from high grade alloys and other unbreakable plastic material. Wind mill directional system will also affect the power generation as its YO-Mechanism must be proper to overcome with this facility.

Key words: Wind power generation, Yo control Mechanism, Wins speed, Wind power abstraction, Friction in the bearings of machine, Rotor speed .

Introduction.

Commercial wind energy is one of the most economical sources of new electricity available today. Wind turbines can be set up quickly and cheaply compared with building new coal-fired generating stations or hydroelectric facilities. Modern wind generating equipment is efficient, highly reliable, and becoming cheaper to purchase. The environmental impact of large wind turbines is negligible compared with an open pit coal mine or a reservoir, and during their operation produce no air pollution. Because of these factors, wind energy is recognized as the world's fastest-growing new energy source.

he first use of a large windmill to generate electricity was a system built in Cleveland, Ohio, in 1888 by Charles F. Brush. The Brush machine was a post mill with a multiple-bladed "picket-fence" rotor 17 meters in diameter, featuring a large tail hinged to turn the rotor out of the wind. It was the first windmill to incorporate a step-up gearbox (with a ratio of 50:1) in order to turn a direct current generator at its required operational speed.

Nomenclature

WD Wind direction

Temp of W Temperature of wind

RS. Rotor speed (%)

WC Weight on the column.

Pabst. Power abstracted by the machine

Heat Tr. Heat transfer

LP Lower pressure.

Pdiff. = Pressure distributed.

1.1 Wind power mechanism

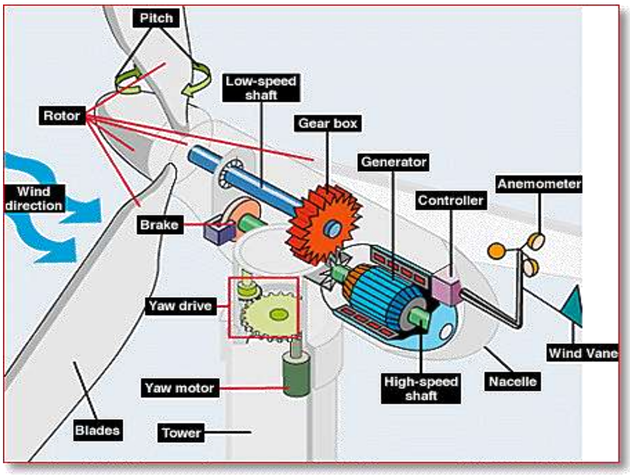

Fig 1 Inside view of Wind Turbine

Wind turbines operate on a simple principle. The energy in the wind turns two or three propeller-like blades around a rotor. The rotor is connected to the main shaft, which spins a generator to create electricity. Wind turbines\are mounted on a tower to capture the most energy. At 100 feet (30 meters) or more above ground, they can take advantage of faster and less turbulent wind. Wind turbines can be used to produce electricity for a single home or building, or they can be connected to an electricity grid (shown here) for more widespread electricity distribution.

Various parts of wind turbine for successful operation:

- Anemometer: Measures the wind speed and transmits wind speed data to the controller.
- Blades: Most turbines have either two or three blades. Wind blowing over the blades causes the blades to "lift" and rotate.
- Brake: A disc brake, which can be applied mechanically, electrically, or hydraulically to stop the rotor in emergencies.
- Controller: The controller starts up the machine at wind speeds of about 8 to 16 miles per hour (mph) and shuts off the machine at about 55 mph. Turbines do not operate at wind speeds above about 55 mph because they might be damaged by the high winds.
- Gear box: Gears connect the low-speed shaft to the high-speed shaft and increase the rotational speeds from about 30 to 60 rotations per minute (rpm) to about 1000 to 1800 rpm, the rotational speed required by most generators to produce electricity. The gear box is a costly (and heavy) part of the wind turbine and engineers are exploring "direct-drive" generators that operate at lower rotational speeds and don't need gear boxes.
- Generator: Usually an off-the-shelf induction generator that produces 60-cycle AC electricity. High-speed shaft: Drives the generator. Low-speed shaft: The rotor turns the low-speed shaft at about 30 to 60 rotations per minute.
- Nacelle: The nacelle sits atop the tower and contains the gear box, low- and high-speed shafts, generator, controller, and brake. Some nacelles are large enough for a helicopter to land on.
- Pitch: Blades are turned, or pitched, out of the wind to control the rotor speed and keep the rotor from turning in winds that are too high or too low to produce electricity.
- Rotor: The blades and the hub together are called the rotor.
- Tower: Towers are made from tubular steel (shown here), concrete, or steel lattice. Because wind speed increases with height, taller towers enable turbines to capture more energy and generate more electricity.
- Wind direction: This is an "upwind" turbine, so-called because it operates facing into the wind. Other turbines are designed to run "downwind," facing away from the wind.
- Wind vane: Measures wind direction and communicates with the yaw drive to orient the turbine properly with respect to the wind.
- Yaw drive: Upwind turbines face into the wind; the yaw drive is used to keep the rotor facing into the wind as the wind direction changes. Downwind turbines don't require a yaw drive, the wind blows the rotor downwind.
- Yaw motor: Powers the yaw drive.

2. Wind Turbine power absorption calculation

Power = Work / t
= Kinetic Energy / t = = $\frac{1}{2}mV^2$ / t , = $\frac{1}{2}(\rho Ad)V^2/t$ = $\frac{1}{2}\rho AV^2(d/t) = \frac{1}{2}\rho AV^3$
Swept area and power available
Swept Area – $A = \pi R^2$ (m^2) Area of the circle swept by the rotor.
ρ = air density – in Colorado its about 1-kg/m^3

2.1 Wind penetration and power generation

Installation in shallow water few kilometers from the seashore. The key feature for off-shore is high reliability of wind. In innovative move, turbines are placed on floating platforms and anchored to the sea bottom. Up to 10% is the short term goal for many countries. Germany in particular, several power utilities are expecting future wind contribution as high as 30%. Uncertainty of wind constitutes a challenge to achieve a much higher degree of grid penetration. Work is on for wind models for predicting the power for next 24 to 48 hours. Criterion for identification of a potential site Sites having wind power density greater than 200 W/m2 at 50 m height.

Environmental impact

- Mechanical Noise - gear box, generator
- Aerodynamic Noise - Swishing sound
- Wind farm at 350 m away
- noise level - dB(A) 35-45
- Electromagnetic interference
- Visual impact
- Shadow flicker
- Ecology, Loss of Bird Life.

Economics

- Annual Energy Production
- Capital Cost
- Annual capital charge rate
- Pay back period, Life Cycle Cost Analysis
- Operation & maintenance cost, insurance, land leasing, etc.

3. National plan

A nationwide wind monitoring campaign is to be started at the earliest to have clear picture of wind resource potential of India. Other alternative is to seek advanced methods of assessment by International Agencies for drawing wind atlas of the country.

Also, current availability in the area of wind energy as follows:

- Integration of WECS with large buildings
- Wind power forecasting model, short and long term
- Penetration limits in grid
- System integration of WE
- Lightning protection of blade and tower structure
- Testing and reliability of composite materials for blade in different environmental conditions
- Numerical & observed wind atlas – modeling, verification & application
- Stand alone and non-grid WECS
- Wind – Solar conversion systems for different applications
- VAWT – aerodynamic studies of various configurations
- Offshore – foundation, cable & peculiar issues of marine operation
- Human resource development & assessment in fast emerging wind energy sector

- Wind farm design and flow modeling.

4. Wind mill with multiple rotors

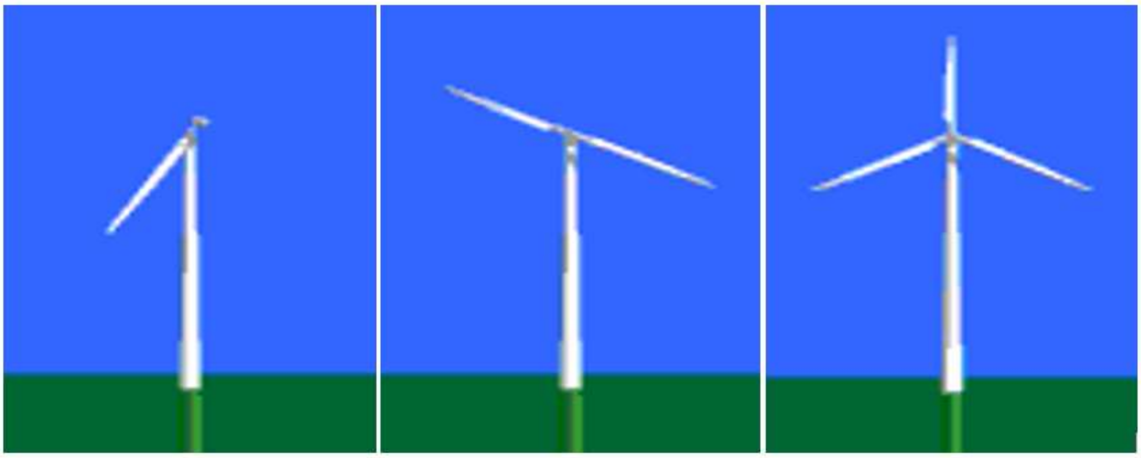

Fig 2 Wind mill with one, two and three rotors.

Most common design is the three-bladed turbine. The most important reason is the stability of the turbine. A rotor with an odd number of rotor blades (and at least three blades) can be considered to be similar to a disc when calculating the dynamic properties of the machine. A rotor with an even number of blades will give stability problems for a machine with a stiff structure. The reason is that at the very moment when the uppermost blade bends backwards, because it gets the maximum power from the wind, the lowermost blade passes into the wind shade in front of the tower.

Wind Turbine generators also play vital role for power generation as follows:

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- Wind power generators convert wind energy (mechanical energy) to electrical energy.
- The generator is attached at one end to the wind turbine, which provides the mechanical energy.
- At the other end, the generator is connected to the electrical grid.
- The generator needs to have a cooling system to make sure there is no overheating. Require less force to turn than larger ones, but give much lower power output. If large wind turbine rotor with a small generator it will be producing electricity during many hours of the year, but it will capture only a small part of the energy content of the wind at high wind speeds.
- Large generators: Very efficient at high wind speeds, but unable to turn at low wind speeds. If the generator has larger coils, and/or a stronger internal magnet, it will require more force (mechanical) to start in motion.

5. Conclusion

Number of rotors is very important parameters at the time of selection of the wind mill. Because less number of rotor will generate less power as on other side if one will increase the number of bladders then drag will be increases and the force applied will be increased. Therefore 3 rotor blade is mostly installed to cover up this type unbalances forces. The decreasing cost of wind power and the growing interest in renewable energy sources should ensure that wind power will become a viable energy source. Wind energy is a domestic, renewable source of energy that generates no pollution and has little environmental impact. Up to 95 percent of land used for wind farms can also be used for other profitable activities including ranching, farming and forestry. Energy output from a wind turbine will vary as the wind varies, although the most rapid variations will to some extent be compensated for by the inertia of the wind turbine rotor.

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References

[1]. Roberts, B. W. (2018). “Quad-rotorcraft to harness high-altitude wind energy,” in Airborne wind energy. Singapore: Springer, 581–601.

[2]. VanKuik,G. A. M., Peinke, J.,Nijssen, R., Lekou, D.,Mann, J., Sørensen, J.N., et al. (2016).

[3]. Wright, A. D., Fleming, P. A., Scholbrock, A. K., Johnson, K., Pao, L., and van Wingerden, J. W. (2019). Wind turbine control design (No. NREL/CH-5000- 71405). Golden, CO: National Renewable Energy Lab.(NREL)..

[4]. Bech, J. I., Hasager, C. B., and Bak, C. (2018). Extending the life of wind turbine blade leading edges by reducing the tip speed during extreme precipitation events. Wind Energy Sci. 3 (2), 729–748. doi:10.5194/wes-3-729-2018

[5]. Murray, R., Snowberg, D. R.,Berry,D. S., Beach, R.,Rooney, S. A., and Swan,D. (2017).

[6]. Aeon. Available at: https://aeon.co/essays/overblown-and-under-loved-windfarms- at-the-edge-of-beauty (Accessed October 7, 2020).

[7]. Hsiao F B and Bai C J (2013), "Design and Power Curve Prediction of HAWT Blade by Improved BEM Theory", Journalof Chinese Society of Mechanical Engineers.

[8]. Faculty of mechanical engineering (2011), design data book of engineering, Coimbatore: kalaikathir achagam page no.: 1.40, 8.1 – 8.53.

[9]. Ugural A. C., Mechanical Design An Integrated Approach, Mcraw – Hill, 2003.

[10]. Fujin Deng, Zhe Chen (2010), wind turbine based on multiple generators drive-train configuration, E-ISBN: 978-1- 4244-8509-3, Print ISBN: 978-1-4244-8508-6 page no.: 1- 8.