

The CDM Executive Board
UNFCCC

भारत इलेक्ट्रॉनिक्स लिमिटेड
(भारत सरकार का उद्यम, रक्षा मंत्रालय)
जालहल्ली पोस्ट, बेंगलूर - 560 013, भारत

BHARAT ELECTRONICS LIMITED
(A Govt. of India Enterprise, Ministry of Defence)
Jalahalli Post, **BANGALORE - 560 013**, India

Phone : No.3516/ES/Ele/WEG
Fax : September 6, 2007
E-mail : Ph: 080 - 22195758
Website : Fax: 080 - 28381968

E-mail : venkateshkr@bel.co.in

Kind Attn: Mr. Kai-Uwe Barani Schmidt
Manager, CDM Section

Dear Sir,

Sub: Request for review of "2.5 MW BEL grid
connected Wind Power project at Davanagere District,
Karnataka, India" (1216)

Ref: 1. Your E-mail message dated 27th Aug., 2007
2. CDM Project activity registration review
Form (F-CDM-RR)

* * *

We are invited to submit response to the Board on an issue raised in the requests for review (refer website: <http://cdm.unfccc.int/Projects/review.html>) by CDM EB as below:

1. *Further evidence of how the assumed plant load factor has been validated is required.*

Our response on the issue raised in the request for review is as below:

The Centre for Wind Energy Technology (CWET), a nodal research and development body under Government of India has mapped the potential wind farm sites in the country, including the state of Karnataka.
(refer website <http://www.cwet.tn.nic.in/Docu/WPDmap.pdf>).

Based on this broad information available, the project developer along with the technology supplier (M/s Vestas RRB Ltd., India) began identifying the potential wind farm sites in Karnataka. The identified site Basavapatna Hills, as mentioned in Section A.4.1.4 of the PDD, was then a virgin land with suitable terrain for establishing wind power project. There were no established wind power projects earlier in that area and hence, wind data for estimation of the probable energy generation was also not available. M/s Vestas RRB set up a wind monitoring station for a year to obtain annual wind pattern at 50 m height using duly calibrated anemometer, wind vane and data logger. The wind data was collected for a year and analyzed. Based on the data collected from wind mast, an estimate of electrical energy generation per annum was calculated by a third party consultant, M/s Power Equations, enclosed as **Annexure-I**.

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The main parameter for determining the approximate plant load factor for wind farms is the estimated energy generation per annum. The realistic estimate of the energy generation per annum depends on site wind data and the power curve data and tested power curve of the Wind Energy Generator (WEG). The project developer selected the CWET approved V-39, 500kw WEG model for the project activity which was micro sited by M/s Vestas RRB for optimizing generation. The power curve data table and tested power curve of V-39 -500kw WEG are enclosed as **Annexure – II**.

Finally, M/s Vestas RRB measured the wind data for 18 months at the site selected, superimposed the power curve and indicated average generation of 11.5 lakh units per annum (One lakh = 0.1 Million) per WEG in the area. The above supportive document is enclosed as **Annexure – III**. Consequently, for the entire 2.5 MW wind project activity, the average generation was estimated as 5.75 million units per annum, as mentioned in the PDD.

The plant load factor (PLF) has been defined as:

$$\text{Plant load factor (\%)} = \frac{\text{Estimated energy generation per annum in kWh}}{\text{Capacity of the plant in kW X 8760hrs/ year}} \times 100 \dots \text{eqn. 1}$$

From eqn 1., for the BEL Wind project activity, PLF has been found as

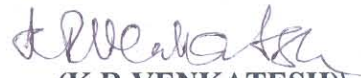
$$= \frac{5750000}{2500 \times 8760} \times 100 = 26.25\%$$

The above information with supportive documents was made available to the DOE during the site validation on 26th April 2007.

We trust that sufficient evidence has been provided by BEL on the comment raised. It is our sincere hope that the CDM Executive Board will accept the above response and clarifications and approve for early registration for the project. However, in case further information is required on this issue, BEL would be glad to respond on the same.

Thanking You,

Yours faithfully,
for **BHARAT ELECTRONICS LTD.,**


(K.R.VENKATESH)
DY.GEN.MANAGER (ELE/ES)

Enclosures:

- 1) Annexure – I: M/s Power Equations summary
- 2) Annexure – II: Power curve data for V39-500 kW WEG with tested power curve
- 3) Annexure – III: Average generation reported by M/s Vestas RRB



Annexure - I

Table 4.1								
Estimated Generation per annum at mast location (Air Density corrected)								
Site name:			Basavappa Hills					
Power curve :			V39-500 kW-47m					
Sensor Height :			50m					
Hub height :			50m					
Class Interval m/s			Wind Speed m/s	Frequency		kW of WEG	Generation kWh	Projected Annual generation
				% of available data	Hours			
0	-	0.49		0.704	41	0	0	0
0.5	-	1.49	1	4.204	245	0	0	0
1.5	-	2.49	2	9.025	526	0	0	0
2.5	-	3.49	3	16.078	937	0	0	0
3.5	-	4.49	4	18.051	1052	3.1	3261	4902
4.5	-	5.49	5	19.200	1119	43.8	49012	73670
5.5	-	6.49	6	21.585	1258	96.1	120894	181714
6.5	-	7.49	7	18.514	1079	163	175877	264359
7.5	-	8.49	8	14.104	822	242	198924	299000
8.5	-	9.49	9	8.253	481	325	156325	234970
9.5	-	10.49	10	6.349	370	400	148000	222457
10.5	-	11.49	11	4.513	263	452	118876	178681
11.5	-	12.49	12	2.539	148	481	71188	107002
12.5	-	13.49	13	1.321	77	494	38038	57174
13.5	-	14.49	14	0.686	40	498	19920	29942
14.5	-	15.49	15	0.275	16	500	8000	12025
15.5	-	16.49	16	0.086	5	500	2500	3758
16.5	-	17.49	17	0.000	0	500	0	0
17.5	-	18.49	18	0.000	0	500	0	0
18.5	-	19.49	19	0.000	0	500	0	0
19.5	-	20.49	20	0.000	0	500	0	0
20.5	-	21.49	21	0.000	0	500	0	0
21.5	-	22.49	22	0.000	0	500	0	0
22.5	-	23.49	23	0.000	0	500	0	0
23.5	-	24.49	24	0.000	0	500	0	0
24.5	-	25.49	25	0.000	0	500	0	0
Uncorrected			Generation kWh at Hub Height				1110815	1669654
Air Density Correction					0.9			
Machine availability					0.9			
Grid Availability					0.95			
Array Effects					0.95			
Rated Power					500kW			
Estimated Generation kWh								1356176

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Annexure - II

POWER CURVE FOR VESTAS V39-500 KW WITH 47 Mtr. ROTOR DIA

Power curve calculated on basis of measurements on Naca 63-600 & FFA-W3 airfoil data.

Parameters for calculated curve	:	50 Hz
Rotor Diameter	:	47 m
Rotor speed (Synchronous)	:	26 RPM
Tip pitch	:	Pitch regulated.
Air Density	:	1.225 Kg/m3
Turbulence	:	10%

<u>Wind Velocity</u>	<u>E1 - Power Output</u>
<u>V (m/s)</u>	<u>Pe1 (KW)</u>
4.0	3.1
5.0	43.8
6.0	96.1
7.0	163.0
8.0	242.0
9.0	325.0
10.0	400.0
11.0	452.0
12.0	481.0
13.0	494.0
14.0	498.0
15.0	500
16.0	500
17.0	500
18.0	500
19.0	500
20.0	500
21.0	500
22.0	500
23.0	500
24.0	500
25.0	500



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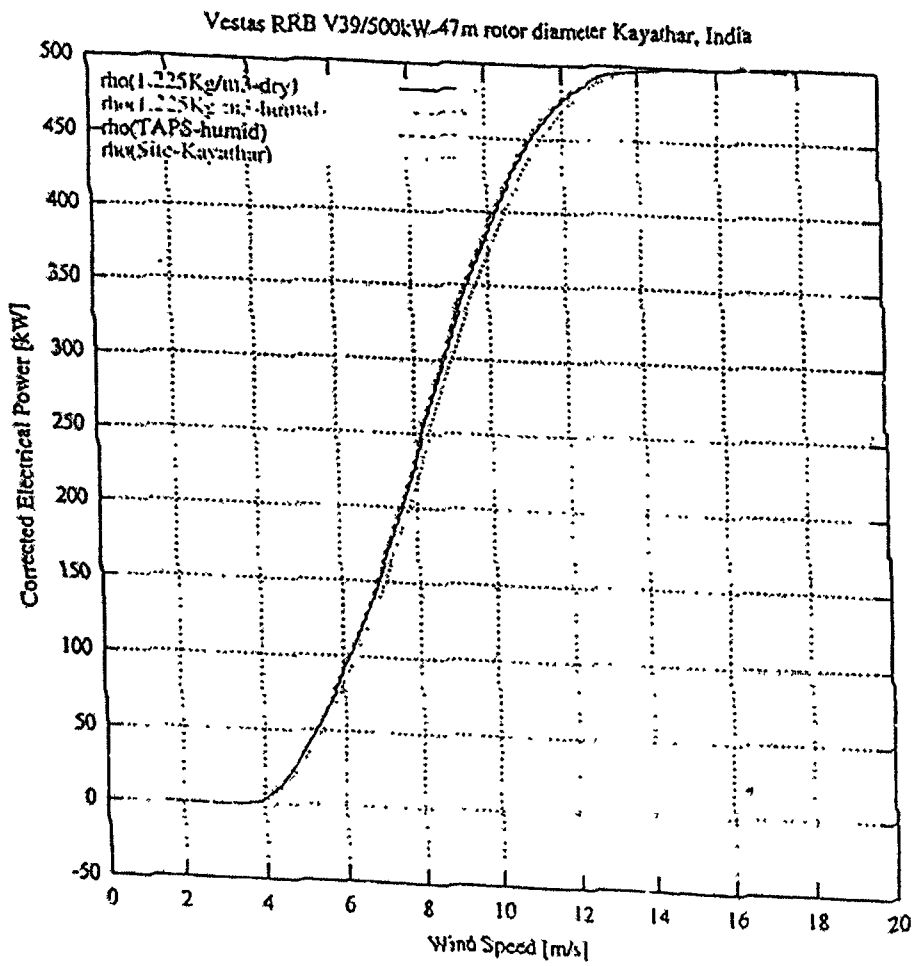


Figure 6.3.3 Corrected electrical power as a function of wind speed for different air densities

C-WET-I-PP-3



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GENERATION DETAILS AT OFFERED LOCATION

We have measured the Wind Data in the specific hill at Basavapatna village for approximately 18 months and based on this the calculated generation per WEG is:

500 KW: 10.7 to 12.5 Lac Units/Annum

600 KW: 11.5 to 13.1 Lac Units/Annum

This variation is based on the specific locations & accordingly we have indicated average generation per WEG as:

500 KW: 11.5 Lac Units/Annum/ WEG

600 KW: 12.2 Lac Units/Annum/ WEG

We always stand Guarantee for the performance of the WEG based on the power curve.

VESTAS RRB INDIA LTD.



B. RAHA

GENERAL MANAGER-BUSINESS DEVELOPMENT



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