COMPREHENSIVE REPORT

OF

DUST FALL MEASUREMENT

FOR

M/s COASTAL GUJARAT POWER LIMITED

(A TATA POWER COMPANY)

4150 MW (5X830MW)

THERMAL POWER PLANT,

MUNDRA, GUJARAT

(NOVEMBER 214 – JUNE 2015)

PREPARED BY

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1.0 INTRODUCTION

M/s Coastal Gujarat Power Limited (CGPL) a Tata Power's wholly-owned subsidiary (5 x 830 MW thermal power plant), hired the services of M/s. CEG Test House And Research Centre Pvt. Ltd., Jaipur to conduct environmental monitoring for the project located near Tunda-Vandh village in Mundra taluka of Kutch district of Gujarat, India. CGPL site is located at 22° 49' 48" N latitude and 69° 30' 58" E longitude (Figure 1 & 2). The power plant is supplying power to five states namely Gujarat, Rajasthan and Maharashtra in Western India and to Haryana and Punjab in Northern India, which are currently facing shortage of electricity. It provides a competitive source of power and helps these states to meet their growing demand of electricity. Reliable power from the power plants helps to improve competitiveness of the manufacturing and services industries, which often rely on expensive standby diesel generation to meet their power needs. Competitively priced power also improves access to electricity in rural and urban areas, while reducing the subsidy burden on the state Governments.

The dust fall study was initially carried out in May 2014 as per scope given in the work order #6300002547, dated 07.06.2014. The detailed comprehensive dust fall study was carried out during Oct to Nov, 2014 (Post Monsoon Season), Jan to Feb, 2015 (Winter Season), and May to Jun, 2015 (Summer Season) as per scope given in the above work order. This report summarizes the observation of dust fall monitoring carried out so far.

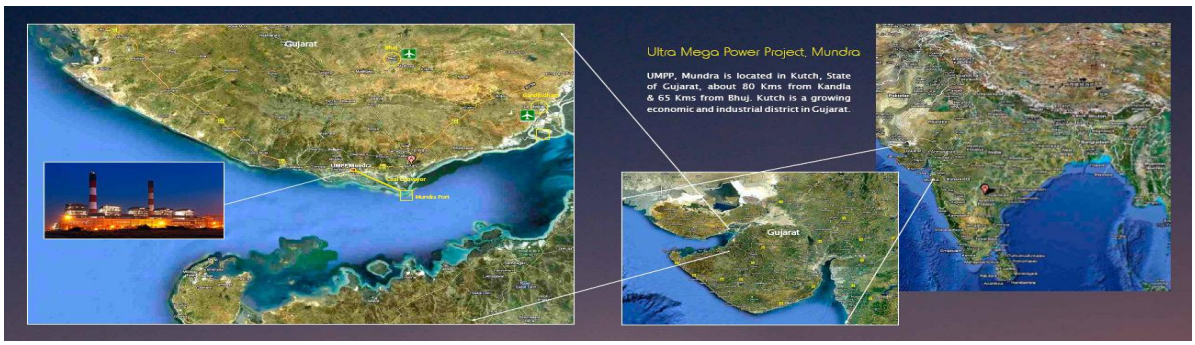


Figure 1: Location Map of CGPL, Mundra, Gujarat

Figure 2: An overview of CGPL Plant, Mundra, Gujarat.

2.0 CEGTH&RC AND QUALITY ASSURANCE

This report is prepared by M/s. CEG Test House and Research Centre Pvt. Ltd, Jaipur which is accredited by:

- National Accreditation Board for Testing & Calibration Laboratories (NABL – Govt. of India) Registration No. NABL-T-1601.
- Ministry of Environment, Forests and Climate Change (MoEF&CC), Govt. of India

Technical members of the team associated with the project are as presented in Table 1.

TABLE 1: PROJECT TEAM

S. No.	Name	Designation	Involvement
1.	Dr Shailendra P Singh	Vice-President (Environment)	Project Director
2.	Dr. O.P. Shukla	General Manager (Environment)	Project In charge, Head (Env. Monitoring) Execution & Reporting
3.	Mr. Bharat Sharma	Asst. Manager	Report Writing, Impact assessment
4.	Mr. Ajai Singh	Asst. Manager	Project Head (Site Lab, Mundra)
5.	Mr. Rai Singh	Technical Manager	In-charge (Lab, Jaipur)
6.	Mr. Lalesh Kumar	Asst. Manager (Environment)	Report Writing
7.	Mr. Dalip Singh Bika	Dy. Technical Manager	Lab work
8.	Mr. Deepak Pareek	Sr. Chemist	Soil and Water Testing
9.	Mr. Vijayendra Gauttam	Chemist	Lab Work
10.	Mr. Ashok Mahta	Field Engineer	Operation and maintenance of Instruments at site
11.	Mr. Mahesh	Field Attendant	Operation and maintenance of Instruments at site
12.	Mr. Ravi	Field Attendant	Operation and maintenance of Instruments at site
13.	Mr. Kamlesh	Field Chemist	Analysis and lab work

The CEG TH&RC strictly maintains the quality management system as per ISO 17025: 2005 throughout the testing by using only calibrated equipment and glassware by trained and experienced personnel, and by using the standard formats and certified reference materials (CRMs) for standardization of solutions used in chemical analysis.

3.0 SCOPE OF WORK

Dust fall measurement studies were conducted as per the scope mentioned in the work order. Previously, a separate study for Dust fall was also conducted in May, 2014. Baseline information of dust fall is important when assessing environmental impact of the particulate matter emitted from a particular source. The contribution of the power plant cannot be considered in isolation, other sources of emissions need to be considered.

This study focuses on dust fall rate for Soluble and Insoluble fraction of dust and total dust. This study consists of findings collected during different seasons (Post Monsoon, winter and summer) during 2014-2015.

4.0 METHODOLOGY

Site Selection

Six locations were selected for dust fallout monitoring in adjoining areas of CGPL, Mundra, with consent of CGPL officers. Monitoring was done for one month at each location in each season. Details of the selected locations are as follows:

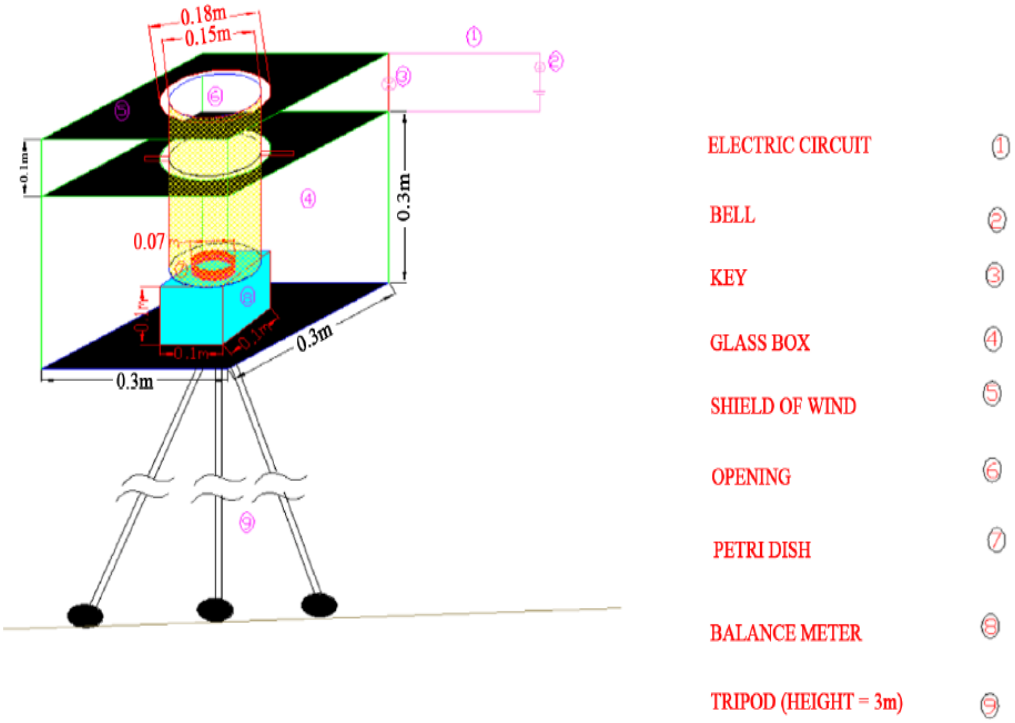
Table 2: Dust Fall Monitoring Locations

S. No.	Location Code	Name of Location	Distance (Km)	Direction	Area Category
1.	DF-1	Mundra	25	E	Urban
2.	DF-2	Bhadreshwar Village	70	NE	Rural
3.	DF-3	Jhakhau	130	NW	Rural
4.	DF-4	Trigadi Bunder	5	S	Rural
5.	DF-5	Vandh Village	3	SE	Rural
6.	DF-6	Kutdi Bunder	8	SE	Rural

IS 5182 (Part-1): 2006 recommends that a cylindrical container should be located on a stand at least 1.2m from the support surface to measure the dust fall. Same was used for the dust fall monitoring using approach and methodology adopted is described in subsequent section.

Dust Fall Collector

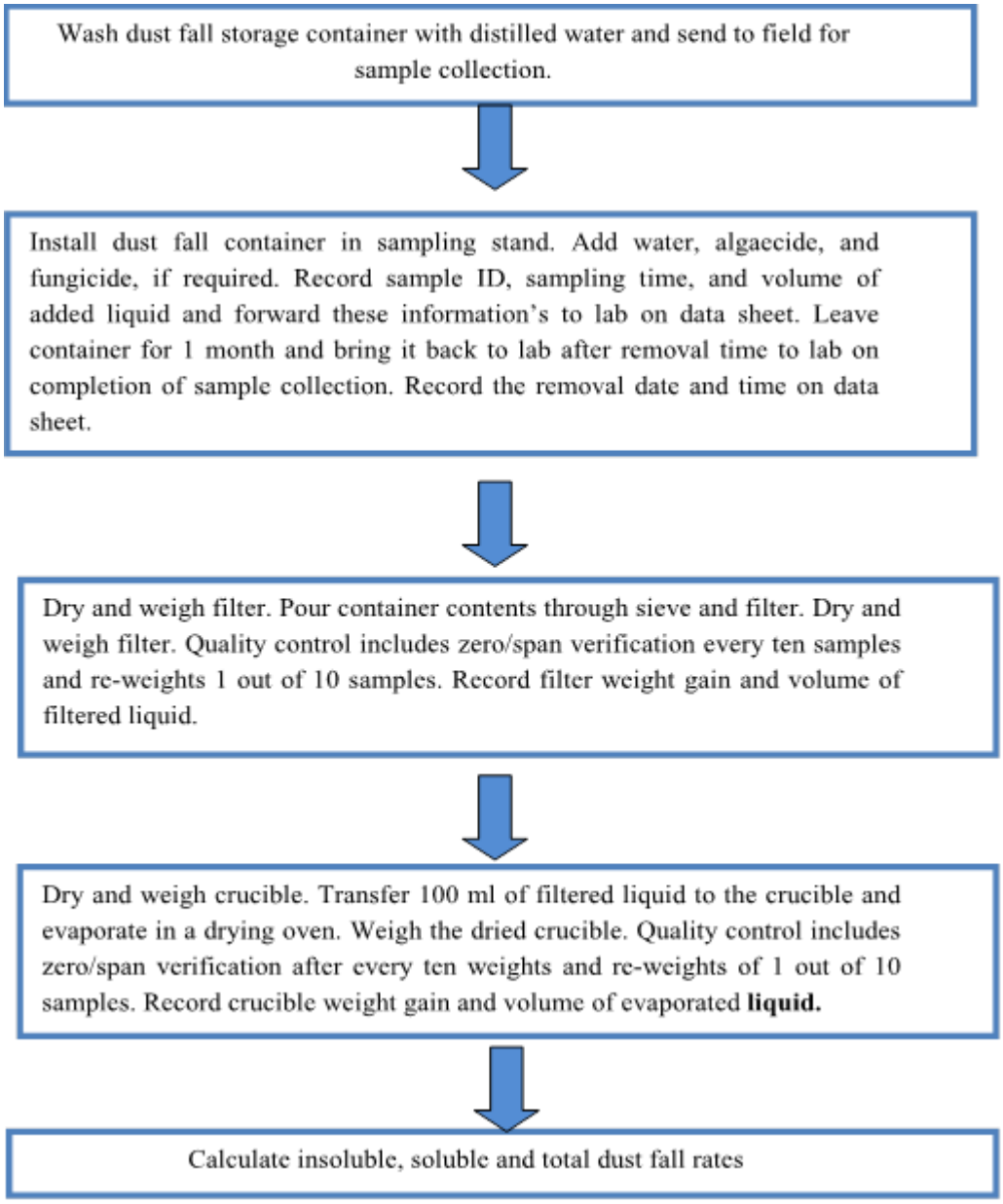
Dust fall stations were mounted 1.3 m high tripods to avoid the collection of dust picked up by wind eddies. There was a bird ring on each holder to avoid material from birds. The sketch of the tripod showing its different parts is given below.



sketch of dust fall station

Monitoring

The collectors were exposed to the atmosphere for a sampling period of 30 days. It should be noted that the measurements represent dry deposition only, as there were no rainfall during the sampling period. The dry deposits (settleable particulates) were transferred from the collectors and placed in an iced container and transported to the analysis laboratory. The content of dust fall was dried at 105°C to a constant mass, and then it was weighed and the quantity of dust fall was computed in µg/m2 month as depicted in detail below.



Sample Analysis

The detail of parameter, methodology adopted and equipment used for sample analysis are given in Table. No.4 as below:

Insoluble Dust Fall Measurement

Dried the filter paper in the oven for at least 2 h at 105 ˚C and re-weighed the filter on the analytical balance and calculated the increase in mass resulting from the filtration process. Thus the quantity of soluble dust is measured.

Soluble Dust Fall Measurement

Weighed a clean crucible on the analytical balance and transferred 25 to 100 ml of the filtered liquid from the graduated cylinder to the crucible; heated this liquid in the oven at 105 ˚C for a sufficient period of time to evaporate all of the liquid. Re-weighed the crucible up to constant weigh and calculated the increase in mass attributable to soluble and calculate the increase in mass attributable to soluble category. Recorded the volume of liquid evaporated on the identification label.

5.0 RESULTS

The result obtained for dust fall rate in the study area is presented in table 3.

Table 3: Comprehensive results for Dust Fall Measurement at CGPL, Mundra, Gujarat, India

Sample code	Location	Dust fall rate in g/m^2/month		
		Insoluble Particles	Soluble Particles	Total Particles
(October 2014 to November 2014) – Post Monsoon				
EM86/211	Mundra	0.23	0.11	0.34
EM86/212	Bhadreswar Village	0.15	0.1	0.25
EM86/213	Jakhaeo Village	0.22	0.24	0.46
EM86/214	Trigadi Bunder	0.13	0.1	0.23
EM86/215	Vandh Village	0.53	0.25	0.78
EM86/216	Kutadi Bunder	0.69	0.2	0.89
(January 2015 to February 2015)- Winter				
EM86/217	Mundra	0.35	0.18	0.53
EM86/218	Bhadreswar Village	0.24	0.13	0.37
EM86/219	Jakhaeo Village	0.25	0.09	0.34
EM86/220	Trigadi Bunder	0.1	0.13	0.23
EM86/221	Vandh Village	0.28	0.24	0.52
EM86/222	Kutadi Bunder	0.43	0.16	0.39
(May 2015 to June 2015) – Summer				
EM86/223	Mundra	0.55	0.94	1.49
EM86/224	Bhadreswar Village	0.2	0.25	0.46
EM86/225	Jakhaeo Village	0.31	0.33	0.65
EM86/226	Trigadi Bunder	0.49	0.51	1
EM86/227	Vandh Village	1.12	0.46	1.58
EM86/228	Kutadi Bunder	0.55	0.53	1.08

Table 4: Site details for dust fall study

S. No.	Name of Location	Distance (Km)	Direction	Site Detail
1.	Mundra	25	E	Urban area with congested roads, streets and haphazard traffic
2.	Bhadreshwar Village	70	NE	Remote location in rural area, Unpaved and dusty streets, agricultural activities

3.	Jhakhau	130	NW	Remote location in rural area, Unpaved and dusty streets, agricultural activities
4.	Tragadi Bunder	5	S	Coastal location and rural area
5.	Vandh Village	0	SE	Rural area near thermal plant boundary, Unpaved and dusty streets, agricultural activities
6.	Kutdi Bunder	8	SE	Coastal location and rural area

6.0 DISCUSSION

This study is aimed to determine the rate and composition of dust fall around the CGPL Plant, Mundra, Gujarat. The sampling was carried out during post monsoon, winter and summer seasons of 2014-15 at six locations in adjoining to and remote areas from CGPL plant. One location at Jakhau village was selected as control site. Average soluble and insoluble and total dust fall rate of all the seasons observed were estimated and summarized in Table 5.

Table 5: Annual average of dust fall rate

Location	Dust Fall Rate (g/m^2/month)		
	Insoluble	**Soluble**	**Total**
Mundra	0.38	0.41	0.79
Bhadreswar Village	0.20	0.16	0.36
Jakhau Village	0.26	0.22	0.48
Trigadi Bunder	0.24	0.25	0.49
Vandh Village	0.64	0.32	0.96
Kutdi Bunder	0.56	0.30	0.79
Average	**0.38**	**0.28**	**0.64**

Average dust fall rate in the study area was found to be less than 1.00 g/m^2/month in all the locations and it varied from 0.36-0.96 g/m^2/month with an average of 0.64 g/m^2/month. The highest dust fall rate was measured 0.96 g/m^2/month at Vandh village followed by 0.79 g/m^2/month at Kutadi Bunder and Mundra. Vandh village and Kutadi Bunder are located in vicinity of thermal power plant whereas Mundra as an urban area. The lowest dust fall rate was observed at Bhadeshwar and Jakhau villages, which are remote locations and can be taken as control site. CEG has referred to other environmental studies relevant to this region. Review of literature indicates the importance of the region due this being a coastal zone. No direct standard is available in India for the dust fall rate as a legal norm however dust fall reported maximum in this study as 1.0 g/m^2/month is well with the national standard fixed for the most of the developing countries like Egypt (14 g/m^2/month) and South Africa (18 g/m^2/month).

Seasonal variation in dust fall

Seasonal dust fall rate was found to be varying significantly across locations as well as seasons as summarized in figure 3.

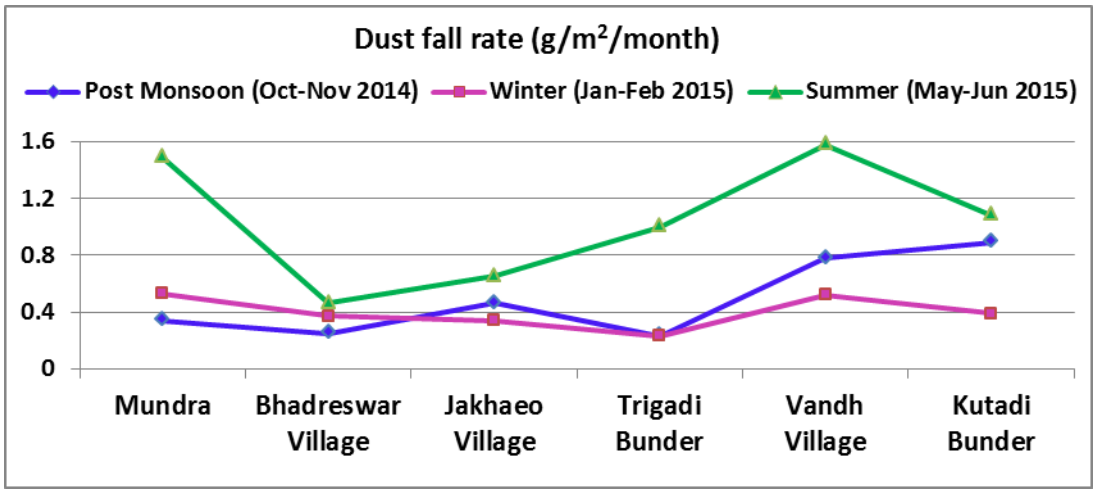


Figure 3: Dust fall rate and seasonal variation

It was observed that dust fall is high in summer as compared to post-monsoon and winter season at all the locations. Dust fall rate at Vandh village located near the plant and Mundra an urban location crosses 1.5 g/m^2/month during summer. In general, higher dust fall rate in summer means higher abundance of crust matter due to high temperature and stronger/ turbulent winds which favor air convection leading to re-suspension of local dust, soil erosion and long range dust transportation from dry desert, and coastal areas. Meteorological factors such as humidity, solar radiation and temperature lead the formation of atmospheric dust. The higher wind speed in summers may leads blows/lifts out the earth crust and re-suspended dust from opens grounds and agricultural fields.

The dust collected in the study area is not only affected by nearby thermal plants but also contributed by regional, local and even domestic activates. Mundra west basin coal port is also located in South and South East direction. The coal is imported and handled here at bulk quantity. All the three high affected locations as Vandh village, Tragadi and Kutadi bunnder are in downwind to this coal port both in winter and post-monsoon period. Therefore, dust fall of these three high affected locations are more from Mundra west coal port as compared to power plant. Unpaved and dusty streets in village are main source of dust at local level.

Further, the Gini coefficient worked out for total particles across different locations indicated that there is not much variation in dust fall. In fact the Gini coefficient worked out for the winter season (0.144) indicated that dust fall was distributed in equal proportion at all the site Gini coefficient was highest for the post monsoon season (0.283) and moderate (0.218) in summer. Overall it may be concluded that there is not much variation in dust fall across the selected locations. The Lorenz curve and Gini coefficient for total particles across 6 locations for the three different seasons are given as below.

7.0 CONCLUSION

Dust fall samples collected from six sites of different direction represent collective /cumulative dust from various sources like industry, surface soil, coal and oil burning, construction activities, motor vehicle and road dust as a dominant source during the study period. Dust depositions on windows, on the outside of the house, and on cars are most frequently due to the other reasons as transportation, vehicular pollution, high wind speed and other natural factors.

Dust fall in the current study varied from 0.52-0.78 g/m^2/month in winter season followed by 0.49-0.81 g/m^2/month in post monsoon and 0.46-1.58 g/m^2/month in summer season. Our study suggests that there is not much variation in the dust fall across the different locations. This is true for all the 3 seasons for which the data was collected.

Currently, there are no standards of dust fall prescribed by statutory bodies in India. However, National Environment Engineering Research Institute (NEERI), Nagpur India has developed a standard for research study in residential areas as $10t/km^2$/month (corresponds to $10g/m^2$/month). Also, it was found that the Egyptian law 470/1970 prescribes dust fall standard of 14 g/m^2/month for industrial area and South African National Standard (2005) prescribes 18 and 36 g/m^2/month for residential and industrial area. Compared with all the standards indicated above, the dust fall in the study area is much less to the standards set for the different countries including the standard set by NEERI.

Annexure 1

South Africa National Standard for the Dust Fall Rate

Table 1: Four-band scale evaluation criteria for dust deposition (SANS 1929:2005).

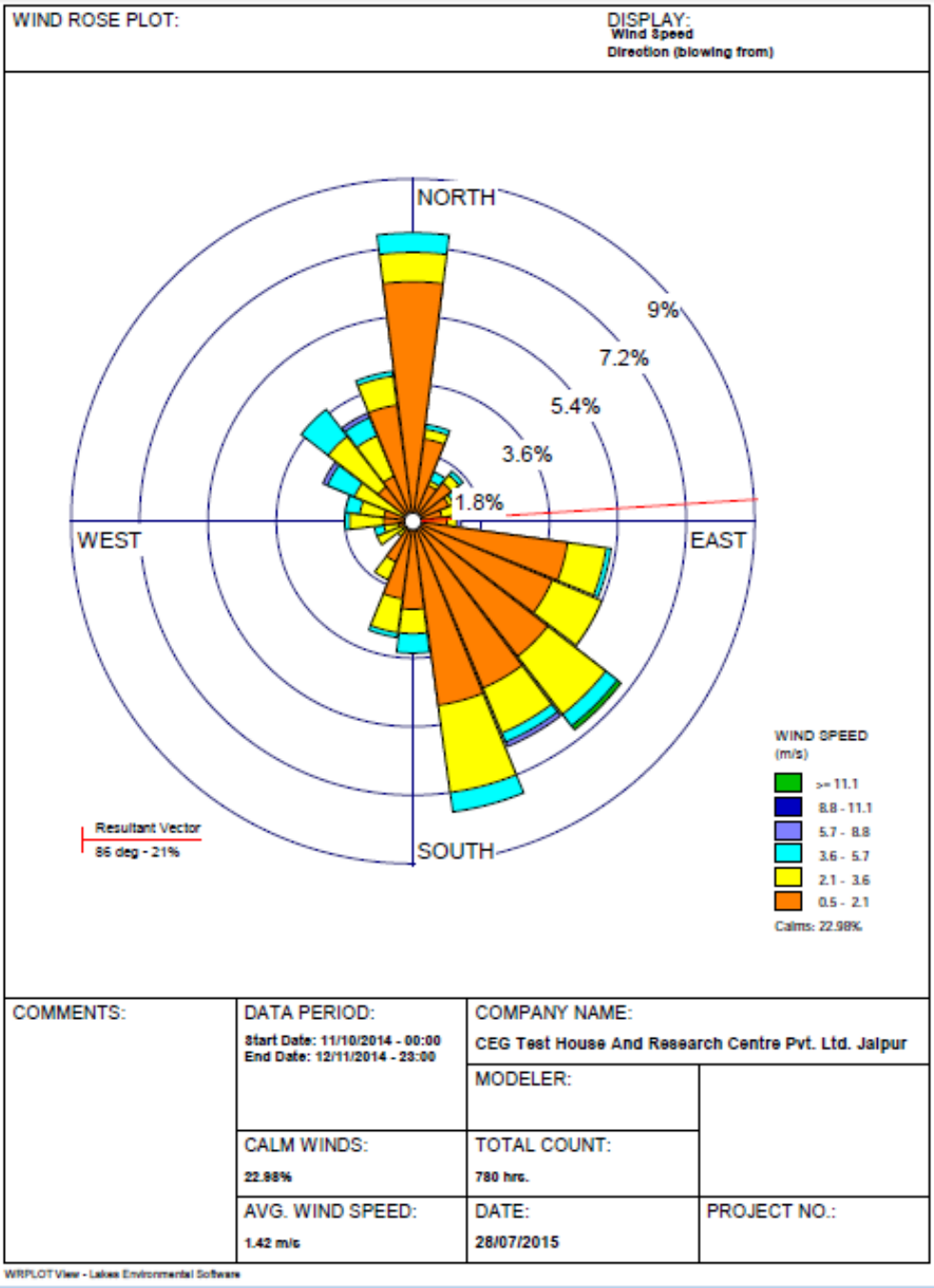
Band Number	Band Description Label	Dustfall rate (mg m^2 day , 30-day average)	Comment
1	Residential	D < 600	Permissible for residential and light commercial
2	Industrial	600 < D < 1 200	Permissible for heavy commercial and industrial
3	Action	1 200 < D < 2 400	Requires investigation and remediation if two sequential months lie in this band, or more than three occur in a year.
4	**Alert**	**2 400 < D**	**Immediate action and remediation required following the first incidence of dustfall rate being exceeded. Incident report to be submitted to relevant authority**.

Table 2 New dustfall standards, target, action and alert thresholds for dust deposition (SANS 1929:2005).

Level	Dustfall Rate ($mg/m^2/day$)	Permitted Frequency of Exceedances
Target	300	
Action residential	600	Three within any year, no two sequential months.
Action industrial	1 200	Three within any year not two sequential months.
Alert threshold	**2 400**	**None. First exceedance requires remediation and compulsory report to authorities.**

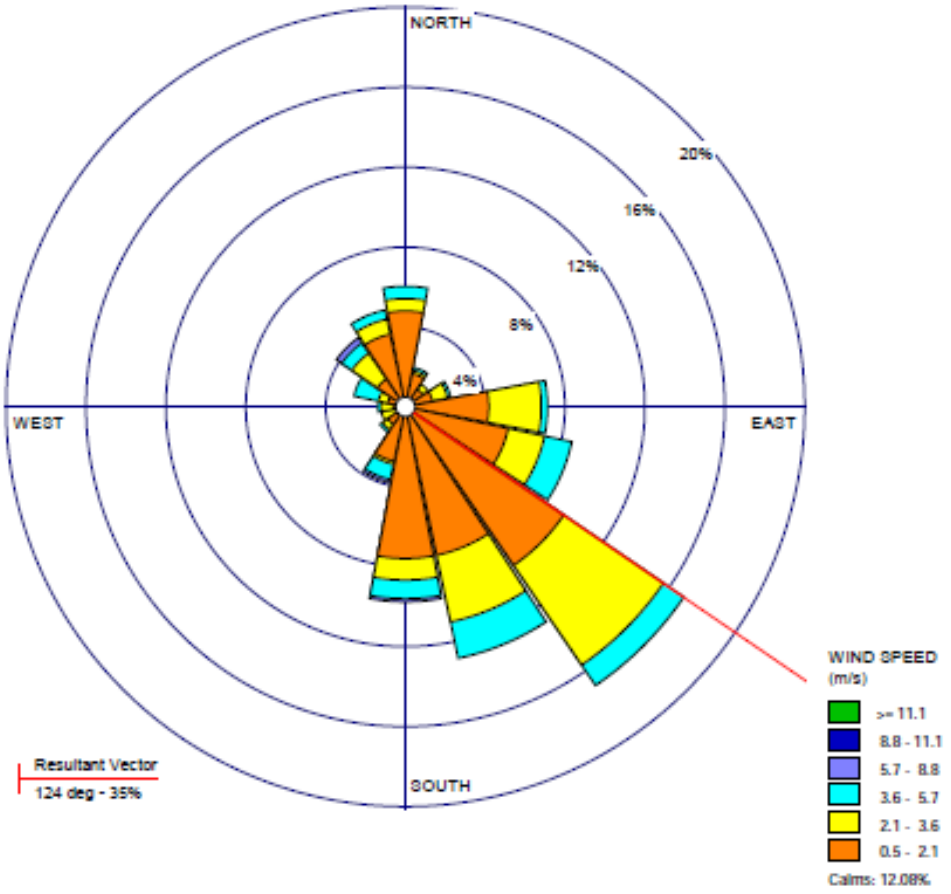
Annexure 2

WIND ROSES OF PLANT SITE



WIND ROSE PLOT:
Station # 5

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
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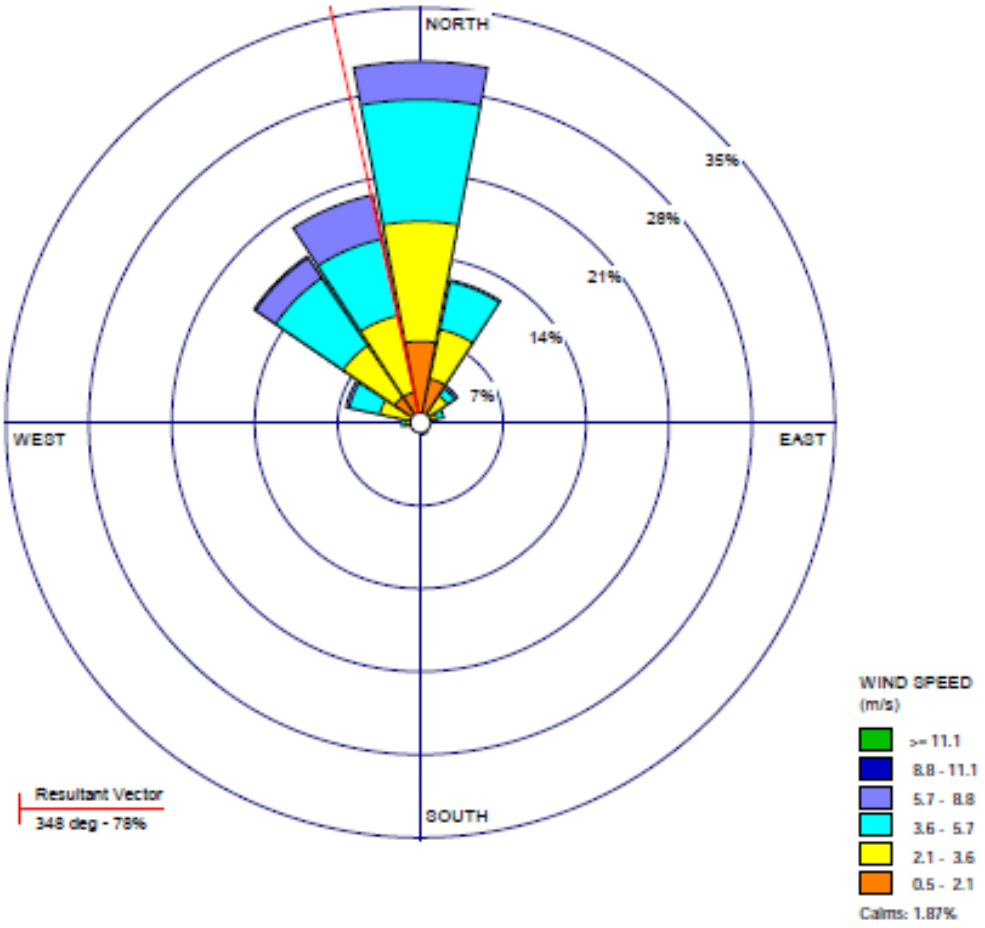
	CALM WINDS:	TOTAL COUNT:	
	12.08%	**647 hrs.**	
	AVG. WIND SPEED:	DATE:	PROJECT NO.:
	1.88 m/s	**16/07/2015**	

WIND ROSE PLOT:
Station # 34

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD: **Start Date: 16/06/2015 - 00:00** **End Date: 12/08/2015 - 23:00**	COMPANY NAME: **CEG Test House And Research Centre Pvt. Ltd. Jaipur**	
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