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An Investıgatıon of Wınd Characterıstıcs for Optımum Wınd Energy Utılızatıon at the Campus of Rajıv Gandhı Technıcal Unıversıty, Bhopal,Indıa

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Abstract

Energy is an essential ingredient of socio-economic development and economic growth. Renewable energy sources like wind energy is one of the most significant and rapidly developing renewable energy sources in the world and it provide a clean energy resource, and can help in reducing the dependency on fossil fuels. Wind is the indirect form of solar energy and is always being replenished by the sun. Wind is caused by differential heating of the earth's surface by the sun. It has been estimated that roughly 10 million MW of energy are continuously available in the earth's wind. Wind energy provides a variable and environmental friendly option. The main purpose of this paper is to present, in brief, wind potential in INDIA and to perform an investigation on the wind energy potential of Bhopal (M.P). Therefore, in this study, a wind observation station was established at RGPV University Main Campus in order to figure out the wind energy potential in the province. Topographical and wind speed measurement data have been collected as a first step. The wind speed has been measured at the 20th and 40th meters of the measurement mast for 2 months. The data collected in this observation station between July 2013 and August 2013 have been evaluated via NRG Symphonie Data Retriever software programs.

Keywords: Wind Energy, Renewable Energy, Wind MAST, WIND Power.

Introduction

Limited reserves of fossil fuels and their negative impacts on the environment lead institutions, organizations and governments to find out more efficient technologies and new and renewable energy resources to produce energy in the natural environment. Recently, wind energy is the growing energy source in the world and wind power is one of the most widely used alternative sources of energy [1]. The wind energy has been used for centuries for navigation and agriculture. Today, the use and the technology of the wind energy have been developing very fast.[2],[3].

The latest Global Wind Report Annual Market Update 2012 from the Global Wind Energy Council (GWEC) reports that the 2012 global wind power market grew by more than 10% compared to 2011. Nearly 45 GW of new wind power capacity resulted from about €56billion of investment. The new global total capacity at the end of 2012 was 282.5GW, equal to about a quarter of the power generation capacity of the U.S. In 2012 the cumulative market growth rate of 19% was somewhat lower than the annual average growth rate of 22% of wind energy over the past 10 years.[4] In 2011 the Indian wind sector experienced a record annual growth, with over 3 GW of new installations. 2012 was a slower year due to a lapse in policy, but India still experienced significant new wind energy capacity which reached 2.3 GW at the end of 2012, for a cumulative total of 18.4 GW.As of January 2013, total renewable energy installations in the country reached 26.9 GW. By the end of 2012, renewable energy accounted for over 12 % of total installed capacity, and about 6% of electricity generation, compared to 2% in 1995.

Wind power accounted for about 69% of total renewable energy capacity or about 8% of the total installed capacity in India. The effective utilization of the wind energy entails having a detailed knowledge of the wind characteristics at the particular location. The distribution of wind speeds is important for the design of wind farms, power generators and agricultural applications such as the irrigation. In this study, the wind energy potential is investigated in 2 months measured wind speed data.

Materials and Methods

The wind speed, which varies proportional to the altitude, is among the main factors that determine the wind energy potential. A site's average wind speed is very important because a small difference in wind speed has a major effect on the amount of wind power

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available. Therefore, the position of the wind observation station should be chosen correctly, the appropriate wind measurement equipment should be used and then, the recorded data should be evaluated [1].While determining the position of the wind observation station established in the RGPV University Main Campus, the buildings and the other factors have been taken into account and ensured that there were not any obstacles at the windward side of the station.

The wind observation station, which is situated in ENERGY PARK,RGPV at the co-ordinates of E 077° 21.668' longitude and N 023° 18.720' latitude stand a mast, on which is fixed equipment erected to measure the wind speed and wind direction at the height of 40 m. And also a data logger (NRG Symphonie Plus 3Data logger) for storing the wind speed and the information about directions, thermometer, barometer, and cables and terminals to provide the connection. Furthermore, a computer was used to transfer the data to be evaluated from data logger. Fig.: (1) showing the snap shots of the wind mast at energy park ofRGPV,Bhopal. India

Fıg.: 1- Snap shots of wind mast system at energy park,rgpv,bhopal.ındıa

Data Loggers

NRG Systems' Symphonie*PLUS3* data logger not only records wind speed and direction, but also makes it easy for you to access and use this information from anywhere in the world with the tools you already use to do business. Make your wind energy project effective and efficient. Get the right quality and quantity of data so you can accurately understand the volume and nature of the wind.

NRG #40C Anemometer

The NRG #40C anemometer is the industry standard anemometer used worldwide. NRG #40C anemometers have recorded wind speeds of 96 m/s (214 mph). Their low moment of inertia and unique bearings permit very rapid response to gusts and lulls. Because of their output linearity, these sensors are ideal for use with various data retrieval systems. A four-pole magnet induces a sine wave voltage into a coil producing an output signal with frequency proportional to wind speed. The #40C is constructed of rugged Texan cups moulded in one piece for repeatable performance. A rubber terminal boot is included

RG #200P Wind Direction Vane, 10K, With Boot

The NRG #200P wind direction vane is the industry standard wind direction vane used worldwide. The thermoplastic and stainless steel components resist corrosion and contribute to a high strength-to-weight ratio. The vane is directly connected to a precision conductive plastic potentiometer located in the main body. An analog voltage output directly proportional to the wind direction is produced when a constant DC excitation voltage is applied to the potentiometer.A PVC terminal boot is included.

NRG #110S Temperature Sensor with Radiation Shield, Calibrated

The NRG Systems calibrated #110S temperature sensor is a low-cost, durable integrated circuit temperature sensor that provides a high level voltage output signal. This sensor is ideal for collecting temperature data for energy density calculations and monitoring air temperature at remote sites. The NRG Systems #110S temperature sensor includes an internal reference, amplifiers, and linearization enclosed in a six-plate UV-stabilized radiation shield. This temperature sensor is also an excellent addition for sites where icing may be a possibility. The universal mounting assembly mounts quickly to any pipe or tower.

NRG #BP20 Barometric Pressure Sensor

The NRG Systems #BP20 pressure sensor is a micro-machined absolute pressure sensor which provides a high-level voltage output signal that is proportional to absolute pressure. The #BP20 pressure sensor includes built-in temperature compensation, linearization, and an output amplifier. Its low cost and rugged ABS enclosure make the BP-20 ideal for collecting absolute pressure data at remote sites.

Symphonie SCM Card for iPack Voltmeter

This Signal Conditioning Module (SCM) is compatible with a Symphonie NRG Logger equipped with an iPack. It installs into one of the four analog type SCM expansion slots. Once installed, the iPack internal 12 V battery voltage is logged.

Wind Rose

The wind rose is graphical method of presenting the wind conditions, direction and speed, over a period of time at a specific location. To create a wind rose, average wind direction and wind speed values are logged at a site, at short intervals, over a period of time, e.g. 1 week, 1 month, or longer. The collected wind data is then sorted by wind direction so that the percentage of time that the wind was blowing from each direction can be determined. Fig. 2 Showing wind rose graphs of channel 1,7 , channel 2,7 and channel 3,8 for July 2013.

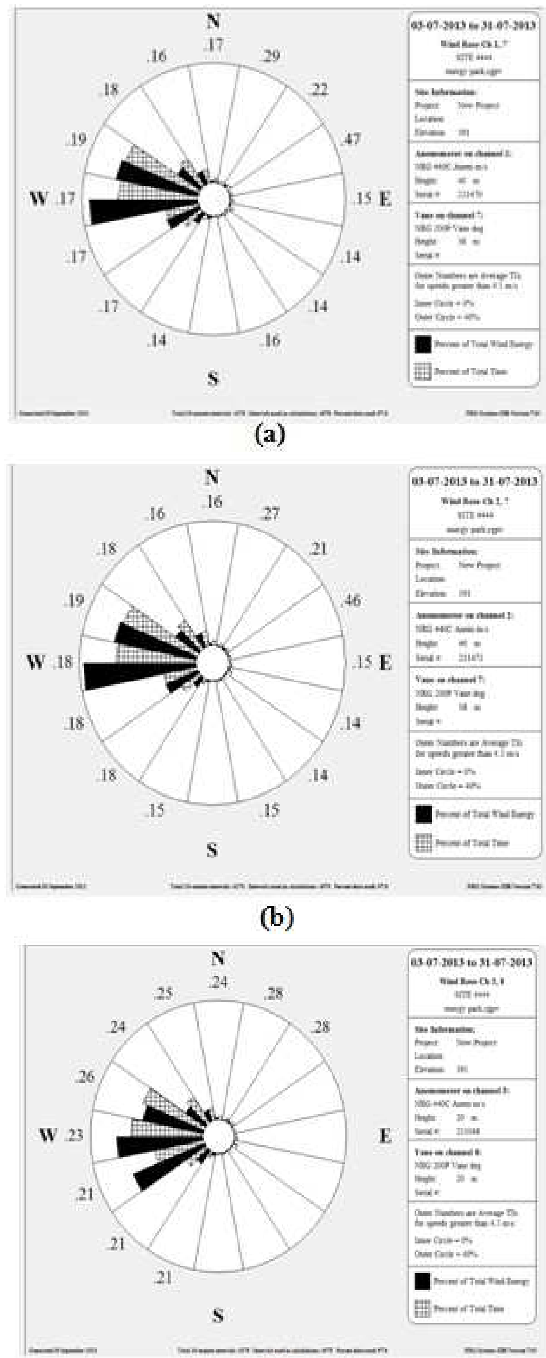
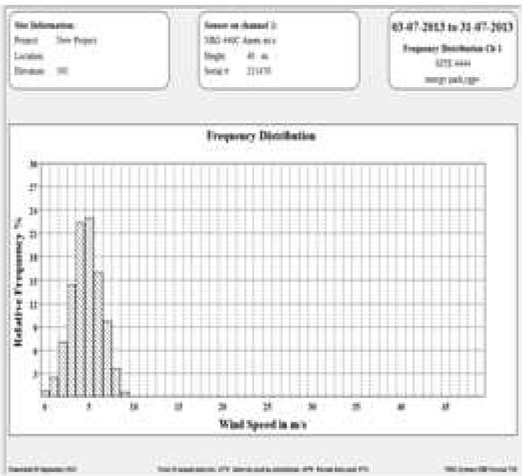


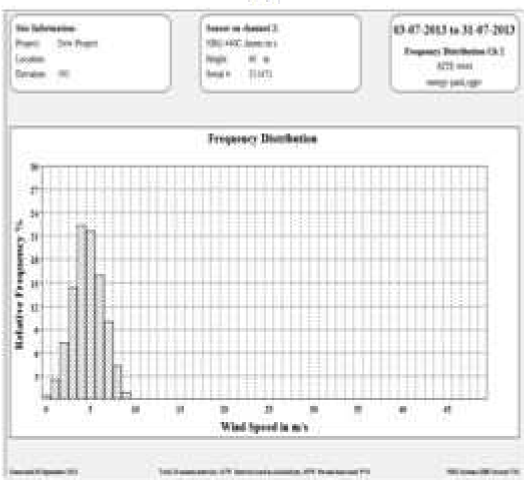
Fig.:2- Wind Rose Graph Of July (2013), (a): Wind rose graphs of ch1,7 (anemometer at 40m height and wind vane at 38m); (b):Wind rose graphs of ch2,7 (anemometer at 40m height and wind vane at 38m); (c):Wind rose graphs of ch3,8 (anemometer at 20m height and wind vane at 20m).

Frequency Distribution

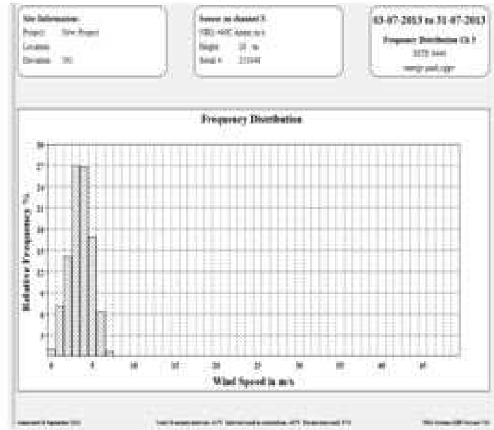
Frequency distribution, in statistics, a graph or data set organized to show the frequency of occurrence of each possible outcome of a repeatable event observed many times. The fig. 3 below shows the frequency distribution graphs for July 2013. The graph is between relative frequency % and wind speed in m/s.



(a)



(b)

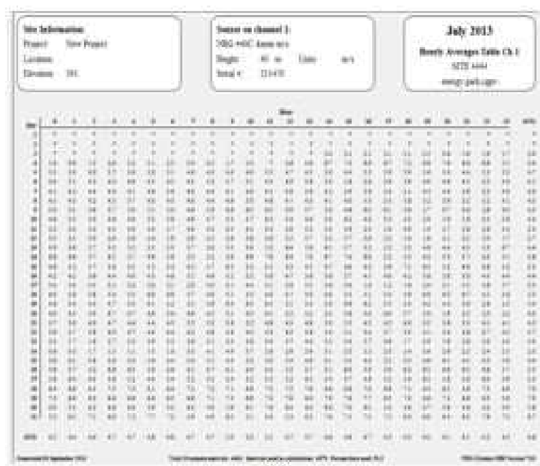


(c)

Fig.:3- Frequency distribution graph of July 2013, (a): Frequency distribution graph for anemometer at 40m height. (b): Frequency distribution graph for anemometer at 40m height. (c): Frequency distribution graph for anemometer at 20m height.

Hourly Average Table

The average wind speed for the day is the average of 24 hourly averages. The daily maximum wind speed is the largest of the hourly maximums and the daily minimum is the smallest of the hourly minimums. The data are in an Access database in the tables "Hourly Wind Speed". The hourly average table for channel1, channel2, channel 3, channel 9, channel10, channel 12 for July 2013 have been shown in fig.4



(a)

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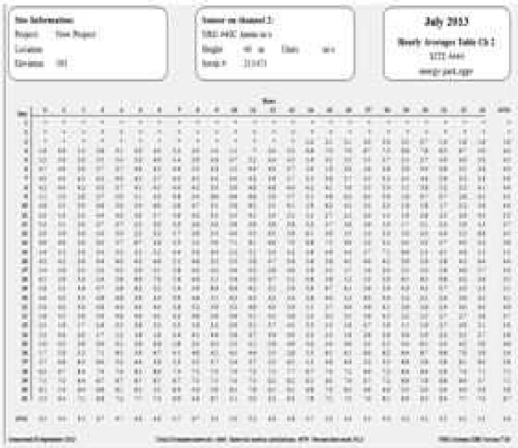
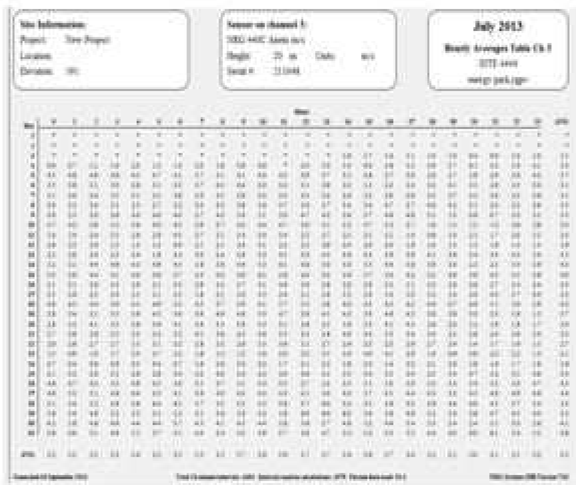
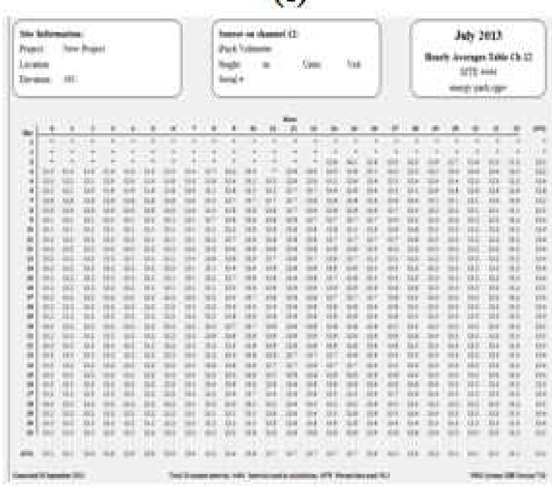


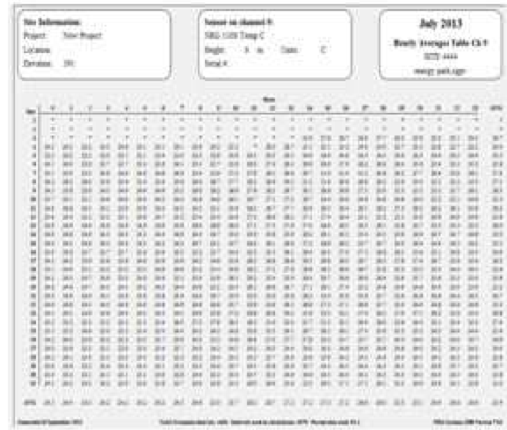
(b)



(c)



(d)



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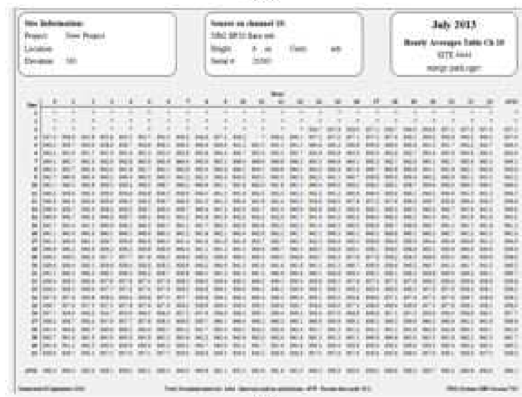

(f)

Fıg.:4- Hourly average table for july 2013, (a): Hourly average table for ch1 anemometer at 40m height., (b) Hourly average table for ch2 anemometer at 40m height. Hourly average table for ch3 anemometer at 20m height. (c) Hourly average table for ch9 thermometer at 6m height. (d) Hourly average table for ch10 barometer at 6m height. Hourly average table for ch12 ıpack voltmeter.

Conclusion

The study presented here is an attempt to promote wind energy potential in MP as well as in the country .A 40 meter height fully calibrated wind measurement mast has been erected on the campus in order to investigate wind characteristics. 'NRG software is using for the evaluation of measured data. The result derived from this study encourages the utilization of wind energy potential .The presence of high wind potential area can be observed from wind rose graphs. From fig. 4 It is clear that the monthly average wind speed recorded at channel 1 have been 4.6m/s, wind speed at channel 2 have been 4.6m/s, and wind speed at channel 3 have been 3.5m/s respectively. The average temperature at channel 9, barometric pressure at channel

10, and ipack voltmeter reading are 25.4C, 940.1mb, and 13.3V respectively.

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