NATIONAL INSTITUTE OF WIND ENERGY

WIND RESOURCE ASSESSMENT UNIT

Chennai-600100

REPORT ON WIND MONITORING STUDY AT PARAPOOL PARA, KANNUR DISTRICT, KERALA

Final Report

Prepared for

M/s. Agency for Non-Conventional Energy and Rural Technology (ANERT).,

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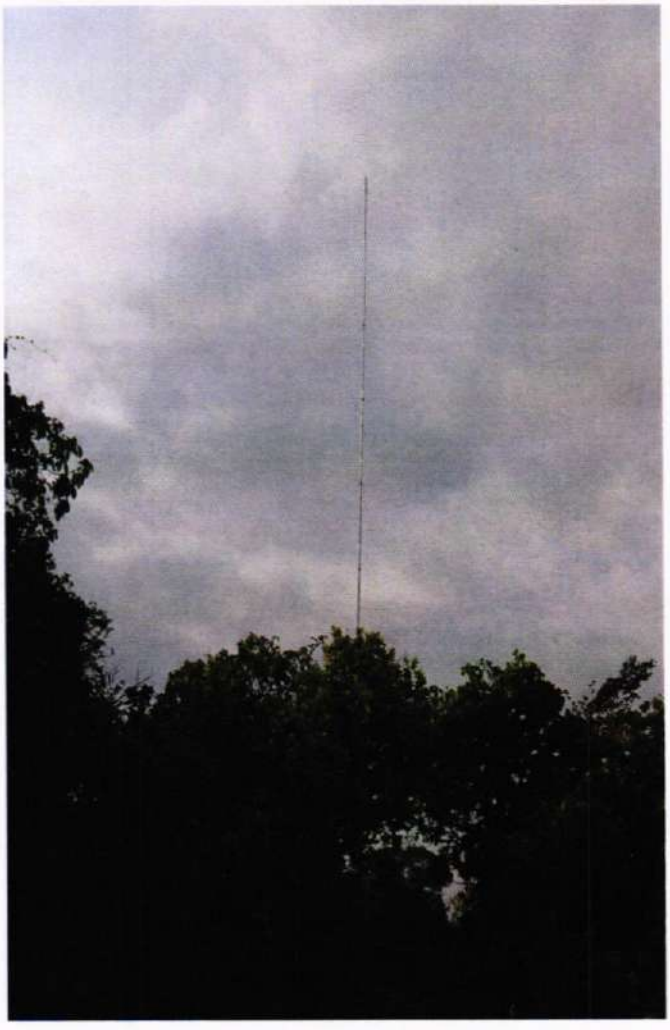
THIRUVANANTHAPURAM



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WIND RESOURCE ASSESSMENT UNIT
NATIONAL INSTITUTE OF WIND ENERGY (NIWE)
Chennai 600 100

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EXECUTIVE SUMMARY

Agency for Non-Conventional Energy and Rural Technology (ANERT), Trivandrum vide their letter No. 4431/WRA/ANERT/2009 dated 22.11.2011 had approached National Institute of Wind Energy (NIWE), Chennai for taking up Wind Monitoring study at Parapool para, Kannur District, Kerala. This report gives the results of the detailed analysis carried out about the wind characteristics at Parapool para, Kannur District, Kerala.

The location Parapool para, Kannur was selected for the study in May 2012 based on the Indian Wind atlas. The wind monitoring station at the proposed location was commissioned on 09.05.2013 with a 80m tall-guyed tubular mast with instrumentations at 80m south, 78m south, 50m and 20m levels. Wind speed sensors (Anemometer) were fixed at all the four levels mentioned above and the wind direction sensors (wind vane) were fixed at 78m & 48m levels. Two year data collection was completed in the month of June 2015 and the data recovery rate is 99.99%.

Based on the analysis of two year data collected at Parapool Para, the Mean Annual Wind Power Density (MAWPD) at 80m level for the period from June 2013 to May 2014 is found to be 57.46 W/m2 and June 2014 to May 2015 is found to be 52.33 W/m2. The predominant wind direction is found to be North West (NW) for both Years.

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WIND RESOURCE ASSESSMENT UNIT

REPORT ON WIND MONITORING STUDY AT PARAPOOL PARA, KANNUR DISTRICT, KERALA

1.0. BACKGROUND

M/s. Agency for Non-Conventional Energy and Rural Technology *(ANERT), Trivandrum* vide their letter no. *4431/WRA/ANERT/2009 dated 22.11.2011* - approached NIWE for a proposal to measure wind characteristics by establishing a Wind Monitoring study at Parapool Para, Kannur District, Kerala. Based on their request, NIWE submitted a project proposal on 28.09.2012 for the aforesaid study with 80m tall tubular met mast.

A Wind Monitoring Station was commissioned on09.05.2013 and data collection was carried out till May 2015. This report gives the results of the wind monitoring study carried out for two year.

2.0. OBJECTIVE

- To establish a 80m height wind monitoring station at Parapool Para, Kerala
- To Collect wind data at various levels for 2 years, analysis of data
- Preparation and submission of wind monitoring study report.

3.0. SITE DESCRIPTION

The site is located at Pattuvam village, Kannur District-Kerala and is approximately 72.44kms South from Talapoya town. The orography of the site is Semi Complex Terrain and the soil type is known to be Alfisols.

The geographical co-ordinates and elevation details of the site are given in the Table 1

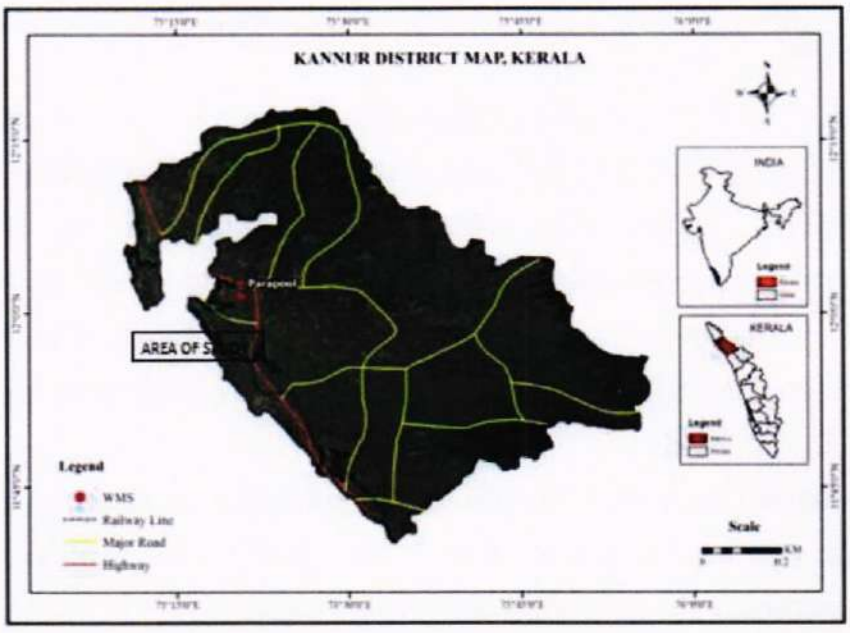

FIGURE 1: DISTRICT MAP OF KANNUR

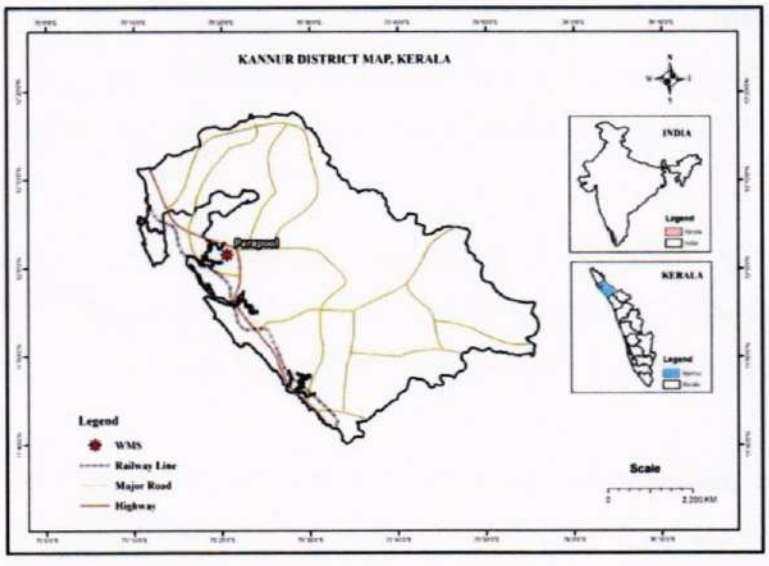

FIGURE.2. MAST LOCATION

TABLE 1: GLOBAL POSITION AND OTHER USEFUL INFORMATION OF PARAPOOL PARA WIND MONITORING STATION

Latitude	12°01' 32.7" N
Longitude	075° 20' 32.4" E
Elevation	83 m AMSL SOI Topomap No.48-P8
State	Kerala
District	Kannur
Taluk	Thaliparamba
Village	Pattuvam
Nearest town	Taliparamba
Nearest Railway station	Kannapuram
Nearest Airport	Kannur
Orography	Semi Complex Terrain
Soil	Alfisols
Earthquake	Zone II
Land Use	Vast land
Physiographic Division	Semi Complex Terrain
Nearest NIWE mast location	TALAPOYA -72.44kms aerially towards South Latitude-11°50'19" Longitude-75°58'09"
Nearest wind farm in operation	Nil

4.0. DESCRIPTION OF THE MASTS &INSTRUMENTATION

A 80m tall guyed tubular wind mast was commissioned on 15.05.2013. A picture of the mast mounting arrangements and a panoramic view taken from the site is presented below (Fig 3).

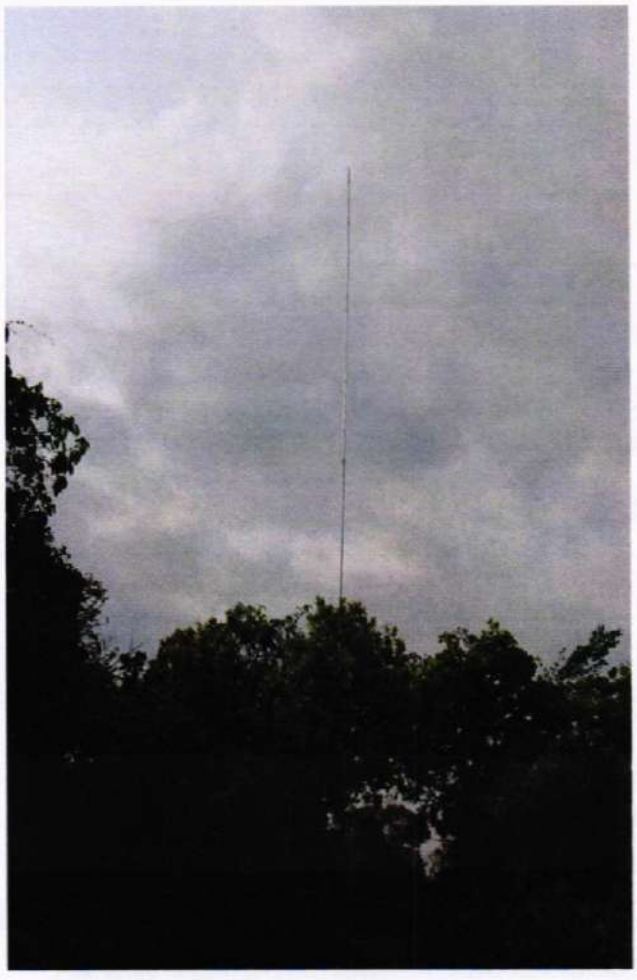

FIG 3. VIEW OF MET MAST

Anemometer (wind speed sensors) were fixed at 80msouth, 78m south, 50m and 20mand the Wind vane(wind direction sensors) were fixed at 78m and 48m levels. The outputs from the sensors were connected to an automatic sophisticated data logger system that was kept about 1.5 m above ground level in locked weatherproof housing. The data logger used

was imported from M/s. Second Wind Inc, USA. The sensors used were imported from M/s. NRG systems Inc, USA and the anemometers used were calibrated at M/s. SOHANSEN.DK. Denmark.

The calibration certificates for the instruments used are given in Annexure 3.

Sensors	Height	Sensor serial Number	Slope	offset
Anemometer	80m south 78m south 50m 20m	179500166155 179500166152 179500166151 179500166149	0.76779 0.76597 0.76702 0.76227	0.30915 0.30507 0.31149 0.32862
Wind Vane	78m 48m	613 614	--	--
Temperature sensor	10m	004	--	--
Pressure Sensor	8m	18177	--	--

5.0. DATA MEASUREMENT

In the data logger, wind speed and directions were sampled at 1 sec and 10 minutes average values were logged. Analysis was performed with 10 minutes average data as per International Electro technical Commission (IEC) standard.Data was stored in removable storage devices (Compact Flash Card) which were collected once in a month regularly by NIWE along with the battery replacement. Data was manually validated to remove outlier events due to failed instruments and repeated values. Periodic quality check

on the data was also carried out to avoid incorrectness in the computation and analysis. The collected data was compiled and interim report was sent to the client regularly as per the terms and conditions prescribed in the project proposal.

Monthly and Daily Mean Wind Speed values for the four heights (20m, 50m, 78msouth and 80m south) are shown in Figure 8 of Annexure-1.

6.0. DETAILS OF DATA ANALYSED

The Wind Monitoring Station was commissioned at Parapool Para, Kannuras per the project terms & conditions and Two-year data collection was completed in the month of May 2015. As the data collections at the location for Two year, the customer had been informed by NIWE in May 2015 that the data collection would be completed and terminates in the month of June 2015.

Analysis of the wind data has been performed using Matlab, MS Excel and Windographer. The data have been checked for quality& correctness, analyzed and details of the analysis / results are given in Annexure-1. The consolidated annual wind data and wind data summary tables for the wind characteristics at Parapool Para are given in Table-4 & Table-5 respectively of Annexure-1.

Mean Hourly Wind Speed, Monthly Mean Wind Speed and Monthly Wind Power Density values are shown graphically in Figure 4 to 6 of Annexure-1. The Mean Hourly Wind Speed tables for the four heights viz., 20m,50m, 78msouth and80msouthare given in Table 6, 6A, 6B & 6C of Annexure-1. The graphical representations for the same are given in Figure 4, 4A and 4B of Annexure-1.

7.0. RESULTS

The data recovery rate is 99.99%for the period of measurement. The comparative details of various parameters are as follows:

Year	Mean Annual Wind Power Density(W/m^2)			
	At height 20m (AGL)	At height 50m (AGL)	At height 78m south (AGL)	At height 80m south (AGL)
2013-2014	21.99	42.11	52.30	57.46
2014-2015	20.04	38.73	49.53	52.33

Year	Mean Annual Wind Speed (m/s)			
	At height 20m (AGL)	At height 50m (AGL)	At height 78m south (AGL)	At height 80m south (AGL)
2013-2014	2.58	3.38	3.54	3.73
2014-2015	2.52	3.30	3.53	3.61

Year	Mean Annual		
	Temperature ^{0} C	Air density Kg/m^3	Power law
2013-2014	26.33	1.163	0.27
2014-2015	26.43	1.164	0.26

7.1. WIND FREQUENCY DISTRIBUTION

A common method of displaying a year wind data is a wind frequency distribution, which shows the percentage of time that each wind speed occurs. Table 7, 7A, 7B and 7C of Annexure-1 show the month wise percentage frequency distribution for the four measurement heights (20m, 50m, 78m south and 80msouth).

Joint frequency distribution is another way to display the data, where the wind is classified by speed and also by direction. Table 8, 8A and 8B of Annexure-1 shows the joint frequency distribution for 50m, 78msouth and 80msouth heights.

7.2. WIND ROSE

Two wind vanes have been installed at the site to measure the 10 minutes mean values of the wind direction. Monthly and Annual wind roses have been calculated to show the predominant wind direction at all the three heights. Figure 7, 7A, 7B & 7C of Annexure-1 show the monthly wind roses at 80msouth, 78msouth and 50mheights. From the wind roses, it is revealed that the wind is flowing predominantly from North West (NW) directions.

7.3. WIND SHEAR PROFILE

The wind shear profile at the site is useful to understand the wind speed variation with height. Figure 9 &10 of Annexure-1 shows the Daily wind shear and Monthly wind shear profiles. The Vertical wind shear profile based on the measured data is given in Figure 11 of Annexure-1.

7.4. TURBULENCE INTENSITY (TI):

Turbulence Intensity is the basic measure of the turbulence of wind. Typically, 10% of TI is desired for minimal wear of wind turbine components. The turbulence intensity related graphs are shown in Figure 12 of Annexure-1.

The Mean Turbulence Intensity for the period of June 2013 to May

2014(at 80m AGL) at15m/s is 0.18 (18%) & June 2014 to May2015 (at 80m AGL) at 15m/s is 0.18 (18%).

7.5. LONG TERM DATA FOR THE STUDY AREA

MERRA (The Modern Era Retrospective-Analysis for Research and Applications) data have been made available for the site asTable-4 and Figure-6. The latitude and longitude of the MERRA grid point nearby the study site is given below. This information gives the wind pattern during the period of Jan 2005 to May 2015at 50m AMSL in the region of interest. This reanalysis data is helpful in understanding the long term variability of wind speed in the region of interest.

Latitude Range: 12°01' 32.7"
Longitude Range: 075° 20' 32.4"
**AMSL – Above Mean Sea Level*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg
2005	2.6	3.1	3.5	2.6	3.8	5.7	6.7	5.6	5.2	3.5	2.7	2.6	4.0
2006	2.3	2.9	3.3	3.6	4.8	4.8	6.7	5.4	4.5	3.0	2.1	2.6	3.9
2007	2.4	3.4	3.4	3.2	3.8	5.0	5.5	4.8	4.3	3.3	2.4	2.9	3.7
2008	3.0	3.3	2.9	3.1	4.0	5.3	5.8	4.9	4.2	2.5	2.6	2.5	3.7
2009	2.6	3.2	2.7	3.3	4.0	4.9	6.5	5.1	4.9	3.2	2.8	2.4	3.8
2010	2.3	2.6	3.5	3.0	4.0	5.6	5.9	5.9	3.6	3.4	2.7	2.5	3.8
2011	2.7	2.9	3.1	3.2	4.1	5.6	5.3	5.2	4.5	2.7	3.1	2.9	3.8
2012	2.6	3.2	3.6	3.2	4.3	4.3	5.3	4.9	4.2	2.7	2.5	2.7	3.6
2013	2.8	2.9	3.0	3.6	4.2	5.9	6.3	5.0	3.9	3.3	2.6	2.8	3.9
2014	2.6	3.3	3.3	2.8	3.0	4.9	5.8	4.8	4.3	2.5	2.6	2.6	3.5
2015	2.7	2.9	2.8	2.5	2.9								2.8
						AVG							3.8

TABLE 3: MERRA REANALYSIS DATA FOR, PARAPOOL PARA, KERALA (JANUARY 2005 –MAY 2015)

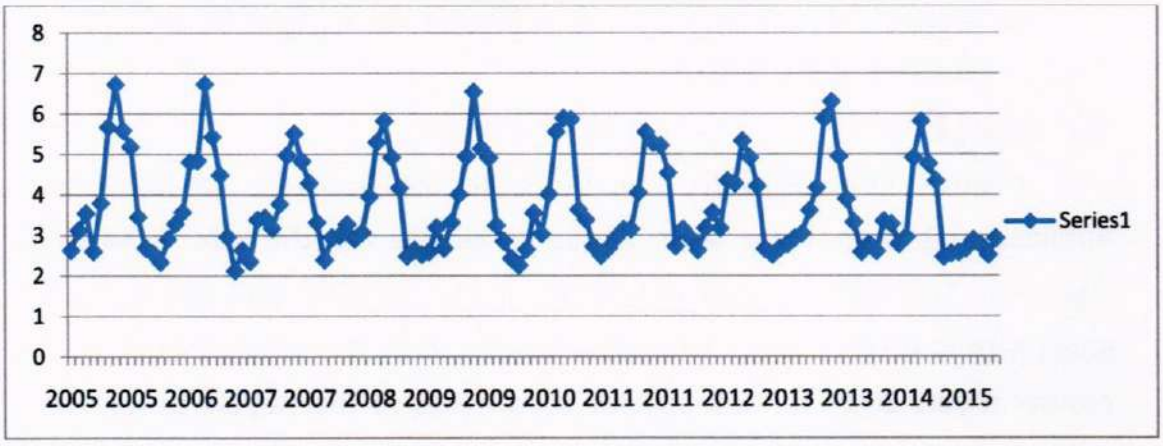

FIGURE.3A. MERRA REANALYSIS DATA FOR PARAPOOL PARA, KERALA (JANUARY 2005 – MAY 2015)

8.0. CONCLUSION

Based on the analysis of two year data collected at Parapool Para, the Mean Annual Wind Power Density (MAWPD) at 80m level for the period from June 2013 to May 2014 is found to be 57.46W/$m^2$and June 2014 to May 2015 is found to be 52.33 W/m^2.

The monthly average wind speed at 80m level for the period from June 2013 to May 2014 is found to be 3.73 m/s and June 2014 to May 2015 is found to be 3.61 m/s. The predominant wind direction is found to be North West for both years.

It has been observed from the analysis and the computation of WPD at 80m level, that the site is not having promising wind power potential for the development of large-scale wind power projects at the area of interest.

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PARAPOOL PARA

2013 - 2015

Annexure-1

Data(Tables & Figures)

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PARAPOOL PARA

STATE	:	KERALA
DISTRICT	:	PALAKKAD
TALUK	:	THALIPARAMB
VILLAGE	:	PATTUVAM
LATITUDE	:	12° 01' 32.7" N
LONGITUDE	:	075° 20' 32.4" E
ELEVATION	:	83M AMSL
INSTRUMENTS USED	:	NOMAD-2
PERIOD OF DATA	:	JUNE 2013 to MAY 2015
COMMISSIONED ON	:	09.05.2013
MAST HEIGHT	:	80m
MEASURED WIND SPEED AT 80m south AGL (JUNE 2013 to MAY 2014)	:	3.73 m/s
MEASURED WIND SPEED AT 78m south AGL (JUNE 2013 to MAY 2014)	:	3.54 m/s
MEASURED WIND SPEED AT 50m AGL (JUNE 2013 to MAY 2014)	:	3.38 m/s
MEASURED WIND POWER DENSITY AT 80m south AGL (JUNE 2013 to MAY 2014)	:	57.46 W/m^2
MEASURED WIND POWER DENSITY AT 78m south AGL (JUNE 2013 to MAY 2014)	:	52.30 W/m^2
MEASURED WIND POWER DENSITY AT 50m AGL (JUNE 2013 to MAY 2014)	:	42.11 W/m^2
MEASURED WIND SPEED AT 80m south AGL (JUNE 2014 to MAY 2015)	:	3.61 m/s

MEASURED WIND SPEED AT 78m south AGL (JUNE 2014 to MAY 2015)	:	***3.53 m/s***
MEASURED WIND SPEED AT 50m AGL (JUNE 2014 to MAY 2015)	:	***3.30 m/s***
MEASURED WIND POWER DENSITY AT 80m south AGL (JUNE 2014 to MAY 2015)	:	***52.33 W/m^2***
MEASURED WIND POWER DENSITY AT 78m south AGL (JUNE 2014 to MAY 2015)	:	***49.53 W/m^2***
MEASURED WIND POWER DENSITY AT 50m AGL (JUNE 2014 to MAY 2015)	:	***38.73 W/m^2***
SOI TOPO MAP NUMBER	:	***58-B9***

Ist Year

Jun 2013 - May 2014

PARAPOOL PARA

TABLE 4

CONSOLIDATED TABLE

	JAN-14	FEB-14	MAR-14	APR-14	MAY-14	JUN-13	JUL-13	AUG-13	SEP-13	OCT-13	NOV-13	DEC-13	ANNUAL
Monthly Mean Wind Speed (m/s)													
20m	2.81	3.02	2.98	2.91	2.73	2.32	2.27	2.61	2.14	2.09	2.34	2.68	2.58
50m	3.56	3.82	3.70	3.59	3.53	3.01	3.09	3.56	3.04	3.10	3.10	3.45	3.38
78 m	3.65	3.83	3.64	3.53	3.70	3.34	3.77	4.23	3.08	3.01	3.15	3.52	3.54
80m	3.73	4.10	3.90	3.80	3.82	3.48	3.82	4.56	3.39	3.36	3.18	3.56	3.73
Monthly Wind Power Density (Watts/Sq.m)													
20m	23.12	26.21	28.15	28.63	23.20	18.55	22.78	33.61	15.10	12.94	13.61	17.92	21.99
50m	45.89	48.17	47.24	46.44	42.29	38.31	46.30	62.73	31.84	28.27	28.71	39.10	42.11
78 m	58.92	55.15	50.20	49.08	51.48	53.95	67.91	86.01	37.49	30.99	35.91	50.50	52.30
80m	61.42	62.94	56.89	54.89	55.73	57.92	72.74	98.17	42.94	37.07	36.77	52.01	57.46
Power Law Index (PLI)													
	0.20	0.22	0.19	0.19	0.24	0.29	0.38	0.40	0.33	0.34	0.22	0.20	0.27
Energy Pattern Factor													
20m	1.79	1.64	1.83	2.02	1.97	2.56	3.33	3.22	2.63	2.41	1.83	1.60	2.24
50m	1.75	1.48	1.61	1.74	1.66	2.41	2.69	2.37	1.94	1.63	1.66	1.63	1.88
78 m	2.08	1.69	1.80	1.93	1.76	2.48	2.18	1.95	2.20	1.95	1.98	1.99	2.00
80m	2.03	1.56	1.65	1.73	1.73	2.34	2.24	1.77	1.89	1.67	1.97	1.98	1.88
Air Density (kg/m^3)													
	1.167	1.163	1.159	1.154	1.155	1.168	1.161	1.168	1.168	1.167	1.163	1.166	1.163
Temperature (^{0} C)													
	26.21	26.69	27.87	28.92	28.15	24.69	24.51	25.24	25.21	25.63	26.79	25.99	26.33
Turbulance Intensity (at 80m agl)													
	At 15m/s : 0.18												
Data Availability (Based on 10 Minutes Interval)													
	4464	4032	4464	4320	4464	4320	4464	4459	4320	4464	4320	4464	

Based on Data June 2013 to May 2014

TABLE 5

PARAPOOL PARA

SUMMARY OF WIND DATA

Monthly Mean wind speed (m/s)			Monthly standard Deviation (m/s)			Peak wind speed(m/s) (date/year/Time of occurance)			Prevailing wind Direction	
(50m)	(80m)	(78m)	(50m)	(80m)	(78m)	(50m)	(80m)	(78m)	(50m)	(80m)
3.56	3.73	3.65	0.52	0.48	0.48	10.51 1/1/2014 10:00	12.90 1/27/2014 4:50	12.71 1/27/2014 4:50	E	E
3.82	4.10	3.83	0.54	0.51	0.52	8.12 2/1/2014 10:20	9.87 2/18/2014 4:10	9.37 2/18/2014 4:10	N	NW
3.70	3.90	3.64	0.55	0.51	0.52	8.72 3/16/2014 13:40	9.45 3/16/2014 13:40	9.37 3/16/2014 13:40	NNW	NW
3.59	3.80	3.53	0.60	0.56	0.57	9.57 4/8/2014 21:00	10.67 4/30/2014 16:20	10.19 4/30/2014 16:20	SSW	SW
3.53	3.82	3.70	0.57	0.54	0.53	13.55 5/5/2014 17:50	16.01 5/5/2014 17:50	15.15 5/5/2014 17:50	NW	NW
3.01	3.48	3.34	0.68	0.66	0.67	12.12 6/14/2013 19:10	13.30 6/14/2013 19:10	13.31 6/14/2013 19:10	W	W
3.09	3.82	3.77	0.72	0.71	0.69	12.70 7/7/2013 11:40	13.29 7/7/2013 11:40	12.92 7/19/2013 6:30	NW	NW
3.56	4.56	4.23	0.71	0.65	0.63	11.68 8/30/2013 17:00	13.02 8/1/2013 23:20	13.14 8/1/2013 23:20	NW/NNW	NW
3.04	3.39	3.08	0.51	0.48	0.48	8.64 9/20/2013 15:20	9.25 9/20/2013 15:20	9.13 9/20/2013 15:20	W	W/WSW
3.10	3.36	3.01	0.47	0.45	0.46	8.30 10/12/2013 16:40	8.77 10/12/2013 16:40	8.83 10/12/2013 16:40	W	W
3.10	3.18	3.15	0.46	0.45	0.45	8.57 11/5/2013 7:10	10.05 11/5/2013 7:10	9.95 11/5/2013 7:10	ESE	E/ESE
3.45	3.56	3.52	0.48	0.46	0.46	9.64 12/13/2013 12:10	11.57 12/23/2013 7:40	11.38 12/23/2013 7:50	E	E
3.64	**3.87**	**3.67**	**0.56**	**0.52**	**0.52**	**13.55 5/5/2014 17:50**	**16.01 5/5/2014 17:50**	**15.15 5/5/2014 17:50**	**NW**	**NW**

Based on Data June 2013 to May 2014

TABLE 6

PARAPOOL PARA

MEAN HOURLY WIND SPEED

MONTH	OO	O1	O2	O3	O4	O5	O6	O7	O8	O9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	AVE
JAN	2.97	3.18	3.09	2.79	3.13	3.51	4.11	4.56	4.74	4.16	3.95	3.67	3.38	3.81	5.06	5.38	5.27	4.60	3.83	2.93	2.64	2.79	3.08	2.87	3.73
FEB	4.04	3.54	3.09	3.10	3.31	3.63	3.64	3.84	3.79	3.07	2.83	2.70	3.53	4.76	5.88	6.12	5.80	5.31	4.65	4.19	4.15	4.51	4.60	4.44	4.10
MAR	3.93	3.51	3.14	2.78	2.53	2.54	2.87	3.14	2.80	2.41	2.59	2.87	4.36	5.77	6.29	6.18	5.69	5.12	4.29	4.03	4.03	4.12	4.34	4.35	3.90
APR	3.56	3.32	2.79	2.59	2.67	2.63	2.78	2.71	2.02	2.00	2.12	3.04	4.63	5.91	6.27	6.41	6.16	5.42	4.78	4.20	4.03	3.84	3.73	3.55	3.80
MAY	3.58	3.49	3.52	3.54	3.70	3.46	3.06	2.68	2.10	2.39	2.86	3.29	4.07	4.92	5.51	5.72	5.51	5.27	4.74	3.80	3.95	3.63	3.43	3.52	3.82
JUN	3.05	3.05	3.33	3.46	3.56	3.60	3.48	3.68	3.28	2.95	3.14	3.54	3.59	4.16	3.97	4.22	4.21	3.90	3.09	3.69	3.21	3.01	3.21	3.28	3.48
JUL	3.44	2.98	3.16	3.39	3.00	3.15	3.36	2.87	2.56	2.97	3.33	4.15	5.10	5.33	5.84	5.34	5.23	5.28	4.09	3.50	3.31	3.32	3.63	3.42	3.82
AUG	4.08	3.99	4.12	3.87	3.94	3.68	3.60	3.32	2.87	3.46	4.37	5.03	5.73	6.10	6.44	6.31	6.23	5.69	5.08	4.63	4.31	4.16	4.15	4.18	4.56
SEP	3.00	2.84	2.85	2.99	2.91	3.13	3.07	2.95	2.68	2.14	2.94	3.72	4.04	4.64	5.03	4.90	4.54	4.24	3.82	3.45	2.88	2.77	2.76	3.00	3.39
OCT	3.23	2.98	3.14	3.24	3.07	3.22	3.10	2.99	2.55	2.22	2.49	2.89	3.71	4.40	4.83	4.74	4.59	3.99	3.51	3.46	3.28	2.97	2.98	3.08	3.36
NOV	2.82	2.90	2.70	2.85	2.97	3.16	3.73	3.98	3.66	3.26	3.10	2.90	2.94	3.67	4.58	4.75	4.31	3.45	2.68	2.35	2.26	2.30	2.47	2.46	3.18
DEC	3.10	3.33	3.58	3.48	3.55	3.89	4.26	4.73	4.86	3.86	3.31	3.18	3.02	3.15	4.01	4.51	4.64	4.29	3.65	2.87	2.40	2.50	2.54	2.70	3.56
Annual	3.40	3.26	3.21	3.17	3.20	3.30	3.42	3.45	3.16	2.91	3.09	3.42	4.01	4.72	5.31	5.38	5.18	4.71	4.02	3.59	3.37	3.33	3.41	3.40	3.73

SENSOR HEIGHT: 80m

Based on Data June 2013 to May 2014

NATIONAL INSTITUTE OF WIND ENERGY CHENNAI

TABLE 6 A

PARAPOOL PARA

MEAN HOURLY WIND SPEED

MONTH	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	AVE
JAN	2.89	3.10	3.01	2.71	3.03	3.43	4.06	4.51	4.69	4.12	3.93	3.64	3.34	3.77	5.01	5.34	5.21	4.50	3.69	2.79	2.50	2.65	2.94	2.73	3.65
FEB	3.73	3.22	2.74	2.78	3.03	3.35	3.38	3.60	3.56	2.82	2.57	2.44	3.31	4.59	5.75	5.98	5.63	5.06	4.30	3.82	3.75	4.13	4.26	4.13	3.83
MAR	3.66	3.20	2.78	2.46	2.23	2.26	2.62	2.87	2.51	2.12	2.30	2.61	4.18	5.64	6.17	6.05	5.54	4.91	4.00	3.66	3.69	3.76	4.00	4.06	3.64
APR	3.26	3.02	2.50	2.27	2.36	2.31	2.52	2.43	1.64	1.65	1.81	2.79	4.49	5.80	6.16	6.29	6.00	5.21	4.51	3.87	3.69	3.53	3.43	3.25	3.53
MAY	3.44	3.37	3.40	3.42	3.60	3.33	2.94	2.56	1.98	2.29	2.75	3.18	3.99	4.86	5.43	5.63	5.38	5.10	4.56	3.62	3.77	3.47	3.30	3.38	3.70
JUN	2.91	2.96	3.17	3.31	3.39	3.46	3.30	3.47	3.11	2.78	2.98	3.37	3.48	4.03	3.86	4.13	4.11	3.79	2.95	3.56	3.05	2.86	3.05	3.14	3.34
JUL	3.40	2.97	3.18	3.38	3.00	3.07	3.32	2.91	2.59	2.95	3.29	4.05	5.02	5.22	5.71	5.22	5.11	5.16	4.02	3.46	3.26	3.30	3.57	3.38	3.77
AUG	3.73	3.64	3.73	3.50	3.61	3.33	3.24	2.90	2.49	3.18	4.10	4.74	5.47	5.84	6.16	6.00	5.92	5.39	4.74	4.27	3.95	3.81	3.84	3.84	4.23
SEP	2.63	2.46	2.46	2.61	2.55	2.82	2.76	2.61	2.32	1.87	2.73	3.52	3.84	4.47	4.84	4.72	4.33	3.99	3.53	3.06	2.50	2.33	2.34	2.59	3.08
OCT	2.83	2.52	2.67	2.75	2.61	2.79	2.64	2.53	2.12	1.95	2.31	2.75	3.58	4.26	4.69	4.59	4.38	3.71	3.10	3.01	2.81	2.51	2.52	2.54	3.01
NOV	2.78	2.88	2.64	2.80	2.94	3.13	3.68	3.93	3.63	3.26	3.10	2.90	2.94	3.66	4.56	4.73	4.27	3.42	2.63	2.29	2.22	2.29	2.44	2.41	3.15
DEC	3.04	3.28	3.54	3.42	3.50	3.85	4.21	4.69	4.81	3.85	3.31	3.17	3.01	3.13	4.00	4.51	4.61	4.19	3.52	2.78	2.37	2.46	2.54	2.69	3.52
Annual	3.19	3.05	2.98	2.95	2.99	3.09	3.22	3.25	2.96	2.74	2.93	3.26	3.89	4.61	5.20	5.27	5.04	4.54	3.80	3.35	3.13	3.09	3.19	3.18	3.54

SENSOR HEIGHT: 78m

Based on Data June 2013 to May 2014

TABLE 6 B

PARAPOOL PARA

MEAN HOURLY WIND SPEED

MONTH	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	AVE
JAN	3.02	3.21	2.96	2.83	3.04	3.21	3.76	4.23	4.10	3.71	3.84	3.59	3.31	3.78	5.00	5.31	5.15	4.40	3.57	2.70	2.39	2.51	2.92	2.86	3.56
FEB	3.57	3.17	2.85	2.93	3.18	3.39	3.41	3.54	3.17	2.86	2.81	2.76	3.52	4.72	5.82	5.99	5.63	5.07	4.29	3.74	3.63	3.84	3.93	3.94	3.82
MAR	3.31	3.00	2.76	2.72	2.72	2.75	2.99	3.02	2.43	2.40	2.62	2.89	4.34	5.69	6.20	6.07	5.56	4.96	4.06	3.70	3.61	3.60	3.74	3.73	3.70
APR	3.09	2.93	2.47	2.36	2.60	2.62	2.83	2.56	1.88	2.04	2.17	3.02	4.63	5.84	6.15	6.25	5.92	5.14	4.47	3.80	3.57	3.39	3.22	3.12	3.59
MAY	3.21	3.03	3.04	3.23	3.42	3.18	2.92	2.40	1.92	2.36	2.78	3.20	3.95	4.77	5.31	5.46	5.21	4.91	4.32	3.46	3.47	3.08	2.93	3.14	3.53
JUN	2.65	2.57	2.89	2.89	3.00	2.99	2.97	3.08	2.69	2.49	2.72	3.17	3.28	3.72	3.57	3.79	3.75	3.38	2.54	3.07	2.66	2.58	2.86	2.89	3.01
JUL	2.73	2.25	2.60	2.53	2.27	2.27	2.40	2.12	1.90	2.39	2.75	3.62	4.53	4.69	5.14	4.64	4.50	4.45	3.24	2.79	2.47	2.54	2.79	2.69	3.09
AUG	2.81	2.74	2.76	2.58	2.67	2.43	2.37	2.02	1.78	2.73	3.80	4.49	5.17	5.53	5.88	5.68	5.54	4.91	4.11	3.50	3.09	2.95	2.92	2.98	3.56
SEP	2.62	2.45	2.49	2.63	2.51	2.73	2.71	2.50	2.26	1.98	2.77	3.47	3.83	4.38	4.76	4.58	4.22	3.87	3.39	2.98	2.41	2.32	2.45	2.66	3.04
OCT	2.90	2.78	2.84	2.94	2.84	2.92	2.87	2.69	2.15	2.12	2.44	2.84	3.60	4.25	4.67	4.53	4.29	3.62	3.13	3.02	2.85	2.63	2.70	2.79	3.10
NOV	2.84	3.01	2.96	2.99	3.04	2.93	3.46	3.52	3.11	3.04	3.02	2.85	2.92	3.64	4.49	4.62	4.14	3.25	2.55	2.26	2.23	2.40	2.47	2.58	3.10
DEC	3.41	3.49	3.61	3.42	3.44	3.71	3.93	4.15	4.05	3.44	3.26	3.13	3.00	3.13	3.99	4.44	4.48	4.06	3.35	2.66	2.36	2.56	2.66	3.02	3.45
Annual	3.01	2.89	2.85	2.84	2.89	2.93	3.05	2.99	2.62	2.63	2.92	3.25	3.84	4.51	5.08	5.11	4.87	4.34	3.59	3.14	2.90	2.87	2.97	3.03	3.38

SENSOR HEIGHT : 50m

Based on Data June 2013 to May 2014

NATIONAL INSTITUTE OF WIND ENERGY CHENNAI

TABLE 6 C

PARAPOOL PARA

MEAN HOURLY WIND SPEED

MONTH	OO	O1	O2	O3	O4	O5	O6	O7	O8	O9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	AVE
JAN	2.14	2.33	2.17	2.20	2.20	2.36	2.71	2.89	2.72	3.08	3.32	3.15	2.96	3.45	4.50	4.76	4.56	3.74	2.75	1.88	1.64	1.76	2.10	2.01	2.81
FEB	2.49	2.09	1.99	2.18	2.31	2.44	2.51	2.41	2.18	2.48	2.56	2.55	3.20	4.28	5.25	5.33	5.01	4.41	3.48	2.80	2.54	2.63	2.68	2.67	3.02
MAR	2.12	2.01	1.95	2.01	2.06	2.08	2.24	2.19	1.92	2.21	2.42	2.66	3.96	5.14	5.61	5.46	4.98	4.37	3.39	2.83	2.60	2.48	2.50	2.46	2.98
APR	2.15	1.99	1.74	1.61	1.80	1.88	2.00	1.65	1.59	1.90	2.02	2.78	4.21	5.27	5.51	5.55	5.22	4.50	3.77	3.00	2.69	2.51	2.26	2.11	2.91
MAY	2.25	2.02	2.00	2.20	2.21	2.10	1.94	1.59	1.49	2.09	2.50	2.84	3.53	4.28	4.73	4.80	4.50	4.16	3.46	2.56	2.37	1.97	1.87	2.09	2.73
JUN	1.93	1.87	2.12	2.09	2.15	2.12	2.11	2.17	2.07	2.10	2.29	2.66	2.83	3.11	3.03	3.15	3.08	2.61	1.85	2.23	1.96	1.89	2.12	2.07	2.32
JUL	1.93	1.43	1.71	1.72	1.53	1.45	1.48	1.38	1.31	1.86	2.20	2.97	3.72	3.87	4.24	3.80	3.62	3.44	2.31	1.88	1.50	1.61	1.82	1.80	2.27
AUG	1.60	1.59	1.53	1.45	1.59	1.33	1.28	1.12	1.31	2.34	3.23	3.87	4.50	4.80	5.07	4.82	4.65	4.01	3.07	2.39	1.88	1.74	1.73	1.77	2.61
SEP	1.50	1.38	1.39	1.54	1.36	1.52	1.55	1.47	1.63	1.58	2.31	2.91	3.27	3.72	4.03	3.88	3.52	3.09	2.38	1.79	1.34	1.37	1.44	1.44	2.14
OCT	1.65	1.47	1.50	1.47	1.44	1.61	1.46	1.30	1.30	1.66	2.02	2.41	3.13	3.68	4.03	3.81	3.54	2.71	2.06	1.76	1.58	1.57	1.57	1.54	2.09
NOV	1.96	2.05	1.99	2.00	2.00	1.95	2.24	2.17	2.20	2.56	2.59	2.51	2.58	3.24	3.99	4.06	3.52	2.56	1.76	1.50	1.53	1.61	1.70	1.85	2.34
DEC	2.48	2.48	2.48	2.45	2.48	2.59	2.75	2.76	2.79	2.87	2.86	2.75	2.69	2.83	3.61	3.94	3.87	3.25	2.42	1.82	1.74	1.94	2.08	2.38	2.68
Annual	2.02	1.89	1.88	1.91	1.93	1.95	2.02	1.93	1.88	2.23	2.53	2.84	3.38	3.97	4.47	4.45	4.17	3.57	2.73	2.20	1.95	1.92	1.99	2.02	2.58

SENSOR HEIGHT : 20m

Based on Data June 2013 to May 2014

NATIONAL INSTITUTE OF WIND ENERGY CHENNAI

PARAPOOL PARA

TABLE 7

PERCENTAGE FREQUENCY DISTRIBUTION OF WIND SPEED

CLASS INTERVAL (m/s)	Jan-14	Feb-14	Mar-14	Apr-14	May-14	Jun-13	Jul-13	Aug-13	Sep-13	Oct-13	Nov-13	Dec-13	ANNUAL
0.0-1.0	7.64	4.41	6.16	9.35	10.30	19.44	30.51	30.71	28.77	25.09	13.03	7.12	16.05
1.0-2.0	21.44	19.17	22.92	25.67	24.08	27.18	22.31	19.20	22.25	26.97	27.99	19.62	23.23
2.0-3.0	33.22	32.09	29.28	25.35	30.38	27.99	18.03	12.10	20.67	23.23	32.64	37.32	26.86
3.0-4.0	16.42	20.96	16.58	13.31	14.67	12.06	12.37	10.78	15.60	14.09	15.49	22.89	15.43
4.0-5.0	13.42	12.20	11.94	11.30	11.09	7.27	6.74	9.41	8.77	7.89	9.03	9.54	9.88
5.0-6.0	6.21	10.02	9.52	11.41	7.39	3.36	5.51	9.97	2.96	2.42	1.60	2.93	6.11
6.0-7.0	1.30	1.14	3.32	3.43	1.79	1.69	2.67	5.58	0.90	0.31	0.23	0.45	1.90
7.0-8.0	0.27	0.00	0.29	0.16	0.22	0.63	1.50	1.84	0.07	0.00	0.00	0.11	0.42
8.0-9.0	0.09	0.00	0.00	0.02	0.04	0.28	0.29	0.27	0.00	0.00	0.00	0.00	0.08
9.0-10.0	0.00	0.00	0.00	0.00	0.00	0.12	0.07	0.16	0.00	0.00	0.00	0.00	0.03
10.0-11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11.0-12.0	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12.0-13.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13.0-14.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14.0-15.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.0-16.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16.0-17.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17.0-18.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18.0-19.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19.0-20.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20.0-21.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

SENSOR HEIGHT: 20m **Based on Data June 2013 to May 2014**

Range 0--1 Extends from 0 to 0.99 m/s &
1-- 2 Extends from 1 to 1.99 m/s etc.

PARAPOOL PARA

TABLE 7A

PERCENTAGE FREQUENCY DISTRIBUTION OF WIND SPEED

CLASS INTERVAL (m/s)	Jan-14	Feb-14	Mar-14	Apr-14	May-14	Jun-13	Jul-13	Aug-13	Sep-13	Oct-13	Nov-13	Dec-13	ANNUAL
0.0-1.0	5.35	3.08	4.01	4.95	5.22	15.49	18.79	16.15	13.70	7.64	6.32	5.40	8.84
1.0-2.0	13.80	9.08	11.00	15.58	11.92	16.37	16.78	13.82	14.54	15.46	16.30	13.10	13.98
2.0-3.0	21.10	20.68	22.24	21.39	21.86	22.43	18.95	15.95	21.06	23.68	27.06	21.42	21.49
3.0-4.0	21.82	20.26	21.66	19.33	25.22	20.30	15.14	14.07	21.13	26.37	24.54	23.16	21.08
4.0-5.0	17.25	21.33	17.41	14.42	16.58	11.97	11.47	11.00	17.71	18.08	16.74	21.86	16.32
5.0-6.0	12.84	16.99	13.75	13.24	11.60	6.02	7.95	11.22	7.78	6.59	6.44	9.32	10.31
6.0-7.0	4.95	7.79	7.71	8.73	5.96	3.50	5.00	9.30	2.85	1.84	1.55	4.12	5.27
7.0-8.0	1.75	0.77	2.06	2.15	1.16	2.31	3.27	5.20	0.97	0.31	0.97	1.19	1.84
8.0-9.0	0.69	0.02	0.16	0.16	0.34	0.86	1.61	2.26	0.25	0.04	0.09	0.34	0.57
9.0-10.0	0.34	0.00	0.00	0.05	0.07	0.44	0.76	0.72	0.00	0.00	0.00	0.09	0.20
10.0-11.0	0.11	0.00	0.00	0.00	0.00	0.21	0.22	0.20	0.00	0.00	0.00	0.00	0.06
11.0-12.0	0.00	0.00	0.00	0.00	0.04	0.09	0.00	0.11	0.00	0.00	0.00	0.00	0.02
12.0-13.0	0.00	0.00	0.00	0.00	0.00	0.02	0.04	0.00	0.00	0.00	0.00	0.00	0.01
13.0-14.0	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14.0-15.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.0-16.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16.0-17.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17.0-18.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18.0-19.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19.0-20.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20.0-21.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

SENSOR HEIGHT: 50m **Based on Data June 2013 to May 2014**

Range 0--1 Extends from 0 to 0.99 m/s &
1-- 2 Extends from 1 to 1.99 m/s etc.

PARAPOOL PARA

TABLE 7B

PERCENTAGE FREQUENCY DISTRIBUTION OF WIND SPEED

CLASS INTERVAL (m/s)	Jan-14	Feb-14	Mar-14	Apr-14	May-14	Jun-13	Jul-13	Aug-13	Sep-13	Oct-13	Nov-13	Dec-13	ANNUAL
0.0-1.0	9.68	8.18	10.04	12.15	7.57	15.49	10.24	10.10	18.68	15.55	9.54	8.22	11.29
1.0-2.0	13.55	10.69	11.96	13.43	10.57	16.37	12.93	9.92	13.87	14.07	18.45	14.72	13.38
2.0-3.0	17.85	15.58	16.49	15.76	19.56	22.43	18.17	12.63	15.72	19.67	22.57	20.36	18.07
3.0-4.0	16.98	15.82	17.09	17.20	20.03	20.30	17.79	15.39	18.26	20.54	18.75	18.28	18.04
4.0-5.0	16.87	18.25	17.38	14.79	16.96	11.97	12.77	13.98	16.88	17.18	17.01	18.53	16.05
5.0-6.0	13.89	19.22	15.41	14.07	14.14	6.02	10.80	12.28	10.25	9.54	8.68	9.21	11.96
6.0-7.0	5.11	9.77	8.98	9.91	7.80	3.50	8.13	13.13	4.05	2.84	2.59	5.76	6.80
7.0-8.0	2.71	1.96	2.33	2.38	2.64	2.31	4.70	7.39	1.71	0.52	1.25	2.82	2.73
8.0-9.0	1.64	0.47	0.29	0.25	0.49	0.86	2.42	3.52	0.51	0.09	0.81	1.32	1.06
9.0-10.0	1.01	0.05	0.02	0.02	0.13	0.44	1.37	1.01	0.07	0.00	0.35	0.58	0.42
10.0-11.0	0.54	0.00	0.00	0.02	0.04	0.21	0.47	0.38	0.00	0.00	0.00	0.16	0.15
11.0-12.0	0.13	0.00	0.00	0.00	0.00	0.09	0.18	0.20	0.00	0.00	0.00	0.04	0.05
12.0-13.0	0.04	0.00	0.00	0.00	0.02	0.02	0.04	0.04	0.00	0.00	0.00	0.00	0.01
13.0-14.0	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00
14.0-15.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.0-16.0	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16.0-17.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17.0-18.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18.0-19.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19.0-20.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20.0-21.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

SENSOR HEIGHT: 78m **Based on Data June 2013 to May 2014**

Range 0--1 Extends from 0 to 0.99 m/s &
1-- 2 Extends from 1 to 1.99 m/s etc.

NATIONAL INSTITUTE OF WIND ENERGY CHENNAI

PARAPOOL PARA

TABLE 7C

PERCENTAGE FREQUENCY DISTRIBUTION OF WIND SPEED

CLASS INTERVAL (m/s)	Jan-14	Feb-14	Mar-14	Apr-14	May-14	Jun-13	Jul-13	Aug-13	Sep-13	Oct-13	Nov-13	Dec-13	ANNUAL
0.0-1.0	8.65	4.29	6.16	6.18	6.38	13.33	12.37	5.56	11.90	8.83	9.47	8.67	8.48
1.0-2.0	12.88	9.52	10.04	13.13	9.43	12.75	10.93	7.86	12.22	11.54	17.64	13.40	11.78
2.0-3.0	17.90	15.67	17.81	17.71	19.13	18.75	16.73	14.29	18.33	20.34	22.59	20.34	18.30
3.0-4.0	17.27	17.73	17.29	17.78	20.21	19.47	17.16	15.28	18.96	24.35	19.19	18.17	18.57
4.0-5.0	16.91	16.59	18.55	15.58	17.88	14.00	13.49	15.79	19.10	19.02	17.11	18.84	16.90
5.0-6.0	14.16	20.81	15.59	15.14	14.38	9.38	10.86	12.43	11.99	11.42	8.87	9.48	12.88
6.0-7.0	6.00	11.86	10.86	11.04	7.95	5.05	8.36	12.86	4.91	3.74	2.69	6.09	7.62
7.0-8.0	2.76	2.85	3.23	2.99	3.63	3.56	4.88	9.21	1.88	0.63	1.32	2.82	3.31
8.0-9.0	1.64	0.47	0.45	0.39	0.60	2.18	2.71	4.39	0.65	0.13	0.74	1.21	1.30
9.0-10.0	1.01	0.20	0.02	0.05	0.29	0.67	1.59	1.41	0.07	0.00	0.37	0.74	0.53
10.0-11.0	0.63	0.00	0.00	0.02	0.02	0.53	0.63	0.58	0.00	0.00	0.02	0.18	0.22
11.0-12.0	0.13	0.00	0.00	0.00	0.02	0.23	0.22	0.22	0.00	0.00	0.00	0.07	0.08
12.0-13.0	0.07	0.00	0.00	0.00	0.02	0.07	0.02	0.09	0.00	0.00	0.00	0.00	0.02
13.0-14.0	0.00	0.00	0.00	0.00	0.00	0.02	0.04	0.02	0.00	0.00	0.00	0.00	0.01
14.0-15.0	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.0-16.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16.0-17.0	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17.0-18.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18.0-19.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19.0-20.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20.0-21.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

SENSOR HEIGHT: 80m **Based on Data June 2013 to May 2014**

Range 0--1 Extends from 0 to 0.99 m/s &
1-- 2 Extends from 1 to 1.99 m/s etc.

PARAPOOL PARA

TABLE 8

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED

Deg/ (m/s)	345-15	15-45	45-75	75-105	105-135	135-165	165-195	195-225	225-255	255-285	285-315	315-345	ANNUAL
0.0-1.0	1.16	1.10	0.80	0.80	0.67	0.49	0.53	0.38	0.52	0.59	0.85	1.00	8.9
1.0-2.0	1.88	1.83	1.63	1.68	1.24	0.74	0.54	0.47	0.62	0.84	1.14	1.37	14.0
2.0-3.0	2.69	2.10	2.20	3.00	2.18	0.88	0.63	0.78	1.17	1.30	2.12	2.43	21.5
3.0-4.0	2.41	1.22	0.92	3.63	2.28	0.52	0.36	0.72	1.81	1.55	2.76	2.92	21.1
4.0-5.0	1.23	0.22	0.14	2.23	1.54	0.20	0.13	0.53	2.97	1.76	2.77	2.58	16.3
5.0-6.0	0.40	0.04	0.04	0.88	0.70	0.06	0.03	0.33	2.73	1.46	2.26	1.36	10.3
6.0-7.0	0.07	0.00	0.01	0.49	0.25	0.02	0.01	0.09	1.38	0.88	1.64	0.43	5.3
7.0-8.0	0.01	0.00	0.00	0.29	0.06	0.00	0.00	0.01	0.25	0.40	0.71	0.11	1.9
8.0-9.0	0.00	0.00	0.00	0.08	0.02	0.00	0.00	0.00	0.03	0.10	0.30	0.03	0.6
9.0-10.0	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.01	0.05	0.10	0.01	0.2
10.0-11.0	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.03	0.01	0.1
11.0-12.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.0
12.0-13.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13.0-14.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14.0-15.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15.0-16.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16.0-17.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
17.0-18.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
18.0-19.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
19.0-20.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
Total	9.9	6.5	5.7	13.1	9.0	2.9	2.2	3.3	11.5	9.0	14.7	12.3	100.0

SENSOR HEIGHT: 50m **Based on Data June 2013 to May 2014**

Range 0--1 Extends from 0 to 0.99 m/s &
1-- 2 Extends from 1 to 1.99 m/s etc.

PARAPOOL PARA

TABLE 8A

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED

Deg/ (m/s)	345-15	15-45	45-75	75-105	105-135	135-165	165-195	195-225	225-255	255-285	285-315	315-345	ANNUAL
0.0-1.0	1.70	1.34	1.14	1.03	0.88	0.60	0.62	0.49	0.56	0.77	1.01	1.10	11.26
1.0-2.0	1.97	1.51	1.23	1.41	1.19	0.69	0.61	0.52	0.59	0.79	1.18	1.47	13.15
2.0-3.0	2.76	1.42	1.30	2.12	1.91	0.79	0.55	0.63	1.12	1.15	1.88	2.17	17.81
3.0-4.0	2.50	0.74	0.49	2.13	2.08	0.61	0.30	0.61	1.77	1.39	2.51	2.79	17.94
4.0-5.0	1.79	0.25	0.12	1.44	1.58	0.30	0.14	0.41	2.82	1.63	2.77	2.87	16.12
5.0-6.0	1.01	0.06	0.04	0.93	0.97	0.12	0.04	0.25	2.68	1.61	2.51	1.92	12.15
6.0-7.0	0.44	0.03	0.01	0.65	0.39	0.03	0.01	0.06	1.34	1.00	1.89	1.01	6.87
7.0-8.0	0.09	0.00	0.00	0.46	0.18	0.01	0.01	0.01	0.29	0.54	0.94	0.29	2.82
8.0-9.0	0.04	0.00	0.00	0.29	0.06	0.00	0.00	0.00	0.03	0.28	0.39	0.07	1.16
9.0-10.0	0.01	0.00	0.00	0.15	0.02	0.00	0.00	0.00	0.02	0.08	0.16	0.03	0.46
10.0-11.0	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.05	0.05	0.01	0.18
11.0-12.0	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.01	0.06
12.0-13.0	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.02
13.0-14.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
14.0-15.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.0-16.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16.0-17.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17.0-18.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18.0-19.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19.0-20.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	12.31	5.34	4.35	10.70	9.27	3.14	2.28	2.98	11.23	9.33	15.32	13.73	100.00

SENSOR HEIGHT: 78m **Based on Data June 2013 to May 2014**

Range 0--1 Extends from 0 to 0.99 m/s &
1-- 2 Extends from 1 to 1.99 m/s etc.

PARAPOOL PARA

TABLE 8B

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED

Deg/ (m/s)	345-15	15-45	45-75	75-105	105-135	135-165	165-195	195-225	225-255	255-285	285-315	315-345	ANNUAL
0.0-1.0	1.10	0.99	0.83	0.79	0.65	0.47	0.46	0.44	0.51	0.64	0.77	0.85	8.5
1.0-2.0	1.71	1.39	1.29	1.29	1.10	0.62	0.59	0.41	0.50	0.73	0.98	1.17	11.8
2.0-3.0	2.83	1.63	1.44	2.21	1.89	0.84	0.64	0.68	1.14	1.13	1.77	2.11	18.3
3.0-4.0	2.81	0.90	0.59	2.27	2.20	0.67	0.34	0.63	1.70	1.47	2.34	2.66	18.6
4.0-5.0	2.03	0.30	0.14	1.51	1.69	0.36	0.18	0.45	2.81	1.67	2.86	2.92	16.9
5.0-6.0	1.13	0.09	0.05	0.95	1.04	0.14	0.05	0.27	2.70	1.62	2.63	2.16	12.8
6.0-7.0	0.49	0.04	0.01	0.68	0.44	0.04	0.01	0.08	1.48	1.05	2.03	1.26	7.6
7.0-8.0	0.16	0.00	0.00	0.47	0.19	0.01	0.01	0.01	0.33	0.58	1.12	0.44	3.3
8.0-9.0	0.03	0.00	0.00	0.27	0.07	0.00	0.00	0.00	0.04	0.29	0.50	0.10	1.3
9.0-10.0	0.02	0.00	0.00	0.16	0.02	0.00	0.00	0.00	0.01	0.07	0.22	0.03	0.5
10.0-11.0	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.05	0.07	0.02	0.2
11.0-12.0	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.02	0.03	0.01	0.1
12.0-13.0	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.0
13.0-14.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14.0-15.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15.0-16.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16.0-17.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
17.0-18.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
18.0-19.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
19.0-20.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
Total	12.3	5.3	4.3	10.7	9.3	3.1	2.3	3.0	11.2	9.3	15.3	13.7	100.0

SENSOR HEIGHT: 80m **Based on Data June 2013 to May 2014**

Range 0--1 Extends from 0 to 0.99 m/s &

1-- 2 Extends from 1 to 1.99 m/s etc.

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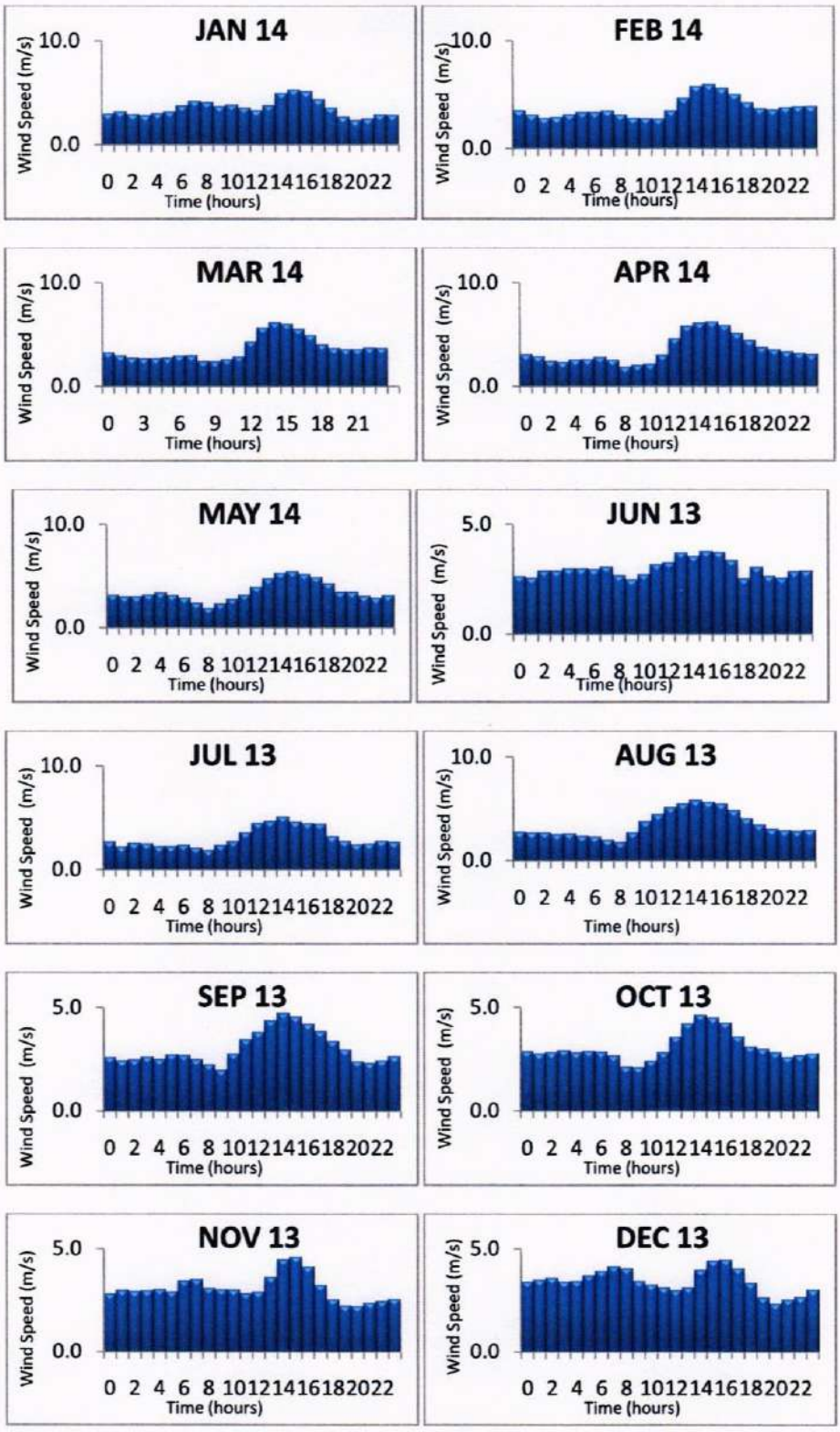

SENSOR HEIGHT: 50m

FIGURE 4: MEAN HOURLY WIND SPEED

NATIONAL INSTITUTE WIND ENERGY
CHENNAI

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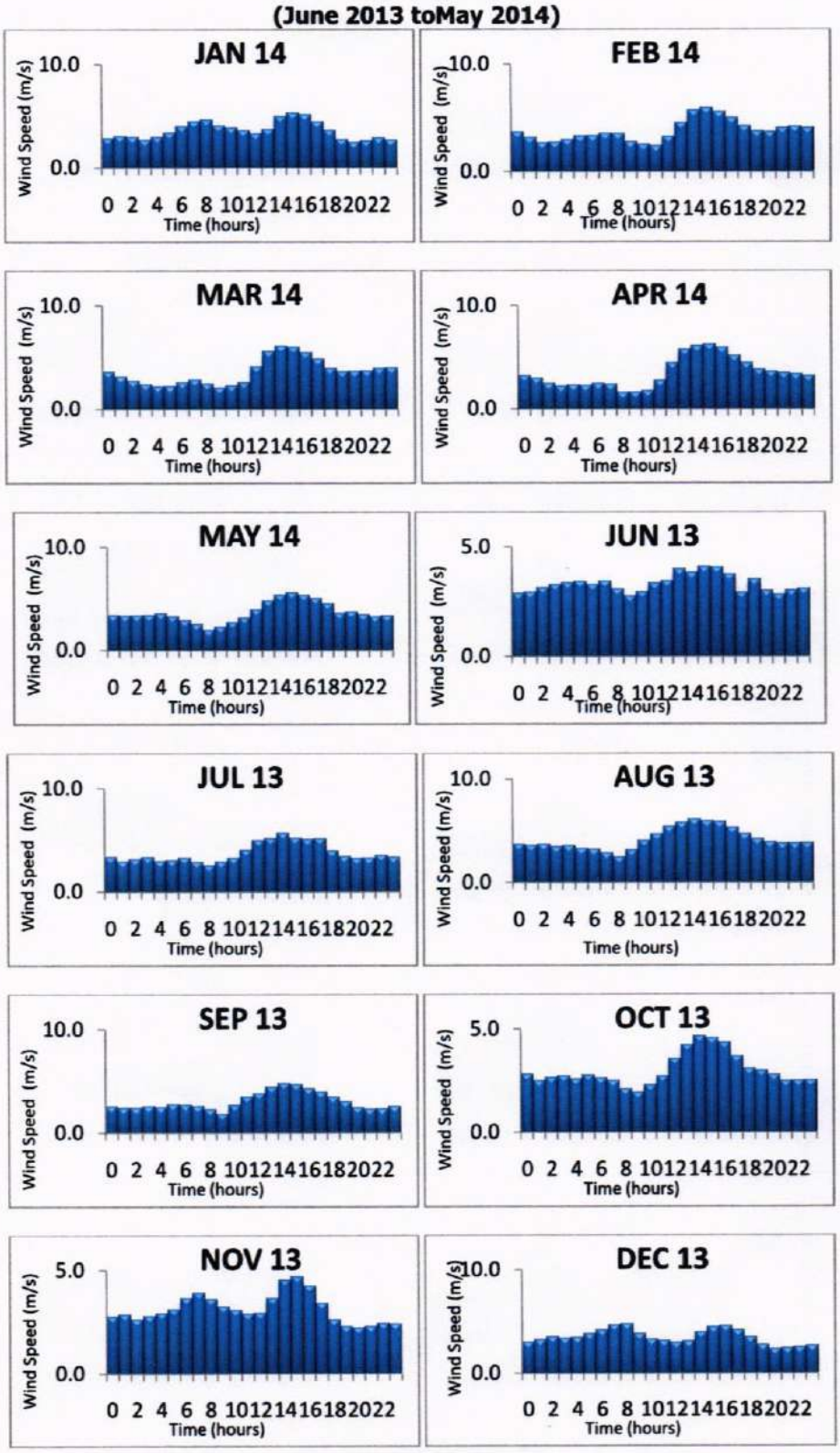
(ISO 9001:2008)

(June 2013 toMay 2014)



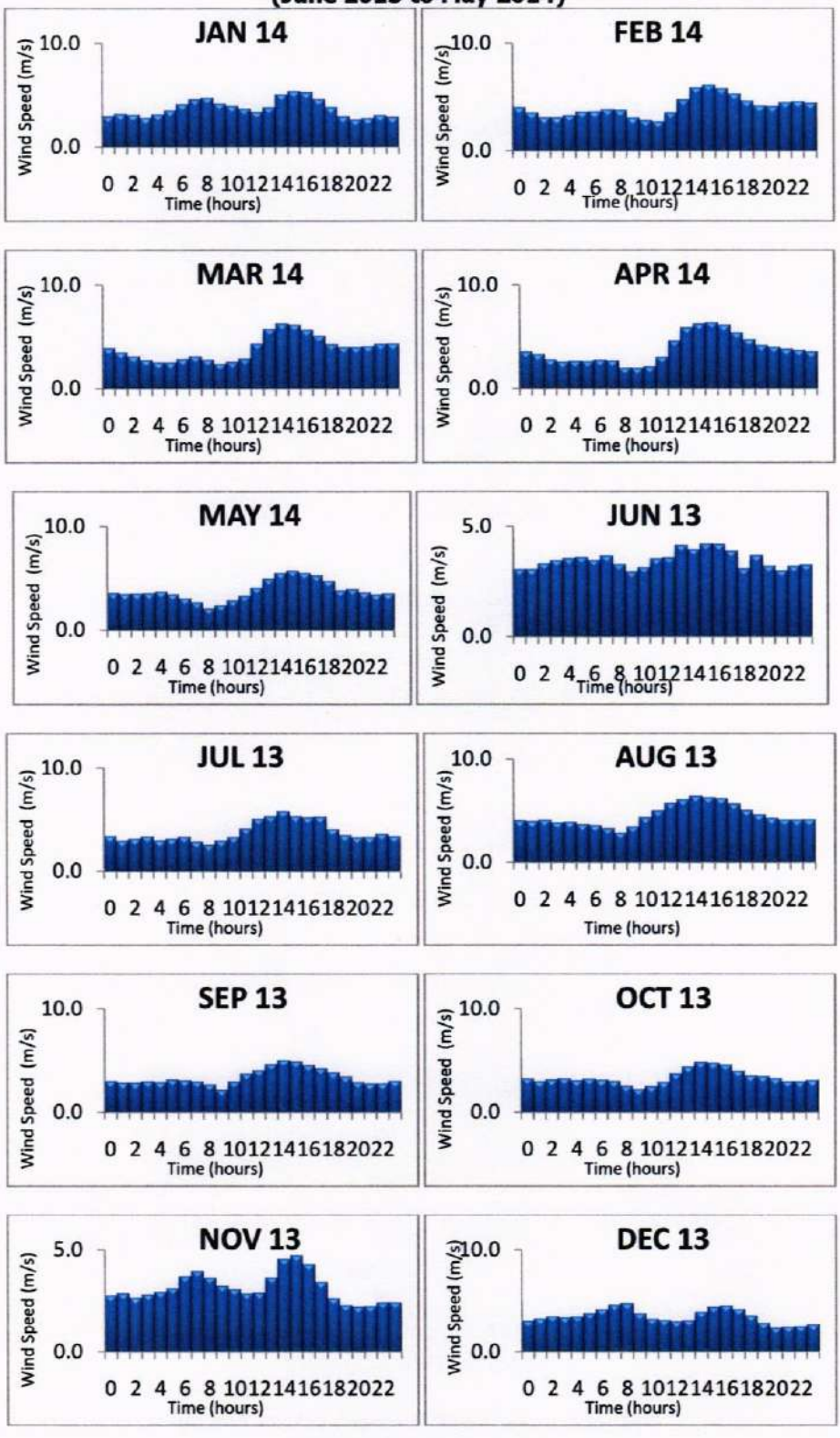
SENSOR HEIGHT: 78m

FIGURE 4A: MEAN HOURLY WIND SPEED

NATIONAL INSTITUTE WIND ENERGY
CHENNAI

नीवे NIWE
(ISO 9001:2008)

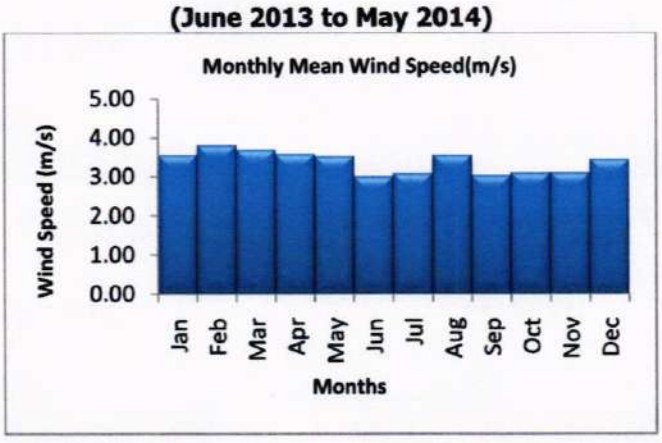
(June 2013 to May 2014)



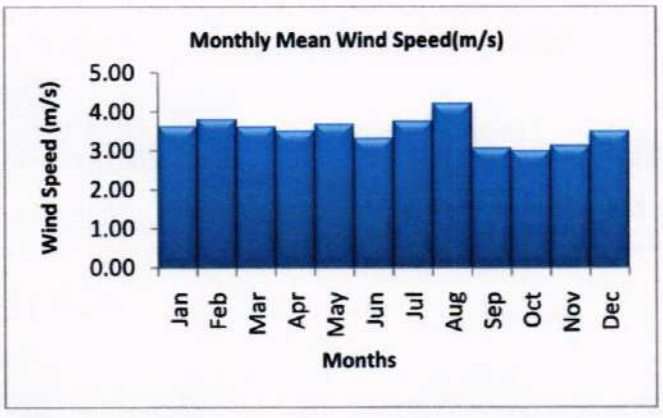
SENSOR HEIGHT: 80m

FIGURE 4B: MEAN HOURLY WIND SPEED

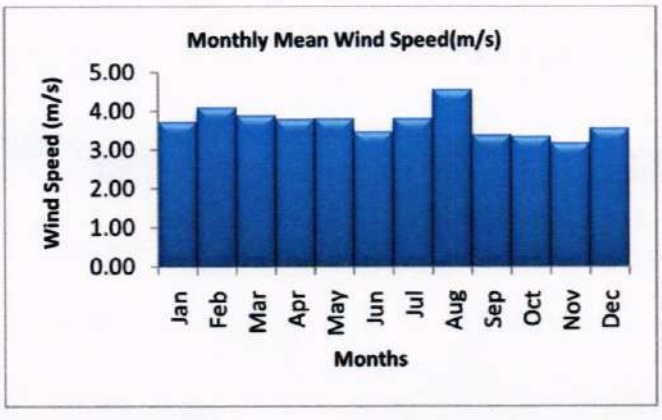
(June 2013 to May 2014)



SENSOR HEIGHT: 50m

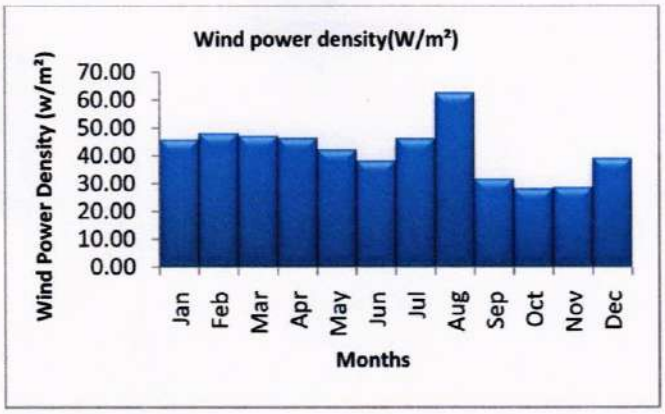


SENSOR HEIGHT: 78 m

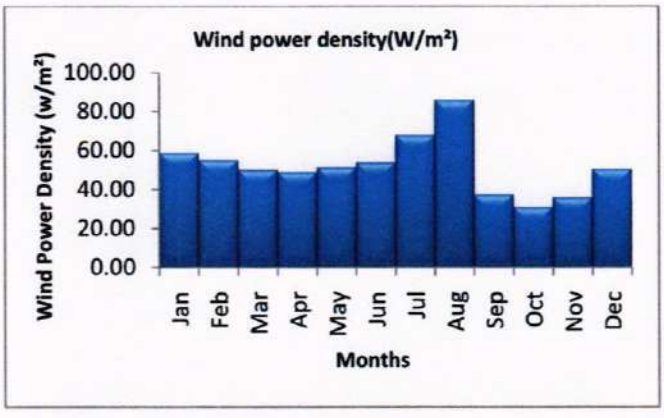


SENSOR HEIGHT: 80m

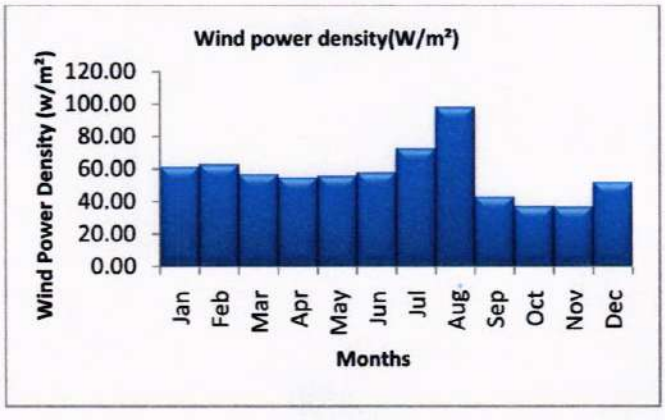
**FIGURE 5: MONTHLY MEAN WIND SPEED
(June 2013 to May 2014)**



SENSOR HEIGHT: 50m



SENSOR HEIGHT: 78m



SENSOR HEIGHT: 80m

FIGURE 6: MONTHLY MEAN WIND POWER DENSITY (June 2013 to May 2014)

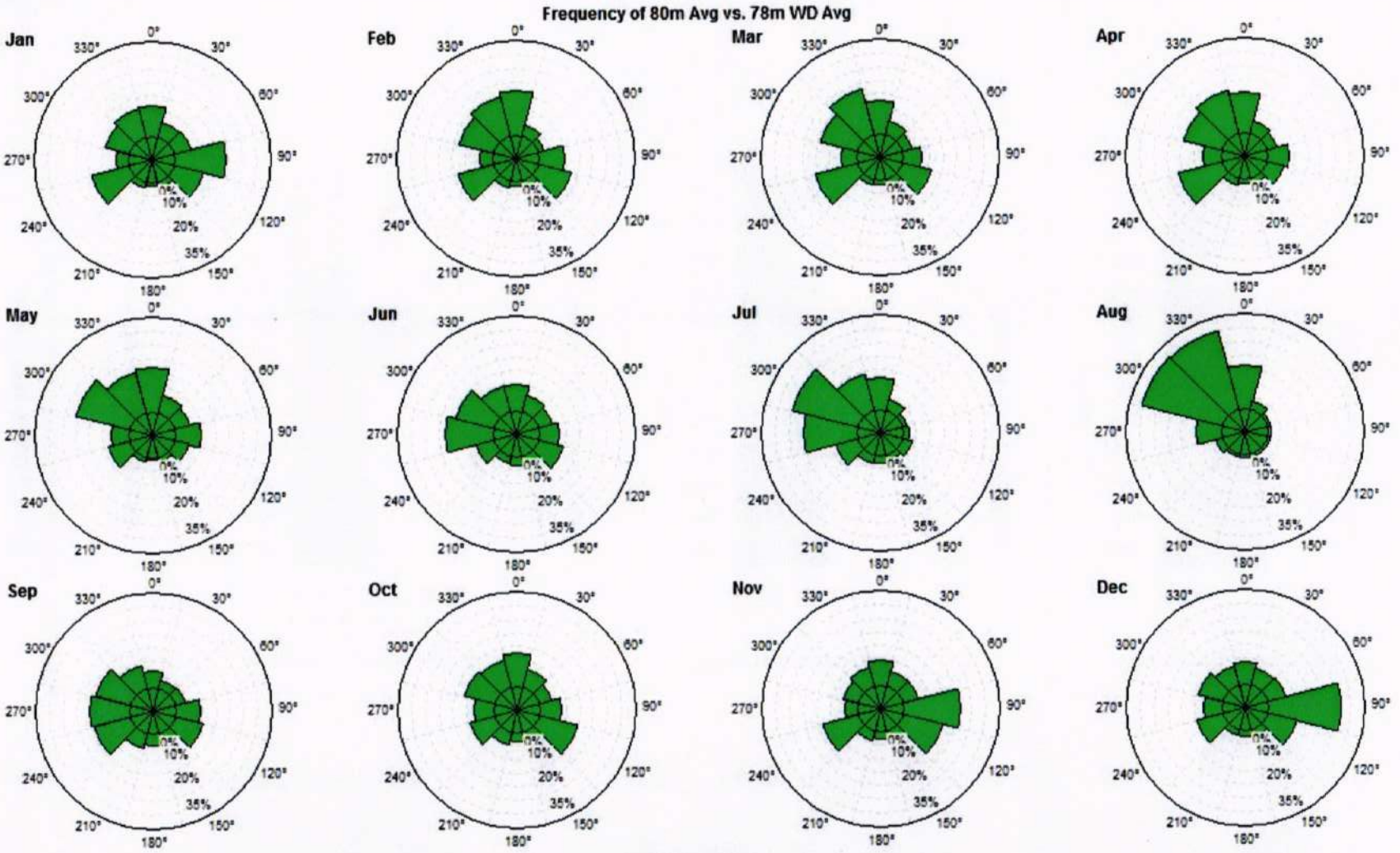


FIGURE 7: WIND ROSE
SENSOR HEIGHT: (80m Anemometer and 78m Wind vane)
(June 2013 to May 2014)

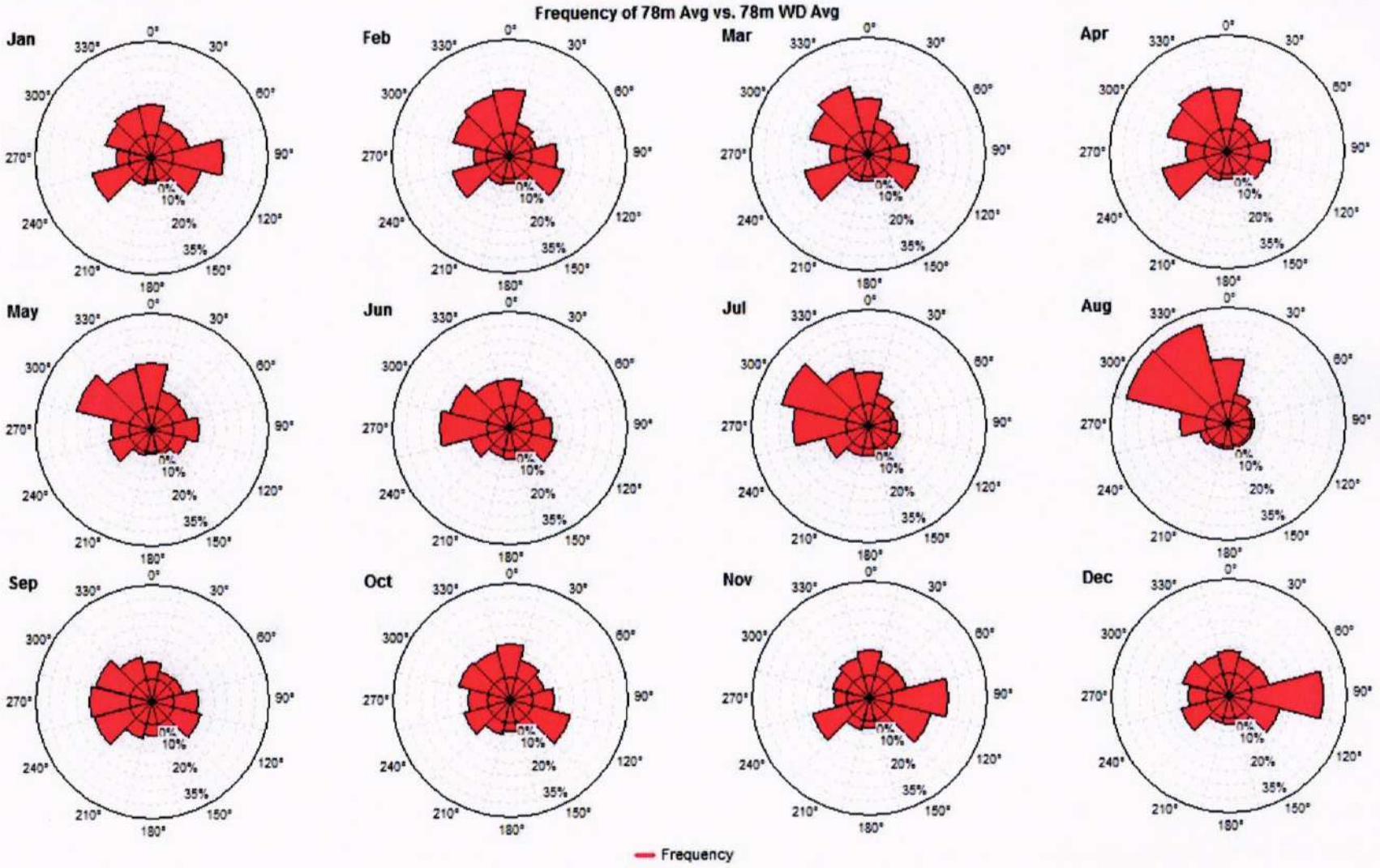


FIGURE 7A: WIND ROSE
SENSOR HEIGHT: (78m Anemometer and 78m Wind vane)
(June 2013 to May 2014)

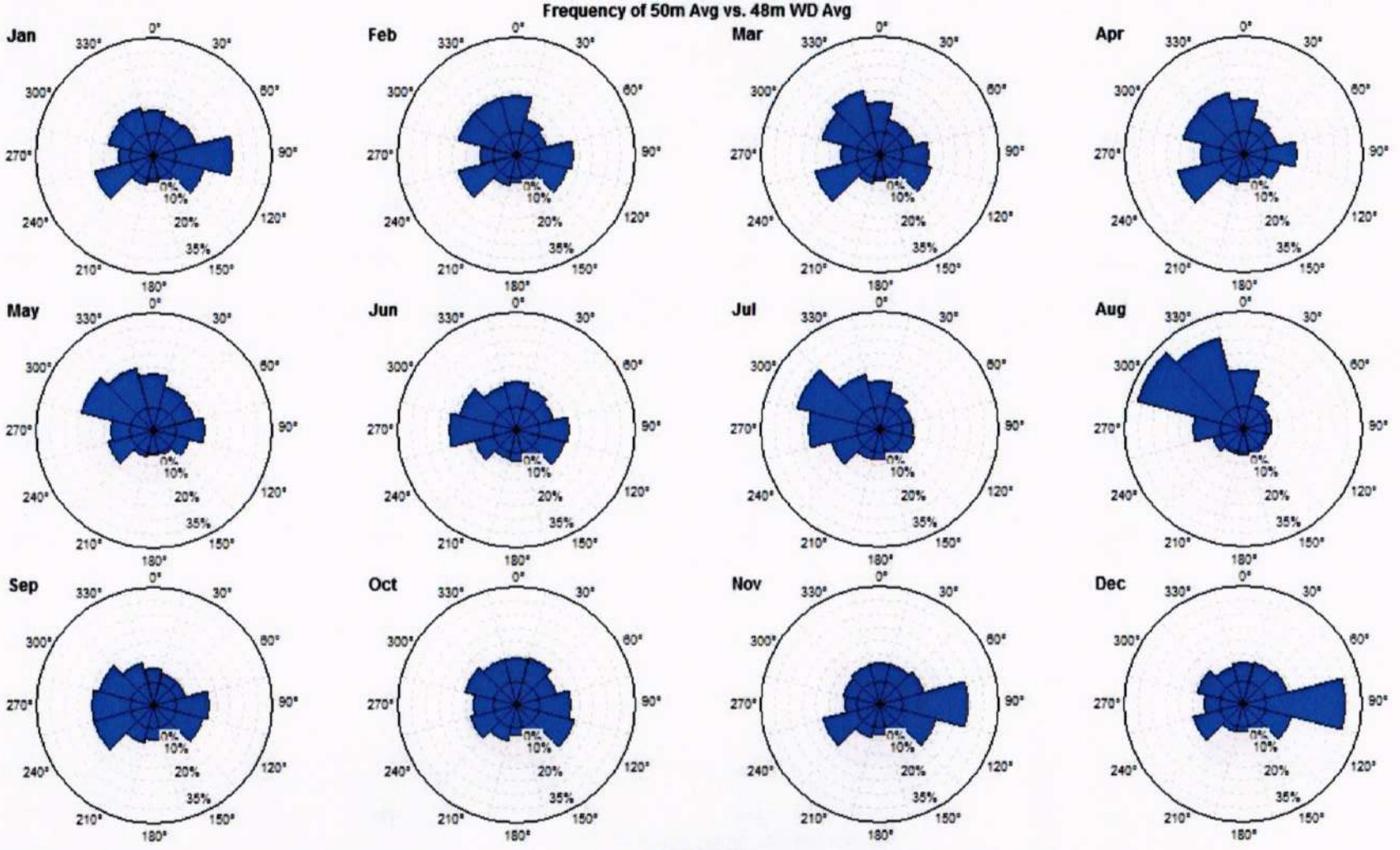


FIGURE 7B: WIND ROSE
SENSOR HEIGHT: (50m Anemometer and 48m Wind vane)
(June 2013 to May 2014)

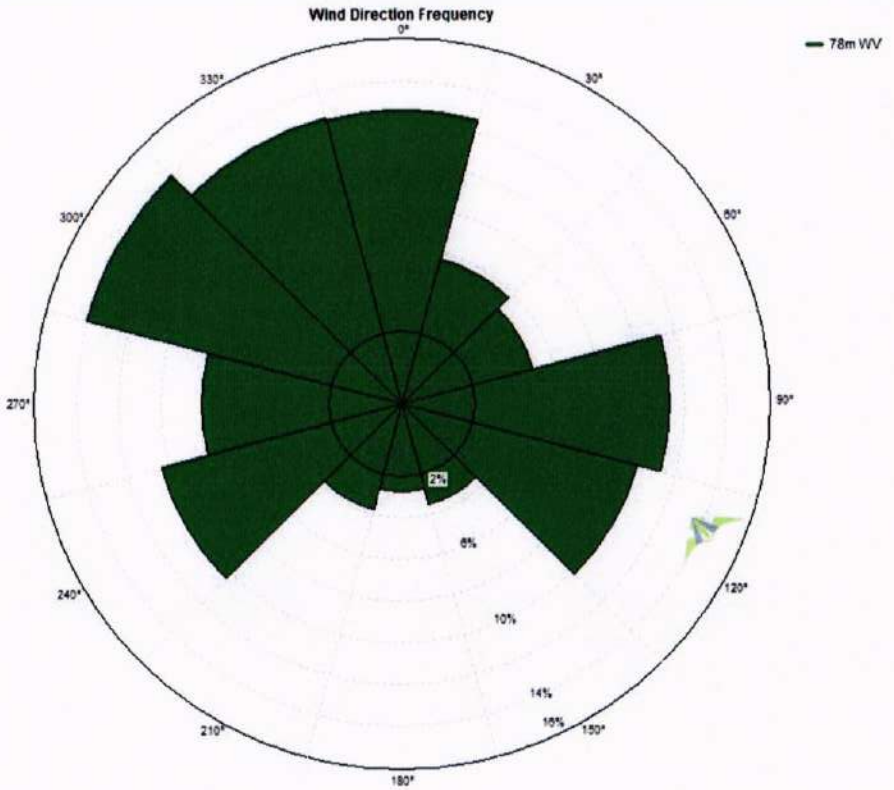
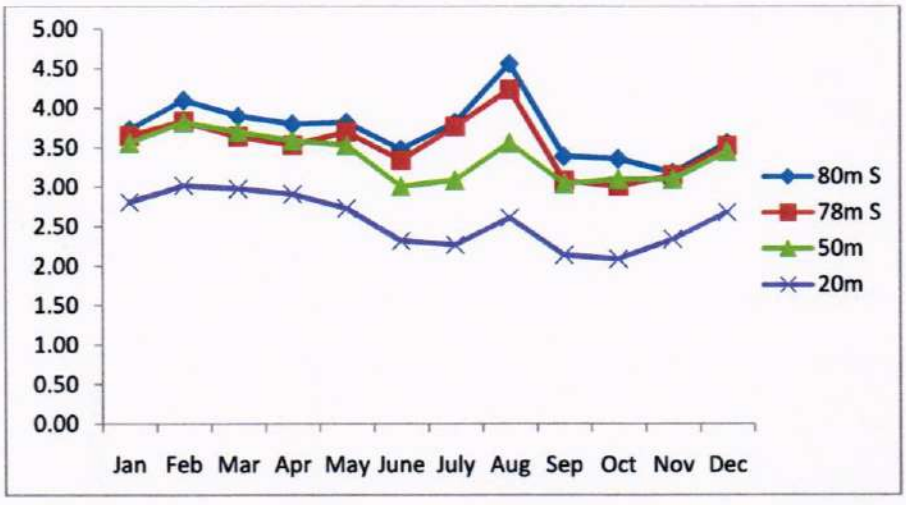
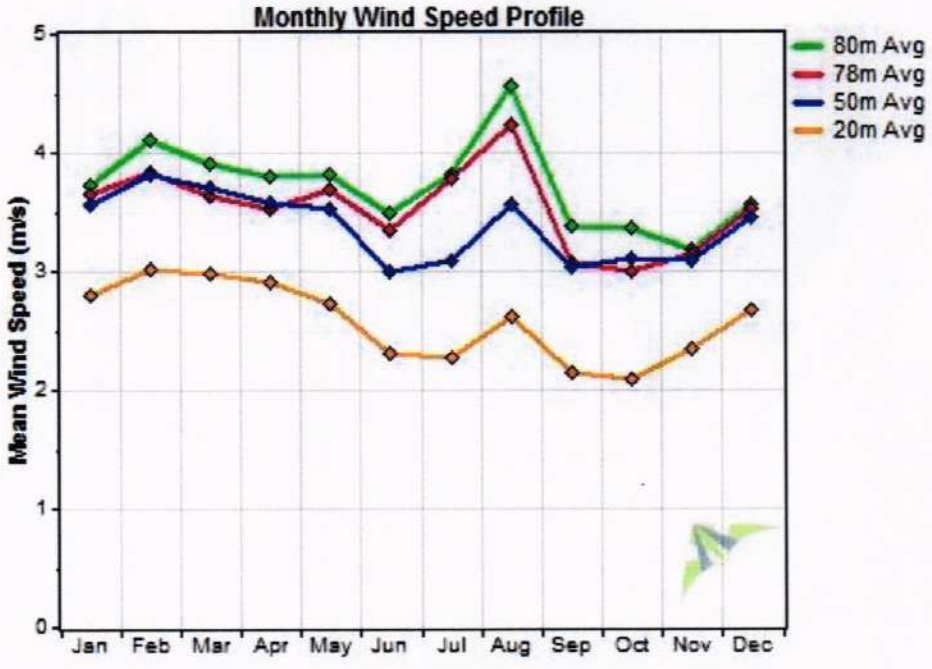


FIGURE 7C: ANNUAL WIND ROSE
SENSOR HEIGHT: (80m Anemometer and 78m Wind vane)
(June 2013 to May 2014)



MONTHLY MEAN WIND SPEED
(JUNE2013 TO MAY2014)



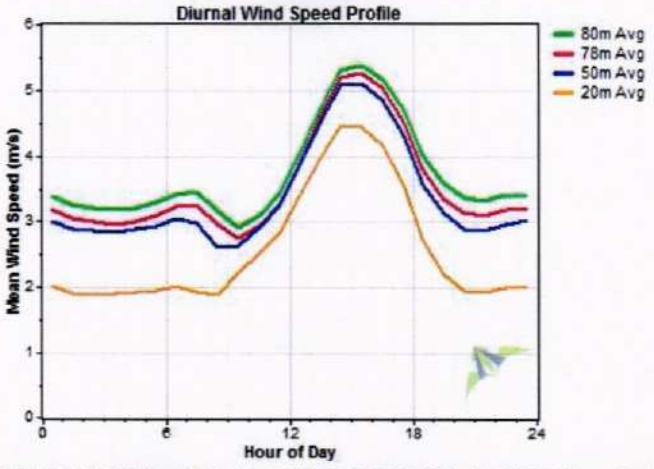


FIGURE 8: MONTHLY WIND SPEED AND DAILY WIND SPEED – PARAPOOL PARA (JUNE2013 TO MAY2014)

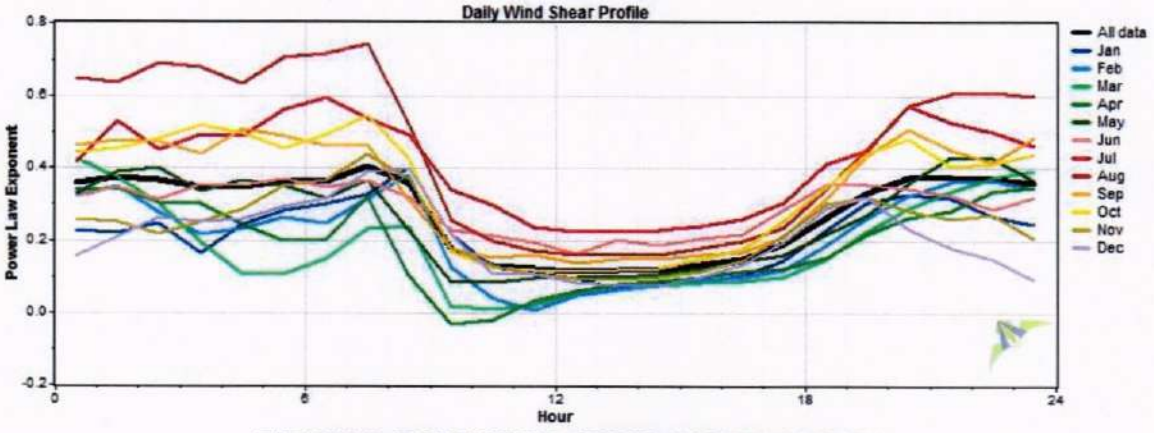


FIGURE 9: DAILY WIND SHEAR-PARAPOOL PARA (JUNE2013 TO MAY2014)

FIGURE 10: MONTHLY WIND SHEAR- PARAPOOL PARA (JUNE2013 TO MAY2014)

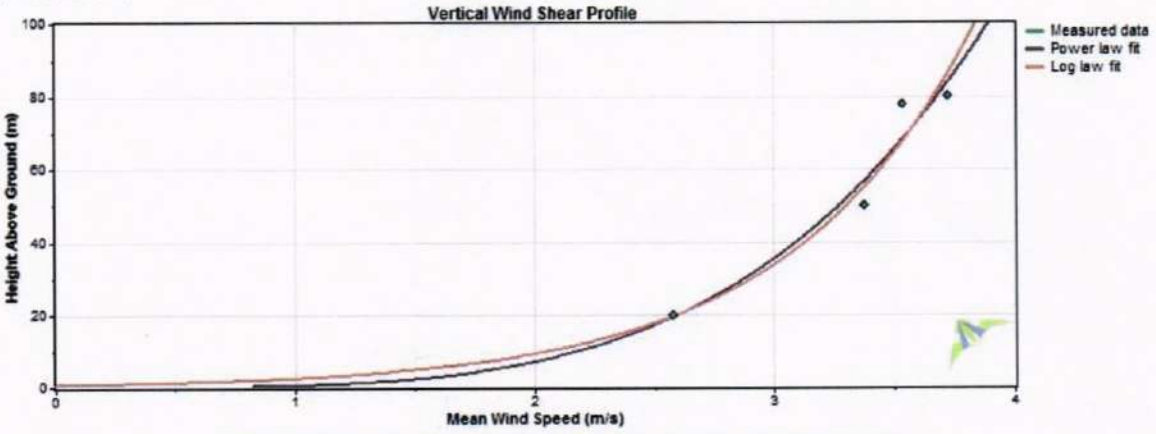
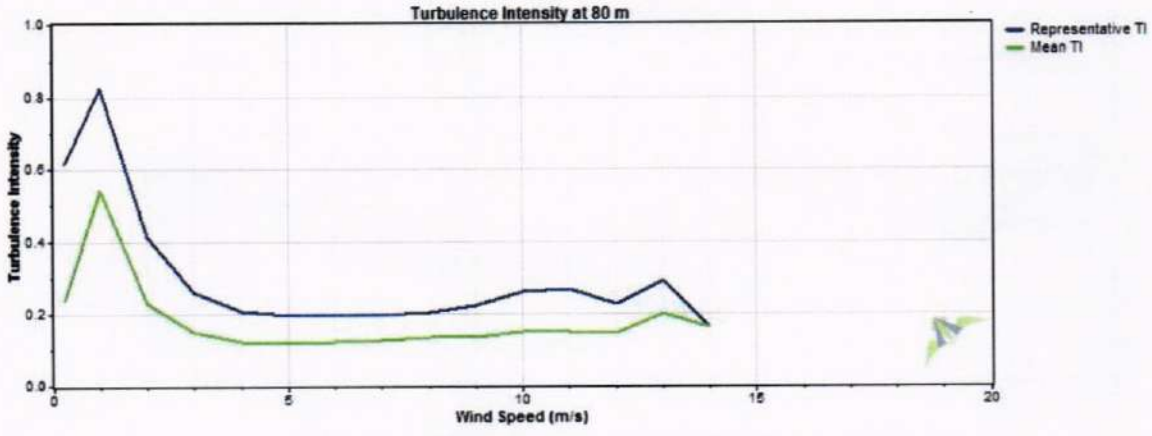
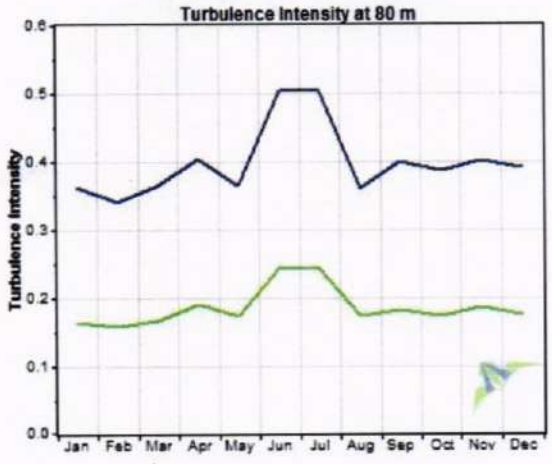
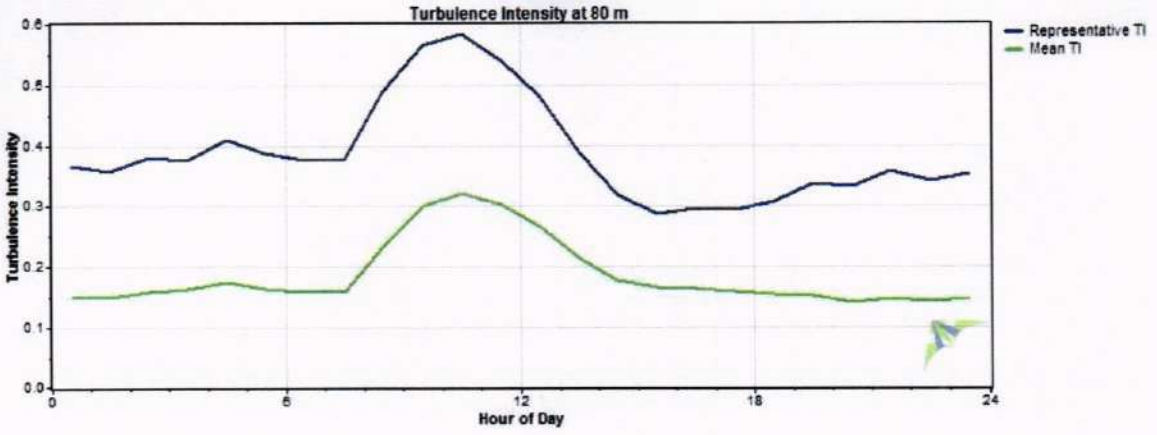


FIGURE 11: VERTICALWIND SHEAR- PARAPOOL PARA (JUNE2013 TO MAY2014)







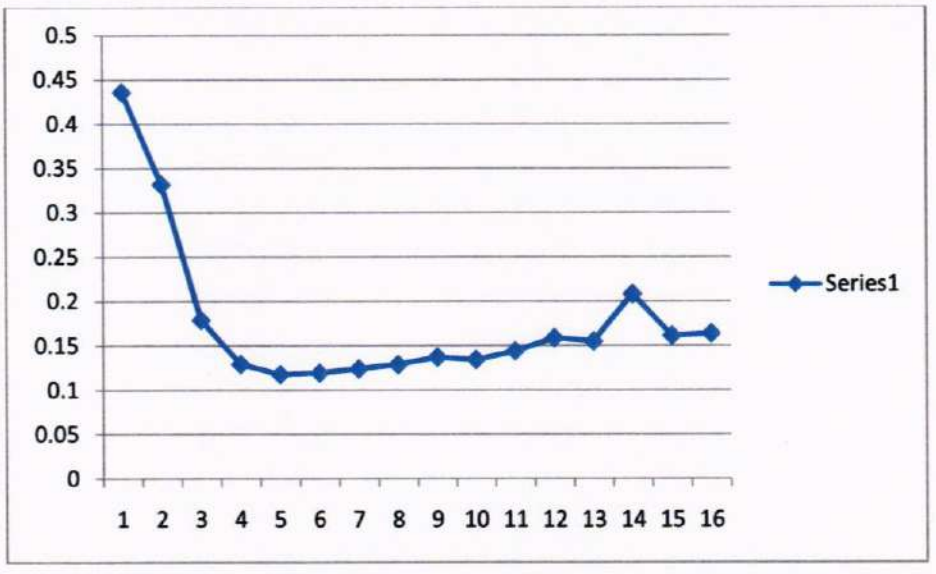


FIGURE 12: TURBULANCE INTENSITY – Parapool Para (JUNE2013 TO MAY2014)

IInd Year

Jun 2014 - May 2015

PARAPOOL PARA

TABLE 4
CONSOLIDATED TABLE

	JAN-15	FEB-15	MAR-15	APR-15	MAY-15	JUN-14	JUL-14	AUG-14	SEP-14	OCT-14	NOV-14	DEC-14	ANNUAL
Monthly Mean Wind Speed (m/s)													
20m	2.73	2.80	2.90	2.67	2.48	2.67	2.47	2.04	2.45	2.16	2.38	2.50	2.52
50m	3.51	3.58	3.66	3.29	3.26	3.69	3.34	2.67	3.26	2.94	3.11	3.25	3.30
78 m	3.72	3.76	3.86	3.47	3.50	4.07	3.94	3.02	3.39	2.96	3.20	3.43	3.53
80m	3.77	3.82	3.94	3.51	3.55	4.18	4.07	3.17	3.58	3.03	3.26	3.45	3.61
Monthly Wind Power Density (Watts/Sq.m)													
20m	18.58	21.67	26.61	22.90	18.19	27.30	25.61	14.61	22.09	12.72	13.77	16.39	20.04
50m	37.70	40.03	45.55	37.46	35.06	58.76	51.93	27.44	40.78	25.61	28.77	35.65	38.73
78 m	48.82	48.36	53.95	44.12	43.91	78.98	75.33	37.77	49.48	29.33	35.88	48.48	49.53
80m	50.76	50.21	57.34	46.07	45.82	84.09	80.20	40.93	54.43	30.94	37.16	50.00	52.33
Power Law Index (PLI)													
	0.23	0.22	0.22	0.20	0.26	0.32	0.36	0.32	0.27	0.24	0.23	0.23	0.26
Energy Pattern Factor													
20m	1.56	1.69	1.88	2.08	2.06	2.46	2.93	2.95	2.57	2.16	1.75	1.80	2.16
50m	1.49	1.50	1.60	1.82	1.75	2.02	2.40	2.47	2.01	1.73	1.64	1.79	1.85
78 m	1.63	1.56	1.62	1.83	1.77	2.03	2.10	2.35	2.19	1.95	1.87	2.06	1.91
80m	1.63	1.54	1.61	1.84	1.77	1.98	2.04	2.19	2.04	1.91	1.84	2.08	1.87
Air Density (kg/m^3)													
	1.169	1.165	1.160	1.157	1.157	1.161	1.168	1.169	1.166	1.165	1.164	1.165	1.164
Temperature (^{0} C)													
	25.63	26.59	27.85	28.21	27.80	26.58	25.13	24.76	25.70	26.25	26.38	26.31	26.43
Turbulance Intensity (at 80m agl)													
At 15m/s : 0.18													
Data Availability (Based on 10 Minutes Interval)													
	4464	4032	4464	4320	4464	4320	4464	4464	4320	4464	4320	4464	

Based on Data June 2014 to May 2015

TABLE 5A

PARAPOOL PARA

SUMMARY OF WIND DATA

Monthly Mean wind speed (m/s)			Monthly standard Deviation (m/s)			Peak wind speed(m/s) (date/year/Time of occurance)			Prevailing wind Direction	
(50m)	(80m)	(78m)	(50m)	(80m)	(78m)	(50m)	(80m)	(78m)	(50m)	(80m)
3.51	3.77	3.72	0.47	0.44	0.44	9.55 1/31/2015 9:50	12.45 1/12/2015 8:00	12.14 1/12/2015 8:00	E	E
3.58	3.82	3.76	0.50	0.47	0.47	8.44 2/23/2015 11:30	9.88 2/4/2015 7:20	9.73 2/4/2015 7:20	E	E
3.66	3.94	3.86	0.54	0.50	0.49	10.78 3/9/2015 16:20	11.45 3/9/2015 16:20	11.31 3/9/2015 16:20	NNW/SW	NNW/SW
3.29	3.51	3.47	0.57	0.54	0.53	11.50 4/26/2015 17:50	12.83 4/26/2015 17:50	12.62 4/26/2015 17:50	E/NW	E/NW
3.26	3.55	3.50	0.55	0.52	0.51	14.66 5/11/2015 1:50	16:34 5/11/2015 1:50	16:25 5/11/2015 1:50	N/NW	E/NW
3.69	4.18	4.07	0.68	0.66	0.65	11.94 6/9/2014 17:20	13.62 6/9/2014 17:20	13.53 6/9/2014 17:20	NW	NW
3.34	4.07	3.94	0.76	0.76	0.74	12.25 7/12/2014 18:30	13.83 7/12/2014 18:30	13.85 7/12/2014 18:30	NW	NW
2.67	3.17	3.02	0.58	0.57	0.56	11.18 8/5/2014 6:20	12.99 8/5/2014 6:20	12.86 8/5/2014 6:20	NW	NW
3.26	3.58	3.39	0.58	0.56	0.55	10.48 9/24/2014 3:40	11.50 9/24/2014 3:40	11.35 9/24/2014 3:40	NW/NNW	NW
2.94	3.03	2.96	0.49	0.47	0.47	8.93 10/5/2014 15:00	10.65 10/5/2014 15:00	9.61 10/5/2014 15:00	SE	E
3.11	3.36	3.20	0.47	0.45	0.46	8.20 11/21/2014 7:50	9.91 11/21/2014 8:10	9.80 11/21/2014 8:10	E	E
3.25	3.45	3.43	0.48	0.45	0.45	10.67 12/1/2014 8:40	12.32 12/10/2014 23:20	12.28 12/10/2014 23:20	E	SE
3.46	**3.72**	**3.66**	**0.53**	**0.49**	**0.49**	**14.66 5/11/2015 1:50**	**16:34 5/11/2015 1:50**	**16:25 5/11/2015 1:50**	**E/NW**	**NW**

Based on Data June 2014 to May 2015

TABLE 6

PARAPOOL PARA

MEAN HOURLY WIND SPEED

MONTH	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	AVE
JAN	3.19	3.10	3.02	2.94	2.97	3.21	3.53	4.15	4.89	4.21	3.57	3.21	3.07	3.52	4.37	4.91	5.13	4.77	4.24	3.68	3.48	3.67	3.89	3.67	**3.77**
FEB	3.42	2.91	2.61	2.76	3.07	3.71	3.79	4.35	4.33	3.37	3.10	3.31	3.48	4.41	5.29	5.89	5.65	5.08	4.27	3.51	3.16	3.23	3.43	3.59	**3.82**
MAR	3.68	3.55	3.34	3.04	3.10	3.18	3.42	3.62	3.48	2.43	2.32	2.65	3.53	5.17	6.19	6.39	6.05	5.28	4.86	4.20	3.68	3.65	3.96	3.92	**3.94**
APR	2.94	3.13	2.82	2.59	2.49	2.79	2.95	2.87	2.41	2.09	2.08	2.61	3.31	4.68	5.62	5.99	5.73	5.19	4.53	3.94	3.65	3.31	3.25	3.34	**3.51**
MAY	3.75	3.50	3.31	3.21	3.25	3.21	2.96	2.71	2.62	2.07	2.15	2.49	3.25	4.12	4.64	5.04	5.33	5.00	4.49	4.23	3.83	3.36	3.11	3.58	**3.55**
JUN	3.60	3.87	4.07	4.10	4.03	3.90	3.45	3.14	3.05	2.81	3.66	4.37	4.86	5.24	5.54	5.37	5.23	4.90	4.19	4.39	4.20	4.40	4.08	3.89	**4.18**
JUL	3.40	3.54	3.37	3.28	3.82	3.67	3.16	3.38	3.16	3.17	3.55	4.19	4.98	5.56	5.66	5.38	5.20	5.15	4.86	4.59	4.35	3.72	3.44	3.11	**4.07**
AUG	2.48	2.86	2.98	2.60	2.82	2.77	3.03	2.64	2.48	2.13	2.49	3.04	3.59	4.39	4.55	4.26	4.30	4.03	3.61	3.42	3.00	2.97	2.92	2.78	**3.17**
SEP	3.01	2.90	2.82	2.98	3.16	2.69	2.34	2.13	2.11	2.15	2.90	3.54	4.39	5.04	5.60	5.49	5.21	4.96	4.28	3.82	3.57	3.65	3.49	3.59	**3.58**
OCT	2.86	2.80	2.62	2.67	2.84	2.69	2.58	2.71	2.19	2.01	2.01	2.28	2.95	4.49	5.10	4.92	4.56	3.89	3.06	2.59	2.72	2.72	2.81	2.70	**3.03**
NOV	2.86	2.80	2.65	2.71	2.80	2.64	2.53	2.64	2.05	1.92	1.96	2.28	2.98	4.51	5.13	4.95	4.55	3.88	3.06	2.60	2.79	2.80	2.81	2.69	**3.03**
DEC	3.21	2.91	2.81	2.85	3.09	3.54	4.13	4.24	4.30	3.65	3.65	3.48	3.30	3.48	4.11	4.48	4.27	3.99	3.38	2.89	2.82	2.71	2.65	2.99	**3.45**
Annual	**3.20**	**3.16**	**3.03**	**2.98**	**3.12**	**3.17**	**3.16**	**3.21**	**3.09**	**2.67**	**2.79**	**3.12**	**3.64**	**4.55**	**5.15**	**5.26**	**5.10**	**4.68**	**4.07**	**3.65**	**3.44**	**3.35**	**3.32**	**3.32**	**3.59**

SENSOR HEIGHT: 80m

Based on Data June 2014 to May 2015

TABLE 6 A

PARAPOOL PARA

MEAN HOURLY WIND SPEED

MONTH	OO	O1	O2	O3	O4	O5	O6	O7	O8	O9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	AVE
JAN	3.07	2.99	2.96	2.89	2.96	3.17	3.49	4.13	4.85	4.18	3.58	3.22	3.08	3.52	4.37	4.90	5.12	4.73	4.14	3.53	3.36	3.57	3.79	3.55	**3.72**
FEB	3.33	2.81	2.53	2.65	3.01	3.66	3.76	4.32	4.29	3.36	3.11	3.33	3.49	4.41	5.27	5.86	5.64	5.03	4.18	3.39	3.01	3.11	3.31	3.47	**3.76**
MAR	3.54	3.40	3.21	2.92	3.02	3.11	3.37	3.57	3.45	2.42	2.31	2.63	3.51	5.15	6.17	6.35	6.02	5.20	4.73	4.03	3.49	3.47	3.78	3.76	**3.86**
APR	2.88	3.06	2.78	2.54	2.43	2.70	2.90	2.82	2.39	2.09	2.09	2.61	3.32	4.67	5.62	5.97	5.68	5.14	4.44	3.83	3.56	3.25	3.17	3.26	**3.47**
MAY	3.68	3.45	3.23	3.14	3.16	3.16	2.92	2.65	2.54	2.04	2.12	2.48	3.24	4.11	4.66	5.03	5.28	4.93	4.41	4.12	3.71	3.28	3.06	3.53	**3.50**
JUN	3.46	3.77	3.97	3.98	3.94	3.78	3.36	3.07	2.99	2.72	3.55	4.25	4.75	5.11	5.42	5.25	5.13	4.79	4.06	4.23	4.04	4.25	3.95	3.76	**4.07**
JUL	3.26	3.39	3.19	3.11	3.66	3.53	3.03	3.25	3.05	3.09	3.48	4.12	4.92	5.48	5.56	5.29	5.10	5.05	4.71	4.42	4.18	3.58	3.25	2.95	**3.94**
AUG	2.28	2.63	2.79	2.39	2.63	2.60	2.85	2.46	2.33	1.99	2.39	2.98	3.54	4.32	4.47	4.18	4.19	3.90	3.44	3.25	2.81	2.76	2.71	2.54	**3.02**
SEP	2.80	2.68	2.57	2.73	2.92	2.41	2.08	1.87	1.88	2.05	2.84	3.49	4.34	4.99	5.53	5.40	5.08	4.80	4.04	3.54	3.29	3.39	3.22	3.32	**3.39**
OCT	2.74	2.73	2.50	2.56	2.80	2.64	2.55	2.68	2.13	1.96	1.97	2.24	2.89	4.45	5.05	4.86	4.49	3.81	2.97	2.47	2.59	2.62	2.70	2.55	**2.96**
NOV	2.76	2.74	2.56	2.62	2.77	2.59	2.50	2.61	1.99	1.88	1.92	2.24	2.92	4.47	5.09	4.88	4.47	3.80	2.97	2.48	2.67	2.70	2.71	2.55	**2.95**
DEC	3.13	2.82	2.76	2.81	3.06	3.52	4.13	4.23	4.28	3.67	3.68	3.54	3.35	3.50	4.11	4.46	4.26	3.97	3.32	2.80	2.74	2.62	2.61	2.97	**3.43**
Annual	**3.08**	**3.04**	**2.92**	**2.86**	**3.03**	**3.07**	**3.08**	**3.14**	**3.01**	**2.62**	**2.75**	**3.09**	**3.61**	**4.51**	**5.11**	**5.20**	**5.04**	**4.60**	**3.95**	**3.51**	**3.29**	**3.22**	**3.19**	**3.18**	**3.50**

SENSOR HEIGHT: 78m

Based on Data June 2014 to May 2015

TABLE 6 B

PARAPOOL PARA

MEAN HOURLY WIND SPEED

MONTH	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	AVE
JAN	2.88	2.87	2.92	2.93	3.08	3.22	3.36	3.85	4.18	3.45	3.39	3.08	2.99	3.44	4.30	4.81	5.00	4.51	3.84	3.22	3.00	3.25	3.46	3.28	**3.51**
FEB	2.97	2.67	2.49	2.63	3.15	3.57	3.66	4.05	3.73	2.80	2.98	3.22	3.38	4.30	5.17	5.73	5.49	4.88	3.95	3.14	2.77	2.92	3.11	3.11	**3.58**
MAR	3.19	3.03	2.88	2.85	3.02	3.14	3.30	3.52	2.95	2.21	2.27	2.59	3.44	5.04	6.01	6.16	5.83	5.02	4.49	3.77	3.24	3.12	3.42	3.44	**3.66**
APR	2.60	2.80	2.59	2.44	2.45	2.64	2.66	2.62	2.06	1.99	2.05	2.58	3.27	4.58	5.49	5.81	5.54	4.97	4.26	3.60	3.28	2.90	2.87	2.96	**3.29**
MAY	3.23	3.19	2.99	2.84	3.02	3.04	2.71	2.67	2.22	1.84	2.10	2.42	3.10	3.95	4.50	4.85	5.08	4.67	4.10	3.81	3.24	2.87	2.73	3.03	**3.26**
JUN	3.09	3.37	3.56	3.50	3.48	3.32	2.91	2.61	2.60	2.45	3.32	4.06	4.54	4.90	5.16	4.97	4.81	4.40	3.75	3.85	3.57	3.67	3.38	3.21	**3.69**
JUL	2.62	2.64	2.34	2.41	3.11	2.95	2.44	2.67	2.35	2.59	3.13	3.82	4.51	5.03	5.12	4.72	4.52	4.45	4.08	3.61	3.32	2.77	2.52	2.30	**3.34**
AUG	1.94	2.30	2.44	2.10	2.29	2.31	2.53	2.08	1.94	1.73	2.16	2.69	3.32	4.06	4.19	3.87	3.87	3.45	3.01	2.73	2.34	2.25	2.22	2.16	**2.67**
SEP	2.58	2.55	2.46	2.69	2.79	2.22	2.15	2.04	1.90	2.08	2.75	3.43	4.22	4.84	5.31	5.19	4.88	4.54	3.78	3.36	3.15	3.22	3.07	3.15	**3.26**
OCT	2.85	2.82	2.58	2.63	2.80	2.63	2.69	2.70	1.97	1.96	1.99	2.27	2.90	4.40	4.93	4.72	4.32	3.53	2.87	2.47	2.60	2.61	2.71	2.68	**2.94**
NOV	2.84	2.81	2.59	2.63	2.75	2.58	2.64	2.62	1.86	1.89	1.94	2.28	2.94	4.42	4.96	4.74	4.30	3.53	2.87	2.49	2.67	2.67	2.71	2.68	**2.93**
DEC	2.94	2.77	2.64	2.74	3.06	3.52	3.98	3.90	3.65	3.11	3.42	3.38	3.23	3.40	4.03	4.33	4.11	3.74	3.07	2.58	2.51	2.45	2.50	2.89	**3.25**
Annual	**2.81**	**2.82**	**2.71**	**2.70**	**2.92**	**2.93**	**2.92**	**2.94**	**2.62**	**2.34**	**2.63**	**2.98**	**3.49**	**4.37**	**4.93**	**4.99**	**4.81**	**4.31**	**3.67**	**3.22**	**2.98**	**2.89**	**2.89**	**2.91**	**3.28**

SENSOR HEIGHT : 50m

Based on Data June 2014 to May 2015

TABLE 6 C

PARAPOOL PARA

MEAN HOURLY WIND SPEED

MONTH	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	AVE
JAN	2.11	2.19	2.11	2.15	2.21	2.40	2.49	2.71	2.60	2.65	3.00	2.76	2.72	3.15	3.93	4.35	4.43	3.90	2.96	2.16	1.98	2.12	2.29	2.25	**2.73**
FEB	1.98	1.92	1.84	2.05	2.36	2.50	2.57	2.75	2.31	2.27	2.68	2.90	3.02	3.90	4.65	5.12	4.90	4.31	3.30	2.25	1.80	1.82	1.97	2.03	**2.80**
MAR	2.05	1.89	1.88	2.08	2.12	2.10	2.30	2.37	1.95	1.98	2.12	2.38	3.15	4.56	5.39	5.48	5.20	4.43	3.83	2.97	2.41	2.22	2.35	2.37	**2.90**
APR	1.83	1.95	1.81	1.73	1.77	1.83	1.78	1.74	1.53	1.76	1.89	2.38	3.00	4.17	4.92	5.19	4.95	4.37	3.63	2.87	2.54	2.18	2.07	2.15	**2.67**
MAY	2.11	2.08	1.99	1.83	2.02	2.10	1.76	1.69	1.45	1.54	1.89	2.17	2.75	3.51	4.02	4.28	4.41	3.92	3.33	2.87	2.24	1.83	1.76	1.94	**2.48**
JUN	1.89	2.04	2.13	2.15	2.03	2.09	1.82	1.61	1.75	1.90	2.77	3.43	3.86	4.19	4.35	4.19	3.98	3.50	2.84	2.69	2.38	2.41	2.17	2.01	**2.67**
JUL	1.73	1.58	1.32	1.41	1.97	1.96	1.64	1.88	1.64	2.06	2.63	3.21	3.78	4.25	4.28	3.88	3.68	3.54	3.10	2.48	2.23	1.77	1.64	1.51	**2.47**
AUG	1.23	1.53	1.67	1.25	1.55	1.59	1.70	1.30	1.38	1.48	1.91	2.42	3.03	3.59	3.69	3.34	3.30	2.82	2.32	1.93	1.56	1.50	1.46	1.38	**2.04**
SEP	1.55	1.58	1.40	1.64	1.70	1.25	1.36	1.22	1.40	1.71	2.40	3.06	3.74	4.29	4.62	4.53	4.16	3.75	2.88	2.34	2.13	2.10	2.00	2.03	**2.45**
OCT	1.78	1.75	1.59	1.75	1.92	1.71	1.67	1.45	1.28	1.59	1.71	1.98	2.56	3.90	4.31	4.06	3.60	2.71	2.09	1.64	1.78	1.72	1.72	1.67	**2.16**
NOV	1.77	1.75	1.59	1.73	1.89	1.69	1.63	1.38	1.19	1.54	1.66	1.99	2.59	3.92	4.34	4.08	3.58	2.71	2.09	1.66	1.82	1.73	1.70	1.67	**2.15**
DEC	2.05	1.91	1.89	2.05	2.24	2.52	2.67	2.56	2.36	2.43	2.93	2.94	2.86	3.02	3.61	3.85	3.55	3.05	2.20	1.80	1.77	1.74	1.85	2.12	**2.50**
Annual	**1.84**	**1.85**	**1.77**	**1.82**	**1.98**	**1.98**	**1.95**	**1.89**	**1.74**	**1.91**	**2.30**	**2.64**	**3.09**	**3.87**	**4.34**	**4.36**	**4.15**	**3.59**	**2.88**	**2.31**	**2.05**	**1.93**	**1.91**	**1.93**	**2.50**

SENSOR HEIGHT : 20m

Based on Data June 2014 to May 2015

NATIONAL INSTITUTE OF WIND ENERGY CHENNAI

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PARAPOOL PARA

TABLE 7

PERCENTAGE FREQUENCY DISTRIBUTION OF WIND SPEED

CLASS INTERVAL (m/s)	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-14	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14	ANNUAL
0.0-1.0	4.44	5.48	6.90	11.06	14.40	17.96	25.45	31.34	22.43	21.35	10.12	9.95	15.07
1.0-2.0	22.80	23.14	23.50	27.87	27.17	21.76	23.68	24.71	23.61	27.11	29.61	26.16	25.09
2.0-3.0	35.98	35.52	31.23	26.83	26.41	23.91	17.99	19.94	21.78	27.62	33.63	33.71	27.88
3.0-4.0	21.82	15.87	14.78	13.66	15.46	15.51	11.49	11.31	12.75	13.49	16.67	18.39	15.10
4.0-5.0	12.05	12.38	12.03	10.63	11.20	9.58	9.61	8.06	9.93	8.24	7.89	8.36	10.00
5.0-6.0	2.33	6.87	8.51	7.38	4.64	5.69	7.10	3.34	6.78	2.08	1.81	2.26	4.90
6.0-7.0	0.54	0.72	2.35	2.43	0.47	3.94	3.34	1.10	2.25	0.09	0.28	1.03	1.54
7.0-8.0	0.02	0.02	0.63	0.09	0.16	1.20	1.19	0.16	0.44	0.02	0.00	0.11	0.34
8.0-9.0	0.02	0.00	0.07	0.02	0.07	0.32	0.11	0.04	0.02	0.00	0.00	0.02	0.06
9.0-10.0	0.00	0.00	0.00	0.02	0.00	0.12	0.04	0.00	0.00	0.00	0.00	0.00	0.02
10.0-11.0	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11.0-12.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12.0-13.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13.0-14.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14.0-15.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.0-16.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16.0-17.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17.0-18.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18.0-19.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19.0-20.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20.0-21.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

SENSOR HEIGHT: 20m **Based on Data June 2014 to May 2015**

Range 0--1 Extends from 0 to 0.99 m/s &
1-- 2 Extends from 1 to 1.99 m/s etc.

PARAPOOL PARA

TABLE 7A

PERCENTAGE FREQUENCY DISTRIBUTION OF WIND SPEED

CLASS INTERVAL (m/s)	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-14	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14	ANNUAL
0.0-1.0	2.89	3.22	3.97	6.55	6.45	9.42	16.80	20.65	10.60	9.59	6.46	9.95	8.88
1.0-2.0	11.45	9.30	11.04	16.57	16.08	12.34	13.96	18.88	15.49	17.25	15.07	26.16	15.30
2.0-3.0	22.24	25.30	21.66	24.86	24.19	18.06	18.03	20.32	22.64	26.23	27.36	33.71	23.72
3.0-4.0	25.54	24.88	23.32	21.02	22.42	18.68	16.73	18.19	19.35	22.49	25.14	18.39	21.35
4.0-5.0	24.10	18.43	18.79	14.17	16.40	17.25	11.16	11.27	13.98	16.13	16.27	8.36	15.52
5.0-6.0	10.46	13.69	12.99	9.42	9.77	11.09	9.61	6.41	9.28	6.79	6.99	2.26	9.06
6.0-7.0	2.11	4.66	6.12	5.51	3.81	6.04	7.55	2.76	5.58	1.41	2.06	1.03	4.05
7.0-8.0	0.87	0.47	1.64	1.67	0.47	3.84	3.85	1.03	2.27	0.02	0.60	0.11	1.40
8.0-9.0	0.27	0.05	0.38	0.19	0.18	2.11	1.77	0.40	0.67	0.09	0.05	0.02	0.51
9.0-10.0	0.07	0.00	0.07	0.00	0.09	0.86	0.47	0.07	0.12	0.00	0.00	0.00	0.14
10.0-11.0	0.00	0.00	0.02	0.00	0.11	0.19	0.02	0.00	0.02	0.00	0.00	0.00	0.03
11.0-12.0	0.00	0.00	0.00	0.05	0.00	0.14	0.00	0.02	0.00	0.00	0.00	0.00	0.02
12.0-13.0	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00
13.0-14.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14.0-15.0	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.0-16.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16.0-17.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17.0-18.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18.0-19.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19.0-20.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20.0-21.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

SENSOR HEIGHT: 50m **Based on Data June 2014 to May 2015**

Range 0--1 Extends from 0 to 0.99 m/s &
1-- 2 Extends from 1 to 1.99 m/s etc.

PARAPOOL PARA

TABLE 7B

PERCENTAGE FREQUENCY DISTRIBUTION OF WIND SPEED

CLASS INTERVAL (m/s)	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-14	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14	ANNUAL
0.0-1.0	3.81	2.65	4.46	6.90	5.67	9.42	11.49	18.59	14.98	13.40	9.17	9.95	9.21
1.0-2.0	11.94	11.43	10.28	14.14	14.61	10.90	11.58	15.93	13.59	17.83	15.60	26.16	14.50
2.0-3.0	19.27	21.53	18.88	23.87	21.89	15.19	14.72	16.08	16.88	21.77	23.61	33.71	20.62
3.0-4.0	20.81	20.71	20.14	18.84	21.15	15.00	15.37	18.23	17.04	18.68	21.18	18.39	18.80
4.0-5.0	22.67	19.27	18.91	15.12	16.40	15.21	14.74	15.59	15.02	16.02	16.67	8.36	16.16
5.0-6.0	14.47	15.80	15.57	11.20	12.61	15.46	11.65	9.03	10.35	9.25	8.01	2.26	11.31
6.0-7.0	4.50	6.70	8.53	6.97	5.94	8.40	9.68	3.90	7.57	2.64	3.45	1.03	5.78
7.0-8.0	1.19	1.29	2.49	2.48	1.05	4.65	5.76	1.39	2.94	0.27	1.64	0.11	2.10
8.0-9.0	0.90	0.42	0.52	0.35	0.20	3.33	3.16	0.96	1.23	0.07	0.51	0.02	0.97
9.0-10.0	0.22	0.20	0.20	0.09	0.25	1.57	1.46	0.22	0.32	0.07	0.16	0.00	0.40
10.0-11.0	0.16	0.00	0.00	0.00	0.13	0.53	0.34	0.04	0.07	0.00	0.00	0.00	0.11
11.0-12.0	0.02	0.00	0.02	0.00	0.07	0.21	0.02	0.00	0.02	0.00	0.00	0.00	0.03
12.0-13.0	0.04	0.00	0.00	0.05	0.02	0.09	0.00	0.02	0.00	0.00	0.00	0.00	0.02
13.0-14.0	0.00	0.00	0.00	0.00	0.00	0.02	0.04	0.00	0.00	0.00	0.00	0.00	0.01
14.0-15.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.0-16.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16.0-17.0	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17.0-18.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18.0-19.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19.0-20.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20.0-21.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

SENSOR HEIGHT: 78m **Based on Data June 2014 to May 2015**

Range 0--1 Extends from 0 to 0.99 m/s &
1-- 2 Extends from 1 to 1.99 m/s etc.

PARAPOOL PARA

TABLE 7C

PERCENTAGE FREQUENCY DISTRIBUTION OF WIND SPEED

CLASS INTERVAL (m/s)	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-14	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14	ANNUAL
0.0-1.0	3.90	2.95	4.41	7.41	5.96	8.96	10.60	18.59	11.74	12.57	8.66	9.39	8.76
1.0-2.0	10.84	10.17	9.21	13.19	13.04	10.02	10.37	15.93	12.66	15.93	14.58	12.84	12.40
2.0-3.0	19.15	20.63	18.28	23.63	21.66	14.35	14.96	16.08	17.82	22.83	23.61	21.91	19.58
3.0-4.0	21.46	21.13	20.09	18.36	21.95	15.51	14.76	18.23	17.22	19.47	21.85	21.01	19.25
4.0-5.0	22.11	19.69	18.95	15.28	16.31	15.46	15.41	15.59	16.00	15.95	17.06	17.20	17.08
5.0-6.0	15.03	16.54	16.06	11.60	12.50	14.88	12.25	9.03	11.00	9.72	8.24	8.00	12.07
6.0-7.0	4.75	6.85	9.27	7.11	6.43	9.44	9.77	3.90	8.19	3.02	3.43	4.35	6.38
7.0-8.0	1.25	1.29	2.55	2.82	1.43	5.25	6.27	1.39	3.38	0.38	1.81	2.46	2.53
8.0-9.0	1.01	0.45	0.83	0.37	0.22	3.36	3.41	0.96	1.41	0.04	0.58	1.64	1.19
9.0-10.0	0.22	0.30	0.25	0.19	0.20	1.85	1.61	0.22	0.46	0.07	0.19	0.65	0.52
10.0-11.0	0.18	0.00	0.07	0.00	0.16	0.51	0.47	0.04	0.07	0.02	0.00	0.38	0.16
11.0-12.0	0.04	0.00	0.02	0.00	0.09	0.23	0.07	0.00	0.05	0.00	0.00	0.11	0.05
12.0-13.0	0.04	0.00	0.00	0.05	0.02	0.14	0.00	0.02	0.00	0.00	0.00	0.07	0.03
13.0-14.0	0.00	0.00	0.00	0.00	0.00	0.02	0.04	0.00	0.00	0.00	0.00	0.00	0.01
14.0-15.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.0-16.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16.0-17.0	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17.0-18.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18.0-19.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19.0-20.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20.0-21.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

SENSOR HEIGHT: 80m **Based on Data June 2014 to May 2015**

Range 0--1 Extends from 0 to 0.99 m/s &
1-- 2 Extends from 1 to 1.99 m/s etc.

PARAPOOL PARA

TABLE 8

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED

Deg/ (m/s)	345-15	15-45	45-75	75-105	105-135	135-165	165-195	195-225	225-255	255-285	285-315	315-345	ANNUAL
0.0-1.0	1.20	1.21	1.03	0.98	0.66	0.54	0.41	0.37	0.39	0.50	0.63	0.76	8.7
1.0-2.0	2.03	1.96	1.88	1.99	1.23	0.73	0.61	0.52	0.56	0.65	1.03	1.19	14.4
2.0-3.0	3.10	2.51	2.60	3.62	2.19	0.83	0.64	0.95	1.05	1.10	2.04	2.49	23.1
3.0-4.0	2.47	1.04	1.15	3.76	2.38	0.64	0.46	0.90	1.70	1.55	2.77	2.97	21.8
4.0-5.0	1.05	0.19	0.28	2.22	1.79	0.29	0.23	0.80	2.91	1.58	2.61	2.24	16.2
5.0-6.0	0.27	0.05	0.06	0.85	0.73	0.14	0.09	0.46	2.51	1.27	2.02	0.90	9.4
6.0-7.0	0.05	0.01	0.02	0.36	0.25	0.04	0.03	0.10	1.07	0.67	1.24	0.34	4.2
7.0-8.0	0.02	0.00	0.00	0.21	0.09	0.01	0.00	0.02	0.18	0.38	0.52	0.11	1.5
8.0-9.0	0.00	0.00	0.00	0.06	0.02	0.01	0.00	0.00	0.03	0.17	0.22	0.03	0.5
9.0-10.0	0.00	0.00	0.00	0.02	0.01	0.00	0.00	0.00	0.01	0.06	0.04	0.01	0.2
10.0-11.0	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.0
11.0-12.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.0
12.0-13.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13.0-14.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14.0-15.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15.0-16.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16.0-17.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
17.0-18.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
18.0-19.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
19.0-20.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
Total	10.2	7.0	7.0	14.1	9.4	3.2	2.5	4.1	10.4	8.0	13.1	11.0	100.0

SENSOR HEIGHT: 50m

Based on Data June 2014 to May 2015

Range 0--1 Extends from 0 to 0.99 m/s &

1-- 2 Extends from 1 to 1.99 m/s etc.

PARAPOOL PARA

TABLE 8A

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED

Deg/ (m/s)	345-15	15-45	45-75	75-105	105-135	135-165	165-195	195-225	225-255	255-285	285-315	315-345	ANNUAL
0.0-1.0	1.55	1.17	1.01	0.90	0.74	0.53	0.58	0.37	0.40	0.50	0.67	0.80	9.2
1.0-2.0	2.29	1.71	1.42	1.65	1.13	0.69	0.62	0.52	0.54	0.54	1.06	1.39	13.6
2.0-3.0	3.15	1.79	1.60	2.48	2.04	0.89	0.60	0.85	1.04	0.94	1.80	2.45	19.6
3.0-4.0	2.62	0.73	0.62	2.29	2.41	0.72	0.48	0.83	1.63	1.30	2.51	2.85	19.0
4.0-5.0	1.82	0.21	0.21	1.62	1.91	0.42	0.28	0.66	2.69	1.62	2.80	2.63	16.9
5.0-6.0	0.86	0.07	0.09	0.99	1.20	0.19	0.13	0.46	2.48	1.34	2.39	1.52	11.7
6.0-7.0	0.25	0.04	0.02	0.62	0.44	0.06	0.03	0.09	1.26	0.86	1.58	0.73	6.0
7.0-8.0	0.03	0.01	0.01	0.33	0.16	0.02	0.01	0.02	0.25	0.45	0.75	0.25	2.3
8.0-9.0	0.01	0.00	0.00	0.22	0.07	0.01	0.00	0.00	0.06	0.31	0.33	0.07	1.1
9.0-10.0	0.01	0.00	0.00	0.10	0.03	0.00	0.00	0.00	0.02	0.15	0.12	0.02	0.4
10.0-11.0	0.00	0.00	0.00	0.04	0.01	0.00	0.00	0.00	0.01	0.05	0.02	0.01	0.1
11.0-12.0	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.0
12.0-13.0	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.0
13.0-14.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14.0-15.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15.0-16.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16.0-17.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
17.0-18.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
18.0-19.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
19.0-20.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
Total	12.6	5.7	5.0	11.3	10.1	3.5	2.7	3.8	10.4	8.1	14.0	12.7	100.0

SENSOR HEIGHT: 78m

Based on Data June 2014 to May 2015

Range 0--1 Extends from 0 to 0.99 m/s &
1-- 2 Extends from 1 to 1.99 m/s etc.

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PARAPOOL PARA

TABLE 8B

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED

Deg/ (m/s)	345-15	15-45	45-75	75-105	105-135	135-165	165-195	195-225	225-255	255-285	285-315	315-345	ANNUAL
0.0-1.0	1.33	1.08	0.95	0.89	0.70	0.49	0.52	0.37	0.39	0.50	0.62	0.72	8.6
1.0-2.0	1.84	1.53	1.40	1.58	1.06	0.65	0.57	0.47	0.53	0.54	0.95	1.21	12.3
2.0-3.0	3.25	1.85	1.66	2.52	2.06	0.91	0.69	0.84	1.02	0.89	1.72	2.36	19.8
3.0-4.0	2.91	0.88	0.63	2.32	2.48	0.75	0.48	0.85	1.64	1.30	2.35	2.70	19.3
4.0-5.0	1.94	0.25	0.20	1.60	1.89	0.45	0.29	0.67	2.68	1.63	2.79	2.76	17.1
5.0-6.0	0.94	0.08	0.10	0.99	1.21	0.19	0.13	0.48	2.50	1.35	2.47	1.62	12.1
6.0-7.0	0.32	0.04	0.02	0.62	0.44	0.07	0.04	0.10	1.27	0.87	1.69	0.87	6.3
7.0-8.0	0.05	0.01	0.01	0.33	0.17	0.02	0.01	0.03	0.26	0.47	0.86	0.32	2.5
8.0-9.0	0.01	0.00	0.00	0.23	0.08	0.01	0.00	0.01	0.07	0.29	0.38	0.11	1.2
9.0-10.0	0.01	0.00	0.00	0.11	0.02	0.00	0.00	0.00	0.02	0.15	0.17	0.03	0.5
10.0-11.0	0.00	0.00	0.00	0.05	0.02	0.00	0.00	0.00	0.01	0.05	0.03	0.01	0.2
11.0-12.0	0.00	0.00	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.1
12.0-13.0	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.0
13.0-14.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14.0-15.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15.0-16.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16.0-17.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
17.0-18.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
18.0-19.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
19.0-20.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
Total	12.6	5.7	5.0	11.3	10.1	3.5	2.7	3.8	10.4	8.1	14.0	12.7	100.0

SENSOR HEIGHT: 80m

Based on Data June 2014 to May 2015

Range 0--1 Extends from 0 to 0.99 m/s &

1-- 2 Extends from 1 to 1.99 m/s etc.

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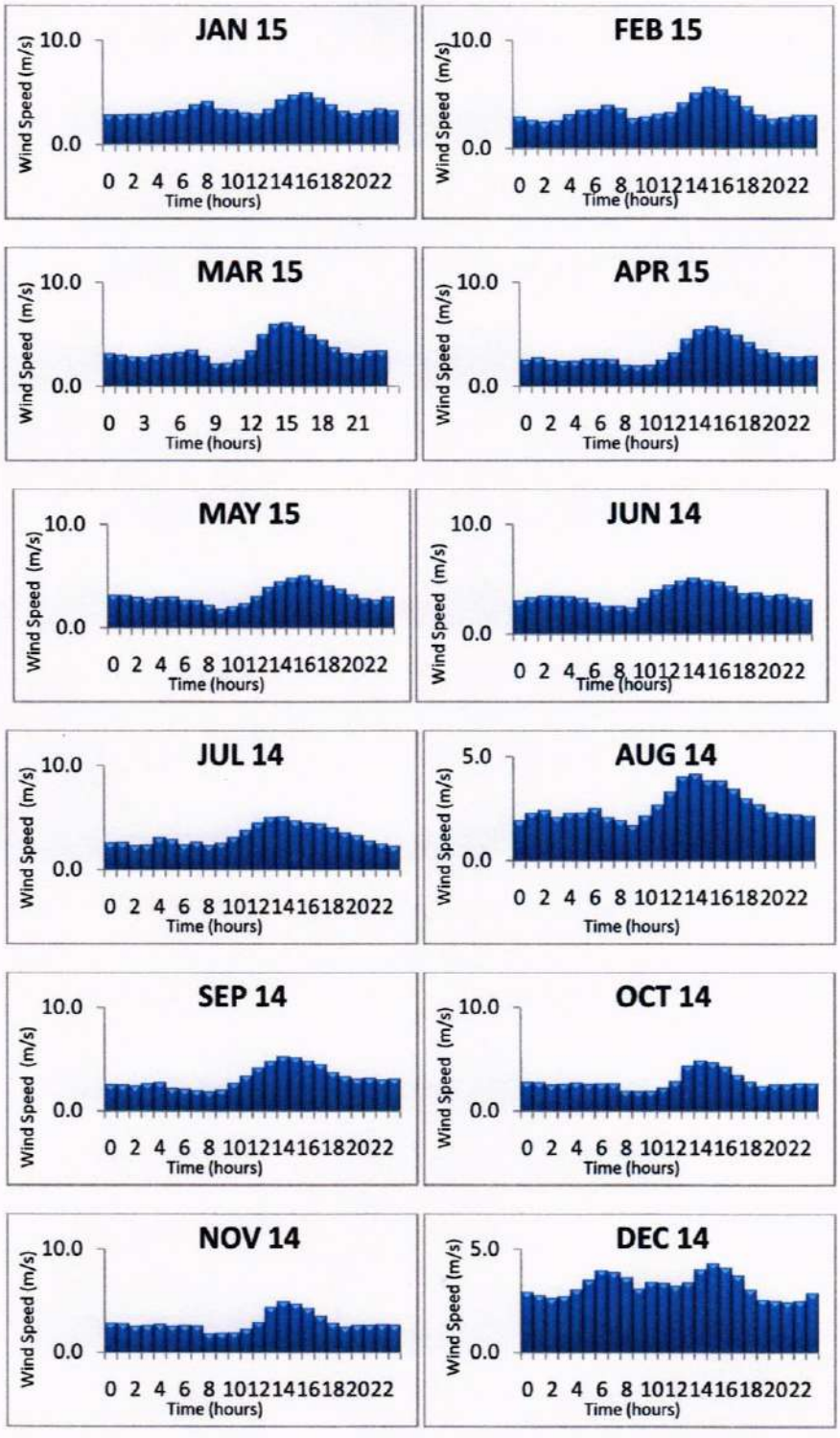
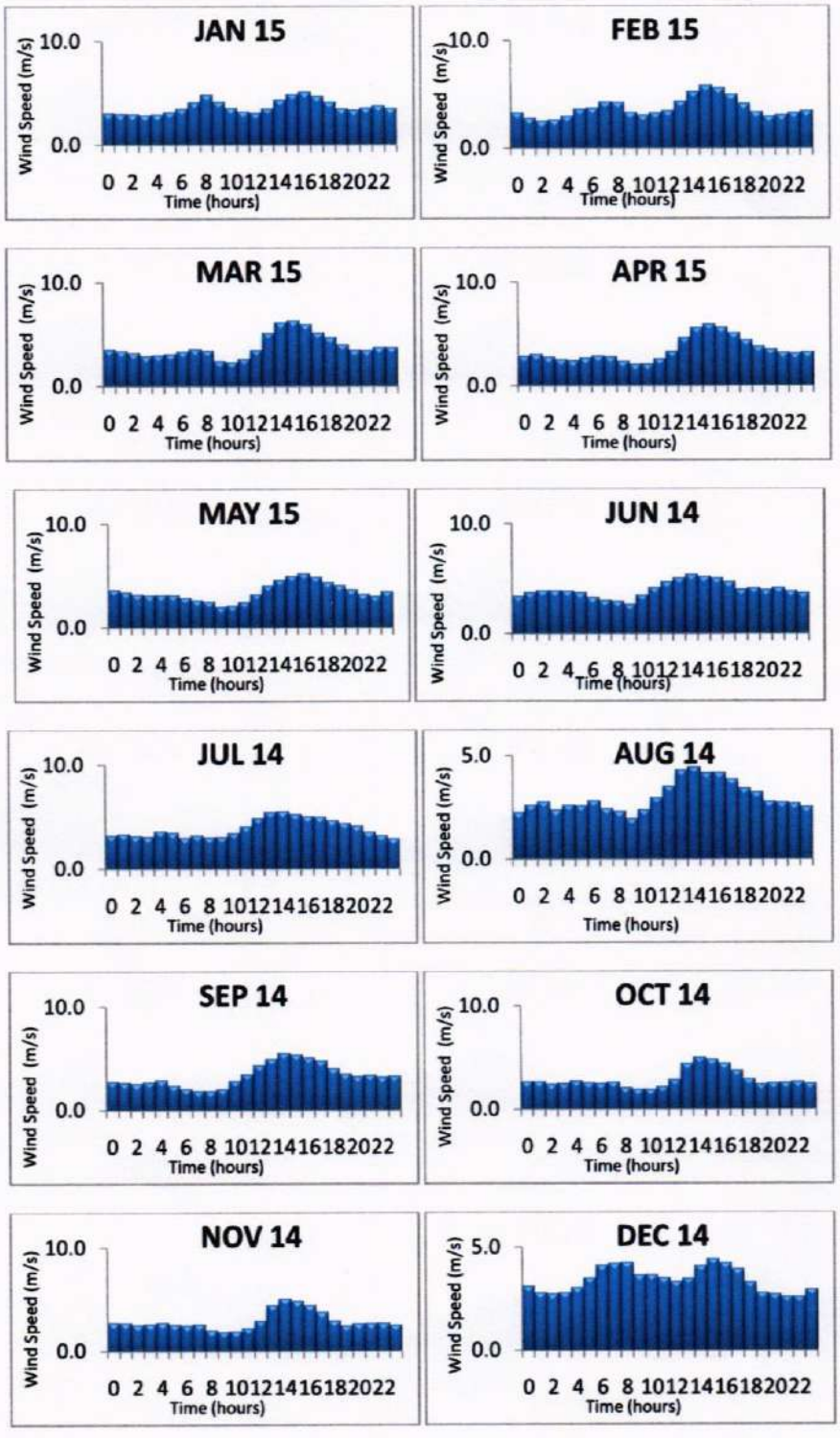
(ISO 9001:2008)



SENSOR HEIGHT: 50m

FIGURE 4: MEAN HOURLY WIND SPEED

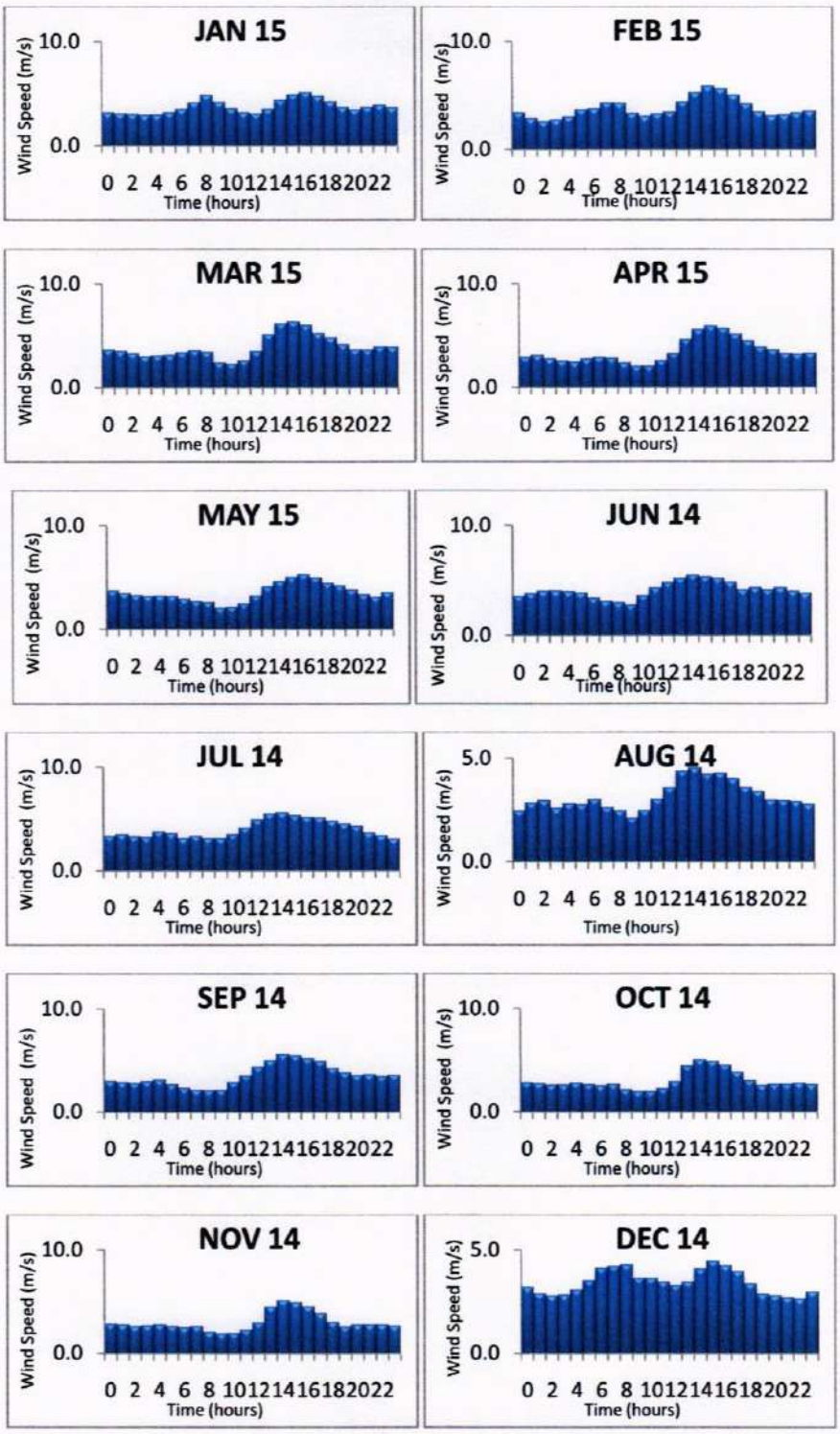
(June 2014 to May 2015)



SENSOR HEIGHT: 78m

FIGURE 4A: MEAN HOURLY WIND SPEED

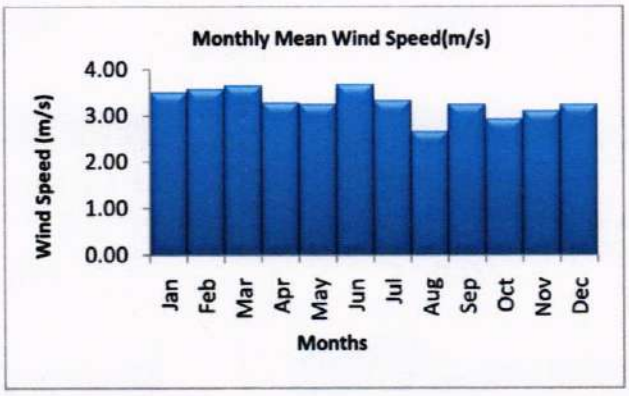
(June 2014 to May 2015)



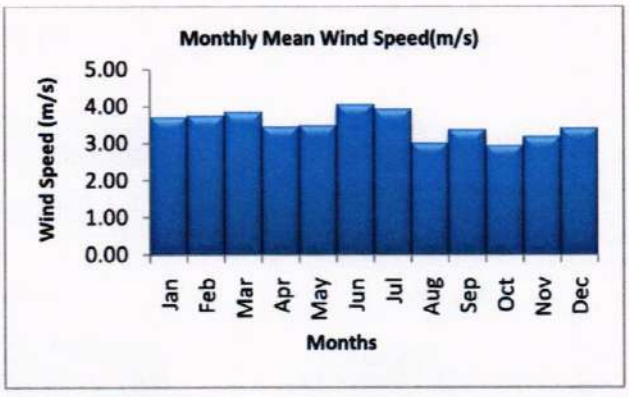
SENSOR HEIGHT: 80m

FIGURE 4B: MEAN HOURLY WIND SPEED

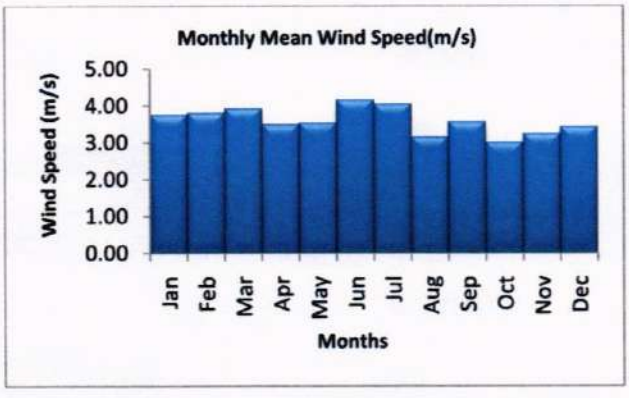
(June 2014 to May 2015)



SENSOR HEIGHT: 50m

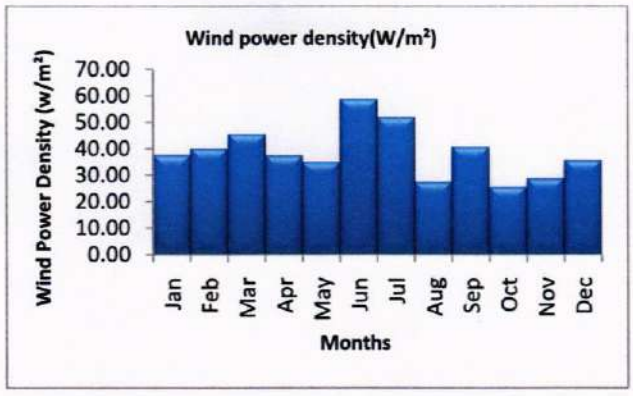


SENSOR HEIGHT: 78 m

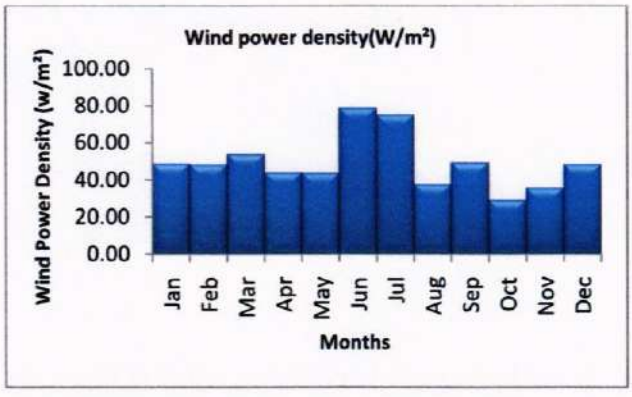


SENSOR HEIGHT: 80m

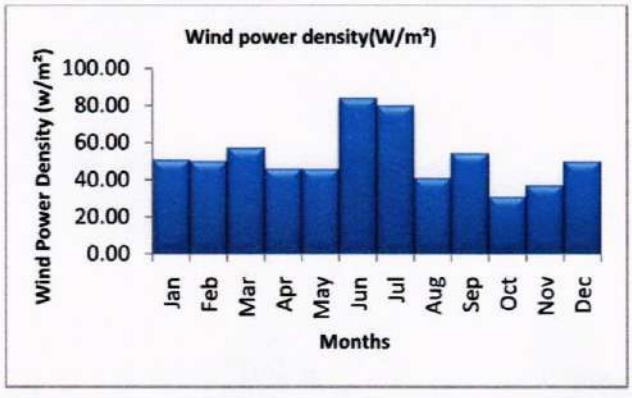
FIGURE 5: MONTHLY MEAN WIND SPEED (June 2014 to May 2015)



SENSOR HEIGHT: 50m



SENSOR HEIGHT: 78m



SENSOR HEIGHT: 80m

FIGURE 6: MONTHLY MEAN WIND POWER DENSITY (June 2014 to May 2015)

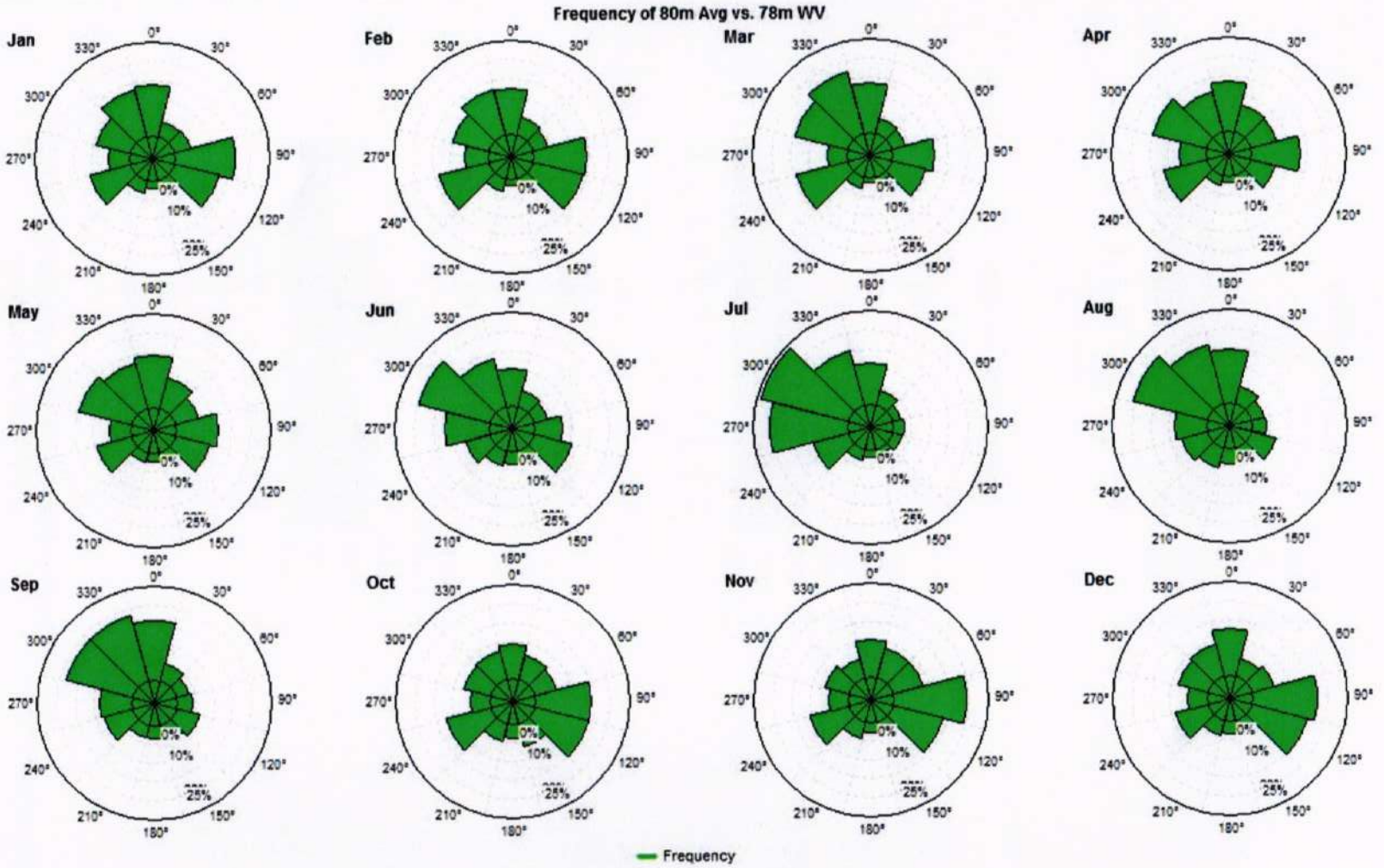


FIGURE 7: WIND ROSE
SENSOR HEIGHT: (80m Anemometer and 78m Wind vane)
(June 2014 to May 2015)

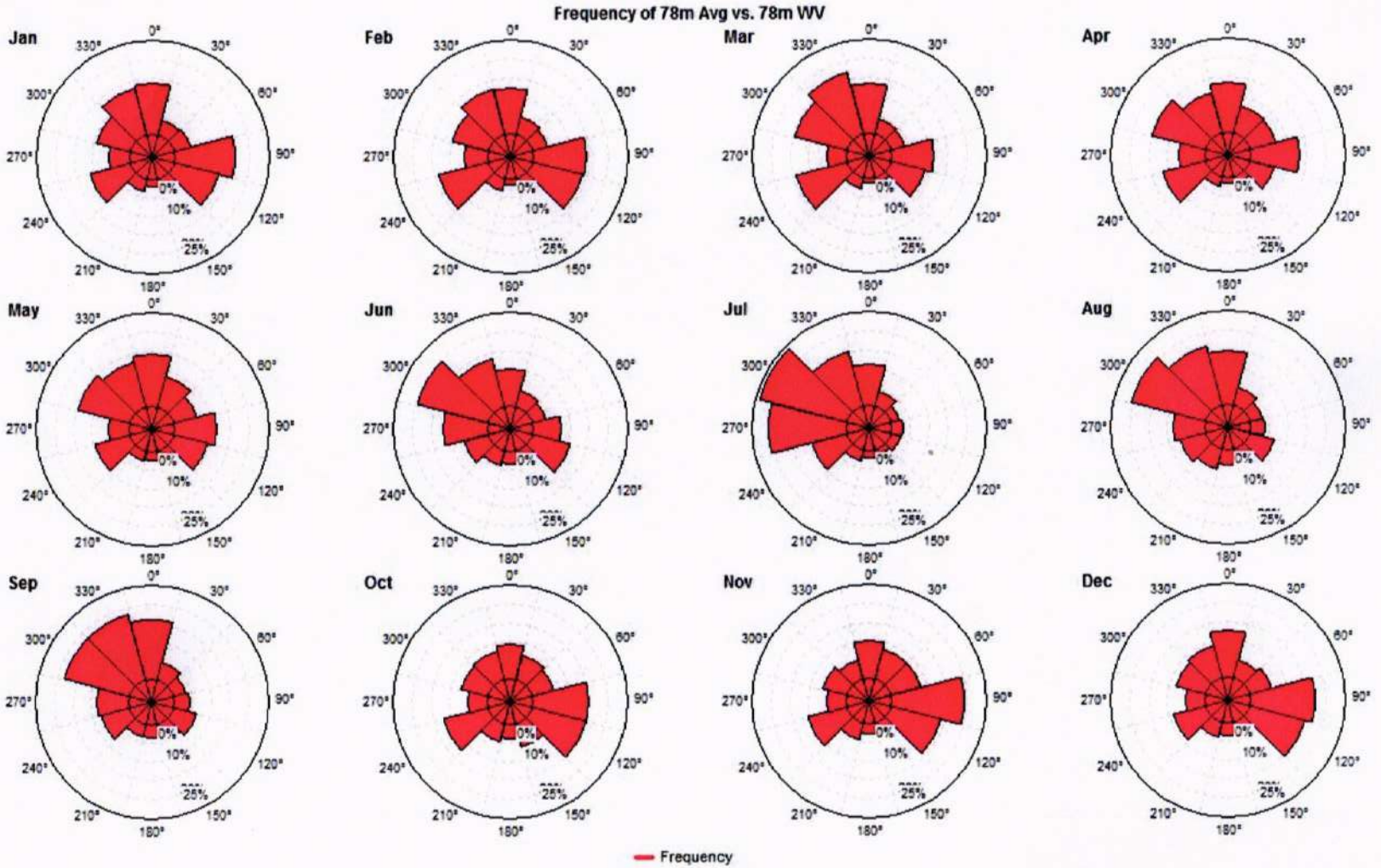


FIGURE 7A: WIND ROSE
SENSOR HEIGHT: (78m Anemometer and 78m Wind vane)
(June 2014 to May 2015)

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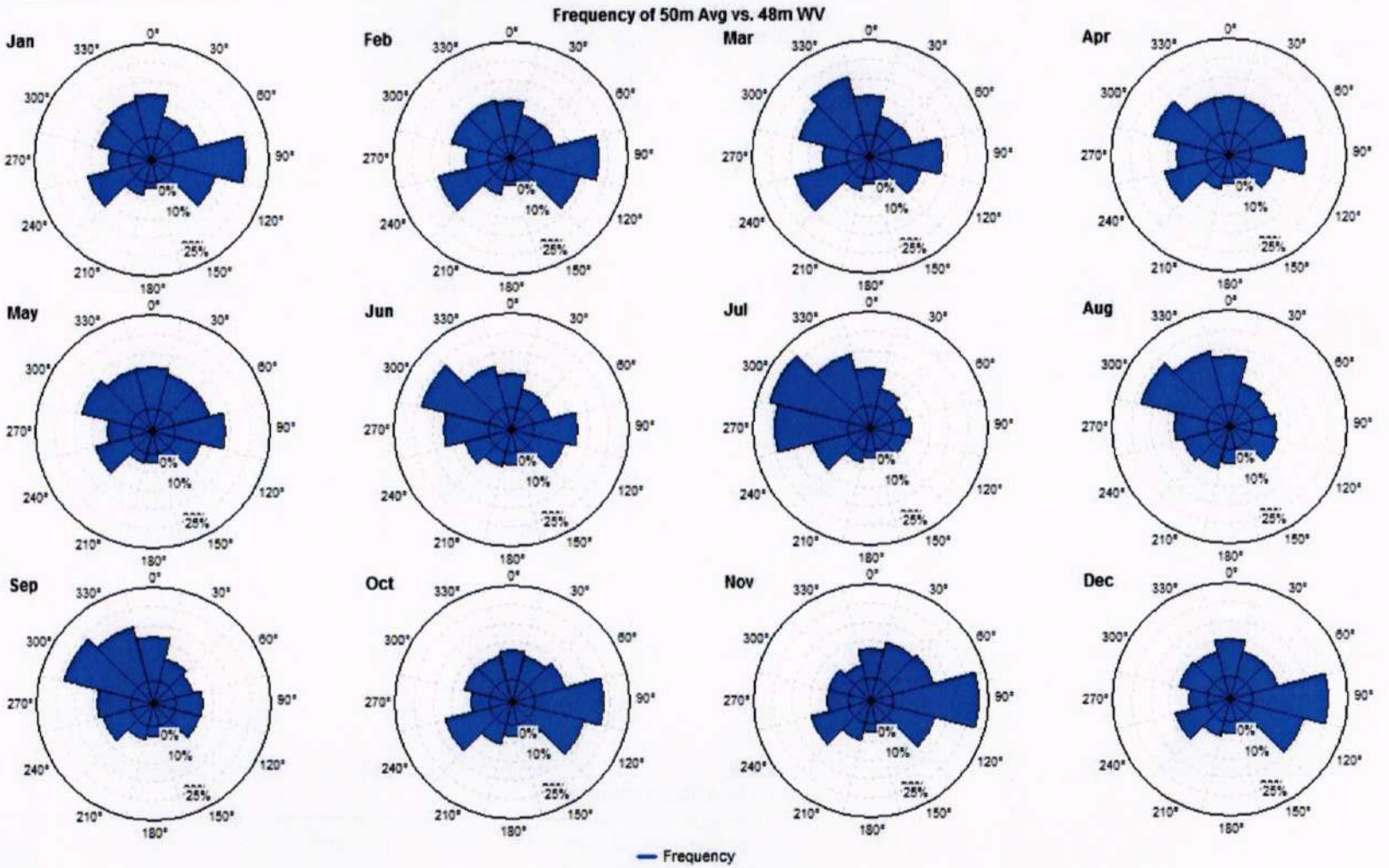


FIGURE 7B: WIND ROSE
SENSOR HEIGHT: (50m Anemometer and 48m Wind vane)
(June 2014 to May 2015)

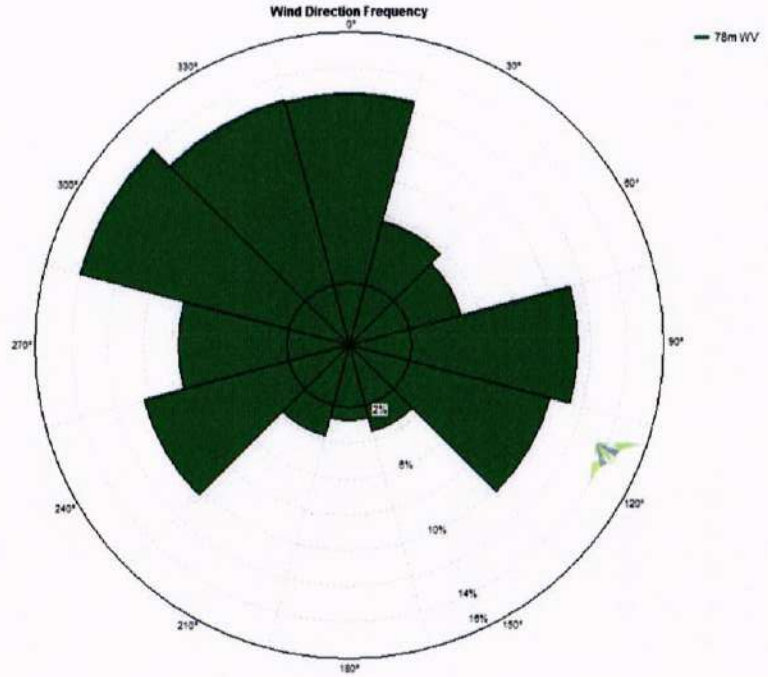
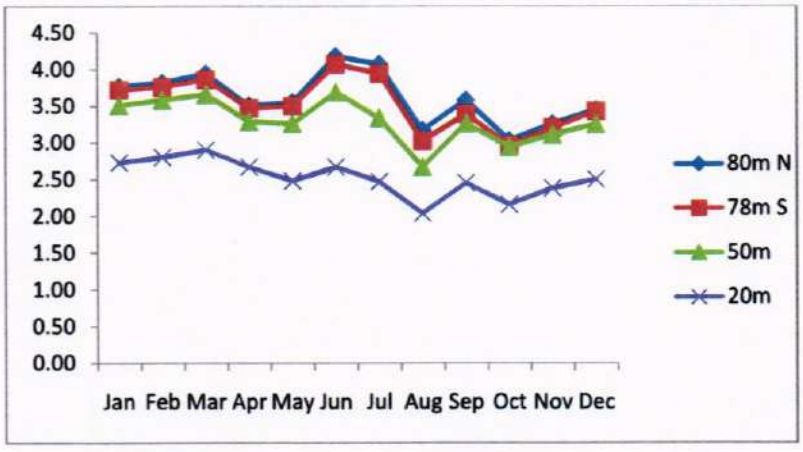
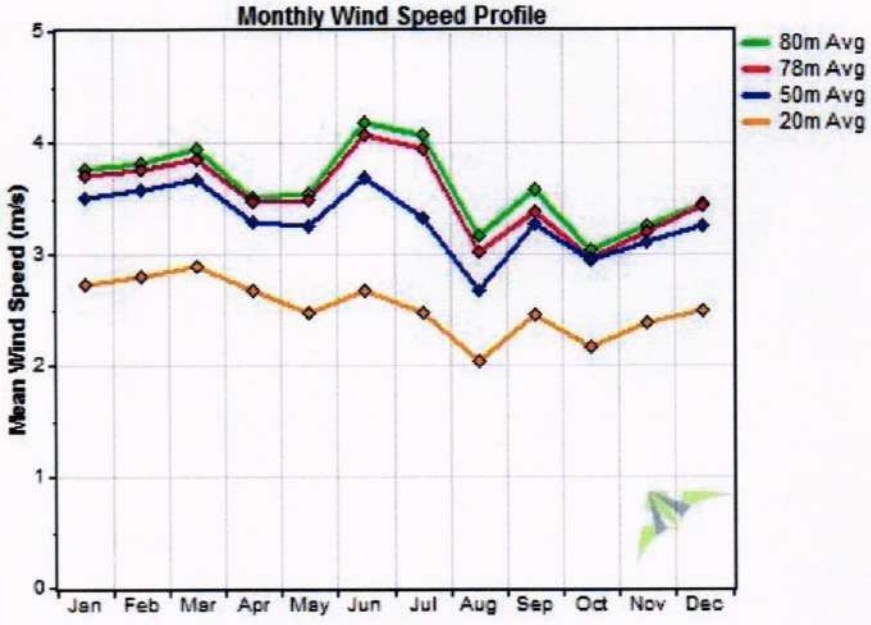


FIGURE 7C: ANNUAL WIND ROSE
SENSOR HEIGHT: (80m Anemometer and 78m Wind vane)
(June 2014 to May 2015)



MONTHLY MEAN WIND SPEED
(JULY2014 TO MAY 2015)



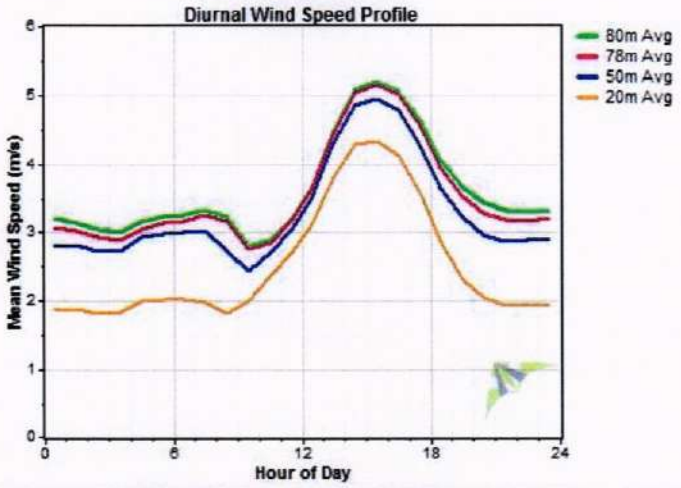


FIGURE 8: MONTHLY WIND SPEED AND DAILY WIND SPEED – PARAPOOL PARA (JULY 2014 TO MAY 2015)

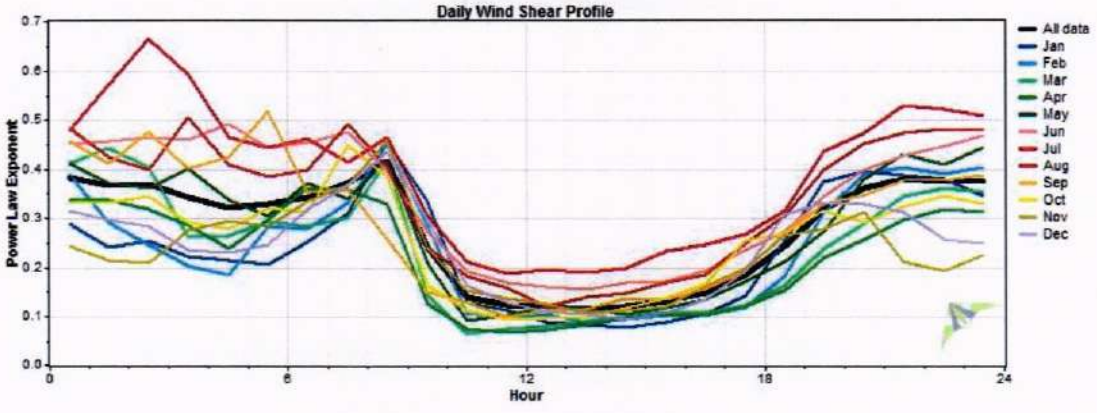


FIGURE 9: DAILY WIND SHEAR-PARAPOOL PARA (JULY 2014 TO MAY 2015)

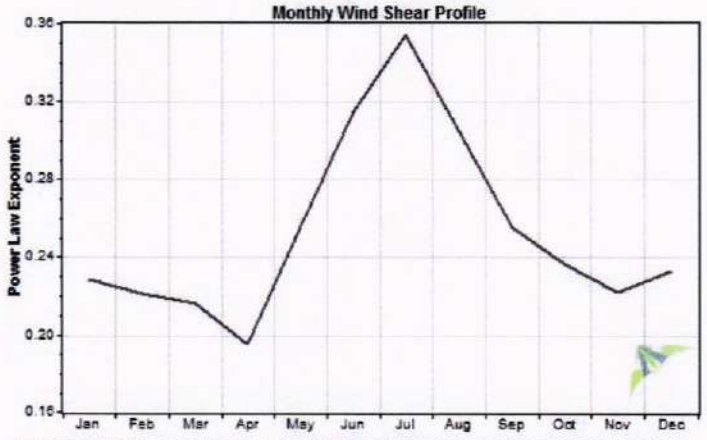


FIGURE 10: MONTHLY WIND SHEAR- PARAPOOL PARA (JULY 2014 TO MAY 2015)

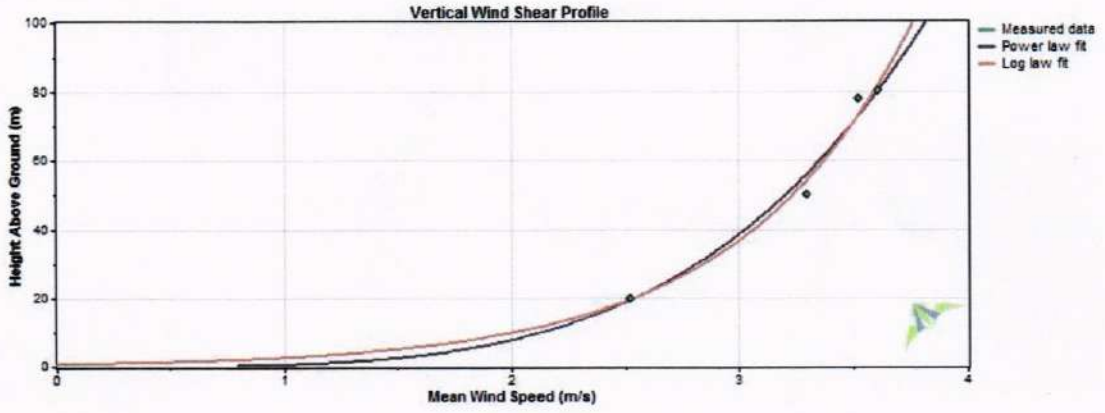
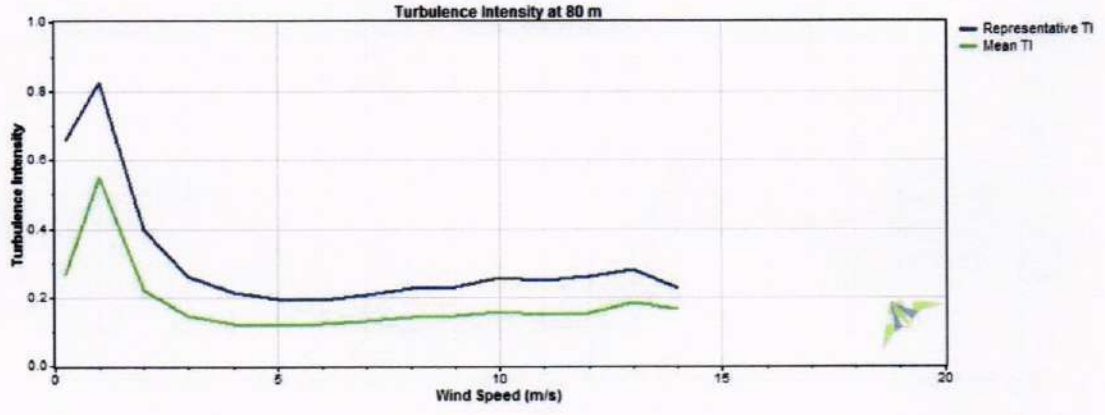
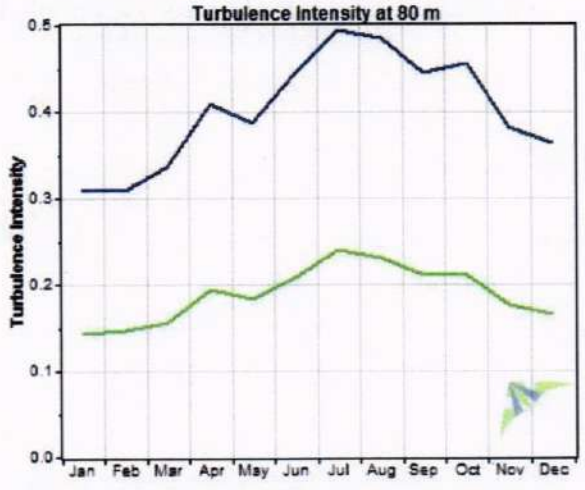
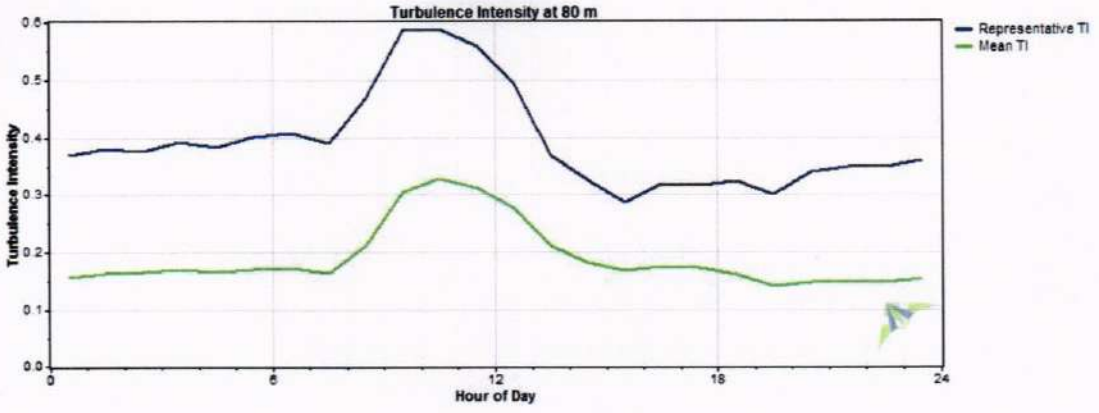


FIGURE 11: VERTICALWIND SHEAR- PARAPOOL PARA (JULY 2014 TO MAY 2015)







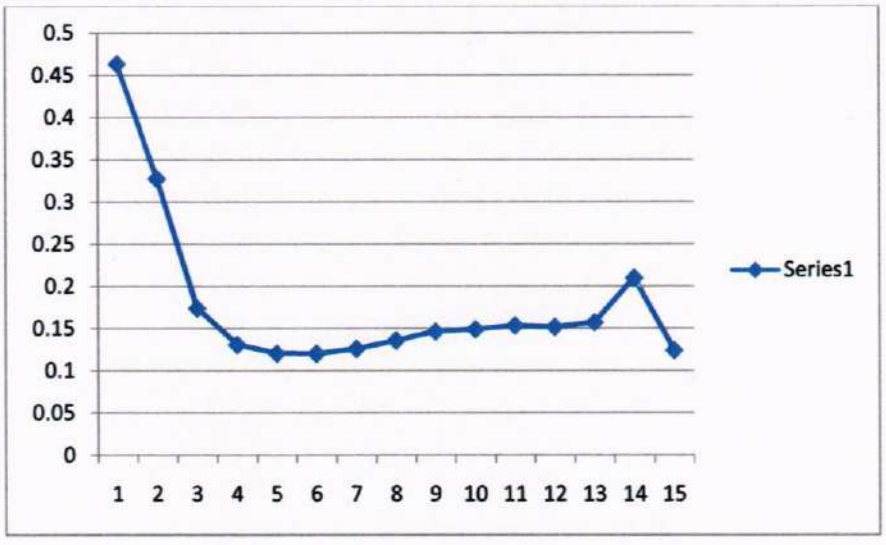
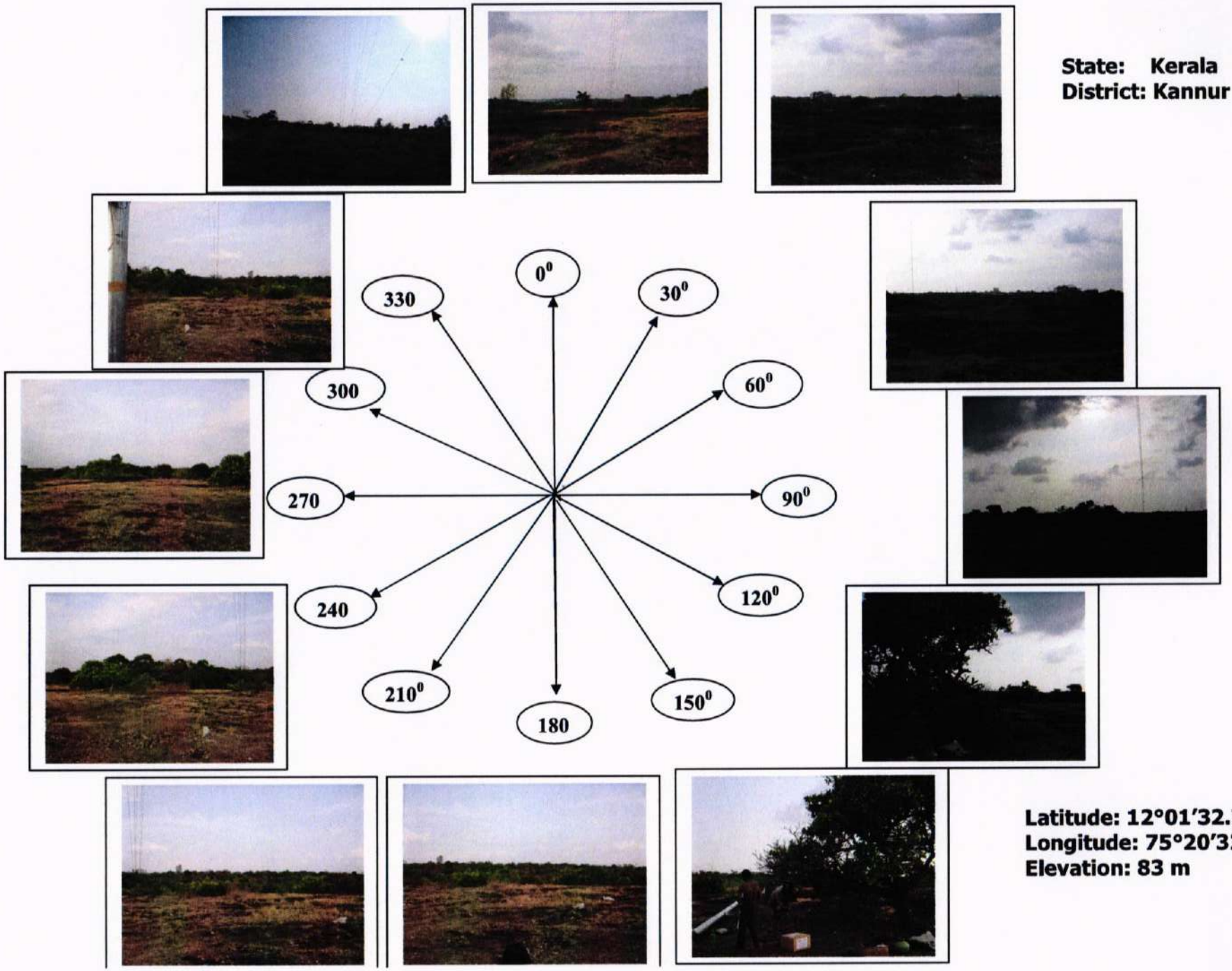


FIGURE 12: TURBULANCE INTENSITY – PARAPOOL PARA (JULY 2014 TO MAY 2015)

Annexure -2

Site Photographs

(a) 12 Sector wise photograph of "Parapool Para" site



State: Kerala
District: Kannur

Latitude: 12°01'32.7"
Longitude: 75°20'32.4"
Elevation: 83 m

Annexure-3

Calibration Reports

Svend Ole Hansen ApS
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WIND ENGINEERING FLUID DYNAMICS

CERTIFICATE FOR CALIBRATION OF CUP ANEMOMETER

Certificate number: 11.02.0928 **Date of issue:** February 10, 2011

Type: NRG #40 **Serial number:** 179500166149

Manufacturer: NRG Systems, 110 Commerce Street, Hinesburg, Vermont 05461, USA

Client: NRG Systems, Inc., 110 Riggs Road, Hinesburg, VT 05461, USA

Anemometer received: December 16, 2010 **Anemometer calibrated:** February 9, 2011

Calibrated by: mr **Calibration procedure:** IEC 61400-12-1, MEASNET

Certificate prepared by: jsa **Approved by:** Calibration engineer, soh

Svend Ole Hansen

Calibration equation obtained: v [m/s] = 0.76227 · f [Hz] + 0.32862

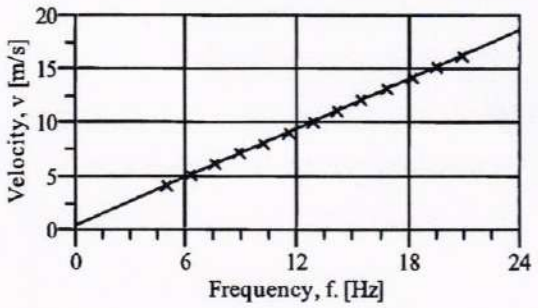
Standard uncertainty, slope: 0.00164 **Standard uncertainty, offset:** 0.05255

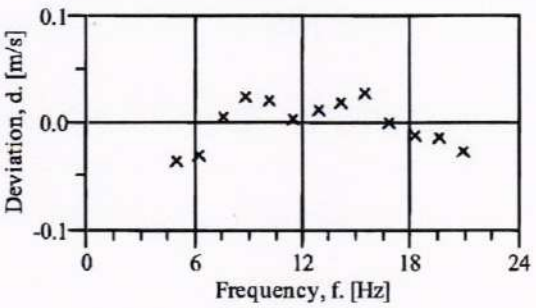
Covariance: -0.0000202 (m/s)²/Hz **Coefficient of correlation:** $\rho = 0.999985$

Absolute maximum deviation: -0.035 m/s at 4.110 m/s

Barometric pressure: 1021.3 hPa **Relative humidity:** 20.2%

Succession	Velocity pressure, q. [Pa]	Temperature in wind tunnel [°C]	Temperature in control room [°C]	Wind velocity, v. [m/s]	Frequency, f. [Hz]	Deviation, d. [m/s]	Uncertainty u_c (k=2) [m/s]
2	9.86	30.6	24.1	4.110	5.0063	-0.035	0.028
4	15.20	30.5	24.1	5.102	6.3005	-0.029	0.032
6	21.75	30.4	24.1	6.101	7.5648	0.006	0.037
8	29.56	30.2	24.0	7.111	8.8666	0.024	0.043
10	38.46	30.2	24.0	8.111	10.1820	0.021	0.048
12	48.73	30.1	24.0	9.129	11.5382	0.005	0.054
13-last	60.31	30.0	24.0	10.155	12.8739	0.013	0.060
11	72.58	30.1	24.0	11.141	14.1593	0.019	0.066
9	86.29	30.2	24.0	12.150	15.4722	0.027	0.072
7	101.58	30.3	24.1	13.185	16.8658	0.000	0.078
5	117.85	30.4	24.1	14.205	18.2190	-0.012	0.084
3	135.10	30.5	24.1	15.211	19.5417	-0.014	0.090
1-first	153.57	30.7	24.2	16.224	20.8877	-0.027	0.096





DANAK
CAL Reg.nr. 452
Accreditation to ISO 17025

EQUIPMENT USED

Serial number	Description
-	Boundary layer wind tunnel.
1256	Control cup anemometer.
-	Mounting tube, D = 25 mm
t1	PT100 temperature sensor, wind tunnel.
t2	PT100 temperature sensor, control room.
9904031	PPC500 Furness pressure manometer
X4650038	HMW71U Humidity transmitter
X4350042	PTB100AVaisala analogue barometer.
P11	Pitot tube
001551	Computer Board. 16 bit A/D data acquisition board.
-	PC dedicated to data acquisition.

Traceable calibrations of the equipment are carried out by external accredited institutions: Furness (PPC500) and Saab Metech. A real-time analysis module within the data acquisition software detects pulse frequency.

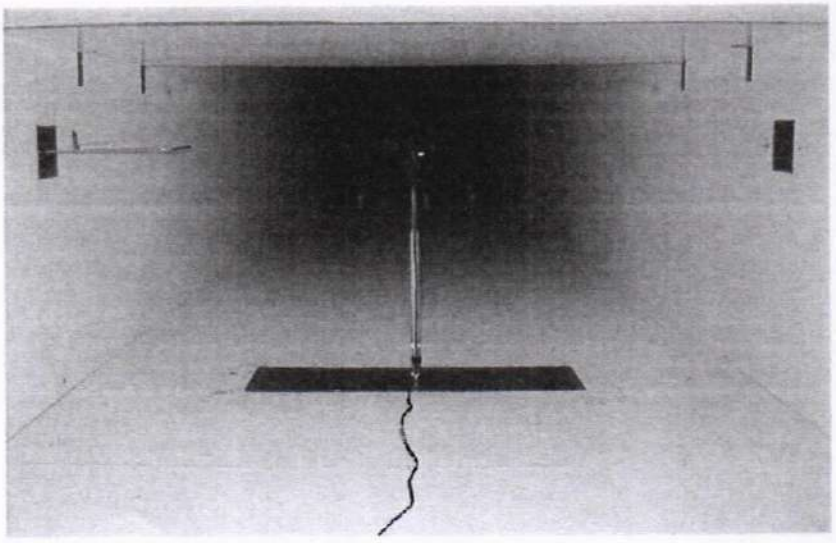


Photo of a cup anemometer in the wind tunnel. The shown anemometer is of the same type as the calibrated one.

UNCERTAINTIES

The documented uncertainty is the total combined uncertainty at 95% confidence level (k=2) in accordance with EA-4/02. The uncertainty at 10 m/s comply with the requirements in the MEASNET procedure that prescribes an absolute uncertainty less than 0.1 m/s at a mean wind velocity of 10 m/s, that is 1%. See Document 97.00.004 "MEASNET - Test report on the calibration campaign" for further details.

Certificate number: 11.02.0928

Svend Ole Hansen ApS

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WIND ENGINEERING FLUID DYNAMICS

CERTIFICATE FOR CALIBRATION OF CUP ANEMOMETER

Certificate number: 11.02.1058 **Date of issue:** February 14, 2011

Type: NRG #40 **Serial number:** 179500166151

Manufacturer: NRG Systems, 110 Commerce Street, Hinesburg, Vermont 05461, USA

Client: NRG Systems, Inc., 110 Riggs Road, Hinesburg, VT 05461, USA

Anemometer received: December 16, 2010 **Anemometer calibrated:** February 13, 2011

Calibrated by: asj **Calibration procedure:** IEC 61400-12-1, MEASNET

Certificate prepared by: jsa **Approved by:** Calibration engineer, soh

Svend Ole Hansen

Calibration equation obtained: v [m/s] = 0.76702 · f [Hz] + 0.31149

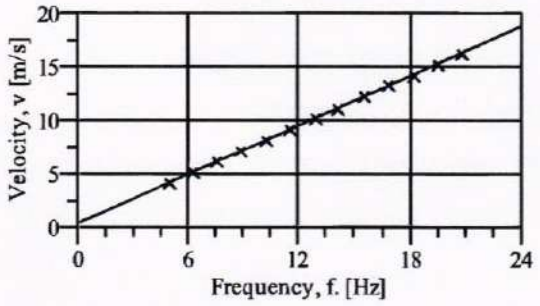
Standard uncertainty, slope: 0.00149 **Standard uncertainty, offset:** 0.05075

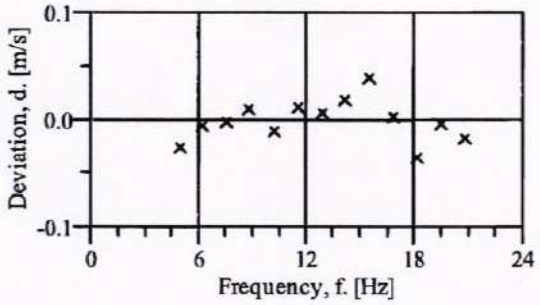
Covariance: -0.0000169 (m/s)²/Hz **Coefficient of correlation:** $\rho = 0.999988$

Absolute maximum deviation: 0.040 m/s at 12.232 m/s

Barometric pressure: 1019.2 hPa **Relative humidity:** 16.1%

Succession	Velocity pressure, q. [Pa]	Temperature in wind tunnel [°C]	Temperature in control room [°C]	Wind velocity, v. [m/s]	Frequency, f. [Hz]	Deviation, d. [m/s]	Uncertainty u_c (k=2) [m/s]
2	9.89	30.0	23.9	4.115	4.9916	-0.025	0.028
4	15.32	29.9	23.9	5.121	6.2754	-0.004	0.033
6	22.01	29.8	23.9	6.137	7.5968	-0.002	0.038
8	29.65	29.7	23.8	7.121	8.8626	0.011	0.043
10	38.92	29.6	23.8	8.157	10.2410	-0.010	0.049
12	49.66	29.5	23.8	9.212	11.5875	0.013	0.055
13-last	61.11	29.4	23.8	10.219	12.9073	0.007	0.061
11	73.18	29.5	23.8	11.183	14.1493	0.019	0.066
9	87.51	29.6	23.8	12.232	15.4900	0.040	0.073
7	102.67	29.7	23.8	13.252	16.8660	0.004	0.079
5	118.43	29.8	23.9	14.236	18.2000	-0.036	0.085
3	136.54	30.0	23.9	15.289	19.5294	-0.002	0.091
1-first	154.79	30.2	24.0	16.285	20.8463	-0.017	0.097





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CAL Reg.nr. 452
Accreditation to ISO 17025

EQUIPMENT USED

Serial number	Description
-	Boundary layer wind tunnel.
1256	Control cup anemometer.
-	Mounting tube, D = 25 mm
t1	PT100 temperature sensor, wind tunnel.
t2	PT100 temperature sensor, control room.
9904031	PPC500 Furness pressure manometer
X4650038	HMW71U Humidity transmitter
X4350042	PTB100A Vaisala analogue barometer.
P11	Pitot tube
001551	Computer Board. 16 bit A/D data acquisition board.
-	PC dedicated to data acquisition.

Traceable calibrations of the equipment are carried out by external accredited institutions: Furness (PPC500) and Saab Metech. A real-time analysis module within the data acquisition software detects pulse frequency.

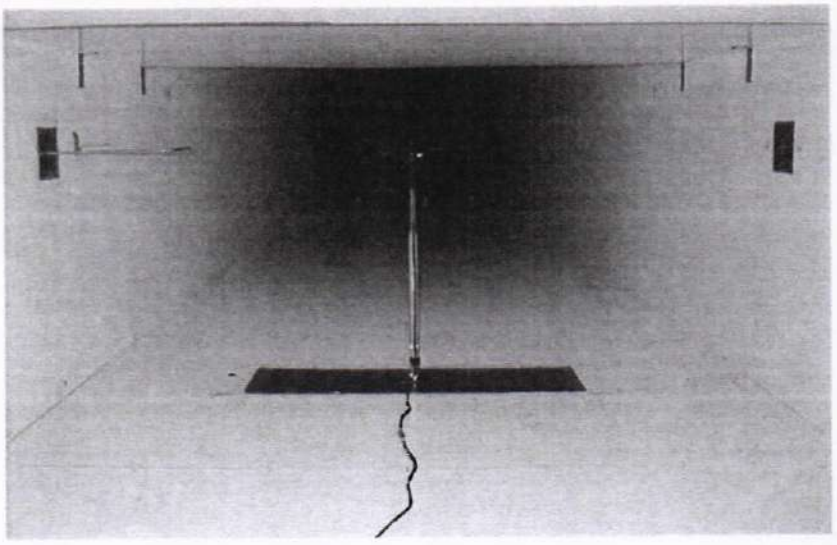

Photo of a cup anemometer in the wind tunnel. The shown anemometer is of the same type as the calibrated one.

UNCERTAINTIES

The documented uncertainty is the total combined uncertainty at 95% confidence level (k=2) in accordance with EA-4/02. The uncertainty at 10 m/s comply with the requirements in the MEASNET procedure that prescribes an absolute uncertainty less than 0.1 m/s at a mean wind velocity of 10 m/s, that is 1%. See Document 97.00.004 "MEASNET - Test report on the calibration campaign" for further details.

Certificate number: 11.02.1058

Svend Ole Hansen ApS

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WIND
ENGINEERING
FLUID
DYNAMICS

CERTIFICATE FOR CALIBRATION OF CUP ANEMOMETER

Certificate number: 11.02.1057 **Date of issue:** February 14, 2011

Type: NRG #40 **Serial number:** 179500166152

Manufacturer: NRG Systems, 110 Commerce Street, Hinesburg, Vermont 05461, USA

Client: NRG Systems, Inc., 110 Riggs Road, Hinesburg, VT 05461, USA

Anemometer received: December 16, 2010 **Anemometer calibrated:** February 13, 2011

Calibrated by: asj **Calibration procedure:** IEC 61400-12-1, MEASNET

Certificate prepared by: jsa **Approved by:** Calibration engineer, soh

Svend Ole Hansen

Calibration equation obtained: v [m/s] = 0.76597 · f [Hz] + 0.30507

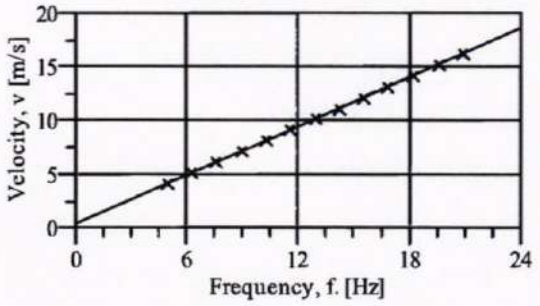
Standard uncertainty, slope: 0.00136 **Standard uncertainty, offset:** 0.04709

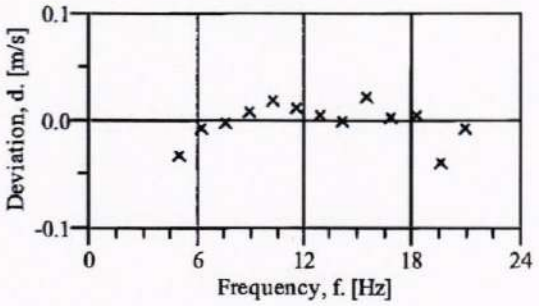
Covariance: -0.0000139 (m/s)²/Hz **Coefficient of correlation:** $\rho = 0.999990$

Absolute maximum deviation: -0.039 m/s at 15.266 m/s

Barometric pressure: 1018.7 hPa **Relative humidity:** 16.2%

Succession	Velocity pressure, q. [Pa]	Temperature in wind tunnel [°C]	Temperature in control room [°C]	Wind velocity, v. [m/s]	Frequency, f. [Hz]	Deviation, d. [m/s]	Uncertainty u_c (k=2) [m/s]
2	9.82	30.0	24.1	4.101	4.9962	-0.031	0.028
4	15.37	29.8	24.1	5.130	6.3070	-0.007	0.033
6	21.92	29.7	24.1	6.124	7.5973	-0.001	0.038
8	30.00	29.6	24.1	7.163	8.9411	0.009	0.043
10	38.98	29.5	24.1	8.164	10.2355	0.019	0.049
12	49.43	29.4	24.0	9.192	11.5856	0.012	0.055
13-last	60.98	29.4	24.0	10.208	12.9204	0.007	0.061
11	73.13	29.5	24.0	11.181	14.1981	0.001	0.066
9	86.98	29.6	24.1	12.196	15.4934	0.024	0.072
7	102.06	29.7	24.1	13.214	16.8467	0.005	0.078
5	118.80	29.8	24.1	14.259	18.2101	0.006	0.085
3	136.10	29.9	24.1	15.266	19.5820	-0.039	0.091
1-first	154.86	30.1	24.1	16.290	20.8750	-0.005	0.097





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CAL Reg.nr. 452
Accreditation to ISO 17025

EQUIPMENT USED

Serial number	Description
-	Boundary layer wind tunnel.
1256	Control cup anemometer.
-	Mounting tube, D = 25 mm
t1	PT100 temperature sensor, wind tunnel.
t2	PT100 temperature sensor, control room.
9904031	PPC500 Furness pressure manometer
X4650038	HMW71U Humidity transmitter
X4350042	PTB100AVaisala analogue barometer.
P11	Pitot tube
001551	Computer Board. 16 bit A/D data acquisition board.
-	PC dedicated to data acquisition.

Traceable calibrations of the equipment are carried out by external accredited institutions: Furness (PPC500) and Saab Metech. A real-time analysis module within the data acquisition software detects pulse frequency.

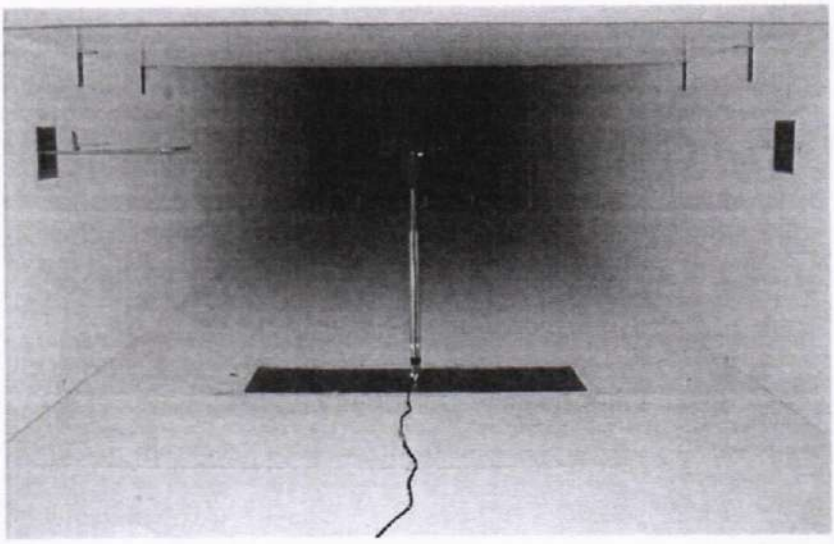

Photo of a cup anemometer in the wind tunnel. The shown anemometer is of the same type as the calibrated one.

UNCERTAINTIES

The documented uncertainty is the total combined uncertainty at 95% confidence level (k=2) in accordance with EA-4/02. The uncertainty at 10 m/s comply with the requirements in the MEASNET procedure that prescribes an absolute uncertainty less than 0.1 m/s at a mean wind velocity of 10 m/s, that is 1%. See Document 97.00.004 "MEASNET - Test report on the calibration campaign" for further details.

Certificate number: 11.02.1057

Svend Ole Hansen ApS

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WIND ENGINEERING FLUID DYNAMICS

CERTIFICATE FOR CALIBRATION OF CUP ANEMOMETER

Certificate number: 11.02.1054 **Date of issue:** February 14, 2011

Type: NRG #40 **Serial number:** 179500166155

Manufacturer: NRG Systems, 110 Commerce Street, Hinesburg, Vermont 05461, USA

Client: NRG Systems, Inc., 110 Riggs Road, Hinesburg, VT 05461, USA

Anemometer received: December 16, 2010 **Anemometer calibrated:** February 13, 2011

Calibrated by: asj **Calibration procedure:** IEC 61400-12-1, MEASNET

Certificate prepared by: jsa **Approved by:** Calibration engineer, soh

Svend Ole Hansen

Calibration equation obtained: v [m/s] = 0.76779 · f [Hz] + 0.30915

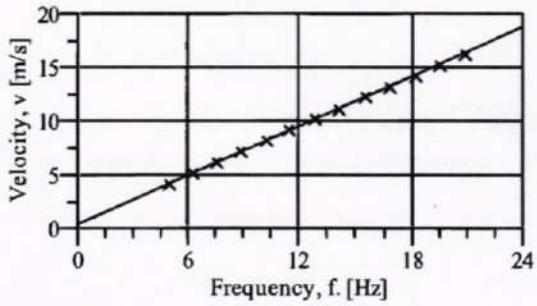
Standard uncertainty, slope: 0.00175 **Standard uncertainty, offset:** 0.05988

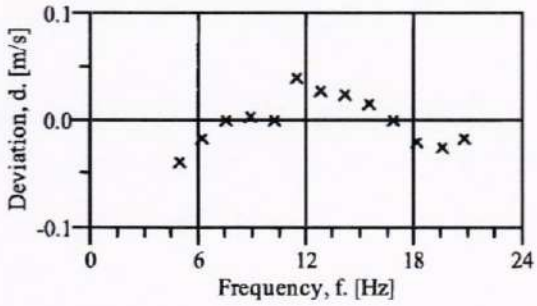
Covariance: -0.0000232 (m/s)²/Hz **Coefficient of correlation:** $\rho = 0.999983$

Absolute maximum deviation: 0.041 m/s at 9.177 m/s

Barometric pressure: 1018.6 hPa **Relative humidity:** 16.2%

Succession	Velocity pressure, q. [Pa]	Temperature in wind tunnel [°C]	Temperature in control room [°C]	Wind velocity, v. [m/s]	Frequency, f. [Hz]	Deviation, d. [m/s]	Uncertainty u_c (k=2) [m/s]
2	9.87	29.9	24.1	4.111	5.0014	-0.038	0.028
4	15.30	29.8	24.0	5.118	6.2841	-0.016	0.033
6	21.95	29.6	24.0	6.128	7.5774	0.001	0.038
8	29.78	29.5	24.0	7.136	8.8873	0.003	0.043
10	39.18	29.4	24.0	8.185	10.2561	0.001	0.049
12	49.27	29.3	24.0	9.177	11.4965	0.041	0.055
13-last	60.92	29.3	23.9	10.203	12.8497	0.028	0.061
11	73.28	29.4	24.0	11.192	14.1420	0.025	0.066
9	87.38	29.5	24.0	12.223	15.4973	0.016	0.073
7	102.10	29.6	24.0	13.216	16.8092	0.000	0.078
5	118.74	29.7	24.0	14.255	18.1883	-0.019	0.085
3	136.52	29.8	24.1	15.288	19.5407	-0.025	0.091
1-first	155.38	30.0	24.1	16.315	20.8688	-0.017	0.097





DANAK
CAL Reg.nr. 452
Accreditation to ISO 17025

EQUIPMENT USED

Serial number	Description
-	Boundary layer wind tunnel.
1256	Control cup anemometer.
-	Mounting tube, D = 25 mm
t1	PT100 temperature sensor, wind tunnel.
t2	PT100 temperature sensor, control room.
9904031	PPC500 Furness pressure manometer
X4650038	HMW71U Humidity transmitter
X4350042	PTB100A Vaisala analogue barometer.
P11	Pitot tube
001551	Computer Board. 16 bit A/D data acquisition board.
-	PC dedicated to data acquisition.

Traceable calibrations of the equipment are carried out by external accredited institutions: Furness (PPC500) and Saab Metech. A real-time analysis module within the data acquisition software detects pulse frequency.

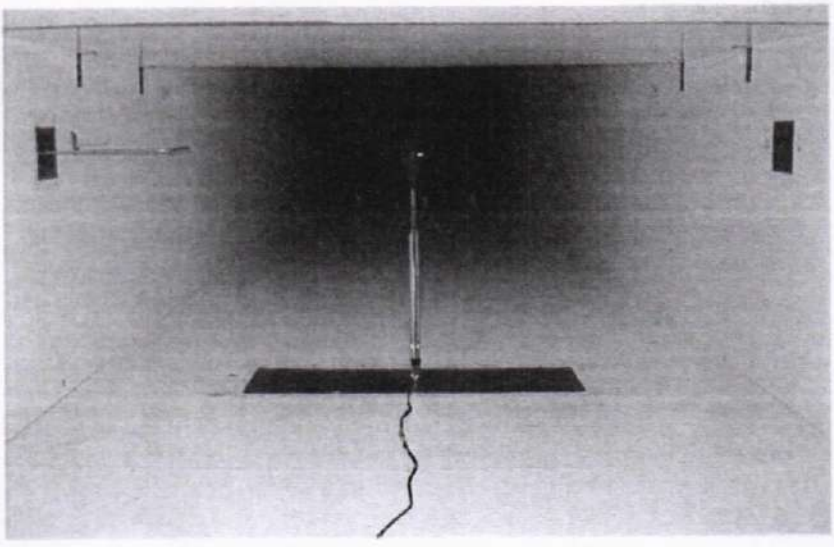


Photo of a cup anemometer in the wind tunnel. The shown anemometer is of the same type as the calibrated one.

UNCERTAINTIES

The documented uncertainty is the total combined uncertainty at 95% confidence level (k=2) in accordance with EA-4/02. The uncertainty at 10 m/s comply with the requirements in the MEASNET procedure that prescribes an absolute uncertainty less than 0.1 m/s at a mean wind velocity of 10 m/s, that is 1%. See Document 97.00.004 "MEASNET - Test report on the calibration campaign" for further details.

Certificate number: 11.02.1054