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Spatial Analysis for the Offshore Wind Energy Potential in Site of Gujarat

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ABSTRACT: Offshore wind energy potential is considered to be the future renewable energy resource as the wind potential are very attractive in the coastal regions and especially in the coastal region of Gujarat. In this work a location named Jafrabad has been selected for the deep analysis and research. The Lidar instrument also been placed in various locations to identify the wind profile at various heights and according to this previous wind speed and potential density. The implementation agency and the government agencies will take actions for the Wind turbine placement locations exactly at the place of best wind potential with the least environmental effects and lesser cost of implementation. The EU sets a target of 500 MW to 5 GW for the Gujarat and Tamil Nadu coastal regions and this target requires a better action plan and research to cover this capacity from the wind energy.

KEYWORDS: Wind speed, wind energy potential, cumulative distribution function, Lidar Light detection and radiation, Renewable Energy Services RES, European Union EU.

I.INTRODUCTION

This study briefs about an overview of the offshore wind development in the state of Gujarat. Eight zones has been identified for the study of the technical, financial and economic parameters of the selected location of the coastal site of Jafrabad. The offshore wind energy is increasing in the coastal countries. India has a vast coastline of around 7600 Kms to explore the offshore wind energy. National institute of wind energy has implemented the first Lidar instrument in the selected site of Gulf of Khambat located near the town Jafrabad to determine the potential. The Lidar instrument successfully on 31st October 2017.The measurement has been done on various sites and different heights. The study shows at the heights 60m, 90m and 120 m good correlation coefficient with meteorological mast data.

Various zones has been selected as per the wind speed and power potential in the sites of coastal areas of Gujarat [1]. The study based on available public domain information of the meteorological department and oceanography of the particular coastal areas of Gujarat. Zones are also divided in various subzones and instruments placed in the sites and locations for few months to estimate the wind speed in m/s and wind power density.
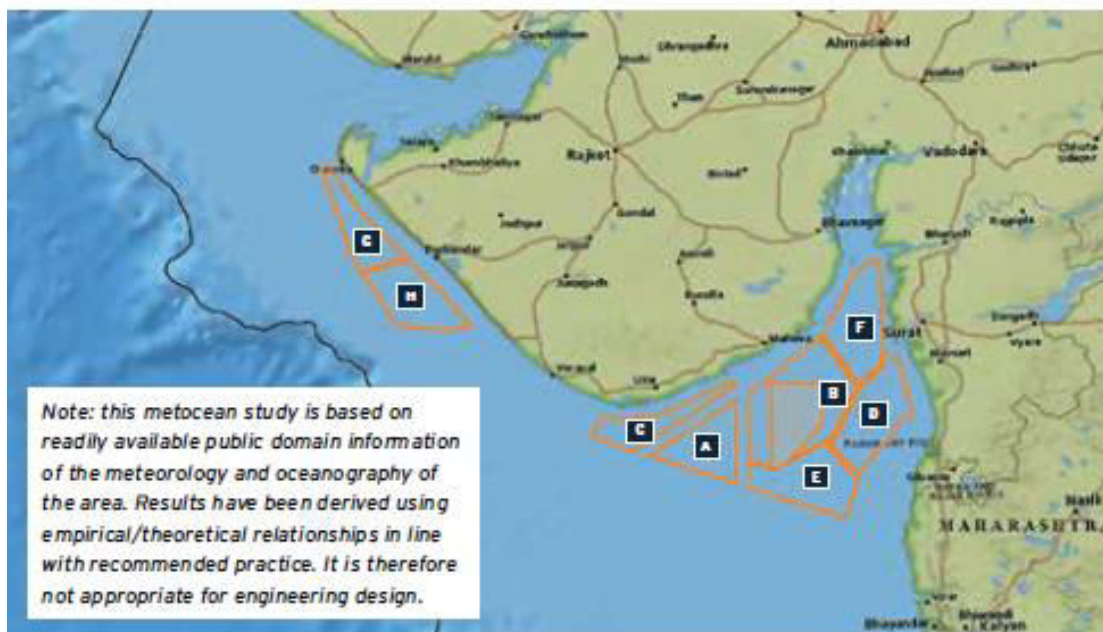
Note: this metocean study is based on readily available public domain information of the meteorology and oceanography of the area. Results have been derived using empirical/theoretical relationships in line with recommended practice. It is therefore not appropriate for engineering design.

Fig. 1 Locations of interest in Gujarat

II. SITE PARAMETERS

Table -1 Wind Power Density with Jafrabad coastal

Height	60m	100m	120m	160m
Nov -17	122	147	162	189
Dec-17	244	291	317	362
Jan-18	105	128	141	159
Feb-18	164	198	214	236
Mar-18	175	218	239	256
Apr-18	186	204	213	223
May-18	369	392	406	421
June-18	523	569	576	622
July-18	621	724	748	803
Aug-18	481	598	616	662
Sep-18	191	247	262	283
Oct-18	65	81	91	102

Table -2 Wind speed in m/s with Jafrabad coastal

Height	60m	100m	120m	160m
Nov -17	5.64	6.00	6.21	6.50
Dec-17	6.94	7.36	7.58	7.89
Jan-18	5.25	5.58	5.75	5.97
Feb-18	6.06	6.36	6.48	6.56
Mar-18	6.56	7.05	7.26	7.41
Apr-18	6.66	6.88	6.98	7.07
May-18	8.50	8.68	8.78	8.88
June-18	9.52	9.77	9.75	9.98
July-18	10.01	10.57	10.70	10.96
Aug-18	9.10	9.79	9.89	10.13
Sep-18	6.41	6.91	7.05	7.21
Oct-18	4.49	4.80	4.98	5.16

The above two tables described the synthesized and validate the results the mean wind speed obtained from the Lidar instrument placed, Table 1 represents the wind power density values and table 2 for the wind speed in m/s.
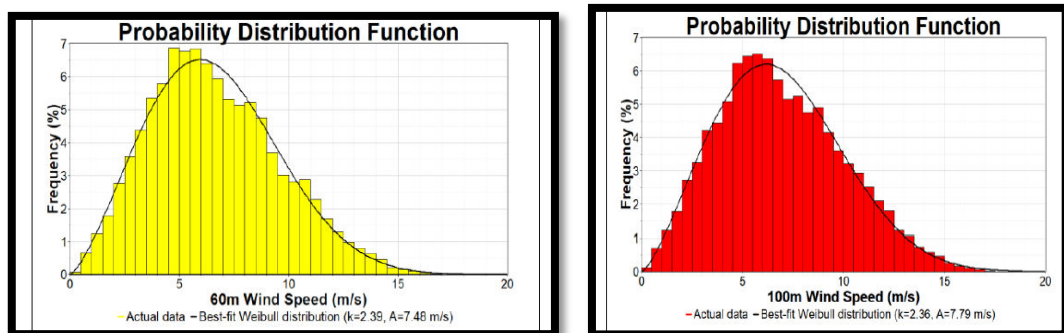

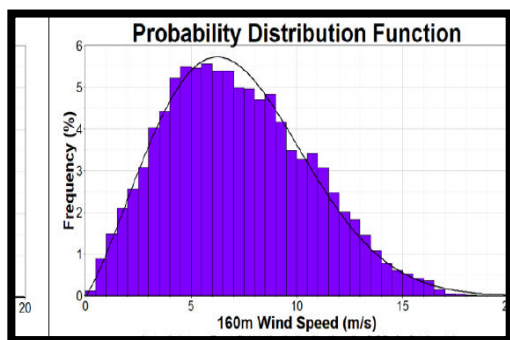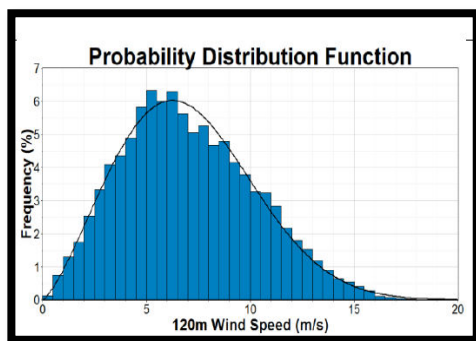Fig. 2 Probability Density Function at 60m and 100m of wind speed in m/s

Fig. 3 Probability Density Function at 120m and 160m of wind speed in m/s

The distribution of the wind speed is represented by the histogram plots and this is a common method of displaying the year wind speed data and is known as wind frequency distribution.. Figures above represented the wind frequency distribution and weibull distribution at various heights measurement of the recorded data.

III. RESULT

National Institute of wind energy has also installed the meteorological mast at the height of 100m at Jafrabad coast along with the line of sight with Lidar at a distance of 25 km approximately from the Lidar for the correlation and validation with the Lidar instrument measurement. The wind power density for the 60m, 100m, 120m and 160m heights plotted in the graphical representation for the analysis and the wind power density average of the calculated year is 232.30 W/m2 and the average wind speed is 6.32 m/s.
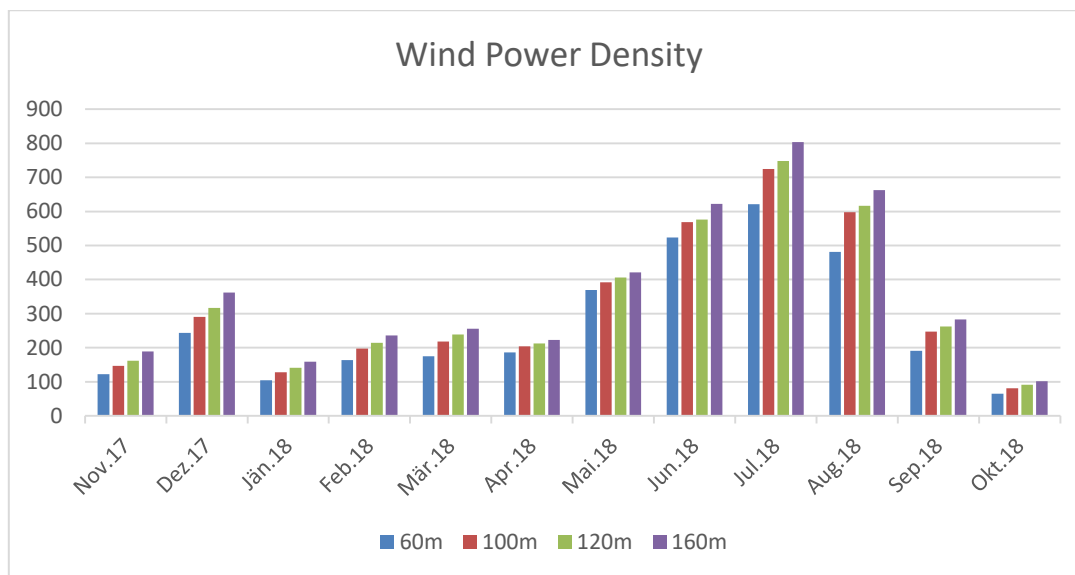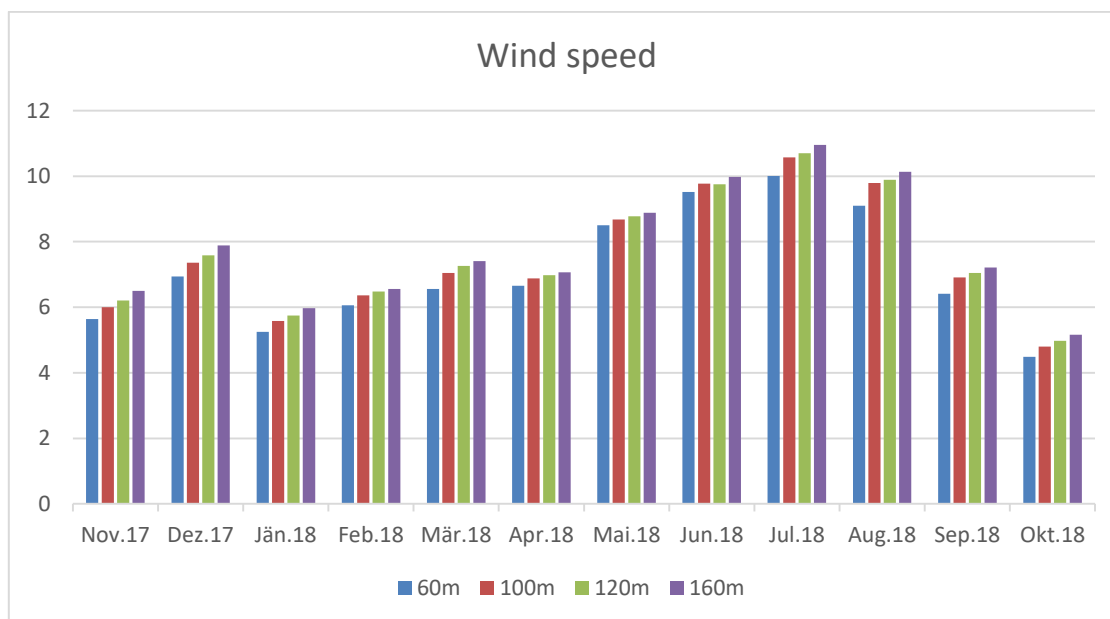
Fig-4 Wind Power Density at various heights

Fig-5 Wind Speed at various heights

IV.CONCLUSION

In this paper the analysis has been done a temperate zone coastal area by the help of Lidar instruments placed for the measurements. The results indicate the monthly and seasonal variations of the wind speed and wind power density calculated for the one year taking all the seasons in consideration. The average wind speed is high in the rainy season and autumn season as compared to other seasons. The site chosen for the analysis has a good wind potential and is suitable for the wind turbine plant installation. The findings indicate the average wind power density has a good value for the plant installation. The probability density function is also an important parameter for assessing wind energy potential, the graphical PDF analysis for few months also taken in consideration.

V.FUTURE WORKS

In the future works we can go for the detailed analysis for the wind turbine installation of various locations. The Lidar instrument placed in some other locations in which the measured data is available in the public domain can also be used

for the detailed analysis and weather forecasting for the wind speed and average wind power density the control system can be defined for the maximum power extraction by using artificial intelligence or machine learning techniques may be proposed in the system.

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