CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
Version 03 - in effect as of: 22 December 2006

CONTENTS

Annexes

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	•The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. •As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03	22 December 2006	•The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

SECTION A. General description of small-scale project activity

A.1 Title of the small-scale project activity:

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2.5 MW BEL grid-connected wind power project at Davanagere district, Karnataka, India

Version: 02

Date: 18 May 2007

A.2. Description of the small-scale project activity:

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The project activity involves setting up of a 2.5 Mega Watt (MW) wind farm, comprising of five 0.5 MW wind turbines near Basavapatna village of Davanagere district, Karnataka state, India. The turbines are of three-blade horizontal-axis type with pitch regulation facility for optimizing adjustment of the blade angles in relation to the prevailing wind conditions. Power generated at 690 Volt (V) will be stepped-up to 66 kilo Volt (kV) for transmission and feeding to the grid sub-station located 17 km. away from the project site.

The project proponent, M/s Bharat Electronics Limited (BEL), is a leading electronics company in India meeting the electronic systems needs of defence and civilian customers. BEL proposes to enter into an agreement with the state transmission utility, Karnataka Power Transmission Corporation Limited (KPTCL) for wheeling the clean power from the project activity to BEL's Bangalore complex. Around 5.75 GWh (1 GWh = 1 million kWh) of clean power is estimated to be fed to the state grid per year from the project activity.

Purpose of the project activity

BEL's Bangalore complex presently requires around 10 MW of power which is met by purchasing power from the KPTCL grid. KPTCL is a part of the thermal dominated Southern Regional grid network of India, with fossil fuels contributing to around 73% of the regional grid's power availability[1]. With growing concern for Green House Gas (GHG) emissions and environmental degradation, BEL intends to shift towards tapping clean and renewable energy source for meeting its power requirement. Hence, BEL

[1] Source: Southern Regional Load Despatch Centre (SRLDC) Annual Report 2005-06 - http://www.srldc.org/var/ftp/reports/yearlyrep/2005-06-year.pdf (pg. 43)

proposes to harness wind energy potential for power generation to partially meet its power requirement and thereby reduce GHG emissions.

Sustainable Development Benefits of the project activity

The project contributes to the sustainable development of the region as follows

(i) Socio-economic well-being –The project activity has led to creation of employment opportunities during construction stage wherein local people from the surrounding villages have been hired as contractors, labourers and drivers. For operating the wind farm local youth have been employed and are being trained to develop their skills in power plant operation. Further, road condition in the nearby villages has also been improved during construction stage with villagers now being able to use motorable road for their activities. Access to pasture land or agricultural land is unhindered. The project will aid in improving the grid stability in the vicinity of the project site. At a more macro level the project activity also contributes to the country's need for energy security.

(ii) Environmental well-being – As mentioned earlier, the present share of electricity generation of thermal energy is about 73% in the Southern regional grid. Installation of wind mills to generate power directly helps in displacing fossil fuel for electricity generation. The project indirectly reduces GHG emissions and specific pollutants (like SOx, NOx, and SPM). It thus adds to conservation of scarce fossil fuel energy sources like coal and natural gas.

(iii) Technological well-being –Wind power technology presently accounts for a mere 3% of installed capacity and 0.72% of gross generation in the country[2]. The successful operation of the project activity would thus encourage other entrepreneurs to install similar projects in India. The project activity would help in grid stability in the surrounding remote areas and also reduce transmission and distribution (T & D) losses.

A.3. Project participants:

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[2] Source: Central Electricity Authority General Review 2006 (containing data for 2004-05) - http://www.cea.nic.in/power_sec_reports/general_review/0405/ch2.pdf and http://www.cea.nic.in/power_sec_reports/general_review/0405/ch3.pdf

Name of party involved (*) ((host) indicates a host Party)	Private and/or public entity (ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
India	Bharat Electronics Limited (Public Entity)	No

A.4. Technical description of the small-scale project activity:

A.4.1. Location of the small-scale project activity:

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A.4.1.1. Host Party(ies):

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India

A.4.1.2. Region/State/Province etc.:

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Karnataka

A.4.1.3. City/Town/Community etc:

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Basavapatna Village, Chennagiri Taluk, Davanagere district

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity :

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The project activity is located at Kothihillu site, near Basavapatna village, Chennagiri taluk, Davanagere district in Karnataka State, India. The wind farm site, located at 14^{O} 13'N latitude and 75^{O} 47'E longitude. It is at a distance of 31 kms from Davanagere town and about 300 kms from the state capital Bangalore. The project activity consists of 5 numbers of wind turbo-generators of 0.5 MW each situated in a one hectare site. The field survey number pertaining to the wind mill is given in Table 1 below.

Table 1: Survey field number of the wind mill site

Survey field number	Village
17	Kothihillu, Basavapatna village, Chennagiri Taluk, Davanagere district

The following are the unique identification numbers and location of the five wind mills

Sl. No.	Location	Machine (Wind mill) Identification No.
1	31	589
2	32	587
3	33	588
4	34	590
5	35	584

The geographical location of the project activity is given in maps below.

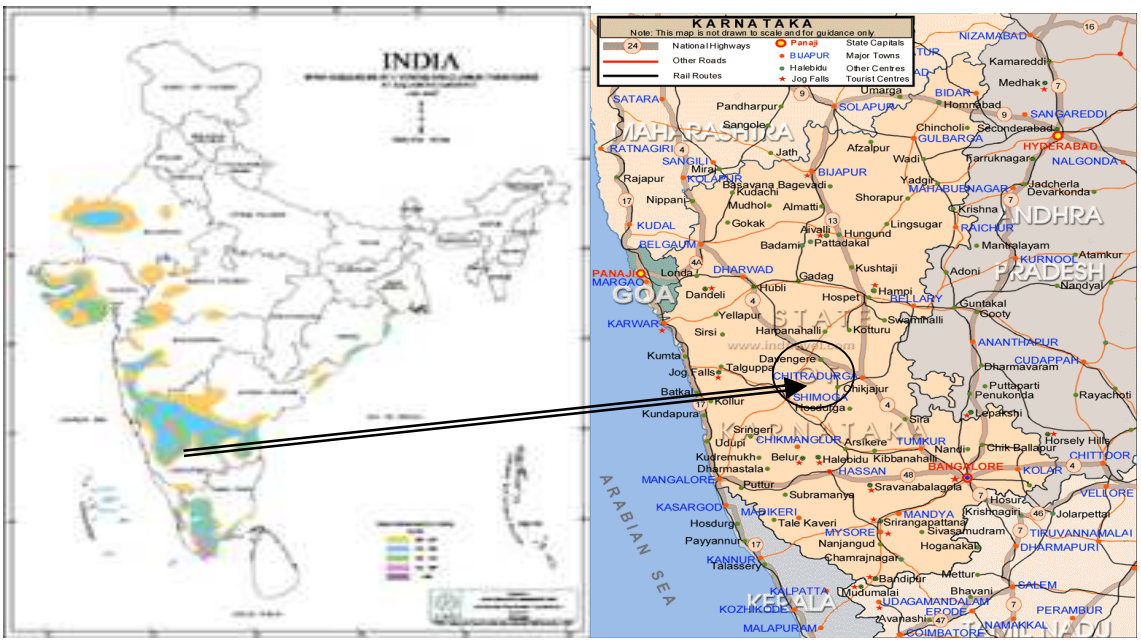

Figure 1: Maps showing the location of the project activity in the state of Karnataka, India

A.4.2. Type and category(ies) and technology/measure of the small-scale project activity:

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Type and category

The project activity involves generation of power exclusively by wind turbo-generators which is a renewable energy technology. The capacity of project activity (2.5MWe) is less than the stipulated maximum output capacity of 15MWe as per indicative simplified modalities and procedures (M&P) for

small scale CDM projects of United Nations Framework Convention on Climate Change (UNFCCC). Hence, the project activity falls under the following type and category of the Appendix B approved small scale methodologies.

Type **:** I 'Renewable Energy Projects'

Category **:** I – D 'Grid connected renewable electricity generation'.

Sectoral Scope : I 'Energy industries (renewable - / non-renewable sources)'

Technology

The project activity involves setting up of 5 numbers of wind turbines of capacity 0.5 MW each (of Vestas RRB make) totaling to 2.5 MW in the state of Karnataka.

Salient features of the technology are as follows:

- The turbine is a pitch controlled upwind turbine with active yaw and a rotor with three blades. Pitch control means that blades can pivot on their own longitudinal axis. The pitch control is used for speed control, optimization of power production and to start and stop the turbine.
- The pitch control is performed by activating a hydraulic/mechanical system. The hydraulic system is also used for the disc brake system.
- Yawing is done by two electrical yaw gear motors, which mesh with a toothed wheel mounted on top of the tower. The bearing system is a slide system with built-in-friction.
- The blades are made from glass fibre. The shells are made in a light sandwich construction and mounted on a supporting closed beam of prepeg. Through a bonded aluminium root-insert the blades are bolted to the blade bearing. The blade bearing is bolted to the blade hub.
- The mechanical power from the rotor is transmitted through the main shaft to the gearbox. The gearbox is a combination of planet and helical gears.
- From the gearbox the power is transmitted through a cardan shaft to the generator. For 500 kW the generator is designed with constant slip of 2-3% depending on the type of generator.
- All functions of the turbine are monitored and controlled by a microprocessor based control unit, called the MP-controller (Multi Processor controller).
- The 'Emergency Stop Button' activates both the aerodynamics brake and the hydraulic disc brake, which is placed at the high speed shaft of the gearbox.
- The nacelle/hub is fully enclosed in a glass fibre reinforced polyester cover. The nacelle can be opened at the reverse and with the crane it is possible to bring up tools, spare parts etc.

Further, the project activity includes construction of a 66kV double-circuit line with Coyote conductor for a distance of 17 km from the project site to the existing 220/66 kV sub-station located at Honnali . Terminal bays have been provided for each circuit lines at the ends.

The power curve (i.e. wind velocity v/s effective power generation) for a 0.5 MW wind turbo-generator is shown in Figure 2 below.

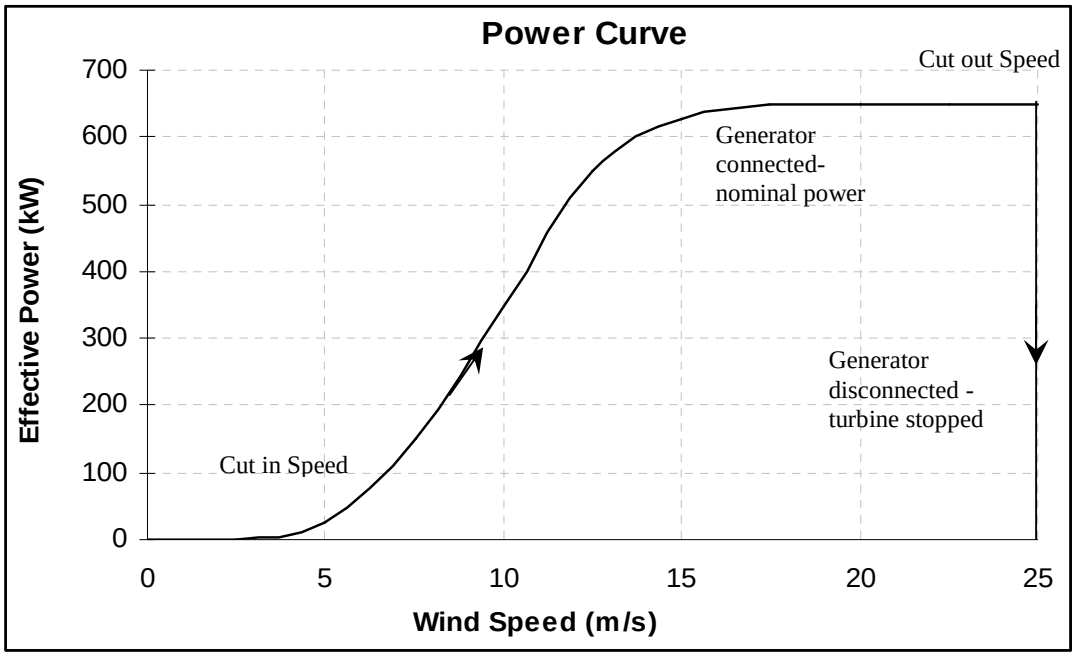

Figure 2: Power curve of the 0.5 MW wind turbo-generator (*Source: Vestas RRB*)

Estimation of plant load factor

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, 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 **Annex-5 Sheet 1 of 4**.

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 C-WET approved V-39, 500 kW 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 **Annex-5 Sheet 2 of 4**

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 1.15 Million units per annum per WEG in the area. The above supportive document is enclosed as **Annex-5 Sheet 4 of 4**. 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:

$$\text{Plant load factor (\%)} = \frac{Estimatedenergygenerationperannu \min kWh}{Capacityoftheplantin kWx8760hoursperyear} x100 \text{ ----------Equation (1)}$$

From Equation (1), for the BEL Wind project activity, PLF has been found as

$$\frac{5750000}{2500x8760} x100 = 26.25\%$$

Overall Data:

1. Cut in wind speed : 4 m/s
2. Cut out wind speed : 25 m/s
3. Hub height : 50 m
4. Nacelle tilt angle : 5^{O}
5. Regulation : Pitch

Generator

1. Rated power output : 0.5 MW electrical
2. Type : Asynchronous
3. Voltage : 690 V
4. Revolutions : 1526 rpm
5. Frequency : 50 Hz

Rotor

1. No of blades : 3
2. Diameter : 47 m
3. Swept area : 1735 m^2

Controls : Microprocessor based

Technology transfer

There is no technology transfer from any Annex-1 country to the project activity.

A.4.3 Estimated amount of emission reductions over the chosen crediting period:

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Years	Annual estimation of emission reduction in tonnes of CO_2e
September 2007 - August 2008	5360.4
September 2008 – August 2009	5360.4
September 2009 – August 2010	5360.4
September 2010 – August 2011	5360.4
September 2011 – August 2012	5360.4
September 2012 – August 2013	5360.4
September 2013 – August 2014	5360.4
September 2014 – August 2015	5360.4
September 2015 – August 2016	5360.4
September 2016 – August 2017	5360.4
Total estimated reductions (tonnes of CO_2e)	**53604**
Total number of crediting years	**10**
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	**5360.4**

A.4.4. Public funding of the small-scale project activity:

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There is no public funding involved in the project activity.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

According to Appendix C of the simplified modalities and procedures for small-scale CDM project activities, a proposed small-scale project activity is deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or a request for registration by another small-scale project activity:

- By the same project participants;
- In the same project category and technology/measure; and
- Registered within the previous 2 years; and
- Whose project boundary is within 1 km of the project boundary of the small-scale activity at the closest point.

None of the above conditions holds for project activity and BEL has not registered or applied for registration of another wind project. Therefore, the project activity is not a debundled component of a larger CDM project activity.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the small-scale project activity:

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Title of Approved Baseline Methodology: 'Grid Connected Renewable Electricity Generation'

Reference of the Approved Baseline Methodology: Category I.D - Renewable Energy Projects – Version 10, dated 23 December 2006 of the Appendix B of Simplified Modalities and Procedures (M & P) of Small Scale CDM Project Activities.

B.2 Justification of the choice of the project category:

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Appendix B of the simplified M&P for small scale CDM project activities, describes the category I.D as comprising renewables, such as photovoltaic, hydro, tidal/wave, wind, geothermal, and biomass, that supply electricity to an electricity distribution system that is or would have been supplied by at least one fossil fuel or non-renewable biomass fired generating unit.

The project activity involves setting up of a 2.5 MW wind power project in Davanagere district, Karnataka state, India. Under an agreement with KPTCL, the project activity will partially meet the power demand of BEL's Bangalore complex by wheeling through the KPTCL grid. The KPTCL grid forms a part of the thermal dominated Southern regional grid network of India with fossil fuels contributing to about 73% the regional grid's total generation. The power generated by the project activity displaces electricity that would otherwise have been supplied by the thermal power plants connected to the regional grid. Thus, the proposed project falls under Category I.D of the Appendix B of the simplified M&P for small scale CDM project activities.

The Methodology is applied in the context of the project activity as follows:

I. Baseline Emissions: The baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient measured in kg CO_2 equivalent/kWh. Two methods are provided for category I.D for estimating the emission coefficient in a transparent and conservative manner. They are:

a. A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the approved methodology ACM0002/ version 06.

b. The weighted average emissions in kg CO_2/kWh of the current generation mix. The data of the year in which project generation occurs must be used.

Since the project activity affects both current generation mix (largely) and future generation mix (to a lesser extent) of the grid, the project proponent opts to use Option a. - the Combined Margin in kgCO_2/kWh for the estimating the emission coefficient of the electricity system. Details of baseline calculations are provided in Section B.4 of the PDD.

II. Project Boundary: The project boundary encompasses the physical, geographical site of the renewable generation source and the electricity system. The details of project boundary are provided in Section B.3 of the PDD.

III. Additionality: The additionality aspects for the project activity have been discussed in accordance with Attachment A to Appendix B in Section B.5. of the PDD.

IV. Monitoring: The detailed Monitoring plan for the project activity is provided in Section B.6 of the PDD.

V. Emission Reductions: Since there are no project emissions or leakage associated with the project activity, the Emission Reductions for a year are equivalent to the baseline emissions avoided for that

particular year. Detailed emission reduction calculations for the project activity are provided in Section B.6 of the PDD.

B.3. Description of the project boundary:

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AMS-I.D defines the project boundary as encompassing "the physical, geographical site of the renewable generation source". For the project activity this includes the wind turbine installations, pooling, and evacuation system till the KPTCL sub-station.

Further, as per the methodology, the spatial extent of the project boundary is to include the project site and all power plants connected physically to the electricity system that the CDM project power plant is connected to. As the project activity feeds power to the Southern regional grid network of India, all power plants contributing to the regional grid have been considered for estimating the baseline emission coefficient.

B.4. Description of baseline and its development:

As per I.D. methodology, the Combined Margin method consisting of combination of operating margin (OM) and build margin (BM) calculated according to the procedures prescribed in the approved methodology ACM0002 **"**Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (Version 06/ dated 19 May 2006) is applied for estimating the baseline emission factor of the project activity

Details of baseline development

The following paragraphs discuss the baseline development:

I. Choice of the grid: Indian Power System is divided into five regional grids – Northern, Western, Southern, Eastern and the North Eastern. The project feeds the generated electricity to the Karnataka Power Transmission Corporation Limited (KPTCL) grid which is a part of the Southern regional grid network of India. Apart from Karnataka, the Southern regional grid comprises of state grids of Andhra Pradesh, Kerala and Tamil Nadu and the Union territory grid of Pondicherry.

As mentioned earlier, the ACM0002 methodology specifies that for the purpose of determining the build margin (BM) and operating margin (OM) emission factor, a project electricity system is to be considered.

The electricity system is defined by the spatial extent of the power plants that can be dispatched without significant transmission constraints. The Southern regional grid too comprises of a well networked grid comprising of the state grids where there are significant intra state exchanges. A common load dispatch centre, namely the Southern Region Load Dispatch Centre (SRLDC) functions as the nerve centre for monitoring and coordinating its operations.

Further, ACM0002/ Version 06 methodology states that where the Designated National Authority guidance is not available, the following definition of boundary is to be adopted "In large countries with layered dispatch systems (e.g. state/provincial/regional/national) the regional grid definition should be used. A state/provincial grid definition may indeed in many cases be too narrow given significant electricity trade among states/provinces that might be affected, directly or indirectly, by a CDM project activity"

Thus, in view of the above discussions, the Southern Regional grid network is chosen as the project electricity system to determine the baseline emission factor for the project activity.

Baseline Emission Factor: The CO_2 emission factor is calculated as Combined margin emission factor using latest data published by Central Electricity Authority (CEA)[3].

The ACM0002 methodology makes available the following four methods for calculating the Operating Margin emission factor:

(a) Simple OM, or
(b) Simple adjusted OM, or
(c) Dispatch Data Analysis OM, or
(d) Average OM.

As per the methodology, Dispatch data analysis should be the first methodological choice. However, as official and publicly available data to determine the set of plants (n) and the dispatch order from national/regional dispatch centre are not available, this option has not been used for calculating the OM.

[3] Refer CEA Report on Baseline Carbon Dioxide Emissions from Power Sector Version 1.1 - http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm

Thus the project proponent proposes to use the Simple OM method for estimating the Operating Margin emission factor and the Build Margin emission factor ,which are published by the CEAas given below.

Description	Units	Value	Source of information
Simple Operating Margin emission factor	t CO2 / MWh	1.0037	CEA Baseline Carbon Dioxide Emissions from Power Sector Version 1.1
Build Margin emission factor	t CO2 / MWh	0.7179	
Weightage for Simple Operating margin emission		0.75	For Wind projects - ACM0002/ Version 06
Weightage for Build margin emission factor		0.25	For Wind projects - ACM0002/ Version 06
Combined Margin emission factor	**t CO2 / MWh**	**0.9323**	

i.e

Emission Factor EF_y = OM * 0.75 + BM *0.25 = 1.0037 * 0.75 + 0.7179 * 0.25 = 0.9323 kg CO_2 / kWh

Thus, baseline emission factor *EFy* = 0.9323 kg CO_2 / kWh

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:

As stated in Section B.2 above, the baseline for the project activity is the kWh produced by the renewable generating unit multiplied by grid emission coefficient measured in kg CO_2 equivalent/kWh. This section justifies in detail how the proposed project activity is additional and is not identical with the baseline scenario (i.e. grid). The additionality aspects of the project are discussed below in accordance with Attachment A of Appendix B of the simplified M & P for small scale CDM project activities.

1) Barrier due to prevailing practice:

BEL's Bangalore complex has a total power demand of 10 MW which is entirely being met by purchasing power from the KPTCL grid. BEL conceptualized a 2.5 MW wind power project with wheeling facility in December 2003 so as to partially meet its captive power demand at the complex.

Prior to the conceptualization period of project activity in November – December 2003, the state transmission and distribution utility KPTCL was unbundled into four different Electricity supply companies (i.e.ESCOMS) in 2002[4] and the new Electricity Act was enforced nationally in June 2003 wherein wheeling was dealt under the new 'Open Access' policy. These developments required new set of interpretations of applicability conditions to wheeling projects among the state utilities and ESCOMS. BEL was aware of these developments and anticipated that it would possibly have to face many new regulatory concerns during setting up and operation of the project.. However, with a view to promote the renewable energy technology, reduce usage of fossil fuel sources and thereby GHG emissions, BEL decided to implement the project activity considering the potential risk coverage under CDM. The regulatory barriers actually faced by the project proponent are discussed below.

Regulatory barriers associated with finalization of wheeling agreement:

As per the new Electricity Act enacted by the Government of India in June 2003, the State Electricity Regulatory Commissions were authorized to formulate and enforce regulations concerned with electricity generation, transmission and distribution in the states. BEL initiated the purchase of equipments for the project activity in April 2004 and at the same time applied to the Karnataka Electricity Regulatory Commission (KERC) for obtaining the tariff structure and terms and conditions for wheeling of power[5]. Since a new Open Access regulation was yet to be finalized in Karnataka post Electricity Act 2003, KERC advised BEL to consider its earlier tariff structure, which was in vogue before the enactment of Electricity Act 2003, and go ahead to submit a formal application to KPTCL[6]. However, KPTCL did not process the application pending receipt of new final notification from KERC[7].

Later, even after KERC passed the Open Access regulations in December 2004 and subsequently fixed the wheeling charges as 5% of renewable energy projects in June 2005, KPTCL has abnormally delayed the agreements for similar wheeling projects in Karnataka[8] including that applicable for BEL. One of the

[4] Refer BESCOM website - http://www.bescom.org/en/aboutus/index.asp

[5] Letter from BEL to KERC dated 27 April 2004.

[6] Letter from KERC to BEL dated 10 June 2004.

[7] Letters from KPTCL to BEL dated 29 June 2004 and 19 Feb 2005.

[8] Refer - http://www.deccanherald.com/deccanherald/mar172006/state175522006316.asp for details

major reasons cited by KPTCL is that wheeling charges are well below the 34% transmission and distribution losses suffered by the utility and hence lower wheeling charges will affect its revenues[9].

Thus, despite repeated requests to both the state electricity regulator (KERC) and the state utility (KPTCL), BEL has not been to finalize the wheeling agreement over the last three years. BEL's project activity, being among the first two renewable energy projects availing wheeling facility in Karnataka state (the other project is by Madras Cements)[9] after the enactment of Electricity Act 2003, and ~~is~~ both are ~~thus~~ facing regulatory problems as mentioned above. This has led to considerable time and cost overruns (as a result of the market price escalation) for the BEL project activity. Further, there is uncertainty too about how wheeling charges will be applied in future to the electricity generated from renewable energy sources, as the draft agreement is yet to be finalized by KPTCL.

2) Other Barriers

The project proponent was not in the business of electricity generation and hence, the project activity represents a divergence from the core business of manufacturing electronic products. The project proponent had to invest in new resources in the form of skilled manpower for handling the regulatory issues and for operating the wind farm.

3) National Policies and Circumstances

There is no mandate from either the national or state government agencies for industries/organizations to set up renewable energy power projects. BEL has set up the project entirely as a voluntary initiative to reduce dependence on fossil fuels and thereby reduce release of GHG emissions.

Notwithstanding the above barriers, BEL is committed to the implementation of the renewable energy technology to partially meet its captive power requirement and thereby reduce GHG emissions. BEL is eagerly waiting to finalize the wheeling agreement with KPTCL and start the commercial operation of the plant.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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[9] Refer - http://www.thehindubusinessline.com/2003/02/26/stories/2003022600851700.htm for details

The project activity is in conjunction with the renewable energy project generating electricity of Type I.D category. The monitoring methodology and baseline selected is as suggested in Category I.D – Renewable Energy Projects – Version 10, dated 23 December 2006 of the Appendix B of Simplified Modalities and Procedures (M & P) of Small Scale CDM Project Activities.

The Methodology is applied in the context of the project activity as follows:

I. Baseline Emissions: The baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient measured in kg CO_2 equivalent/kWh. Two methods are provided for category I.D for estimating the emission coefficient in a transparent and conservative manner. They are:

a. A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the approved methodology ACM0002.

b. The weighted average emissions in kg CO_2/kWh of the current generation mix. The data of the year in which project generation occurs must be used.

Since the project activity affects both current generation mix (largely) and future generation mix (to a lesser extent) of the grid, the project proponent opts to use Option a. - the Combined Margin in kgCO_2/kWh for the estimating the emission coefficient of the electricity system. Details of baseline calculations are provided in Section B.4. of the PDD.

II. Emission Reductions: Since there are no project emissions or leakage associated with the project activity, the Emission Reductions for a year are equivalent to the baseline emissions avoided for that particular year. Detailed emission reduction calculations for the project activity are provided in Section B.6.3 of the PDD.

B.6.2. Data and parameters that are available at validation:

Data / Parameter:	EF_y
Data unit:	kg CO2 / kWh
Description:	CO2 emission factor of the grid
Source of data used:	Calculated as weighted average of Simple OM, BM
Value applied:	0.9323 kg CO2 / kWh
Justification of the choice of data or description of measurement methods and procedures	Calculated ex-ante as per ACM0002 methodology

actually applied :	
Any comment:	

Data / Parameter:	$EF_{OM,y}$
Data unit:	kg CO2 / kWh
Description:	CO2 operating margin emission factor of the grid
Source of data used:	Calculated
Value applied:	1.0037 kg CO2 / kWh
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated ex-ante as per Simple OM step of ACM0002 methodology
Any comment:	

Data / Parameter:	$EF_{BM,y}$
Data unit:	kg CO2 / kWh
Description:	CO2 Build Margin emission factor of the grid
Source of data used:	Calculated y
Value applied:	0.7179 kg CO2 / kWh
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated over recently built power plants as per Option 1 of the BM estimation defined in the ACM0002 baseline methodology
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

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The baseline emission factor (EF_y) is calculated as per ACM0002 methodology, as a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) factors. The OM and BM emission factors are considered from published data of CEA for southern regional grid.

Calculate the baseline emission factor EF_y

The baseline emission factor EF_y is the Combined Margin. The Combined Margin is calculated as the weighted average of the Operating Margin emission factor ($EF_{OM,y}$) and the Build Margin emission factor ($EF_{BM,y}$) calculated as follows:

$$EFy = wOM \times EF_{OM,y} + w_{BM} \times EF_{BM,y} \quad \text{---------- (5)}$$

where,

EFy	is the Combined Margin (the baseline emission factor) in tCO_2 / MWh
w_{OM} and w_{BM}	are default weights. As per the methodology, for wind and solar projects, (similar to the project under consideration), the default weights are w_{OM} = 0.75 and w_{BM} = 0.25 (owing to their intermittent and non-dispatch able nature), and
$EF_{OM,y}$ and $EF_{BM,y}$	are calculated as described in Steps 1 and 2 above and are expressed in tCO_2 / MWh

Baseline emissions

$$BE_y = EF_y \times EG_y \times 1000$$

where

BE_y = Baseline emission for year y, t CO_2 /year

EFy = Baseline Emission factor t CO_2 / MWh

EGy = Grid electricity replaced due to the project (or net electricity fed to the grid in the project), GWh/year

Emission Reductions

Since there are no anthropogenic emissions by sources of GHG due to the project activity and there is no leakage attributed due to the project activity, the emission reduction will be equal to the baseline emission.

Hence, ER_y (Emission reduction) = BE_y (Baseline emission)

The plant load factor (PLF) was calculated as per the details provided by the supplier. PLF was calculated based on the wind mast data, power curves and annual operating hours for each of the 0.5 MW turbines. The data collected over a period of one year was analyzed and the readings are documented in **Annexe Sheet 4 of 4**. Based on the data available 1.15 Million units/annum/WEG has been estimated. For 5 numbers of 0.5 MW turbines, the annual energy generation is 5.75 Million units per annum.

B.6.4 Summary of the ex-ante estimation of emission reductions:

>>

Years	Estimation of project activity Emissions (tonnes of CO_2 e)	Estimation of baseline Emissions (tonnes of CO_2 e)	Estimation of leakage (tonnes of CO_2 e)	Annual estimation of emission reductions in tonnes of CO_2 e
September 2007 - August 2008	0	5360.4	0	5360.4
September 2008 – August 2009	0	5360.4	0	5360.4
September 2009 – August 2010	0	5360.4	0	5360.4
September 2010 – August 2011	0	5360.4	0	5360.4
September 2011 – August 2012	0	5360.4	0	5360.4
September 2012 – August 2013	0	5360.4	0	5360.4
September 2013 – August 2014	0	5360.4	0	5360.4
September 2014 – August 2015	0	5360.4	0	5360.4
September 2015 – August2016	0	5360.4	0	5360.4
September 2016 – August 2017	0	5360.4	0	5360.4
Total (tonnes of CO_2 e)	**0**	**53604**	**0**	**53604**

B.7 Application of a monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Data / Parameter:	EG_y
Data unit:	kWh
Description:	Net electricity annually fed to the grid from the project activity
Source of data to be used:	KPTCL wheeling energy receipts at generation point (i.e. Form B)
Value of data	5.75 Million kWh / year
Description of measurement methods and procedures to be applied:	Measured monthly from main meter readings
QA/QC procedures to	The meter reading of net electricity fed to the grid is undertaken by KPTCL

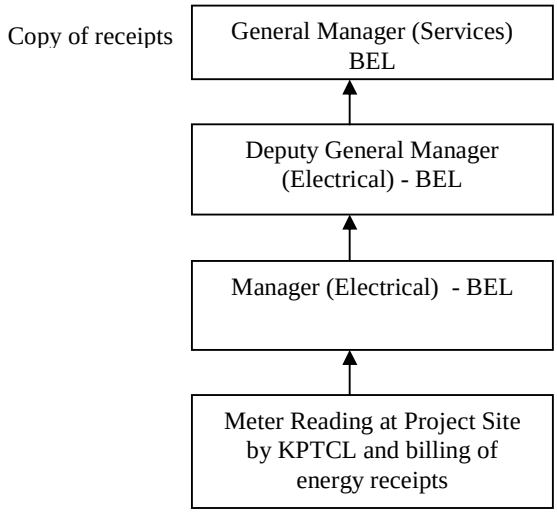
be applied:	personnel jointly with BEL representatives at site. Further KPTCL will submit energy receipts to BEL on a monthly basis. The meter is calibrated and sealed by KPTCL. Main meter reading is cross checked with check meter reading at site for any accuracy deviation beyond permissible limits. Hence uncertainty is low.
Any comment:	Records will be archived in the form of paper for entire crediting period + two years thereafter.

B.7.2 Description of the monitoring plan:

>>

Same as mentioned in B.7.1 above. The monthly KPTCL energy receipt (Form B) for the net electricity fed from the project activity will be checked for correctness by BEL management taking into account the energy injected to the grid and the wheeling charges. A report on net power fed from the wind farm and the corresponding GHG emissions reduced will be submitted to General Manager-Services BEL once a year.

Operational and management structure for internal monitoring of emission reductions and archiving records



B.8 Date of completion of the application of the baseline and monitoring methodology and the name of the responsible person(s)/entity(ies)

>>

Date of completion of the baseline study: 18 May 2007

Name of person/entity determining the baseline:

Bharat Electronics Limited (as listed in Annex I of the PDD) and its associated consultants

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

>>

25/03/2006

C.1.2. Expected operational lifetime of the project activity:

>>

25y 0m

C.2 Choice of the crediting period and related information:

The project will use a fixed crediting period of 10 years.

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

>>

C.2.1.2. Length of the first crediting period:

>>

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>

01/09/2007

C.2.2.2. Length:

>>

10y 0m

SECTION D. Environmental impacts

>>

D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

>>

The overarching environmental legislation in India is the Environment (Protection) Act, 1986. Under the framework of this law, the Government of India has made environmental impact assessment statutory for categories of activities, as defined in Schedule I of the recent Ministry of Environment and Forests

Environment Impact Assessment Notification S.O.1533, dated 14 September 2006 (incorporating subsequent amendments made in 1994, 1997, 2000, 2001, and 2002). Wind power projects are *not* listed in this Schedule I, and hence, environmental impact assessment is not required.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

>>

Although, there is no mandate for environmental assessment by the host country, the project has been scrutinized from the perspective of possible environmental, ecological, and socioeconomic impacts, and found to be free from any significant negative impacts, as summarized in the Table 7 below.

Table 7: Environmental, ecological and socioeconomic impacts

Category	**Remarks**
Air	
Changes in ambient levels and ground level concentrations due to total emissions from point, line and area sources	Reduction in sulphur dioxide (SO_2), nitrous oxide (NOx) and particulate matter due to displacement of fossil fuels at the thermal power plants.
Noise	
Changes in ambient levels due to noise generated from equipment and movement of vehicles	Noise from the individual wind turbo-generator is 85dB (maximum) at a point just below the wind mills. Further, as the habitations are at a considerable distance from the windmills, there is no noise pollution.
Water	
Availability to competing users	Water is brought from the river channel by habitants. Availability to competing users not impacted.
Changes in quality	No negative impact identified
Land	
Changes in land use and drainage pattern	No agricultural or pasture land will be affected.
Ecological	
Deforestation/tree-cutting and shrinkage of animal habitat	Trees have not been cut for setting up the windmills.
Impact on flora and fauna, and migratory path/route of animals	The project site is not on the migratory path of birds. There are no protected forest areas near the project site.

Impact on breeding and nesting grounds	No negative impact
Socio-economic	
Impact on the local community	Improvement in road access. Unhindered access to agricultural and pasture land.
Impact on economic status	Employment generation in both construction and operational stages
Impact on human health	No negative impact identified
Impact of increased traffic	Temporary increase in traffic during construction phase

Land has been leased from the Forest Department and Revenue Department for the project and all necessary clearances have been obtained. No agricultural or pasture land has been affected. Further, none of the trees have been cut in setting up the windmills. Villagers continue to have access to the areas they have been using as pasture land.

SECTION E. Stakeholders' comments

>>

E.1. Brief description how comments by local stakeholders have been invited and compiled:

>>

The project site is 31 km from Davangere and 300 km from Bangalore. The villages nearest to the project site include Kumblur (2 km), Basavapatna (4 km), and Horasagara (1.5 km) and Daginakatte (0.5 km), all in Davanagere District. Stakeholders included the residents of the above nearby villages, persons employed on the project site, KPTCL, KERC, Bangalore Electricity Supply Company (BESCOM), Karnataka Renewable Energy Development Limited (KREDL), the state Forest department and Government of Karnataka. The local stakeholders were interviewed for their comments on the project activity on 18th October 2006. The interviews covered topics such as general perception of villagers towards the wind mill project, socio-economic changes observed, and environmental impacts – including air, water, noise, and ecology. The comments received from them are summarized in section E.2 below.

E.2. Summary of the comments received:

>>

1. The village authority of Daginakkate village, Chennagiri Taluk, Davanagere District has communicated that the BEL project activity has lead to employment generation in the construction

stage by hiring people as contractors, labourers and drivers. He said that educated local youth are benefited by being trained as service staff for the operation of the project activity.

The villager authority stated that the road access has improved as a direct result of the project. While villagers would earlier climb up to the hilltop, they can now drive up using the motorable road built. Though the traffic through the village had increased temporarily during the construction phase, but the village authority did not mention any problems as a result. Further, he said that as habitations are at a considerable distance from the windmills, noise pollution was not an issue. The village authority also commented that the project will make an important contribution to the power situation in the local grid and benefit the country.

2. Mr. Manjunath, a local who is employed as a driver for the service vehicle has appreciated the efforts of BEL to set up the project activity.
3. The technicians Mr. Hanumanthappa and Mr. Syed Mubarak have also commented that the project has benefited the educated local youth in providing employment.
4. KERC, KREDL and Energy and Forests Department of Government of Karnataka have provided their consents and approvals for setting up of the project activity.

E.3. Report on how due account was taken of any comments received:

>>

No negative comments were received from the stakeholders.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Bharat Electronics Limited
Street/P.O.Box:	Jalahalli Post
Building:	--
City:	Bangalore
State/Region:	Karnataka
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FAX:	+91 80-28380266
E-Mail:	--
URL:	www.bel-india.com
Represented by:	--
Title:	Deputy General Manager
Salutation:	Mr.
Last Name:	Venkatesh
Middle Name:	R
First Name:	K
Department:	Engineering Services
Mobile:	--
Direct FAX:	--91-80 28381968
Direct tel:	--91-80 22195758
Personal E-Mail:	venkateshkr@bel.co.in

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public funding involved in the project activity.

Annex 3

BASELINE INFORMATION

Please refer to Section B.4 for details.

Annex 4

MONITORING INFORMATION

Please refer to Section B.7 for details

The project proponent being an ISO 9001 and ISO 14001 certified company, has laid out systems and procedures to supervise the performance of the project activity. The company has a 'GHG Monitoring Procedure' in place to monitor and review power fed to grid, calibration of metering instruments, and will present an annual GHG performance report to the top management.

Further, BEL also has internal audit procedures in place for the project activity to be conducted by a authorized Internal Auditor of BEL. Internal audit shall involve independent evaluation of the GHG procedure. Any Corrective Action Requests (CARs) or clarifications arising out of the Internal Audit will be promptly addressed and subsequently reviewed and closed by the top management.

- - - - -

Annexe 5

DETAILS OF PLANT LOAD FACTOR ESTIMATION

Power Equations

TURNKEY OPERATORS

BANGALORE

Annex 5
Sheet 1 of 4

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 avilable 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

24/95

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Bagalur Road, Hosur - 635 109,
TAMIL NADU.

Annex 5
Sheet 2 of 4

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%

Wind Velocity V (m/s)	E1 - Power Output Pel (KW)
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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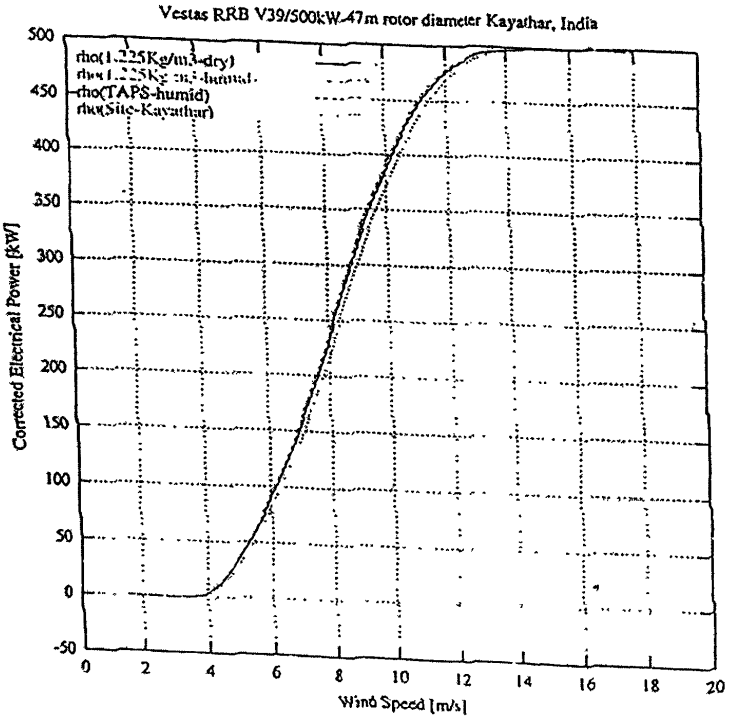

Figure 6.3.3 Corrected electrical power as a function of wind speed for different air densities

C-WET-I-PP-3

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Annex 5
Sheet 4 of 4

VRRB

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

VESTAS RRB INDIA LIMITED * BANGALORE *

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