International Journal on Recent and Innovation Trends in Computing and Communication ISSN: 2321-8169
Volume: 3 Issue: 9 5604 - 5607

A Novel Theory of Wind Power in KGF

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Abstract: -The paper gives the details case study of power generation using wind as the main source in Kolar Gold Fields Mining Area. This paper gives the detailed factors, limitation methods and site selection for generation of wind power.

Wind energy is powerful renewable and clean energy on the earth. Now a days in many areas people are trying to utilize the wind energy with is most renewable source.

Wind is defined as the difference of air pressure causes the wind. Wind moves from high pressure to low pressure which is caused from the sun. The present world is facing global warming, this will cause more wind energy which can be used to generate Electric Power.

"*Changing negative factors into positive energy as conversion without affecting the environment* "

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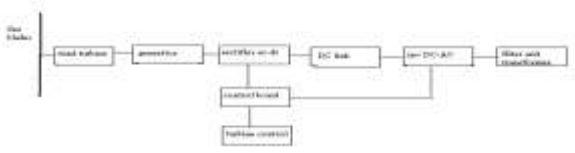
I. Introduction:

Energy which is the most primary and of all kinds of work. What ever happens in the world is in the flow of energy, which is important in all the sectors of a country's economy. The per capital energy consumption is directly related to the standard of living.

Due to the rapid development in industries, increase in the population and standard of living, we are facing with shortage of energy. Hence, Non Conventional Energy Sources have emerged as larger source of energy in India and world at large. From the various non-conventional energy sources, wind energy plays a major role in the growth of energy. Wind power which is the most clean energy sources in the 21st century, the construction and development of wind energy is of great importance for energy conservation and reduction in emission, protection of environmental and sustainable development of the country. Compared with other traditional fossil energy, its environmental benefit is remarkable. With significant achievements in construction technology, it is facing many difficulties in the meantime such as: consumptive level, outgoing channel, blocked capacity. The urgent task of alleviating the consumptive problem of wind power is to enhance the capacity of consuming the wind energy locally in kolar gold fields mining area. The Conclusions will provide a new energy policy in energy consumption locally and saving benefits of new energy.

II. Block diagram:



Wind Energy principle

Converting kinetic energy to mechanical energy is called wind energy

Power available from wind plant= ½ ρ A V^3

Where, ρ – air density = 1.225 Kg. / m^3 at sea level. (Changes by 10-15% due to Temperature and pressure variations)

A – Area swept by windmill rotor = πD^2 sq-m. (D – Diameter)

V – Wind speed m/sec.

Air density, which linearly affects the power output at a speed, which depends on the height, temperature and pressure of the area . Variation in temperature and pressure can affect air density up to 10 % in either direction

III. Available Wind energy in KGF

MONTH	WIND SEPPED IN km/hr	Wind speed in M/sec
January	70	19.44
February	65	18.055
March	74	20.55
April	74	20.55
May	63	17.5
June	93	25.83
July	44	12.22
August	44	12.22
September	50	13.88
October	33	9.166
November	89	24.72
December	70	19.4

The table shows the wind speed available throughout the year from the weather forecast. If we calculate the average speed throughout the year is around 60km/hr.

IV. Calculations of wind energy for the given data

It is very important that to know the power and the energy produced by different turbines in any condition. We shall consider an example to calculate kinetic energy in the wind turbine at the rated wind velocity by considering the values as given below.

Given data:

r=*l* = 52 m,

$V_{avg.}$ = 18.39 m/sec,

$V_{min.}$ = 9.166 m/sec,

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$V_{max.}$ = 25.83 m/sec
ρ = 1.23 kg/m^3 ,
Power Coefficient, *Cp* = 0.4

We can calculate the power from the wind into rotational energy in the turbine using Equation

$P = ½ \rho A V^3 C_p$
For average available velocity V =18.39 m/s
$P_{avg} = ½*1.23*\pi*52^2*18.39^3*0.4$ =12996.816 KW
For maximum available velocity V =25.83 m/s
$P_{max} = ½*1.23*\pi*52^2*25.83^3*0.4$ =36013.4353 KW
For minimum availablevelocity V=9.166 m/s
$P_{min} = ½*1.23*\pi*52^2*9.166^3*0.4$ =1609.277 KW

V. Site location

The town of kolar gold fields, mining area is place where green and Stone Mountains are located. The topology view of the mining area is as shown in the fig from the Google maps. It is located at 12°57'13.2"N 78°14'55.2"E. To the east of KGF is a ridge of hills of which Dod- Beta hill, 3196 feet above sea level.

It satisfies the following factors for wind power generation: -

1. High annual average wind speed is around 60km/hr.
2. No high rise buildings for a radius of 5 Km.
3. Open space.
4. High mountains with gentle slops.
5. Mountain gap which produces wind funneling.

Environmental factors:

When there is large construction, it always affects the surrounding vegetarian, living and non living creatures. A study has to be conducted regarding this but as per the previous studies of different wind power plant it will not affect the environment in any way.

Before setting up a wind power plant, it has to cleared form the environment department, local body and people who are staying nearby the site.

Photos where wind plant can be constructed:

VI. Construction of the proposed site:

To construct the wind power plant at the proposed site the following has to be cleared,

1. Clearances form the government body.
2. To lay the road and to construct the bridges to the construction site.
3. To clear any of the transmission lines comes in between the plants.
4. The project is to set up in to different phase as civil, electrical and turbine installation.

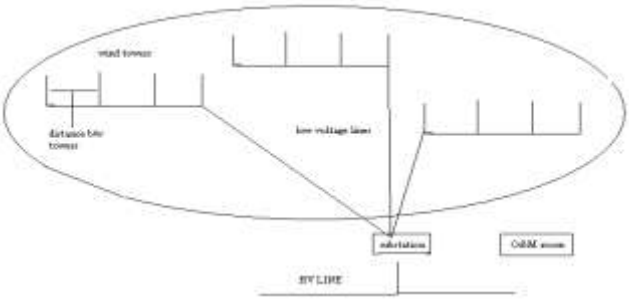
VII. Access roads:

In order for equipment and personal to reach the construction site a connecting road system is needed form the local existing road.

The parts of the wind power plant are so huge and long, and wide radius of the road is required for the long trucks which carries the equipment.

After completing the construction of plant, the road is made permanent which is to provide the access to the work place.

Wind power plant layout:



VIII. Design of rotor:

The rotor is only one of the important components for an effective utilization, all the components need to be properly designed and matched with rest of the components .There are two types of rotors Horizontal axis rotor and Vertical axis rotor .

Horizontal axis using two aero dynamic blades:

Rotor drives a generator through step gear box because of the high cost of the blade rotors with more than two blades are not recommended. In future blades may use carbon fiber which combines light weight and flexibility with immense strength. The wind speed increases with height. Horizontal axis rotor can be either lift or drag devices.

I. Lift is preferred because of higher power co-efficient performance (Cp) and lower cost to power output ratio.
II. Capable of turning at very high speed. Lift devices use slender blades with an aerofoil section that generate aerodynamic lift when placed in an air current.
III. Lift rotors often used tapered & / or twisted blades to reduce bending strains on the roots of the blades.

IX. Tip Speed Ratio (TSR):

It is defined as the ration of speed of the rotor blade tips to that of speed of the wind.
$TSR=V_{tip}/V$, V_{tip} = Speed of the rotor tip, V= free wind speed.

The TSR increase with decrease in number of blades, from $S=NC/\pi D$, where N= no. of blades, C= Average Breadth of the blade, D= Diameter of the circle described by a blade, S=solidity.

For the the TSR of 8-15 the no of blades will be 1-2. Two blade systems are capable of operating with high TSR.

X. Electrical Generator:

The choice of an electrical generator and control method to be decided by considering the below factors,

1. The constant tip speed or constant TSR.
2. The wind power rating of the turbine.
3. The type of load demand Ex. Battery connection

Wind power rating are been classified as follows,

1. Small-upto 1KW.(Permanent magnet DC Generator)
2. Medium-upto 50KW.(PM DC generator, Induction Generator, Synchronous Generator)
3. Large –upto 200KW to MW (Induction Generator, Synchronous Generator)

XI. Wind Power Generation schemes:

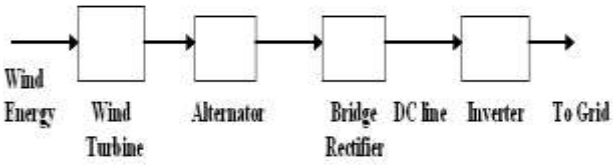
The different types of schemes of power generation are given below,

1. CSCFS - (Constant Speed Constant Frequency Scheme)
2. DSCFS - (Dual Speed Constant Frequency Scheme)
3. VSCFS - (Variable speed constant frequency scheme)
4. (VSCF with DO)- Variable speed constant frequency with double output
5. (VSVFS) -Variable speed variable frequency schemes

The better one which is suited for this place is ***variable speed constant frequency scheme***. It involves wind generator which is small is commonly used in many applications. This scheme is a variable speed operation, which yields high power for both low and high wind speeds .Results in higher annual energy yields per rated kilowatt capacity. The different schemes in the above method as

a. AC-DC-AC LINK

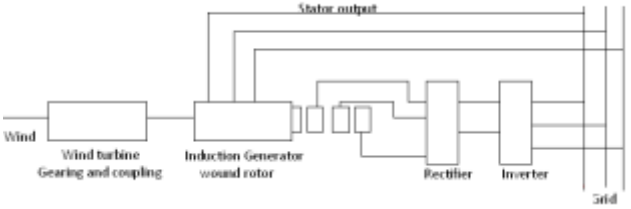
With the high powered thyristors and high voltage DC transmission system, AC output of the 3 phase alternator is rectified using a bridge rectifier and then converted back to AC using line commutated inverters they utilize an AC source and cause natural commutation.



XII. BLOCK DIAGRAM OF AC-DC-AC LINK

b. Double output induction generator.

Slip ring induction motor is used rotor power output at slip frequency is converted into line frequency power by rectification and inversion output power is obtained both from stator and rotor and hence this device is called double output induction generator. Increasing rotor output lead to increasing slip and higher speed



Block Diagram double output of IGWR

XIII. Mathematical calculation for wind energy:

The table shows wind speed to the power density and the output of the wind turbine assuming 30% efficiency of the turbine.

Wind Speed in kmph	Wind Speed m/s	Power Density Watts/m^2	Turbine Output 30% Efficiency
1	0.278	0.013	0.004
5	1.39	6.43	1.929

10	2.77	13.39	4.01
15	4.16	45.21	13.56
20	5.55	107.16	32.15
40	11.12	857.33	257.20
50	13.88	1671.27	501.38
100	27.77	13395.91	4018.77
125	34.722	26163.904	7849.17

XIV. Conclusion:

It is very important as the technology and demand of power is increasing, the population living in kolar gold fields to have an uninterrupted power supply. This puts a huge burden on electrical board. So by using wind energy compared to the other resources it is having minimum operating cost. The power generated from the available wind varies from 1.6MW to 36MW. It falls in the large groups, for this type induction generator and synchronous generators are used. With this generation we meet the demand of the kolar gold fields which is very clean and safe energy

Suggestion:

Wind forms can be located near the demand centers avoiding the power generated to be transmitted over long distance resulting in loss of power

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