Wind Turbines

Wind Energy in general

The future is very positive for wind power. The technology is growing exponentially due to the ever increasing global demand for electricity and the ongoing negative viewpoint about the high risk in nuclear power plants. Wind turbines are becoming more efficient and are able to produce more electricity per unit of kinetic energy as technology improves each year.

Converting wind power into electrical power:

A wind turbine converts the **kinetic energy** of wind into rotational mechanical energy. The mechanical energy is converted into electrical energy with the generator as it is turned by the wind vanes. Large wind turbines typically have a generator installed on top of a high tower. A gearbox operates to adjust the speed of the wind to the required speed of the generator. Various sensors for wind speed, humidity and temperature measurement are placed inside and outside to monitor the environmental conditions. A controller unit analyzes the environmental data and adjusts the yaw and pitch of the blades to the correct position. See the schematic below.

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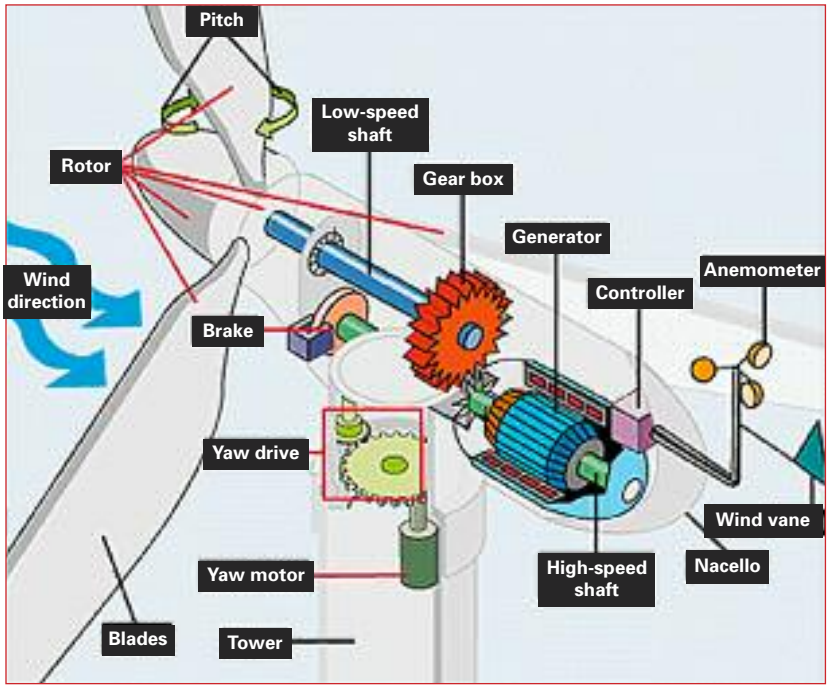

Facts & Figures

- There is over 336 GW (Gigawatt) of installed wind energy capacity in the world.
- The Global Wind Energy Council (GWEC) has forecasted a global capacity of 2300 GW by 2030 supplying up to 22% of global power consumption.

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The formula for wind power density:

$W = d \times A^2 \times V^3 \times C$ where:

d: the density of the air; typically 1.225Kg/m^3; a value which varies depending on air pressure, temperature and humidity.

A^2: the diameter of the turbine blades; this value is quite effective with its squared relationship; the larger a wind turbine is the more electricity can be produced.

V^3: the velocity of the wind; the wind speed is the most effective value with its cubed relationship.

In reality, the wind is never the same speed and a wind turbine is only efficient at certain wind speeds. Usually 10 mph (16 km/h) is the most effective speed.

C: a constant which is normally 0.5 for metric values; a combination of two or more constants depending on the specific variables and system of units used.

Why the need to measure the local climate?

To forecast the power of the wind over a few hours or days is not an easy task.

Wind farms often extend over hundreds or even thousands of acres of land or sea where the climate and the wind speed can vary substantially. Variation is especially difficult to predict in hilly areas. Positioning towers slightly to the left or right can make a significant difference in power generation. To determine an optimum location for the wind farm, a process called 'wind mapping' is performed. Wind

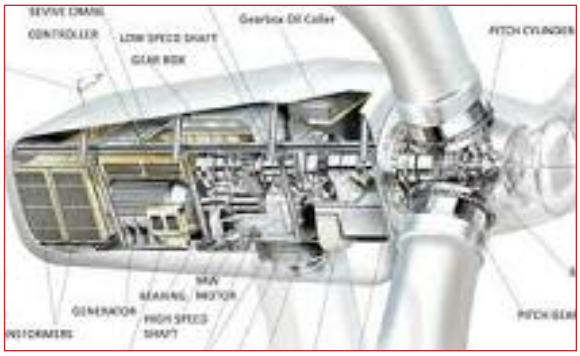
maps are produced with Doppler radars which are equipped with stationary temperature and humidity sensors to improve the accuracy of the results.

Wind mapping is conducted throughout the different seasons. After mapping is completed, optimum wind tower positions are determined. Each turbine is equipped with sensors for wind direction and speed, temperature and humidity. Using these parameters, the turbine characteristics and the weather forecast, a power prediction can be made using complex modelling formulas.

Why the need to measure inside a wind turbine?

Wind farms are normally installed in areas with harsh environments where strong winds are common. Salty air, high humidity and condensation are common daily issues for wind turbines.

Normal ventilation of the housing is not sufficient to ensure a proper operating environment and continuous operation. The internal environment must be monitored and dehumidified by desiccant to protect the electrical components against short circuits and the machinery against corrosion. Maintaining a dry operating environment extends the life of equipment and reduces the cost of maintenance.



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