Feasibility Study of Wind Energy for Vignan Hills and Design of an Effective Wind Energy Conversion System

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Abstract- Energy play's a very important role in everyday life. Growth of the economy is largely depend upon the adequate supply of energy available in its original form in nature such as Crude Oil, Nature Gas, Coal, Solar Heat e.t.c. In future, in the view of fast depleting fossil fuels and growing concerned for the environment protection, some other system based on non-conventional and renewable sources are been tried; these are Solar wing, Sea and Geothermal & Biomass.
Wind energy is one of the non-conventional energy sources.
Wind energy uses kinetic energy of the wind to convert into required from. There had been many attempts of wind an effective wind energy conversion system. Our project work deals with the finding out the different elevation of the Vignan hills and the wind potential power site. It also identified the local disturbances, which causes the obstruction for the flow of wind.
Wind speed at different potential site has been recorded and also the variation of wind speed at different elevations is found.
An effective wind energy conversion system has been designed, consists of designing of wind turbine for mean wind velocity, electrical storage devices e.t.c.
In designing of wind turbine a modified savonius rotor is designed.
The modified savonius rotor is consists of two levels and each pair of blade is offset by 600. A suitable generator is made with produces D.C. Output, this output is used to charging a battery.
Keywords – wind energy, savonius motor

I. Introduction

Wind has for long been recognized as an abundant source of clean and renewable energy. Wind results from uneven heating of earth and atmosphere by unlimited energy from the sun. In actuality wind is more complex. The wind is also caused due to earth's rotation, which causes Coriolis force resulting in an easterly wind velocity component in the northern hemisphere.[1,4]
Our country is blessed with abundant renewable energy in the different forms. Use of wind mill in India leads back to 1879. After independence systematic approach was made to harness wind energy in the areas of water pumping. The oil crises of 1973 revived interest for harnessing of renewable energy. Up to mid-eighties, work continued only in the area of, water pumping windmills the importance of power generation from wind energy in India was realized during seventh five year plan (1985-1990). India's potential for power generation from wind energy today ranks as

one of the most promising renewable sources of energy. The world – watch institute recognized India as a "NEW WIND SUPER-POWER".[1,8}

II. SELECTION OF WIND ENERGY SITE

While evaluating feasibility of setting up a windmill project, one needs to known energy load, available wind speeds and choice of specific WEG. One should also work out economics of the project after taking into account cost and financial incentives offered by the government. Feasibility of a windmill project can be analyzed by evaluating the proposal in the following steps :

1. Survey of historical wind data.
2. Contour maps of terrain and wind are consulted.
3. Best site are instrumented for approximately one year.
4. Potential sites are visited.
5. Chose optimal site.

III.VARIATION OF ATMOSPHERIC PRESSURE WITH ALTITUDE

The drop of atmospheric pressure with increase in altitude is almost linear. At about 16000 feet = 5000m height above sea level, fliers have experienced and atmospheric pressure elevations. Other observational data yield the following values of pressure:[1,3]

H=0	1000	2000	3000	5500	m above sea level
P=101.33	92	80	70	50	k Pascal

TABLE.1

Assuming a relation p = a + bH, and using values at H = 0 and 5500m. there result a = 101.33, and b= (50-101.33)/5500 = -9.33* 10-3. Thus, an equation for the pressure variation with elevation above sea level is, with H in meters,

$$p=101.33-9.33*10-3H, kPa\text{…………. } (1)$$

If is in mm-Hg, since 1kPa = 7.5mm-Hg, Pmm = 760-70*10-3H, mm-Hg, with H in meters.

Since air density is directly proportional to p at the same temperature, the density change with elevation can be obtained. But as the temperature also changes with altitude, we will consider both effects at little later.

3.1. VARIATION OF TEMPERATURE WITH ALTITUDE

For an adiabatic process, the variation of temperature with pressure follows the relation

$$T/T0 = (p/po)\ 0.286 \text{ …………………………………. } (\ 2\ )$$

Where the factor 0.286 = (1.4-1) 1.4, the well-know constant.

Therefore, upon using equation (1) for pressure variation with height, we obtain the relationship for temperature variation with height.

$$T = [(101.33-9.33*10-3H)\ 101.33]\ 0.286\ T0$$
$$= (1-92.1*10-6H)\ 0.286\ T0$$

Here,

T0 = temperature at H=0 or at sea level, and H is in meters above sea level.

From practical observations, the temperature is known to fall 100c for every 1000m. Increase in elevation. The approximate formula based on this rule becomes

$$t=tgr – 0.01H, 0C$$

This applies for low altitudes (<100m).

3.2 VARIATION OF AIR DENSITY WITH ALTITUDE

Equation (1) gave the variation of density with pressure and temperature, both of which vary with height H above sea level. Equation (1) can be written as

P = (1 – 92.1 * 10-6 H) 101.33, kPa

While

T = (1 – 92. * 10-6 H)0.286 T0, K

Therefore

p = 3.48555 p/T = 3.4855 (1 – 92.1*10-6H)0.714*101.33/T0

At H = 0 and T0 = 273.15, ρ=304855*101.3/293.15=1.205kg/m3

At H = 0 and T0 = 293.15, ρ=304855*101.33/293.15=1.205kg/m3

3.3 VARIATION OF WIND SPEED WITH HEIGH

For low changes in height up to 120m, wind loading on buildings have been measured very carefully. An empirical formula for wind-velocity ratio at two different heights is

V2/V1 = (H2/H1)1/7

This is known as the 1/7th power law.

3.4 ELEVATIONS AND VIGNAN SITE REPORT

The site also helps us to know the local disturbances, which cause obstructions for the flow of wind like college building, hostel, school building, canteen, etc. The contour map also helps us to know the are available at the required elevation and also to know the required distance to be maintaining between the different turbines at that elevation. The site also gives us the information about the future proposed workshops and proposed administrative buildings. The effects of wind speed with elevation can also be evaluated. The contour site also helps us to know the top of a smooth well-rounded hill with gentle slopes lying on the flat plane. This can be observed in the North zone where the elevation is gradually increasing from 122m to 166m above sea level.[3,5]

3.5 WIND SPEED AT VIGNAN HILL

The mean average wind velocity from the nearest wind monitoring station is taken, it is found to be 21 km/hr. the latitude and longitude of the place is also is determined.

The latitude of the place is 170 11'.

The longitude of the place is 780 55'.

The mean annual wind power density at 25m is 176 W/sq.m.

Aero turbine convert energy in moving air to rotary mechanical energy. In general, they require pitch control and yaw control (only in the case of horizontal or wind axis machines) for proper operation. A mechanical interface consisting of a step up gear and a suitable coupling transmits the rotary mechanical energy to an electrical generator. The output of the generator is connected to the load or power grid as the application warrants.

Yaw control. For localities with the prevailing wind in one direction, the design of a turbine can be greatly simplified. The rotor can be in a fixed orientation with the swept area perpendicular to the predominant wind direction. Such a machine is said to be yaw fixed. Most wind turbines, however, ate yaw active, that is to say, as the wind direction changes, a motor rotates the turbine slowly about the vertical (or yaw) axis so as to face the blade into the wind. The area of the wind stream swept by the wind rotor is then a maximum.[2,7]

In the small turbines, a tail vane, similar to that in a typical pumping windmill, controls yaw, action. In larger machines, a servomechanism operated by a wind-direction sensor controls the yaw motor that keeps the turbine properly oriented.[3'5]

The purpose of the controller is to sense wind speed, wind direction, shafts speeds and torques at one or more points, output power and generator temperature as necessary and appropriate control signals for matching the electrical output to the wind energy input and protect the system from extreme conditions brought upon by strong winds electrical faults, and the like.[4,8]

3.6 BASIC COMPONENTS OF WECS (WIND ENERGY CONVERSION SYSTEM)

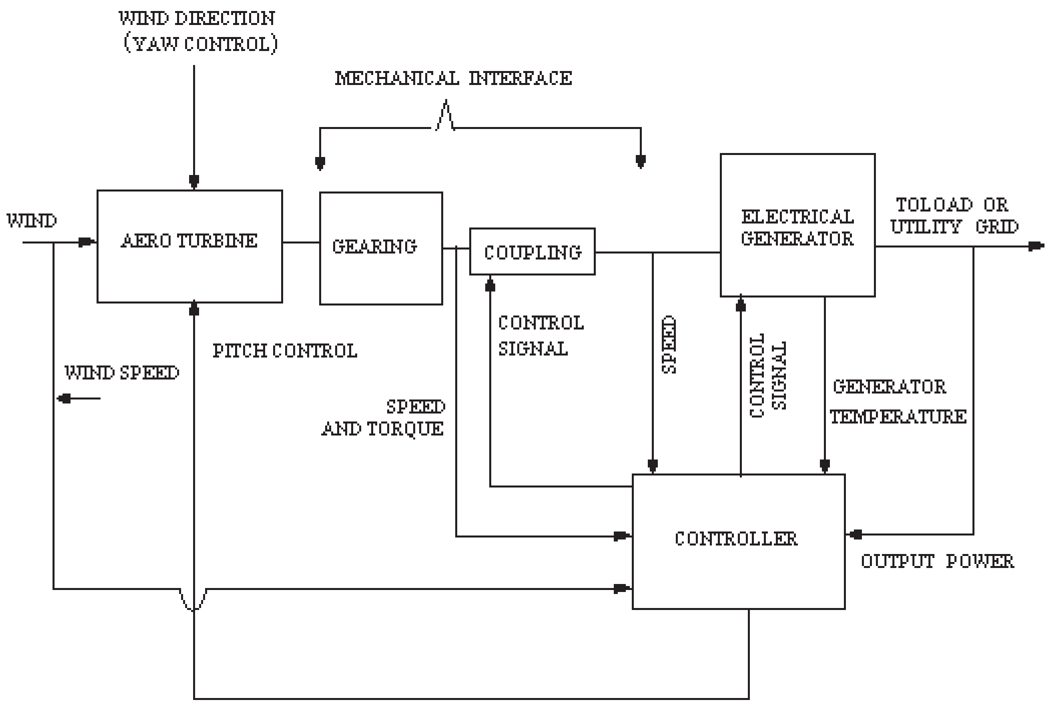

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FIG.2 SCHEMATIC DIAGRAM OF WIND ENERGY CONVERSION SYSTEM

The type of the supporting structure and its height is related to cost and the transmission system incorporated. It is designed to withstand the wind the wind load during gust (even if they occur frequently and for very short periods). Horizontal axis wind turbines are mounted on towers so as to be above the level of turbulence and other ground-related effects. The minimum tower height for a small WECS is about 10m, and the maximum practical height is estimated to the roughly 60m.[4,7]

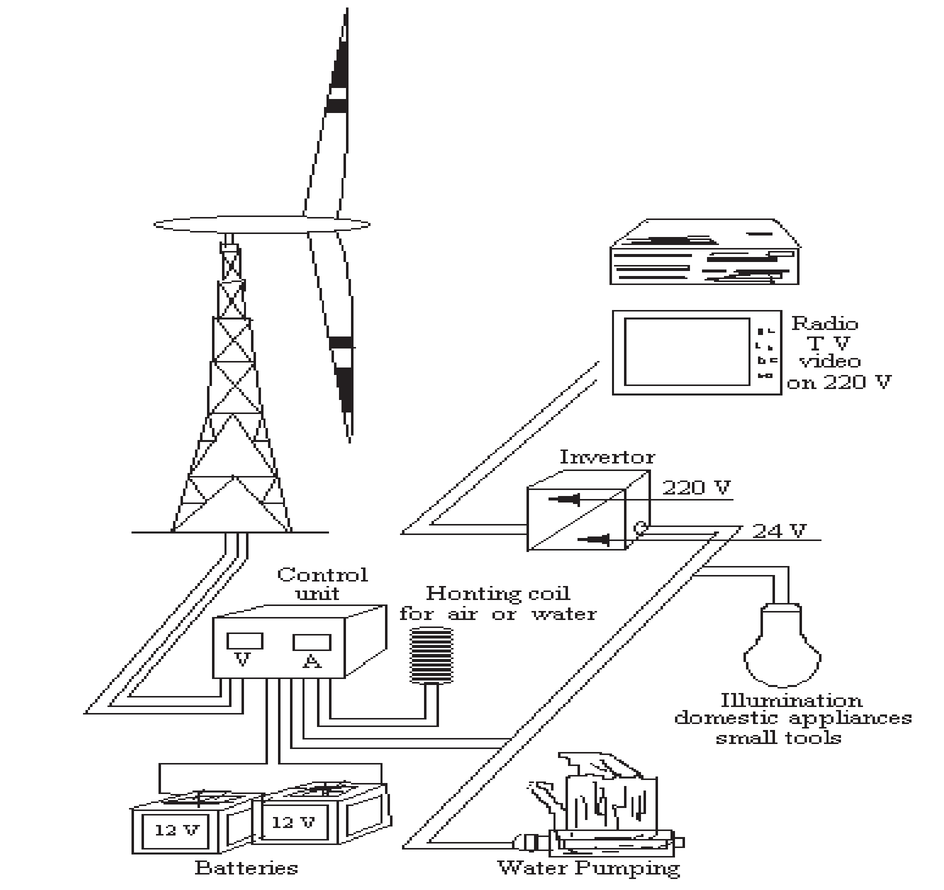

FIG.3 A SCHEMATIC VIEW OF COMPLETE UNIT OF WIND-POWER SYSTEM

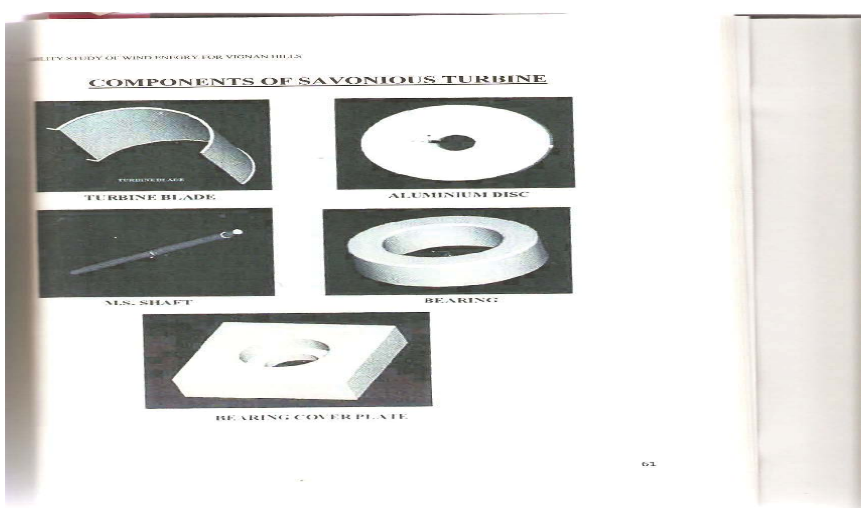

FIG.4COMPONENTS OF SAVONIOUSTURBINE

IV.CONCLUSIONS

The potential sites of VIGNAN site are determined and the average wind velocity at those locations has also been determined. The local disturbances are also identified. The average wind velocity data for three years has been provided. The savonius rotor has been modified to get a better performances and a power output of 7.1 V and 300-400mA current is generated.

V. FUTURE WORK

The material used for the blades in this turbine is aluminum, in further study alternate material like synthetic fibers, composite material can be used to reduce weight and increase strength of the blade.

The design of turbine blades in a project is a semi circular bucket with constant thickness in further study the blade can be made aerofoil instead of constant thickness.

The wind speed in site report is presented only in hourly basis, in future work the wind speed can be recorded monthly and yearly basis.

Analysis of stress developed in the blades using the packages like ANSYS.

Study of the airflow over the wind turbine blade in order to reduce eddy loses and friction loses.

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