Empirical Analysis of Wind profile characteristics at Multiple Heights at RGPV Bhopal Wind Observation Site

Vijay Sahu , Anurag Gour , Savita Vyas , Dr. Mukesh Pandey

***Abstract* — In this study wind characterization and wind energy assessment of the RGPV Bhopal in M.P. state situated in India were analyzed during the period Between September 2013 to August 2014. Wind speed, direction pressure and temperature at 40 and 20 meters were collected from 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. The average wind speed for 40 and 20 m were found 3.86 m/s and 2.64 m/s respectively. The wind speed predominate direction found were S (180 degrees) from both 40m and 20m heights. The wind speed distribution curve and Wind Rose was obtained using the NRG Symphonie Data Retriever software programs.**

***Index Terms*— NRG Symphonie, Wind Rose, Wind Power, Wind MAST.**

I. INTRODUCTION

The measured maximum speed and direction of the wind represent important data for the design, construction and exploitation of any structure with a dominant wind load. in order to optimize wind energy conversion systems and maximize the energy extraction, annual, monthly, daily, hourly, and even by-minute frequency distributions of wind data are required[1]. According to the recommendations of the Indian norms the main wind parameter used in computation of wind action upon structures is the referent wind speed defined as a maximum 10-minute average speed at 40m and 20 m level above the ground.

Wind energy is the type of solar energy and it is derived form of solar energy. Wind energy has been used for many thousands of years, but only in the past 35 has it come to be integrated into the modern energy supply on a significant scale. It is derived ultimately from sunlight. It is estimated that approximately 2% of the sunlight that falls on the earth is converted to wind energy. However, the amount of energy that is technically extractable from the wind greatly exceeds the world's electricity use at the present time. Currently wind provides approximately 1% of the world's electricity, and the amount of installed capacity is continuing to increase.

Manuscript received March 07, 2015.

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Wind energy is derived fundamentally from solar energy via a thermodynamic process. Sunlight warms the ground causing air above it to rise. The ensuing pressure differential causes air from elsewhere to move in, resulting in air motion (wind). Different regions on earth are heated differently than others primarily a function of latitude. Air motion is also affected by the earth's rotation. The net effect is that certain parts of the world experience higher average winds than others. The regions of highest winds are the most attractive for extracting its energy: Theoretically, the power which can be extracted from the wind is proportional to the cube of the velocity, so a good wind regime is particularly important. The power that can be extracted in practice, however, is somewhat less than proportionally related to the cube of velocity. [2]

II. NRG SYMPHONIE

Symphonie is a very flexible logging system that can be set up as a standalone unit or as an internet enabled logging system. When used as a standalone unit, data files are retrieved manually through regular site visits. When used in conjunction with a snap-on CDMA, GSM, or satellite communications iPack, data files are delivered to the user as email attachments.

III. THEORY OF OPERATION

The NRG Symphonie data logger is an internet ready, ultra-low power microprocessor-controlled data logging system specifically designed for the wind energy industry. Addition of communication iPacks allows for internet transfer of data via email. CDMA, GSM, and satellite iPacks can be easily connected to the back of the Symphonie logger to enable remote internet communications.[3] The Symphonie logger has a fixed averaging interval of 10 minutes. Each of the 7 channels averages, standard deviations, minimum and maximum values are calculated from continuous 2 second data samples. Data intervals are calculated every 10 minutes, time stamped with the beginning time of each interval and written to the Multimedia Card (MMC) at the top of each hour. Symphonie Data Retriever (SDR) software is then used to process raw data files stored on your computer either from an MMC Reader or email. Configuration of iPacks is also performed by the SDR software with the use of a programming cable.

IV. WIND ROSE

Wind Rose based on the data 01 September 2013 to 31 August 2014 collected at 40 and 20 meters height. Wind Rose depicts that the prevailing wind direction during September-13 to August-14 is mostly West and The average

wind speed for 40 and 20 m were found 3.86 m/s and 2.64 m/s respectively

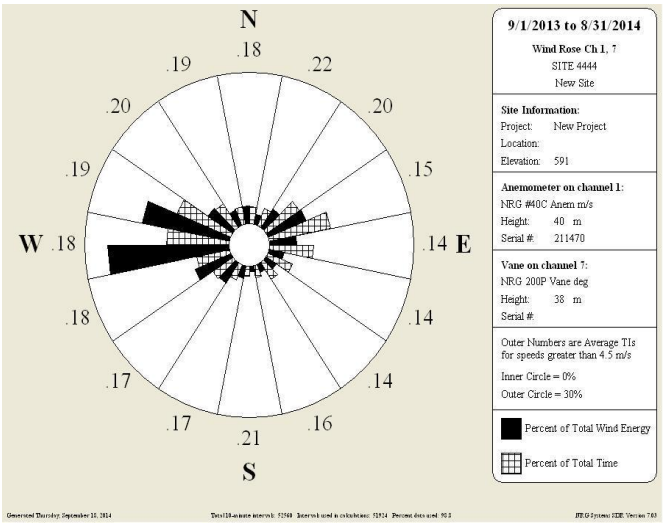

Fig. 1 Wind Rose of wind speed at height 40 m v/s wind vane at height 38 m (Channel 1 v/s Channel 7)

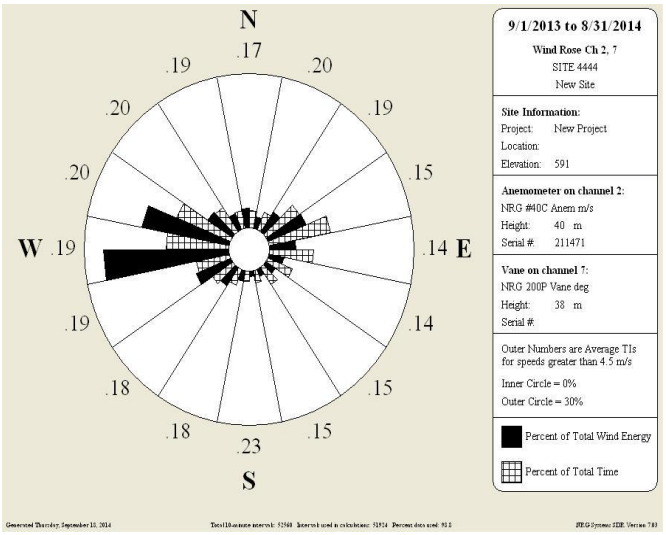

Fig. 2 Wind Rose of wind speed at height 40 m v/s wind vane at height 38 m (Channel 2 v/s Channel 7)

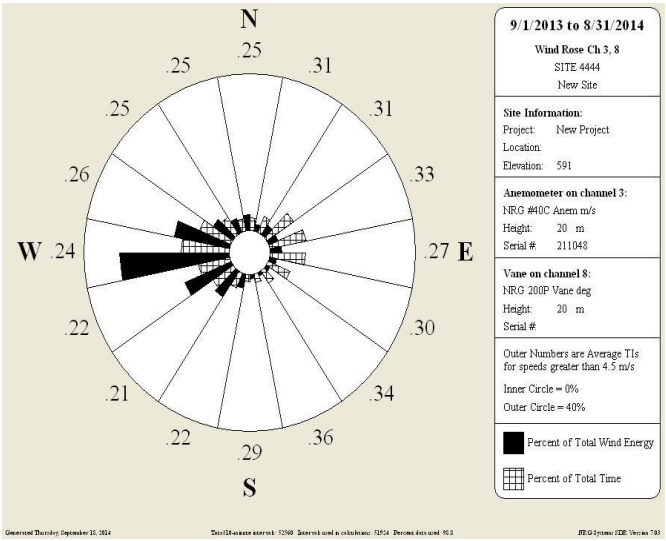

Fig. 3 Wind Rose of wind speed at height 20 m v/s wind vane at height 20 m (Channel 3 v/s Channel 8)

V. WIND MAST

In this particular investigation NRG symphonie wind MAST system is analyzed for this purpose a data logger unit is used which provide us with the necessary information in the form of a NRG raw data file (.RWD) which can be decoded using a NRG symphonie data Retriever software. In this system basically there are certain parameter which we have analyzed like wind speed, direction, temperature, pressure and voltage are divided into different channels belongs to different parameters.

VI. SITE DESCRIPTION

The system under observation is situated at Energy park RGPV. With a coordinate of E 077° 21.668' longitude and N 023° 18.720' latitude. Where on an erected MAST fixed on which some equipment are fixed at different altitude for measurements of i.e. wind speed, direction, temperature, pressure and voltage.

The measurement data presented in the paper include for each level and for each 10-minute interval the following parameters: average wind velocities, the dominant wind direction and the highest second values of the wind speed with the respective direction and the standard deviation of the wind speed for the period from 01 September 2013 to 31- August 2014.

Fig 4: Wind Mast System (Energy park RGPV Bhopal, M.P.)

VII. RESULTS

The data were analyzed over the period of 1 year (September 2013 to August 2014) and following results were carried out. The average wind speed at 40 and 20 m were found to be 3.86 m/s and 2.64 m/s respectively. The predominate wind direction at 40 and 20 m were found to be same i.e. S (180 degrees).

MONTH	CH1 Avg. (m/s)	CH2 Avg. (m/s)	CH3 Avg. (m/s)	CH7 Avg. (Deg)	CH8 Avg. (Deg)	CH9 Avg. (C)	CH10 Avg. (mb)
September	3.3	3.5	2.4	170.9	173.4	27.6	946.1
October	3.1	3.3	2.1	137.8	140.4	25.8	949.1
November	3.1	3.2	1.7	105.7	104.7	21.6	952.5
December	2.9	3	1.8	141.4	140	18.5	951.9
January	3.5	3.6	2.1	105.2	103.1	16.7	953.5
February	3.4	3.4	2.1	154.5	155	19.1	950.5
March	3.7	3.7	2.3	171.2	169.9	25.3	951.8
April	3.8	3.7	2.5	190.8	189.8	31	949.8
May	4.3	4.2	3.1	228.2	227.3	33.5	946.8
June	5.7	5.7	4.4	250.6	248.4	33.8	942.8
July	5.1	5	3.9	259.1	255.2	27.4	941.2
August	4.4	4.1	3.3	245.5	242.4	26.4	944.6
AVERAGE	3.85	3.86	2.64	180.075	179.13	25.55	948.38

Table 1: Monthly and Yearly Average parameters

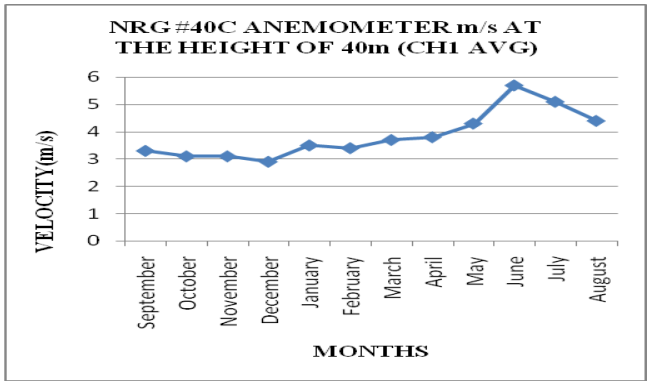

Fig. 5 Wind velocity at height of 40 m (CH1 Avg)

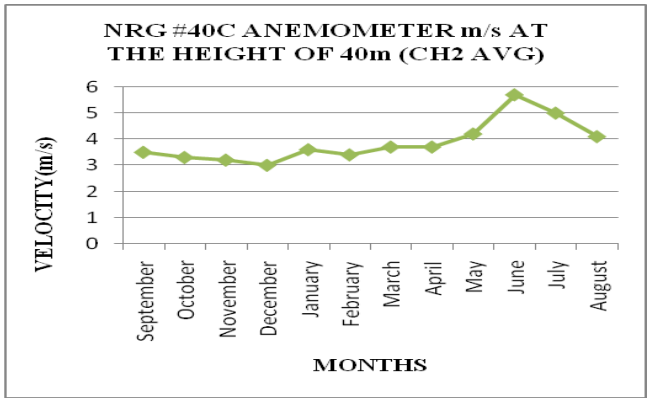

Fig. 6 Wind velocity at height of 40 m (CH2 Avg)

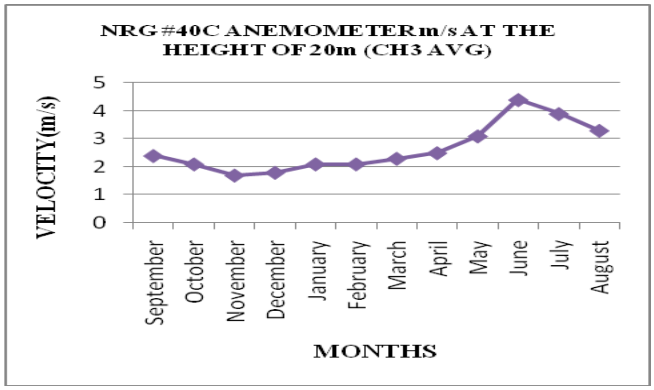

Fig. 7 Wind velocity at height of 20 m (CH3 Avg)

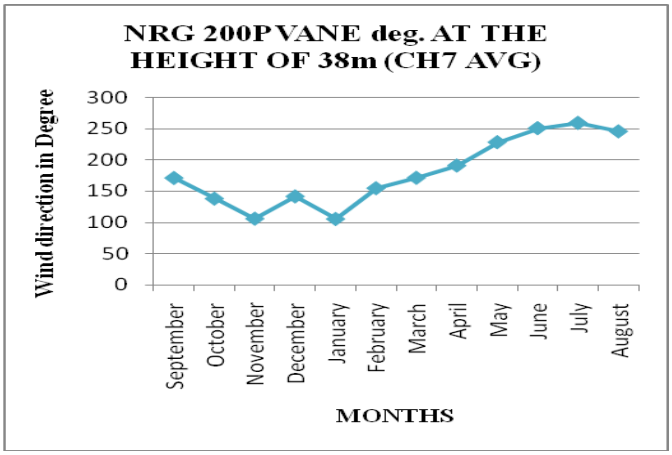

Fig. 8 Wind Direction at height of 38 m (CH7 Avg)

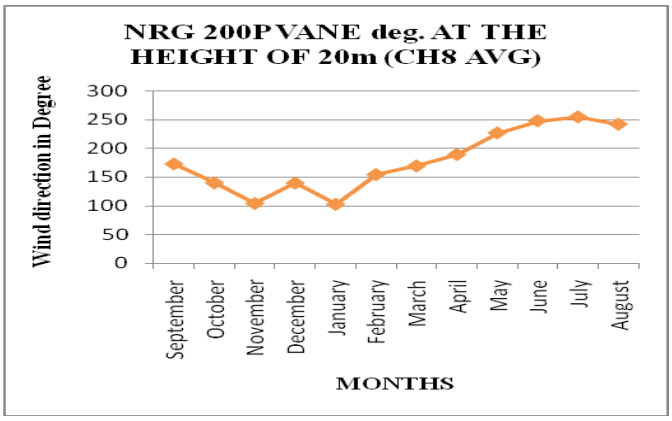

Fig. 9 Wind Direction at height of 20 m (CH8 Avg)

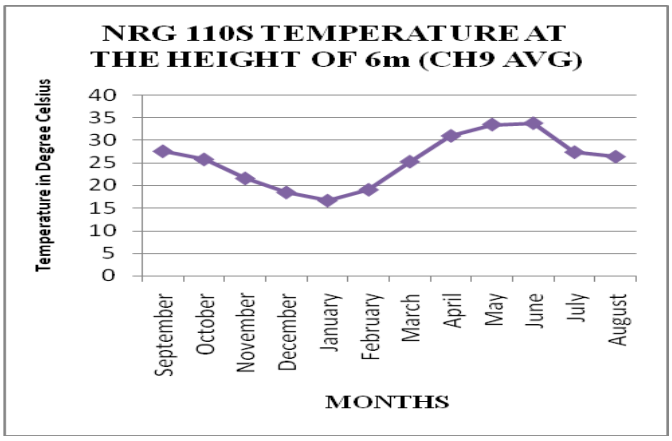

Fig. 10 Temperature in Degree celcius (CH9 Avg)

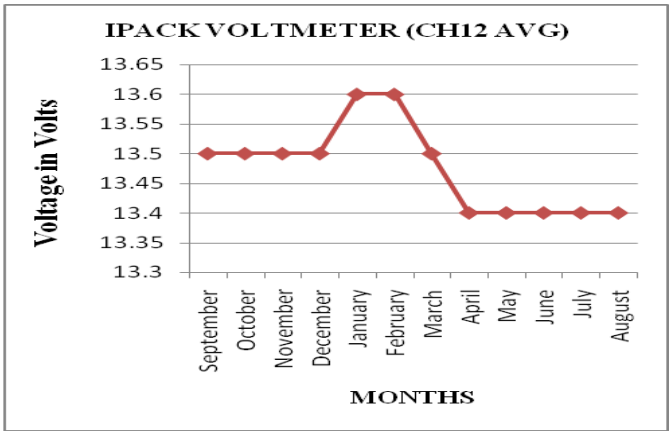

Fig. 11 Voltage in Volts (CH7 Avg)

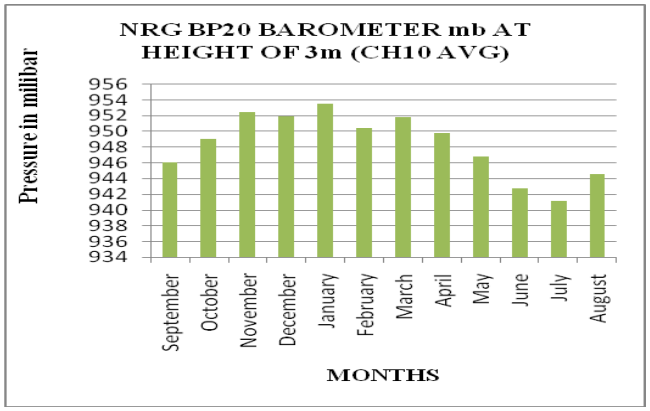

Fig. 12 Pressure in milibar at height of 3 m (CH10 Avg)

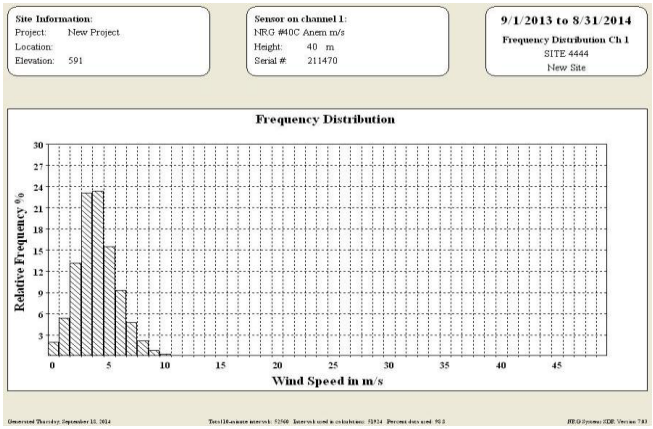

Fig. 13 Frequancy distribution of CH1

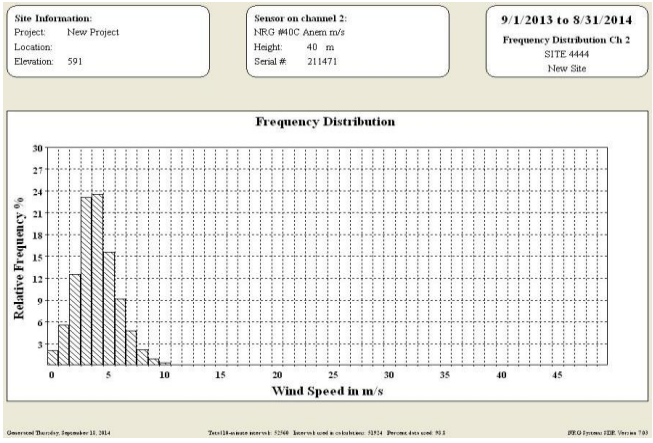

Fig. 14 Frequancy distribution of CH2

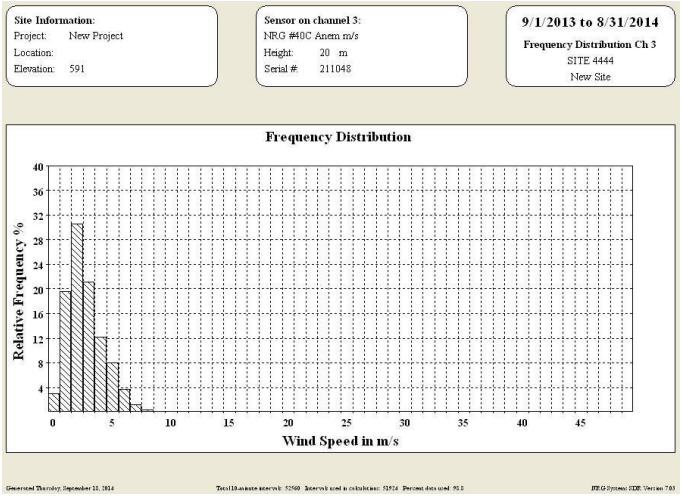

Fig. 15 Frequancy distribution of CH3

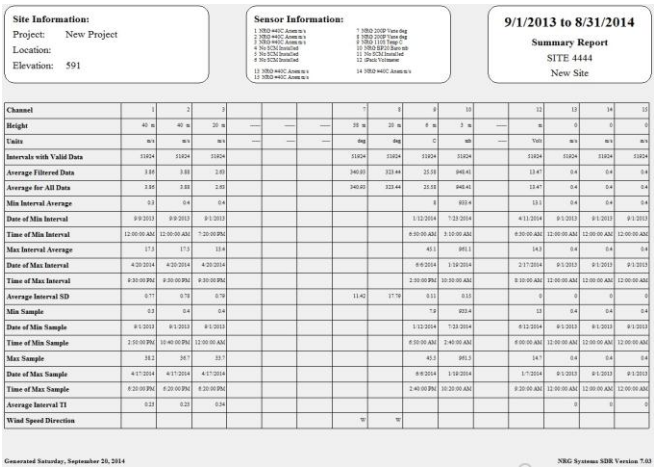

Fig. 16 Summary table

VIII. CONCLUSION

The properties of local wind at the site of investigation are carried out in order to analyze the yearly wind speed at different Altitude along with its corresponding direction. In this observation wind characterization and wind energy assessment of the RGPV Bhopal in M.P. state situated in India were analyzed during the period Between September 2013 to August 2014. Wind speed, direction pressure and temperature at 40 and 20 meters were collected from the wind observation station. The average wind speed for 40 and 20 m were found 3.86 m/s and 2.64 m/s respectively. The wind speed predominate direction found were S (180 degrees) from both 40m and 20m heights. The wind speed distribution curve and Wind Rose was obtained using the NRG Symphonie Data Retriever software programs. The study presented here is to promote wind energy in India. An standard parameter of wind will carried out on the campus in order to investigate wind characteristics.

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