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

**CONTENTS**

**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.<br>• 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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15 MW Grid Connected Wind Turbine Project in Karnataka
[Version: 06 April 8, 2008]

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

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The proposed CDM project is a 15 MW wind power project comprising 20 Wind energy Generators (WEGs) based in the Jogimatti wind corridor in Chitradurga district of the southern Indian state of Karnataka. The project is promoted by Mineral Enterprises Limited, a company engaged in the mining industry in India, with at least 5 mines in the state of Karnataka, of which one is located in the same district as the project, i.e. Chitradurga. The project began in May 2004 with the issue of the purchase order by the project promoter and implementation was completed by March, 2006 when the last WEG was installed.

Mineral Enterprises Limited has entered into power generation and sale of power to the grid in the Indian state of Karnataka, through introduction and application of wind power technology. In the current global scenario, investment in renewable energy such as wind power is considered environmentally desirable and socially acceptable.

The purpose of the project is to sell clean and environmentally sustainable power to the grid, which is owned and managed by the Karnataka Power Transmission Corporation Limited (KPTCL) under special provisions introduced at the central level by the government of India to promote renewable energy initiatives, contained in Indian Electricity Act, 2003. The Karnataka state grid is integrated with the Southern grid of the country. Although the provision of a national grid for India has been contained in various policy documents and efforts are on to integrate regional grids into a national grid. However as on date the interchange of power between regional grids being negligible, the relevant GHG baseline for the proposed CDM project will be the southern grid.

The contribution of wind energy sector to electricity generation in India is not significant. Currently, at 1374 MW it is a miniscule 1% of the total installed capacity for electricity generation from all sources in India. In addition, with an average capacity utilisation factor of just 20% its contribution in terms of units generated is of even lesser significance. However, the potential for development of wind energy is very significant. The Planning Commission, Government of India estimated the potential for wind energy in the country to be as high as 45,000 MW, of which less than 1,400 MW have been exploited[1]. Thus, the penetration of the technology has not been adequate, even though India remains among the top wind energy producers in the world.

With regard to the technology, the proposed CDM project features a technological innovation in the form of gearless and synchronous wind turbine generators (WTG) of Enercon make. The project seeks to engage state of the art WTG of the gearless variety in 2 sizes, viz. 600 kW and 800 kW, depending upon the wind speeds in the wind corridors that the project promoters have identified. It may be mentioned that the 800 kW gearless and synchronous wind turbine generators is among the first of its kind to be introduced by the technology supplier, Enercon India Limited in India.

*Project contribution to sustainable development*

[1] Tenth Five Year Plan: www.planningcommission.nic.in

The project's contribution to sustainable development goals and objectives are assessed from the points of view of social, economic, environmental and technological well being. The Indian Designated National Authority, Ministry of Environment and Forests, Govt. of India has stipulated guidelines and indicators to assess a CDM project's contribution to sustainable development in the approval guidelines for CDM projects.

The first and most significant contribution of the project to sustainable development is embodied in the overall impact of the project in the national development context. The project seeks to utilise low wind speeds (of even 2m/s) in power production using nearly MW-scale turbines (800 kW). For a country where wind speeds are expectedly lower than the ideal levels of 8-10 m/s, the project has the potential to transform several other sites in the country with around 3-5 m/s wind speeds into viable wind power project. In the long run, and across the nation, this raises the possibility that the overall potential of wind power is revised upwards based on the success of the proposed CDM project, and similar projects that may be installed.

Specific contributions are enumerated as below:

A. **Social well being** – *the CDM project activity should lead to alleviation of poverty by generating additional employment, removal of social disparities and contribution to provision of basic amenities to people leading to improvement in quality of life of people.*

In the context of the proposed CDM project, the activities of project installation, maintenance and repair involve significant inputs of human labour. This leads to direct employment for local people in the area. It is interesting to note in this regard that near the wind corridor around Vanivilasagar and the Jogimatti wind corridor, the base point of Hiriyur has developed into a township of skilled and unskilled professionals involved in the development of the wind energy sector in the country. Along with professionals, an entire service industry has also come up to provide housing, daily necessities and even banking facilities. This has transformed the area into an urbanised hub, and attracted business volumes. Thus, there has been significant 'social progress' as per the definition outlined by the DNA i.e. MoEF.

B. **Economic well-being** - *The CDM project activity should bring in additional investment consistent with the needs of the people.*

The project activity leads to an investment of about INR 750 Million into the region, which would not have happened in the absence of project activity. In light of the power shortage situation currently faced by Karnataka, additional power generation options are considered to be consistent in line with the region's developmental priorities. Further, 'green energy' is a strategic national developmental priority of the Indian government as outlined in the Eleventh Five Year Plan document and the Vision 2025 Document produced by the Indian government (Ministry of Power).

C. **Environmental well being** - *a discussion of impact of the project activity on resource sustainability and resource degradation, if any, due to proposed activity; bio-diversity friendliness; impact on human health; reduction of levels of pollution in general.*

Wind energy for generation of electricity is generally considered as the cleanest option for power generation, even within the ambit of renewable energy based options. Wind based power generation produces virtually no pollutants: they are considered to be benign on the local environment and not perceived as a threat to human habitat. Further, the project has been commissioned on a site that was earmarked for the purpose by the Government of India (GoI). Thus, it is furthermore expected that

GoI would have satisfied itself that the wind power projects do not by design only create any adverse impacts on the local environment.

D. **Technological well being** - *The CDM project activity should lead to transfer of environmentally safe and sound technologies with a priority to the renewables sector or energy efficiency projects that are comparable to best practices in order to assist in upgradation of technological base.*

The project had during the time of its installation, been one of the first examples of state of the art 800 kW capacity *gearless, synchronous generator type* wind turbine generators installed by Enercon in India, in addition to then existing top of the line 600 kW gearless generators. Till date, the 800 kW model remains the technological benchmark for gearless WTG in India. These are high efficiency systems capable of operating at low wind speeds of even under 3 m/s. This is relevant for India where there is plenty of potential at lower wind speeds.

## A.3. Project participants:

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| 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) |
|---|---|---|
| Government of India<br>(host Party) | Mineral Enterprises Limited | No |

(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party (ies) involved is required.

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

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

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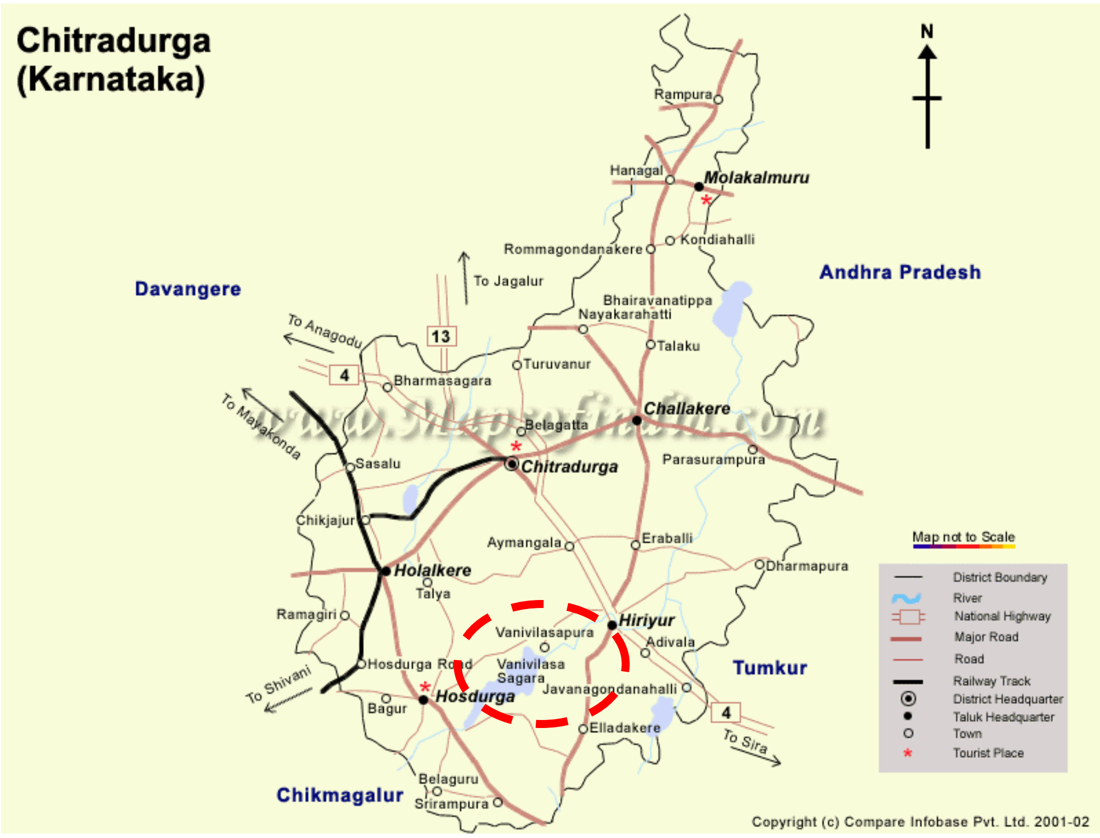
The proposed small scale CDM project activity is located in the state of Karnataka in Southern part of India. The site is located in Chitradurga district in the Jogimatti wind corridor, encompassing the sites of Vanivilasagar, Gim2 (West), Gim2 (Central) and MMCL. Specifically, they are located as detailed below in Hiriyur and Hosadurga talukas of Chitradurga district in Karnataka.

WEGs Set 1: Vanivilasagar Site (600 kW x 5 WEGs = 3.0MW) N13$^0$ 51' 21.5" & E76$^0$ 29' 33.8",

WEGs Set 2: MMCL Site (800 kW x 3 WEGs = 2.4 MW), N14$^0$ 05' 22" & E76$^0$ 20' 35",

WEGs Set 3: GIM 2 (Central) Site (800 kW x 7 WEGs = 5.6MW) N13$^0$ 56' 46.5" & E76$^0$ 25' 10.3" and GIM 2 (West) Site (800 kW x 5 WEGs = 4.00MW) N13$^0$ 59' 42" & E76$^0$ 24' 8.6"




The area marked in red indicates the area where the WTGs are installed.

#### A.4.1.1. Host Party(ies):

>>
India

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

Country : India

State : Karnataka

District : Chitradurga

**A.4.1.3. City/Town/Community etc:**

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Nearest town to the wind power locations is **Hiruyur**. Please see the map, and refer to the preceding section for details of the names of villages.

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

>>
The project is located in Hiriyur and Hosadurga talukas of Chitradurga district. Specifically, in the following locations:

WEGs Set 1: Vanivilasagar Site (600 kW x 5 WEGs = 3.0MW) N13$^{0}$ 51' 21.5" & E76$^{0}$ 29' 33.8",

WEGs Set 2: MMCL Site (800 kW x 3 WEGs = 2.4 MW), N14$^{0}$ 05' 22" & E76$^{0}$ 20' 35",

WEGs Set 3: GIM 2 (Central) Site (800 kW x 7 WEGs = 5.6MW) N13$^{0}$ 56' 46.5" & E76$^{0}$ 25' 10.3"
and GIM 2 (West) Site (800 kW x 5 WEGs = 4.00MW) N13$^{0}$ 59' 42" & E76$^{0}$ 24' 8.6"

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

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The project has a total installed capacity of 15 MW, which is the qualifying ceiling for small scale CDM project. Having qualified as a small scale CDM project, it becomes eligible to utilise simplified modalities and procedures for small scale CDM (SSC) projects. It falls under type I, Renewable Energy Projects, under category 1D: Grid Connected Renewable Electricity Generation.

As discussed under project description, the project utilises wind power based energy generation technology, which is environmentally among the most environment-friendly of technology options for power generation. The technology in this case features an innovation which has been transferred from Annex I countries. However the transfer is not project specific: the technology has been transferred to India by its original promoter and developer, who have set up a wholly owned Indian subsidiary in the country to promote its successful proliferation. As explained above, the project developer Mineral Enterprises Limited introduced 600 kW at a time when 600 kW was the state of the art in the gearless WTG segment, and also compared well with the state of the art prevalent in the country. The present range of 800 kW turbines were also introduced at a time when the 800 kW is considered equivalent to a 1 MW turbine in terms of capacity utilisation factor, and thus is currently the state of the art. Therefore, the project compares favourably with the technology status in India.

The Enercon make gearless technology features a synchronous generator suitable for variable speed options. This enables power generation at very low speeds, which therefore has the potential to

improve power generation from any particular site, and therefore improve the potential of wind power in the country. Thus, in addition to being technologically superior, it also is resource efficient. The component parts of the WTG, which largely focus on the flagship E-48, are explained below[2].

**Synchronous Generator with Inverter**: Enercon has introduced synchronous generator (SG) in place of induction type generators usually used with gears; the generator is used with a high frequency inverter for operating even under variable wind speeds. The advantage with SG is that it draws very less reactive power at less than 1% of the power that it generates. In comparison, induction generators draw a higher level of reactive power; therefore the actual power generation (derived by subtracting reactive power from total power drawn) is much higher in the case of synchronous generators..

**Rotor Blade Design**: The new rotor blade concept of Enercon focuses on yield, noise emission and load-optimisation. Blades also use the inner part of the rotor area and considerably increase the energy yield. The success of the rotor blade design is based on the fact that the wind flow is concentrated on the nacelle, exactly where the blades reap the wind. The blade is flush with the wide blade connection on the spinner, thus picks up additional wind yield from two sides: thereby improving resource (wind) utilisation. Further, turbulence that occurs at the blade tips due to pressure variations are effectively removed from the rotor plane. The entire length of the blade is thus utilised without any energy loss caused by turbulences.

**Control System**: Enercon wind turbines are equipped with state-of-the-art microelectronic control technology developed in-house. The MPU (main processing unit), the central element of the control system, is in continuous contact with the peripheral control elements, such as the yaw control and active pitch control system. Its function is to adjust the individual system parameters to ensure that the Enercon WTG operates at optimum yield in all weather conditions.

**Yaw System**: The Enercon features adaptive yaw control of the nacelle by means of constant yaw of the WTG, based on evaluation of the measurement data received from the wind sensor.

The other key features of the Enercon wind turbine that assure higher PLF are:

- Slow speed generators that result in less wear and tear and therefore, lower maintenance costs
- Near unity power factor is maintained by use of DC to AC inverter along with a Grid Watch Card that ensures that power is always pumped into the grid as per the grid frequency.
- Use of the DC to AC inverter as a variable speed drive allows the use of a synchronous generator instead of the conventional Induction (Asynchronous). This leads to lower reactive power being drawn from the grid.
- Generation at wind speeds even as low as 2m/s, unlike the Vestas wind turbines, which have a cut in wind speed of 4 m/s.
- Use of FRP blades with Epoxy Resin and reinforcing with aluminium strips throughout the periphery of the blade has resulted in a low-weight but mechanically very strong blade. Also, they do not warp, as do conventional blades made of FRP with polyester plastics.

[2] The bulk of the information provided may be verified from Enercon GMBH website: http://www.enercon.de

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

| Years | Estimation of annual emission reductions in tonnes of $CO_2$e) |
|---|---|
| Yr-1: 2008 – 2009 | 28,106.46 |
| Yr-2: 2009 – 2010 | 28,106.46 |
| Yr-3: 2010 – 2011 | 28,106.46 |
| Yr-4: 2011 – 2012 | 28,106.46 |
| Yr-5: 2012 – 2013 | 28,106.46 |
| Yr-6: 2013 – 2014 | 28,106.46 |
| Yr-7: 2014 – 2015 | 28,106.46 |
| Yr-8: 2015 – 2016 | 28,106.46 |
| Yr-9: 2016 – 2017 | 28,106.46 |
| Yr-10: 2017 – 2018 | |
| Total Emission Reductions (tonnes of $CO_2$e) | **2,81,064.60 tons $CO_2$ over 10 years** |
| Total number of crediting years | **10 years** |
| Annual average of the estimated reductions over the crediting period ($tCO_2$e) | **28,106.46 tonnes per year on average** |
| | |

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

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No public funds were used to finance or support the project in any manner.

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

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According to paragraph 2 of Appendix C to the Simplified Modalities and Procedures for Small-Scale CDM project activities (FCCC/CP/2002/7/Add.3), a small-scale project is considered a debundled component of a large project activity if there is a registered small-scale activity or an application to register another small-scale activity:

- With the same project participants
- In the same project category and technology
- Registered within the previous two years; and
- Whose project boundary is within 1 km of the project boundary of the proposed small scale activity

The project proponent, Mineral Enterprises Limited hereby confirms that none of the conditions mentioned above are applicable to the project, and no other Wind Energy Generator (WEG) based or

any other CDM project has been or will be submitted for consideration by the investor, which have or will have satisfied the de-bundling norms.

## 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 the approved baseline and monitoring methodology: Type I Renewable Energy Projects – ID Renewable Electricity Generation for a grid. Version 11, valid from 18th May 2007 onwards (CDM EB 31).

Reference: Appendix B to the simplified modalities and procedures for small-scale CDM project activities (contained in annex II to decision 21/CP.8, FCCC/CP/2002/7/Add.3)

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

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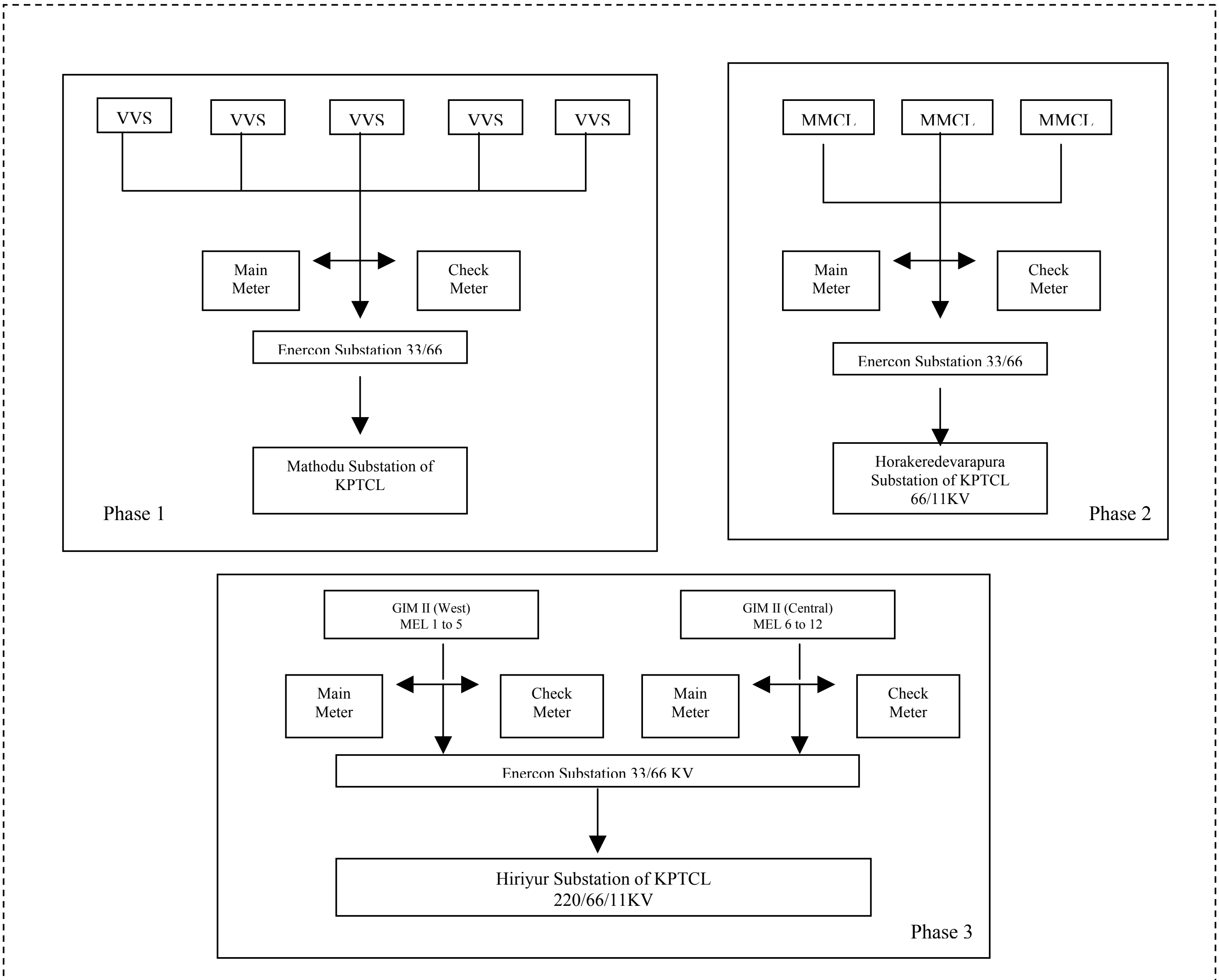
As per Appendix B to the Simplified Modalities and Procedures for small-scale CDM project categories, all renewable energy projects under the threshold of 15 MW of installed capacity qualifies as a small scale CDM project.

As the installed capacity of the proposed project is 15 MW, the project qualifies as a small scale CDM project and qualifies to apply baseline and monitoring methodologies for small scale CDM project categories. The Project Proponent further, states that the proposed project will not exceed 15MW during the entire period of the project and thus, would continue to qualify as a Small-scale CDM project.

### B.3. Description of the project boundary:

The project boundary encompasses the physical, geographical site of the 15.0 MW project sited at the project location specified in Section A.4.1.4 above. It would include the wind turbine installations and pooling and KPTCL sub-stations. The schematic depicts the project boundary pictorially.




As per the guidance, the project boundary includes the wind turbine generators that are installed in the 3 aforementioned sites of Vanivilasagar, Gim2 (West), Gim2 (Central) and MMCL as part of the proposed CDM project. The boundary also includes metering equipment, including the SCADA software, which have been installed to ensure that the project operations are monitored on a continuous basis. Finally, the project boundary includes the sub-station and interface with the Southern grid, which is the *de facto* baseline for the project.

**B.4. Description of baseline and its development:**

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Under sub-category 1D of the Indicative Simplified Baseline and Monitoring Methodologies for Selected Small Scale CDM Project Categories, the applicable baseline selected is the combined margin of electricity generation in the Southern grid for India.

The rationale behind the choice of the proposed methodology has been built upon the fact that the project supplies power to the grid at 33 kV. Thus, the reference zone for the construction of the 'but for' situation is the local grid.

For India, the local grid is no longer the state grid. Following the introduction of the new Economic Policy and the de-regulation of the Indian power sector, there have been efforts to integrate power grid network into a single *national grid*. However as on date, the grid is yet to be nationalised. However, there is sufficient power exchange across state electricity boards. The management of the power exchanges are carried out at the Regional Electricity Board (REB) and the load management is taken care by the Regional Load Despatch Centre (RLDC), which lend view to the conclusion that the reference zone for the baseline is not the state grid but the regional grid. For southern India, this reference zone is the Southern Regional Electricity Board (SREB) and the Southern Regional Load Despatch Centre (SRLDC). For the project therefore, the SREB grid acts as the emissions baseline.
It must be mentioned here however that all renewable energy projects supplying power to the grid may not automatically qualify for SREB as the baseline scenario. The rationale behind selection of the regional baseline is that for a 15 MW wind power plant supplying power to Karnataka Power Transmission Corporation Ltd (KPTCL) grid at 33 kV / 132 kV will not be consumed within the local network, but will be utilised as per the load (demand) at any given point in time. Since the southern grid has several generating stations whose power are utilised in the grid, the SREB in effect becomes the baseline scenario: in the absence of the wind power project, power would have been supplied by the existing fuel mix in the grid, which is the "what would have happened otherwise" scenario.

Based on the above rationale, there are certain assumptions that have been made to arrive at the precise baseline scenario. They are listed as follows:

**A1: The Combined Margin Approach:**

The approach adopted for the construction of the project baseline is the Combined Margin. This is based on the guidance provided for in Section 1D of the indicative simplified baseline and monitoring methodologies for selected small scale CDM project categories. The Combined Margin (CM) takes into account historical emissions in the reference zone (the Operating Margin) while giving due value to the latest additions to the baseline through newly commissioned plants that would normally have a better environmental performance.

**A2: Simple Operating Margin**

It has been postulated that the project will generate power to replace the grid. At this point, the grid has an existing fuel mix which can be reflected in the operating margin (the project chooses the Simple Operating Margin or Simple OM as the variant). The Simple OM then is the historical component in the baseline.

**A3: Build Margin**

In addition to the Simple OM, the project shall also, to a lesser extent, influence and be influenced by the additions to the existing OM by newly 'built' units, over the last 5 years. This is usually referred to as the 'Build Margin' (BM). The BM and the Simple OM are then averaged.

**A4: Ratio of Combination**

This assumption deviates from the standard postulate that Simple OM and BM are averaged using equal weights, that is, 50%. Here, considering the small size of the wind power project, it is less likely that the Build Margin forms the business-as-usual scenario for the project. The rationale behind this assumption is that Karnataka as well as the southern grid are experiencing shortfalls in peak power supply, and the gas finds in the Krishna-Godavari (K-G) basin have also not been fully

converted into mega power projects. Thus, the Build Margin may represent the b-a-u scenario to a lesser extent. Thus, the project attributes a 75% weightage for the Simple OM, and a 25% weightage for the BM.

For the calculation of the baseline, the document referred to was the report titled, "CO2 Baseline Database for the Indian Power Sector Ver.3.0"; brought out by the Central Electricity Authority, Ministry of Power, Government of India. This is a public document that has the concurrence of the government of India and therefore can be quoted as a reliable source of information. This is also in line with the recommendation under guidance for Section 1D (grid connected renewable electricity generation) to the effect that for designing project specific baselines the calculations were to be 'based on an official source'.
The grid based GHG emission factors thus derived from the CEA report are retained throughout the project crediting period. This is considered to be a conservative estimate. A quick glance at the future capacity addition for the Southern grid clearly shows the erection of large scale coal fired power plants using advanced technologies such as super critical boiler and coal gasification. In comparison the share of hydropower will actually fall as most of this resource has been utilised in the southern grid, and that of renewables may remain the same. Thus, future capacity additions will reflect in a higher GHG emission factor over time. However, to remain at the conservative end, GHG emission factors used in the project have been retained throughout the crediting period.

**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:**

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To assess the proposed CDM project in perspective, it is necessary to look into the policy and regulatory regime of the Indian power sector as well as the wind power sector in the country.

The details of the baseline involve analyses of the Indian power sector, the role of renewables in the Indian power sector and an in-depth analysis of the Southern grid, where the project is located.

**Power scenario: India**

The total installed capacity in India, as on January 2004 was about 1,08,315.30 MW, with thermal power plants constituting a major share at 71.50 % of the total capacity, followed by hydro (26 %) and nuclear (2.5%). The total generation for the year 2003-2004 till January 2004 was about 460712 million units with nearly 83%, coming from thermal power plants. It is evident that the power generation is heavily dependent on the thermal generation. There are about 143 thermal power stations in India, out of which 90 are coal based and remaining use other fuels like gas, diesel, naphtha, etc.

In India, power is a concurrent subject between the state and the central governments. The perspective planning, monitoring of implementation of power projects is the responsibility of Ministry of Power, Government of India. At the state level the state utilities or state electricity boards (SEBs) are responsible for supply, transmission, and distribution of power. In addition, there are different central / public sector organizations involved in generation like National Thermal Power Corporation (NTPC), National Hydro Power Corporation (NHPC), etc. in transmission e.g. Power Grid Corporation of India Ltd. (PGCIL) and in financing e.g. Power Finance Corporation Ltd. (PFC).

There are five regional grids in India: Northern, Western, Southern, Eastern and North-Eastern. Different states are connected to one of the five regional grids as shown in the Table below.

**Table 1: States connected to different regional grids**

| Regional grid | Northern | Western | Southern | Eastern | North Eastern |
|---|---|---|---|---|---|
| States | Haryana, Himachal Pradesh, Jammu & Kashmir, Punjab, Rajasthan, Uttar Pradesh, Uttaranchal, Delhi | Gujarat, Madhya Pradesh, Maharashtra, Goa, Chattisgarh | Andhra Pradesh, Karnataka, Kerala, Tamil Nadu, | Bihar, Orissa, West Bengal, Zarkhand | Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura |

The management of generation and supply of power within the state and regional grid is undertaken by the state load despatch centres (known as SLDC) and regional load dispatch centres (RLDC). Different states within the regional grids meet the demand from their own generation facilities plus generation by power plants owned by the central sector i.e. NTPC and NHPC etc. Depending on the demand and generation there are exports and imports of power within different states in the regional grid. Thus there is an exchange of power among states in the regional grid. Similarly there exists imports and export of power between regional grids.

**Present power generation in southern region**

The project is located in the state of Karnataka and connected to the Southern Grid. The southern grid is common to the four southern states of Tamil Nadu, Karnataka, Andhra Pradesh and Kerala and the Union territory of Pondicherry. There is also a common load dispatch centre, namely the "southern region load dispatch centre' (SRLDC).

The proposed project would be feeding electricity into the southern regional grid serving the four southern states and the Union Territory of Pondicherry. Hence the proposed project would have impact on all the generation facilities in the southern grid. Thus all the power generation facilities connected to this grid form the project boundary for the purpose of baseline estimation. The southern grid is also connected with other regional grids, however, the net exchange of energy within the regional grids is very small and hence other regional grids are not included in the boundary.

The total installed capacity in the southern region, to which the proposed project would be feeding electricity, at the end of the financial year 2005-2006 is 36,051 MW (as on 31st March 2006). While hydropower (non-small scale) accounted for roughly a third of total installed capacity (30.6%), total contribution from thermal power sources accounted for 56.5%, while nuclear power (2.3%) and renewable energy (10.7%) roughly made up for the rest.

The major sources of thermal power generation in the southern region are coal and lignite, with an increasing role for gas based generation in the region. The generation mix in the southern region is as given below.

**Table 2: Capacity mix in the Southern Grid (MW) in 2005-2006**

| State | Hydro | Thermal | Gas | Diesel | Nuclear | Wind+RE | Grand Total |
|---|---|---|---|---|---|---|---|
| **Andhra Pradesh** | 3575.94 | 2952.5 | 1738.4 | 36.8 | 0 | 603.74 | 8907.38 |
| **Karnataka** | 3486.4 | 1730 | 220 | 234.42 | 0 | 843.17 | 6513.99 |
| **Kerala** | 1818.2 | 0 | 174 | 256.44 | 0 | 87.35 | 2335.99 |
| **Tamil Nadu** | 2145.85 | 3220 | 919.3 | 411.66 | 0 | 2294.66 | 8991.47 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Pondicherry** | 0 | 0 | 32.5 | 0 | 0 | 0.6 | 33.1 |
| **Lakshadweep** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Central Sector** | 0 | 8090 | 350 | 0 | 830 | 0 | 9270 |
| **Southern Grid Total** | 11026.39 | 15992.5 | 3434.2 | 939.32 | 830 | 3829.52 | 36051.93 |
| **Southern Grid % share** | 30.6% | 44.4% | 9.5% | 2.6% | 2.3% | 10.6% | 100% |

As far as the generation scenario is concerned, the table below provides generation details for the year 2005-2006. The table is slightly different from the one above in the sense that it does not give details for individual states, but concentrates on the classified energy supply options.

### Table 3: Southern Grid Generation Details (MW)

| **Southern grid generation details** | | | | | | |
|---|---|---|---|---|---|---|
| **State** | **Hydro** | **Thermal, Gas and Diesel** | **Nuclear** | **Wind** | **IPPs** | **Grand Total** |
| **2004-2005** | 24,699.4 | 109,585.5 | 4,407.8 | 37.2 | 18,987.6 | 157,717.5 |
| **% Share** | 15.7% | 69.5% | 2.8% | 0.0% | 12.0% | |
| **2005-2006** | 32,970.8 | 108,660.7 | 4,711.6 | 34.7 | 20,675.9 | 167,053.5 |
| **% Share** | 19.7% | 65.0% | 2.8% | 0.0% | 12.4% | 100.0% |

As can be seen from above, thermal energy sources account for roughly 58% of installed capacity, in terms of actual generation the share of thermal energy sources is higher, even if IPPs in the sector are not considered in the analysis. Comparatively, the share of hydropower comes down from 30% (in the case of installed capacity) to less than 20% for actual generation, which is reflective of the lower capacity utilisation factor. Over the 2 years for which the data have been analysed, it is clearly visible that the share of thermal power has declined while that of hydropower has gone up, along with that of wind power. However, the contribution of wind energy is very insignificant.

**Demand projections and capacity additions: Southern Grid**

The Fifteenth Electric Power Survey (EPS) of India has made long term demand projections, in terms of peak and base load energy demand. As per the 15th EPS, the peak demand in the southern regional grid would be about 37,996 MW and the energy requirement would be 234164 million units. The demand projections have been revised in the sixteenth EPS, and as per the 16th EPS the peak demand in the year 2011-12 would be 42,061 MW and the energy requirement would be about 262718 million units. Thus, it is clear that the demand for electricity in the southern region is increasing, at about 6%. The capacity addition studies are carried out by the Central Electricity Authority (CEA), based on demand projections. The capacity addition studies are carried out in order to arrive at optimum resource mix to meet the demand. The CEA uses the Electric Generation Expansion Analysis System (or EGEAS) and the Integrated System Planning Model (or ISPLAN) models for optimisation. The EGEAS model selects the optimum generation mix among different fuel options. The ISPLAN model analyses the integrated system of capacity addition along with fuel and power transportation. The

capacity addition plans are based on such studies and thus could be considered as optimum generation mix/low cost system mix for meeting the future demand.

About 7,673 MW is planned to be added in the southern region in the 10th five year plan, i.e. from 2003 to 2007. Coal and lignite remain major fuel for future capacity additions with about 58% share.

Based on the status of the planned power generation projects, about 11,097 MW would be added in the southern region in the period from 2008-2012. By the end of 2012, the additional installed capacity in the southern region is targeted to be about 18475 MW against the projected peak demand of 42061 MW. The achievement rate in the capacity additions has mostly been low in the previous plans e.g. in the ninth plan, the actual capacity additions were 19,000 MW as against the target of additional 40,000 MW, which is about 47% of the target. In case of the eighth plan the achievement was about 54%. Thus it may be concluded that the southern region would face the demand supply gap even after 2012.

## Evolution of wind power policy in India

The wind power programme in India was initiated towards the end of the Sixth Plan in 1983-84. After the creation of a separate ministry (Ministry of New and Renewable Energy; MNRE) in 1992, special emphasis was given in the Eighth Plan to generation of grid quality power from renewables. The government provided a market orientation to the programmes to make them commercially viable and sustainable, with limited budgetary allocations to be utilized for selected demonstration projects. The key elements of the strategy to promote wind energy were:

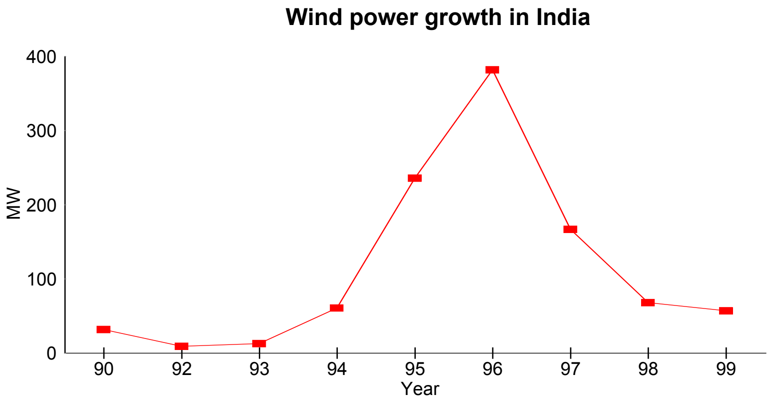
- Implementation of a comprehensive wind resource assessment programme;
- Induction and demonstration of state-of-the-art wind turbine equipment;
- Active association of the SEBs (state electricity boards);
- Involvement of private industry; and
- Introduction of fiscal and promotional incentives.

Policy support and fiscal incentives were offered by both the central and the state governments that led to large-scale investment in wind farms from the private sector.

Initially, the state governments followed MNRE guidelines in varying degrees but not totally. The state governments were then urged by MNRE to bring their policies in line with the MNRE guidelines. MNRE further suggested implementation of Empowered Institutional Mechanism (EIM) with sufficient funding be created to deal with all aspects of non-conventional energy power projects at the state level. These policies, coupled with a booming economy and the attractive fiscal incentives, provided the impetus for accelerated growth of the wind power sector. Due to the high initial capital cost and low capacity utilization of wind power projects, IREDA (Indian Renewable Energy Development Agency) started providing loans with the long repayment period. IREDA did play a significant role in promoting renewable energy projects, in general, and wind energy projects, in particular, through its well-designed funding programme. It attracted bilateral and multilateral financial assistance from the World Bank, GEF (Global Environment Facility), DANIDA (Danish International Development Agency), and ADB (Asian Development Bank) for the wind energy sector. However, after a period of explosive growth that made India the world's third largest producer of wind power, investments fell sharply mid-1996 onwards. According to the MNRE, the factors responsible for the slowing down of the development of the wind power sector were:

- Economic and industrial recession since 1996-97
- Introduction of the MAT (minimum alternate tax)

- Reduction of corporate tax from 43% to 35%
- *Anticipated reduction in the ceiling for accelerated depreciation from 100% to 50%*
- Increase in IREDA's interest rate to 19% during 1996-97
- Slow process of land allotment, forest clearance, and approval of projects by state agencies/SEBs
- Poor performance of some projects.




In addition non-uniformity in the state policies for RE power also contributed to this downward trend.

One positive fall out of the downturn was that only really serious investors remained, leaving out those investors whose prime interest was to take benefit of tax credits.

Thus, now the investors were interested in performance of their wind farms so as to (i) enhance their profitability and (ii) minimize dependence on the utilities (about 80% of the wind power has been used for captive consumption). The fact that some manufacturers/developers started giving guarantee for certain minimum level of electricity generation, also helped in building up the confidence of the investor community. This period also saw transition from smaller capacity machines to bigger ones, from 100 kW to 225 kW and then to 500 kW and 750 kW machines. The scenario started looking up in 1999 and this upswing is still continuing. The main factors that contributed to this positive growth are:

- Technological maturity and introduction of machines, suitable for the Indian conditions (e.g. wind turbines designed for low wind regimes) that resulted in overall higher capacity utilization. This factor helped in attracting more investments from the private sector.
- Introduction of bigger capacity and more cost-effective wind turbines.
- Better site selection due to improved wind resource assessment and micro-siting.
- Establishment of initial infrastructure for implementing wind power projects by the wind turbine manufacturers themselves
- Conducive policy regime, including attractive power purchase prices, introduced by some states such as Maharashtra, now extended to most states in India.

## Technology Options in Wind Energy in India

In the Indian wind energy sector, the growth phase can be characterised in phases. After the initial growth phase in the first half of the 1990s going up to 1996-97, the industry stabilised as some of the sops provided were withdrawn, such as the reduction of the accelerated depreciation from 100% to

60% and then further revised up to 80% in the first year, for instance. As has been discussed above, these changes crowded out the spurious investor and left genuine investors behind.

From the technological perspective, wind turbine technology has been benchmarked on the basis of the efficiency of the wind turbine generators. The turbine size (commonly referred to as the WTG) increased from 150-kW size of the individual generator in the early 1990s to around 400 kW by the turn of the century (2001). By 2003-2004, as the industry continued to grow, the state of the art WTG touched the 600 kW mark. Over the next few years, the MW-scale turbines began to be introduced in India for the first time, creating a new benchmark for wind power technologies in India. However, the introduction of MW-scale turbines is of recent origin, and bulk of the power projects developed in the country is around the 600-kW turbines.

For the proposed CDM project, the project employs 600 kW (E-40) and 800 kW (E-48) turbines of Enercon make for power generation. Enercon India (http://www.enerconindia.net/) is one of the leading wind turbine generator (WTG) manufacturers in the world today. It is the only manufacturer in India that offers gearless wind turbines with synchronous generators.

Although the turbines qualify as being better than the business - as - usual scenario for the country, the key claim for technological innovation in the project is that the turbines are designed as *gearless wind turbine* generators. Being devoid of gears, the WTG avoids friction significantly and can therefore operate at low wind speeds, in spite of their higher dead weight. These are state of the art, high-efficiency wind turbine generators that are reliable and can generate power even at wind speeds of 2m/s. In terms of size these are well above the average size of wind turbine generators in India conservatively estimated at around 500 kW to 600 kW. Enercon India Private Limited has been the only entity so far in India to have introduced the gearless wind turbines, which in addition to being technologically advanced are also relatively priced higher than the *geared* WTGs, thereby increasing the project costs. It may be mentioned here that the 800-kW WTG is the latest and most advanced one to emerge from the Enercon stable, and clearly is hailed as a key innovation success story in India.

***Comparing Geared and Gearless WTG:*** Wind speeds, especially those located on-shore are variable due to the obstructions faced; such varying wind speeds take a toll of the moving parts that come with a gearbox, leading to frequent failure and costs of repair and replacement. A gearless wind turbine eliminates these problems and represents a radical departure from conventional wind turbines. In addition, gearless wind turbines result in higher energy output, since the gearbox transmission loss of 8 to 10% is also saved.

The other key features of the Enercon wind turbine installed in the project are:

- Slow speed generators that result in less wear and tear and therefore, lower maintenance costs
- Near unity power factor is maintained by use of DC to AC inverter along with a Grid Watch Card that ensures that power is always pumped into the grid as per the grid frequency.
- Use of the DC to AC inverter as a variable speed drive allows the use of a synchronous generator instead of the conventional Induction (Asynchronous). This leads to lower reactive power being drawn from the grid.
- Generation at wind speeds even as low as 2m/s, unlike other WTGs such as the Vestas WTG, which need a cutting wind speed of 4 m/s.
- Use of FRP blades with Epoxy Resin and reinforcing with aluminium strips throughout the periphery of the blade has resulted in a low-weight but mechanically very strong blade. Also, they do not warp, as do conventional blades made of FRP with polyester plastics.

The above sections discuss the power sector policy, the regulatory framework and the wind energy sector in detail. Finally, there is a discussion on the technological parameters for the project, which being based on wind energy is naturally technology and capital intensive. The following section discusses the additionality for the proposed project in the light of the above discussion.

**Consideration of CDM**
The Board of Directors of Mineral Enterprises Ltd., through their resolution dated March 22, 2004 had authorised the Managing Director, Mr.Basant Poddar to negotiate with agencies in the field to avail of CDM benefits for the proposed wind energy project[3]. This clearly establishes that CDM benefits were considered by the project proponent at the time of making the investment decision.

**Additionality Analysis**
Simplified modalities and procedures for small scale CDM project activities guides to establish additionality of the project activity as per Attachment A to Appendix B. The Attachment A to appendix B mentions various barriers and requires explanation to show that the project activity would not have occurred due to at least one barrier.

**Investment Barrier**
The project seeks to establish an investment barrier by carrying out an investment analysis that would compare the Equity IRR of the CDM project with the benchmark Return on Equity that is guaranteed to renewable energy projects. If the Equity IRR of the project is lower than the benchmark, the project is deemed additional.
The benchmark return on equity for renewable energy projects as specified by CERC[4] (Central Electricity Regulatory Commission) and the Karnataka Electricity Regulatory Commission [5]is 16%.

The Project IRR and the Equity IRR of the project was calculated based on the following information[6].

| Sl. No. | Item | Details |
|---|---|---|
| 1 | CAPEX in Rs. Lakhs | **7284.54** |
| 2 | Equity in Rs. Lakhs | **3496.54** |
| 3 | Debt in Rs. Lakhs | **3788** |
| 4 | Depreciation | **Depreciation @80% as per Section 32 of the Income Tax Act.** |
| 5 | Salvage value at the end of 20 years | **Salvage value has been calculated based on depreciation taken at 15.33% written down value basis as per The Companies Act, 1956. Therefore residual value at the end of 20th year is treated as salvage value.** |
| 6 | IT benefits | **Income tax Exemption U/s.80 I (A) and tax benefit on account of high depreciation claimed.** |
| 7 | Capacity Utilisation factor | **23%** |

[3] Copy of the board resolution duly certified by the company has been made available to the validators at the time of field visit

[4] PageNo.122 of CERC Order dated January 16, 2004

[5] http://www.kerc.org/order2005/Order%20on%20NCE%20Tariff%20(FINAL).doc

[6] Detailed calculations made available

| | | |
|---|---|---|
| 8 | Sale price of power | **For projects commissioned after August, 2003, tariff is Rs.3.10 in base year 2003-04 escalated @ 2% per year on the base year for 10 years from date of commissioning. This was the tariff prevailing at the time the present project was considered[7].**<br><br>**From 11th year onwards tariff is considered conservatively as the Simple average of the first 10 years tariff.** |
| 9 | IT rate | **36.59%** |
| 10 | Minimum Alternative Tax (MAT) | **8.415%** |
| 11 | Life of wind generators | **20 years as per equipment supplier** |
| 12 | Interest | **7%** |

The following table summarises the outputs of the Equity IRR Analysis with and without CER revenues:

| | Without CERs | Benchmark | With CERs |
|---|---|---|---|
| Equity IRR without tax shelter | 7.99% | 16% Return on equity | 10.61% |
| Equity IRR with tax shelter | 14.83% | | 18.01% |

- The project as a standalone activity returned an Equity IRR of just 7.99%, substantially lower as compared to the benchmark Return on Equity of 16%.
- However, when the project is taken as a part of a larger business that is able to generate profits at a volume where it is able to absorb the surplus tax savings (TAX SHELTER) that is available in the wind project on account of accelerated depreciation, the Equity IRR increases to 14.83%.
- Thus, the Equity IRR of the project activity changes with the profit levels of the project proponent's core business, which in no way can be influenced by the project activity per se.
- However, even this Equity IRR of 14.83% is lower as compared to the benchmark Return on Equity of 16%.
- However, when CDM benefits are considered, the Equity IRR of the project improves to 18.01% (based on an CER value of Euro13/CER), crossing the benchmark hurdle rate of 16%. From an overall perspective therefore, one may conclude that *prima facie*, carbon credit revenues propelled the project from a non-viable zone to a viable zone.

Apart from the ability of the core business to absorb the tax savings that the project generates, the equity IRR of the project is directly dependent on the PLF and the tariff. In the following sections, we shall discuss how the PLF and the tariff have affected the returns to equity for this project.

**Plant Load Factor:** The PLF of a Wind Energy Generator depends on a variety of factors, chief among them being wind speed, air density, machine availability, grid availability, etc. Of these, wind speed and air density are uncontrollable factors and hugely impact the PLF. The remaining is relatively controllable with better management.

[7] Relevant documentation included in Annex 6

At the time of considering this project in April 2004 for investment decision-making, the Project Proponents were confronted with the following situation:

- The equipment supplier, Enercon India Ltd., had mentioned in the letter of offer that a PLF of 28.54% would be guaranteed for a period of 2 years from the date of commissioning, subject to 100% grid availability..
- The average PLF in the preceding 3 years (2001-02, 2002-03 & 2003-04) prevailing in Karnataka for generation from wind was[8]

| Year | 2001-2002 | 2002-2003 | 2003-04 |
|---|---|---|---|
| Generation in units | 92859341 | 175108542 | 306675709 |
| Capacity in MW added | 24 | 55.6 | 84.9 |
| Cumulative capacity | 68.7 | 124.3 | 209.2 |
| **PLF on annual basis in %** | 15.43 | 16.08 | 16.73 |
| **PLF on incremental basis %** | **9.8** | **16.9** | **17.7** |

Based on this the Project Proponents felt that the PLF mentioned by the supplier was unrealistic. Moreover, they felt that since it was guaranteed only for a period of 2 years out of a project life of 20 years, it should not be the basis for making investment decisions.

However, they felt that the average PLF for Karnataka as shown above also was not realistic since it included non-performing and lower capacity machines that had been installed earlier. Therefore, the average PLF was calculated on an incremental basis, i.e., all incremental generation in a year was exclusively attributed to incremental capacity addition in that year. For example, the average PLF for the year 2003-04 based on total capacity is 16.8%. However, PLF based on incremental capacity addition and generation is 17.7%

Thus, at the time of making the investment decision on the project, the prevailing PLF for wind project in Karnataka based on incremental capacity addition and generation was around 18% as compared to 28% that the supplier was offering as a guarantee for a limited period of 2 years.

The Project Proponents felt that while the 28% PLF was too unrealistic and was more in the nature of a commercial offer to make the deal attractive, the prevailing PLF of 18% was too pessimistic a view. Therefore, the Project Proponents estimated the PLF that was likely in 2004-05 based on a trend analysis of the incremental PLF that prevailed during 2001-02 to 2003-04[9]. This analysis showed that given the progress in technology, infrastructure and management systems of wind parks in Karnataka, the projected PLF that was likely in 2004-05 was 22.68%, which is rounded off to 23%.

Therefore, the Project Proponents felt that given that they were going to use superior machines based on gear-less technology and synchronous generators, they should realistically achieve a PLF of 23% in the project which is about 28% higher PLF as compared to the 18% prevalent at that time. This is further vindicated by the actual PLF that the project is delivering, which is at 23.5%.

Thus, the project has, based on a careful consideration of the PLF prevalent at the time of investment decision-making, the guaranteed PLF offer made by the supplier, that is for a limited period of the

[8] See Annex 5: "**Plant Load Factor trends in Karnataka**" for a fuller explanation

[9] See Annex 5: "**Plant Load Factor trends in Karnataka**" for a fuller explanation

project life and the expected improvement in performance due to better machines and management estimated the PLF that the project would achieve as 23%. The Equity IRR for the project has therefore, been calculated based on this PLF only.

**Sale Price of Power:** The Karnataka Electricity Regulatory Commission sets the price at which power is purchased by the Distribution Companies (DISCOMS) in Karnataka. Based on this rate, DISCOMS enter into power purchase agreements (PPA) with suppliers of electricity. The PPA, its format and contents are as prescribed by KERC.

However, when, the present project was being considered in 2004, KERC was yet to determine the tariff and KPTCL was entering into PPA with power producers based on Government of Karnataka's letter of approval of tariff[10]. See Annex 5 & PPA in 2003 as a sample[11].

Tariff as per this letter and the PPA referred to above is broadly as follows:

- For project commissioned after August 31, 2008, tariff is Rs.3.10 (2003-04) with annual escalation of 2% over base year upto the 10th year from date of commissioning
- The PPA is valid only for a period of 10 years
- From the 11th year onwards, tariff will be based on operating cost + appropriate incentive (16% return on equity)

The Project Proponents have calculated the tariff accordingly upto the 10th year. From the 11th year onwards, as explained in the previous paras tariff has been conservatively estimated as the simple average of the first 10 years' tariff, Equity IRR of the project is calculated based on this.

Thus, as explained above, based on a realistic estimate of PLF and tariffs, the equity IRR for the project (without taking into account the tax shelter available) is just 7.99%%, which is significantly lower as compared to the benchmark return on equity rate of 16% that is as per KERC and CERC norms. Further, the equity IRR for the project (taking into account the entire tax shelter available) is 14.83% which is also significantly lower as compared to the benchmark return on equity rate of 16%. Thus, the project faces an investment barrier.

**Debt financing:** Gearing or leveraging equity by borrowing to finance a project is an accepted way of increasing returns to equity shareholders. Thus, the extent to which a project can leverage its equity determines its return on equity. A lender decides on the extent of debt he can extend to a project based on its returns to total investment (Project IRR) and the creditworthiness of the borrower himself.

The project shows a Project IRR (with tax shelter) of 11.64% as compared to the benchmark prime lending rate (BPLR) of around 11% for most of the scheduled (or nationalised) commercial banks in the country that prevailed in December 2003[12]. Since then, the interest rates have increased substantially. For a global 'prime bank' such as Hong Kong Shanghai Banking Corporation (HSBC), the current BPLR is 15.50% with effect from May 15, 2007[13].

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[10] Government letter No./DE 13 NCE 2003 (P) dated 23.6.2003

[11] http://cdm.unfccc.int/UserManagement/FileStorage/BSO69I8RPOFQZF2H0XHPPS4C6YHH9G

[12] http://www.domain-b.com/finance/finance_diary/2003finance_diary/200312dec/20031229financediary.html

[13] http://www.hsbc.co.in/1/2/miscellaneous/about-hsbc/prime-landing-rate

Further, as explained in the previous paras, the tax shelter can be utilised only, if the core business of the project proponent is making profits in sufficient volumes to absorb it. Thus, if the ability of the core business to absorb the tax shelter falls, the project IRR of the proposed CDM project would also fall[14]. This represents an element of risk to the lender in considering Project IRR with tax shelter.

Therefore, conventional bank based financing options were not viable for implementation of the CDM project.

Therefore, the project developers had to take recourse to External Commercial Borrowing (ECB) at lower rates of interest to be able to finance their project. As is well known, foreign commercial funds are usually not available for project finance (non-recourse financing) but for financing based on export earnings of the promoter company, and the size of the balance sheet (recourse financing). The project promoters sought finance to the tune of USD 6.7 Million from Standard Chartered Bank, Mauritius at 3-month LIBOR + 150 BP[15], which could translate to an effective rate of 6% -6.5%. At this rate, it was possible to finance the project. The fact that off-shore funds were resorted to substantiates the fact that **there was a barrier to financing**.

**Barrier due to prevailing practice**

In the absence of the proposed CDM project, the prevailing practice of producing power from fossil fuel sources would have continued. Table 2 in the preceding pages shows that the contribution of wind energy to total energy generated in the southern grid is just 0.02%, while those from fossil-fuel sources are 65%. This shows that generation of electricity from fossil-fuel sources is the prevailing practice. Projects based on these sources enjoy considerable policy support and are in fact performing better in terms of return on equity as compared to the proposed CDM project.

Fossil-fuel based large utility projects enjoy a two-part tariff that guarantees payment towards fixed costs in case the power plant is backed-down. However, wind energy projects do not get that benefit.

A study carried out by CRISIL Advisory Services16 in 2004 on the "cost of capital for central utilities" showed that the return on equity for these utilities was in the range of 16-22% as compared to the bench-mark of 14% that is prescribed for these utilities. Thus, power generation projects based on fossil-fuels is the prevailing practice because they are based on well-established, proven technologies, have a return on equity that is better than even the bench-mark for renewable energy projects and have a tariff regime that insulates them from grid availability.

Thus, the fact that the prevailing practice is better in terms of returns, tariff policy and use of well-established technology means that it forms ***a barrier to rapid penetration*** of wind technology that the proposed project uses. This is substantiated by the fact that the installed capacity of wind generation in Karnataka as of 2005 was just 7.36%.

**Other barriers:**
**Barrier due to uncertain policy on tariff and PPA**

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[14] See Annex 7 for sensitivity analysis based on PLF and Tax Shelter

[15] LIBOR stands for London Inter Bank Offer Rate; the lending rate is 150 basis points (BP) or 1.50% over the 3-month LIBOR rate

[16] http://cercind.gov.in/rep1304.pdf

As discussed earlier, tariff and the PPA for power purchase by the DISCOMS is set by the KERC in Karnataka. As per the tariff order of January 2005[17], the tariff rate is valid for a period of 10 years for a wind project from the date of commissioning. In addition, the PPA is also valid only for a period 10 years from the date of commissioning.

This is what the PPA prescribed by KERC and signed by the Project Proponent has to say about tariff from the 11th year onwards:

> "From the 11th year onwards, from the Commercial Operation Date, MESCOM shall pay to the Company for the energy delivered at the Metering Point at a rate determined by the Commission. In case MESCOM is unwilling to purchase the power at the rated determined by the Commission, the Company shall be permitted to sell energy to third parties and enter into a Wheeling and Banking agreement with MESCOM / Corporation to sell power for which it shall pay transmission and other charges to MESCOM/ Corporation at rates applicable from time to time as approved by the Commission."

Clearly, the tariff and the validity of the PPA and thereby the revenue from the project is unclear and at risk for more than 50% of the project life. Thus, uncertainty in terms of tariff and revenue stream from the 11th year onwards constitutes a barrier to taking up this project

**Barrier due to promoter's experience**
Among the other barriers that the project is confronted with, relative lack of experience of the project promoters in power generation may act as a barrier in the way of successful implementation of the proposed CDM project. Wind power projects, especially grid connected, MW-scale projects require strong technical skills to ensure optimal performance of the project. This barrier is more pronounced due to the technology involved in the project, which is not a b-a-u technology in the field of wind power generation.

**Sensitivity Analysis**
**Sensitivity analysis based on PLF and the extent of Tax Shelter absorbed by the core business was carried and out and the same is presented in Annex 7. The broad conclusions are:**

- Both PLF and the extent of Tax Shelter availed are very critical to the project, but the chances that the PLF would actually increase from a mere 18% to 26% is very unlikely. Therefore, the estimated PLF of 23% that already represents an increase of 28% over the 18% PLF that existed at that time would prevail.

- With respect to the ability to absorb the Tax Shelter, there exists a high probability that there may be a fall leading to a lower than estimated Equity IRR.

- However, in both cases **revenue from CDM is critical** to help the project meet the **benchmark of 16% ROE.**

To summarise, the project is additional because it faces the following barriers:

- **Investment barrier**
    - Equity IRR of the project per se (without tax shelter) is substantially lower than the benchmark of 16% return on equity that is allowed for renewable energy projects.

[17] Even as the first set of WEGS for this project were commissioned, the KERC determined new tariffs through its order of January 18, 2005. It became applicable to all projects that applied for a PPA on or after 10.06.2004.

        - Equity IRR of the project even after taking into account the entire tax shelter available is lower than the bench-mark 16% return on equity that is allowed for renewable energy projects
        - The Project IRR varies significantly with the extent of Tax Shelter availed, thus making it risky for conventional sources of borrowing. This has forced the project proponent to resort to ECB
- **Barrier due to prevailing practice**
    - Power plants based on fossil-fuels are the prevailing practice. They enjoy better returns on equity, better terms of tariff and use well-established technologies.
    - As compared to them, wind based energy project such as the proposed project suffers from lower returns on equity, have an uncertain tariff policy and use technology that is innovative but nascent.
    - Thus, in the normal course of business, it is very likely that a fossil-fuel based power plant would have been set up, leading to higher GHG emissions.
- **Barrier due to uncertain policy**
    - Tariff and validity of the PPA is restricted to only 10 years, while the project life is for 20 years. Given this, uncertainty on tariff and revenue stream due to prevalent policy constitutes a barrier to taking up this project.
- **Barrier due to promoter's experience**
    - Appreciation of technicalities of power project management is needed, which is not present in the company as on date due to lack of prior experience.

***Thus, the project activity would not have been possible without consideration of CDM benefits due to barriers listed above. Therefore, we conclude that the project is additional and not conceivable without CDM benefits***.

## B.6. Emission reductions:

### B.6.1. Explanation of methodological choices:

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Guidance on methodological choice has been provided by Section 1D of the indicative simplified baseline and monitoring methodologies for selected small scale CDM project categories. The methodological choices explained here pertain to the project emissions, baseline emissions, leakage emissions and emission reductions are applied to the proposed project activity.

***Project Emissions*:**

As a wind power based CDM project, GHG emissions from project operation are zero.

However, article 10 of section 1D indicates that in the case of project activities that involve the addition of renewable energy generation units at an existing renewable power generation facility, where the existing and new units share the use of common and limited renewable resources, the potential for the project activity to reduce the amount of renewable resource available to, and thus electricity generation by, existing units must be considered in the determination of baseline emissions, project emissions, and/or leakage, as relevant.

In the case of the proposed CDM project, the facility is a new unit that **does not replace** any existing generation. It also does not affect the utilisation of the natural resource, since wind power is not rationed

in its quantity like biomass or hydropower. Thus, existing electricity generation from the site is also zero. In terms of the equation under article 10, which is -

*EGy = TEy – WTEy*, where

*TEy* = the total electricity produced in year y by all units, in this case the units installed as part of the proposed CDM project;
*WTEy* = the estimated electricity that would have been produced by existing units (installed before the project activity) in year y in the absence of the project activity;

It is concluded that WTEy = 0, therefore the relevant variable is the total electricity generation from the CDM project that acts as the basis for calculation of the emission reductions.

***Baseline Emissions*:**

Under sub-category 1D of the Indicative Simplified Baseline and Monitoring Methodologies for Selected Small Scale CDM Project Categories, the baseline design options provided include the following:

(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. Any of the four procedures to calculate the operating margin can be chosen, but the restrictions to use the Simple OM and the Average OM calculations must be considered;

Or

(b) The weighted average emissions (in kg CO2e/kWh) of the current generation mix. The data of the year in which project generation occurs must be used.

The options for baseline design mentioned above have been analysed to further justify the choice of methodology usage for the project. Among the options listed, option (b) is simpler and is in general reflective of the generic conditions in the project baseline. In contrast, option (a) discusses operating margins for the base year, as well as the Build Margin, which constitutes the weighted average emissions (in kg CO2equ/kWh) of recent capacity additions to the system, which capacity additions are defined as the greater (in MWh) of most recent 20% of existing plants or the 5 most recent plants.

It is evident that the combined margin approach gives additional weight to the presence of recent capacity additions. This is more reflective of a project based in India and in southern India, where the power sector is under a process of technological transition from a coal-based, low-efficiency regime to a technology led, higher efficiency regime with possibility of introduction of advanced coal and natural gas fired power projects in the operating system.

As discussed in the earlier section on baselines and emission reduction estimation, the methodology has further focused on a mix of the Simple Operating Margin (Simple OM) and the Build Margin (BM) to determine the Combined Margin (CM), at the ratio 3:1 (75% weightage to the Simple OM; 25% weight to the BM).

Based on the information provided by the ***CO2 Baseline Database for the Indian Power Sector, VER.3.0***, the emissions factor for the **BM** for the southern grid is deduced as *0.71 kg* $CO_2$ */ kWh*, while the emission factor for the **Simple OM** is derived as *1.004 kg* $CO_2$ */ kWh*. The combination of the two, multiplied with their relevant weights generates a GHG emissions factor for the **combined margin** as ***0.93 kg*** $CO_2$ ***/ kWh of electricity generation.***

***Leakage Emissions*:**

As per the guidance provided under section 1D, no leakage estimation is required

***Emission Reductions*:**

The total project emissions as well as leakage emissions being zero, in effect the total emission reductions are equal to the baseline emissions.

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

*(Copy this table for each data and parameter)*

| **Data / Parameter:** | **Net electricity exported to the grid for Yr 1** |
|---|---|
| Data unit: | KWh |
| Description: | Net generation of power *(total power generated by the project – reactive power consumed by the project)* from the installed WTGs under the project |
| Source of data used: | • Monthly bill raised on KPTCL (or the local Energy Service Company that has entered into an Power Purchase Agreement with MEL) which is based on actual metering of power into grid<br>• Actual metering of power into grid – metering of power taken from grid as measured at the Main Meter and Check Meter at the point where the power from the MEL turbines in a site is aggregated. The meters are recalibrated on a quarterly basis with reference to a portable standard meter in the presence of KPTCL and MEL representatives;<br>  • The metered units are recorded in a specified format on a continuous basis;<br>  • The metered units can be cross verified by the SCADA (Supervisory Control & Data Access System) system as well as the metering in the individual WTGs. |
| Value applied: | 30,222 MWh |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | • Actual metering of the net energy pumped into the grid by the project is a relevant and valid data to monitor since it is the basis for the power purchaser (KPTCL or an ESCOM) to make payment for power purchased during a period.<br>• In addition, it is readily verifiable by SCADA an advanced system of measuring electricity generation that is almost completely automated. This results in high levels of efficiency in measurement, and eliminates the error factor. |
| Any comment: | The data monitoring system has 3 levels at which the data is being tracked and verified.<br>1. Actual metering of power being pumped into the KPTCL grid based on which monthly bills are raised and payment being made by the power purchaser<br>2. Readings of power generated in each WTG that is recorded on line by SCADA<br>3. Power produced by each WTG is recorded in the energy meter installed |

| | |
|---|---|
| | in each WTG tower |

| Data / Parameter: | Baseline emissions for 2003-04, 2004-2005, 2005-06 |
|---|---|
| Data unit: | ton $CO_2$ / MWh of power generation |
| Description: | Baseline GHG emissions for the proposed CDM project expressed as a rate per unit of electricity generation |
| Source of data used: | Data has been drawn from the ***CO2 Baseline Database for the Indian Power Sector, Ver.3.0,*** which is published by the ***Central Electricity Authority, Ministry of Power, Government of India*** for the purpose of designing project specific baselines for grid-connected CDM projects. |
| Value applied: | 0.93 kg $CO_2$ / kWh |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | The data has been sourced from government of India sources and is made available by the Central Electricity Authority, government of India, which is the apex body of authority for information on the electricity sector in India. This data has been processed and technical inputs provided by GTZ India, through Factor AG, one of the best known organisations involved in CDM project and methodology design. |
| Any comment: | None |

**B.6.3 Ex-ante calculation of emission reductions:**

>>

To calculate the GHG emission reductions, the document "***$CO_2$ database for the Indian power sector***" Ver. 3.0, published by the ***Central Electricity Authority, Ministry of Power, Government of India*** under technical support and assistance from GTZ (Gesellschaft Fur Technische Zimmernaurbeit), the German Agency for Technical Co-operation has been utilised. The results have been derived in 2007 and therefore are currently valid. The document becomes the most reliable source for designing GHG emissions baselines at the RLDC levels (such as Southern grid), and takes care of imports and exports of power across RLDC while computing the emissions factors as well.

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

>>

As has been discussed, the combined margin has been used as the baseline for the project. The combined margin is constructed using a combination of the Simple Operating Margin and the Build Margin, giving 75% weightage to the Simple OM and 25% weightage to the Build Margin.

The average Simple OM for South for the years 2003-04, 2004-05 & 2005-06 is 1.004 kg $CO_2$ / kWh of energy generated. The Build Margin for the same period is 0.71 kg $CO_2$/kWh of energy generated.

Based on the estimates and the weights attributed, the final GHG emission factor arrived at is 0.93 kg $CO_2$/kWh of energy generated. Using this value and based on the projections of electricity generation from the proposed CDM project, a total ER of 28,106.46 tons of $CO_2$per year are obtained for those years when the project is in full operation and realises the net total generation of 30,222 MWh.

To safeguard against possible years of low wind, mechanical failure for the wind turbine generators and other Force Majeure events beyond the control of the project, the project promoters have sought

to keep aside a fraction of the total emission reductions generated. **Accordingly, a total of 28,000 tons shall be submitted for sale.**

The table shows year-wise estimates of GHG Emission Reductions:

| Year | Estimation of project activity emissions ($tCO_2e$) | Estimated Baseline Emissions (tCO2e) | Estimation of Leakage (tCO2e) | Estimation of overall emission reductions (tCO2e) |
|---|---|---|---|---|
| Yr-1: 2008-09 | Nil | 28,106.46 | Nil | 28,106.46 |
| Yr-2: 2009-10 | Nil | 28,106.46 | Nil | 28,106.46 |
| Yr-3: 2010-11 | Nil | 28,106.46 | Nil | 28,106.46 |
| Yr-4: 2011-12 | Nil | 28,106.46 | Nil | 28,106.46 |
| Yr-5: 2012-13 | Nil | 28,106.46 | Nil | 28,106.46 |
| Yr-6: 2013-14 | Nil | 28,106.46 | Nil | 28,106.46 |
| Yr-7: 2014-15 | Nil | 28,106.46 | Nil | 28,106.46 |
| Yr-8: 2015-16 | Nil | 28,106.46 | Nil | 28,106.46 |
| Yr-9: 2016-17 | Nil | 28,106.46 | Nil | 28,106.46 |
| Yr-10-2017-18 | | | | |
| **Total Emission Reductions** (tonnes of $CO_2e$) | | **2,81,064.60 tonnes of $CO_2e$ over 10 years** | | |

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

### B.7.1 Data and parameters monitored:

*(Copy this table for each data and parameter)*

| | |
|---|---|
| **Data / Parameter:** | **Net electricity exported to the grid for Yr 1** |
| Data unit: | KWh |
| Description: | Net generation of power *(total power generated by the project – reactive power consumed by the project)* from the installed WTGs under the project |
| Source of data to be used: | • Monthly bill raised on KPTCL (or the local Energy Service Company that has entered into an Power Purchase Agreement with MEL) which is based on actual metering of power into grid<br>• Actual metering of power into grid – metering of power taken from grid as measured at the Main Meter and Check Meter at the point where the power from the MEL turbines in a site is aggregated. These meters are recalibrated on a quarterly basis with reference to a portable standard meter in the presence of KPTCL and MEL representatives;<br>  • The metered units are recorded in a specified format on a continuous basis;<br>  • The metered units can be cross verified by the SCADA (Supervisory Control & Data Access System) system as well as the metering in the individual WTGs. |

| Value of data | Variable |
|---|---|
| Description of measurement methods and procedures to be applied: | • At each site, machines owned by the project proponent are connected on 33KV side to a tri-vector meter of accuracy class 0.2, as specified in the Power Purchase Agreement with KPTCL or its representative Energy Distribution Companies.<br>• Actual metering of the net energy pumped into the grid by the project is a relevant and valid data to monitor since it is the basis for the power purchaser (KPTCL or an ESCOM) to make payment for power purchased during a period.<br>• In addition, it is readily verifiable by SCADA an advanced system of measuring electricity generation that is almost completely automated. This results in high levels of efficiency in measurement, and eliminates the error factor.<br>• In case, where the main meter fails, the procedure would be as described in section B.7.2, para below titled “Meter Test Checking”<br>• Where the date of joint meter reading by MEL and KPTCL is different from the date of crediting CERs, generation data shall be taken from the SCADA readings for that period.<br>• A simple average of the previous 3 months transmission loss shall be deducted from the SCADA reading to arrive at the net generation. |
| QA/QC procedures to be applied: | • The Main meter from which readings are taken on a monthly basis can be cross checked by a Check meter that is installed next to it<br>• The Main Meter and the Check Meter are calibrated every quarter with reference to a portable standard meter in the presence of MEL and KPTCL representatives<br>• Data taken from the meter readings is readily verifiable by reading taken from the SCADA system that records it online<br>• Lastly, energy meters in each WTG tower records energy generated on a cumulative basis |
| Any comment: | Since data is available from 3 independent sources the parameter under consideration can be measured in a fool-proof manner |

**B.7.2 Description of the monitoring plan:**

>>
The main objective of having a monitoring system is to have a constant check on the emission reductions. Energy delivered by the project as recorded in the Main Meter is the relevant data to monitor to keep a constant check on the emissions reductions achieved by the project.

Project proponents in co-ordination with KPTCL or its representative Energy Distribution Companies meter the delivered energy. The project activity is supplying electricity at 33 kV through double circuit overhead transmission (suspension type) conductors to Mathodu 66/11KV susbstation (from Phase 1), Horakeredevarapura 66/11KV susbstation (from Phase 2) and Hiriyur 220/66/11KV substation (Phase 3).

The general conditions set out for metering, recording, meter readings, meter inspections, Test & Checking and communication shall be as per the PPA (power purchase agreement) with KPTCL.

**Metering:** The Delivered Energy shall be metered by the Parties at the high voltage side of the step up transformer installed at the Project Site.

**Metering Equipment:** Metering equipment shall be electronic trivector meters of accuracy class 0.2% required for the Project (both main and check meters). The main meter shall be installed and owned by the Project Proponent, whereas check meters shall be by KPTCL. Dedicated core of both CT's and PT's of required accuracy shall be made available by the Project Proponent to KPTCL. The metering equipment shall be maintained in accordance with electricity standards. Such equipment shall have the capability of recording half-hourly and monthly readings. The Project Proponent shall provide such metering results to KPTCL. The meters installed shall be capable of recording and storing half hourly readings of all the electrical parameters for a minimum period of 35 days with digital output.

**Meter Readings:** The monthly meter readings (both main and check meters) shall be taken jointly by the parties on the first day of the following month at 12 Noon. At the conclusion of each meter reading an appointed representative of KPTCL and the Project Proponent shall sign a document indicating the number of Kilowatt-hours indicated by the meter. Where the date of joint meter reading by MEL and KPTCL is different from the date of crediting the CERs, generation data shall be taken from the SCADA readings for that period. A simple average of the previous 3 months transmission loss shall be deducted from the SCADA reading to arrive at the net generation.

**Inspection of Energy Meters:** All the main and check energy meters (export and import) and all associated instruments, transformers installed at the Project shall be of 0.2% accuracy class. Each meter shall be jointly inspected and sealed on behalf of the Parties and shall not be interfered with by either Party except in the presence of the other Party or its accredited representatives.

**Meter Test Checking :** All the main and check meters shall be tested for accuracy every calendar quarter with reference to a portable standard meter which shall be of an accuracy class of 0.1%. The portable standard meter shall be owned by the Corporation at its own cost and tested and certified at least once every year from an accepted laboratory standard meter in accordance with electricity standards. The meters shall be deemed to be working satisfactorily if the errors are within specifications for meters of 0.25 accuracy class.

The consumption registered by the main meters alone will hold good for the purpose of billing as long as the error in the main meters is within the permissible limits. If during the quarterly tests, the main meter is found to be within the permissible limit of error and the corresponding check meter is beyond the permissible limits, then billing will be as per the main meter as usual. The check meter shall, however, be calibrated immediately.

If during the quarterly tests, the main meter is found to be beyond permissible limits of error, but the corresponding check meter is found to be within permissible of error, then the billing for the month up to the date and time of such test shall be as per the check meter. There will be a revision in the bills for the period from the previous calibration test upto the current test based on the readings of the check meter. The main meter shall be calibrated immediately and billing for the period thereafter till the next monthly meter reading shall be as per the calibrated main meter.

If during the quarterly tests, both the main meters and the corresponding check meters are found to be beyond the permissible limits of error, both the main meters shall be immediately calibrated and the correction applied to the reading registered by the main meter to arrive the correct reading of energy supplied for billing purposes for the period from the last month's meter reading upto the current test. Billing for the period thereafter till the next monthly reading shall be as per the calibrated main meter.

If during any of the monthly meter readings, the variation between the main meter and the check meter is more than the permissible limit for meters of 0.2% accuracy class, all the meters shall be re-tested and calibrated immediately.

The project proponent has entrusted the operations and maintenance of the project to Enercon India, since they themselves lack the technical expertise to do so. Enercon India, the technology supplier, is an ISO 9000 company and has elaborate procedures and well trained staff to carry out the various functions to ensure that the project delivers energy as planned and that the data is duly recorded and communicated to the Project Proponent on a regular basis.

Enercon India, has the following management structure to carryout the operation and maintenance as per its ISO 9000 manual:

| **Designation** | **Responsibility** |
|---|---|
| Regional Service Head | • <br>• <br>• <br>• <br>• |
| Area Service | • Real-time monitoring of business |

The project is being monitored through the Supervisory Control and Data Acquisition System, also known as SCADA. SCADA is a fully-automated, state of the art monitoring framework that allows a centrally located hub to have continuous and streamlined feedback from spatially situated project sites such as individual wind turbine generators (WTG). Thus, the project promoters may be credited with a sophisticated and robust mechanism for project monitoring that is in place. Moreover, the installation of SCADA enables easy and seamless retrieval of data, day to day storage and generation of records.

Apart from SCADA, generation data collected is uploaded daily into the SAP (an Enterprise Resource Planning System) system so that data is available to officers of Enercon India as well as the Project Proponent for regular monitoring, review and corrective action.

**Record Handling:** Net electricity generated is based on the B-form that is generated based on the Main Meter reading taken on a monthly basis. This record in paper form is maintained at the respective Enercon Substation as well as at the office of the Project Proponent and shall be archived for period of 2 years beyond the end of the crediting period.

In addition, the data will also be archived in an electronic form on the SAP servers maintained by Enercon India.

**Internal audits & performance review:** The project proponent has constituted a CDM-Team to monitor the emissions reductions commitment of the company. The team consists of Manager Technical, Manager Commercial, both reporting to the Managing Director of the company.

The team audits the performance and documentation during their visits to the site. They visit once in 6 months and audit the records. The officials will crosscheck the emissions reductions claimed in PDD with respect to actual emissions reduction. Specifically, they will check the Main & Check Meter readings at each site and compare with the B-form for that month. They will also check the quarterly Preventive Maintenance reports as well as Breakdown Maintenance Reports.

In addition, Manager Commercial will review the daily generation report that is received by him online from Enercon India.

The diagram in Annex 4 gives an overview of the metering and evacuation arrangements for the proposed CDM project.

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

>>

The application of the baseline and monitoring methodologies were completed in 10.02.2007. The responsible entities are as under:

1. Mr. Abhijit Chatterjee
   Mr. S.C. Rajshekhar
   Symbiotec Research Associates
   #517, “Amritha Nilayam”, 24th ‘A’ Cross, 18th Main,
   Judicial Layout, Allalsandra Post,
   Yelahanka, Bangalore 560 065
   sra@srarural.com

2. Mr. Prabhakar
   Vijayaillu.
   107, 6th main, 8th cross,
   Malleshwaram
   Bangalore 560003
   vijayaillu@yahoo.com

## 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:

>>

The starting date of the proposed CDM project activity is 28-05-2004.

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

>>
The operational lifetime of the project activity will be 20 years 0 months.

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

#### 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:

>>
Start date of the crediting period will be 01/06/2008 or a date not earlier than the date of registration of the project.

##### C.2.2.2. Length:

>>
Length of the crediting period is 10 years 0 months.

## SECTION D. Environmental impacts

>>

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

>>

Environmental Impact Assessment is not required to be conducted by the host Party (India) for wind power projects. In addition, all the sites have been leased by Enercon India, from the Department of Forests, Government of Karnataka after they were pre-cleared for development of wind energy parks. The project proponent has in turn taken a sub-lease for each site. However for better clarity of understanding of environmental impacts associated with wind power projects, possible environmental impacts arising out of the various stages of operation of the project are highlighted as below:

*Construction and Erection*

The construction phase involved erection of a WEG in particular location. Movement of materials, especially blades, rotors and towers for erection involve their transportation from the manufacturer's factory, which leads to emissions of local and global pollutants that are associated with transportation. However, in real terms the emission is negligible compared to the size of the project and the amount of clean energy produced by it.

*Operation*

The wind power projects involve energy generation from wind sources. There is no impact on local environment by way of air pollution, since no pollutants are emitted in the power generation process. In addition, no water is consumed for the project activity and no effluent is discharged from the project activity and hence, there is no impact on water due to the project activity.

However, there is some noise that is created from the rotation of the blades of the WEG. This noise could act as a pollutant. The noise levels are however far below the acceptable levels of 90 decibels that are usually set as a benchmark for noise pollution.

Moreover, wind energy projects have been known to create obstruction for avian movement. In this regard, possible impacts on flora and fauna have been pre-assessed by the government of India before the announcement of a particular site for the construction of wind farms. Thus, it may be reasonably expected that impacts on local avian movement will not be affected as a consequence to the wind power project.

### 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:

>>

As mentioned above, environmental impacts are not considered to be significant for the project, either legally or by the project developers.

## SECTION E. Stakeholders' comments

>>

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

>>

The population in the local villages of Ittigehalli, Haladyamanahalli, Katheholle, Banjagondanahalli, Lakkihalli, Kenkere and Kereyagalahalli, constitutes the local stakeholders of the project activity. Apart from the local stakeholders, the other stakeholders are:

1. Designated National Authority, Government of India;

The Ministry of Environment & Forests is the Designated National Authority in India. The government of India, through Ministry of Environment and Forests (MoEF) is encouraging project participants to take up such Climate Change initiatives.

2. Ministry of Non Conventional Energy Sources, Government of India

The government of India, through Ministry of New and Renewable Energy Sources (MNRE), has been promoting energy conservation, demand side management and renewable energy projects including wind, small hydro and hydro / bio-mass power. Promotion of high value wind power that utilises locally available resources more effectively are appreciated by the MNRE.

3. Karnataka Renewable Energy Development (Agency) Limited (KREDL)

As the state of Karnataka is yet to utilise its wind power potential fully, and has in fact some way to go before the potential can be harnessed, the installation of projects where such capacity can be enhanced are appreciated. Further, projects such as the one proposed, which has the capability to make use of low wind speeds in a sustainable manner, improves the overall resource utilisation at the macro level. Thus, such projects are a welcome addition to the state, and KREDL has granted the no-objection to it.

4. Karnataka Power Transmission Corporation Limited (KPTCL)

The KPTCL have granted necessary permissions and licenses to the project proponents. Detailed terms and conditions are mentioned in the agreements executed between the concerned parties.

5. Local stakeholders

In order to appraise the local community about the economic, social and environmental benefits from the project activity and to invite their views on the same a local stakeholders meeting was conducted on December 28, 2006 at the project site office.

Accordingly, a public notice in Kannada (the local language) was distributed in the villages surrounding the project area on December 1, 2006. Copies of the public notice were also pasted in prominent areas such as the local temple, school, etc., so that people at large could be informed of the proposed local stakeholder meeting.

Following this, a local stakeholders' consultation meeting was conducted on December 28, 2006 at the project site.

During the meeting representatives of project proponents have engaged in stakeholder dialogues and have understood their concerns and sought their reactions for the project.

**E.2. Summary of the comments received:**

>>

*Local stakeholder response:*

The respondents have indicated that the wind power projects in the area had transformed the local economy and made way for the introduction for higher levels of revenue streams for their families. The areas around the Jogimatti wind corridor being largely dryland, the land was used by the local villagers for cattle grazing, which has continued unabated as the wind power projects occupy a token area in comparison with the total area available. Moreover, the chance to work in a new installation gives the local villagers employment of up to 5-6 months per year. Finally, their assistance is also required during the processes of overhauling, renovation, maintenance and major repairs, and they envisage the employment to keep continuing as one wind farm is retired and a second one crops up. The overall benefit to the community outweighs any possible displacement of grazing area for their cattle that they have encountered, and has improved their chances to secure sustainable livelihoods.

For the other stakeholders mentioned above, no adverse comments were received.

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

>>

No adverse comments were received on the project activity by project participants

## Annex 1

### CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

| | |
|---|---|
| Organization: | Mineral Enterprises Ltd. |
| Street/P.O.Box: | #300/1-B, 16th Cross, Sadashivanagar, |
| Building: | |
| City: | Bangalore |
| State/Region: | Karnataka |
| Postfix/ZIP: | 560 080 |
| Country: | India |
| Telephone: | +91-80-23612569, 23613182, 23619939 |
| FAX: | +91-080-23612737 |
| E-Mail: | minent@blr.vsnl.net.in |
| URL: | www.mineralenterprise.com |
| Represented by: | Mr. Basant Poddar |
| Title: | Managing Director |
| Salutation: | Mr. |
| Last Name: | Poddar |
| Middle Name: | --- |
| First Name: | Basant |
| Department: | --- |
| Mobile: | --- |
| Direct FAX: | |
| Direct tel: | +91-80-23611652 |
| Personal E-Mail: | minent@blr.vsnl.net.in, bp97@hotmail.com |

**Annex 2**

**INFORMATION REGARDING PUBLIC FUNDING**

## Annex 3

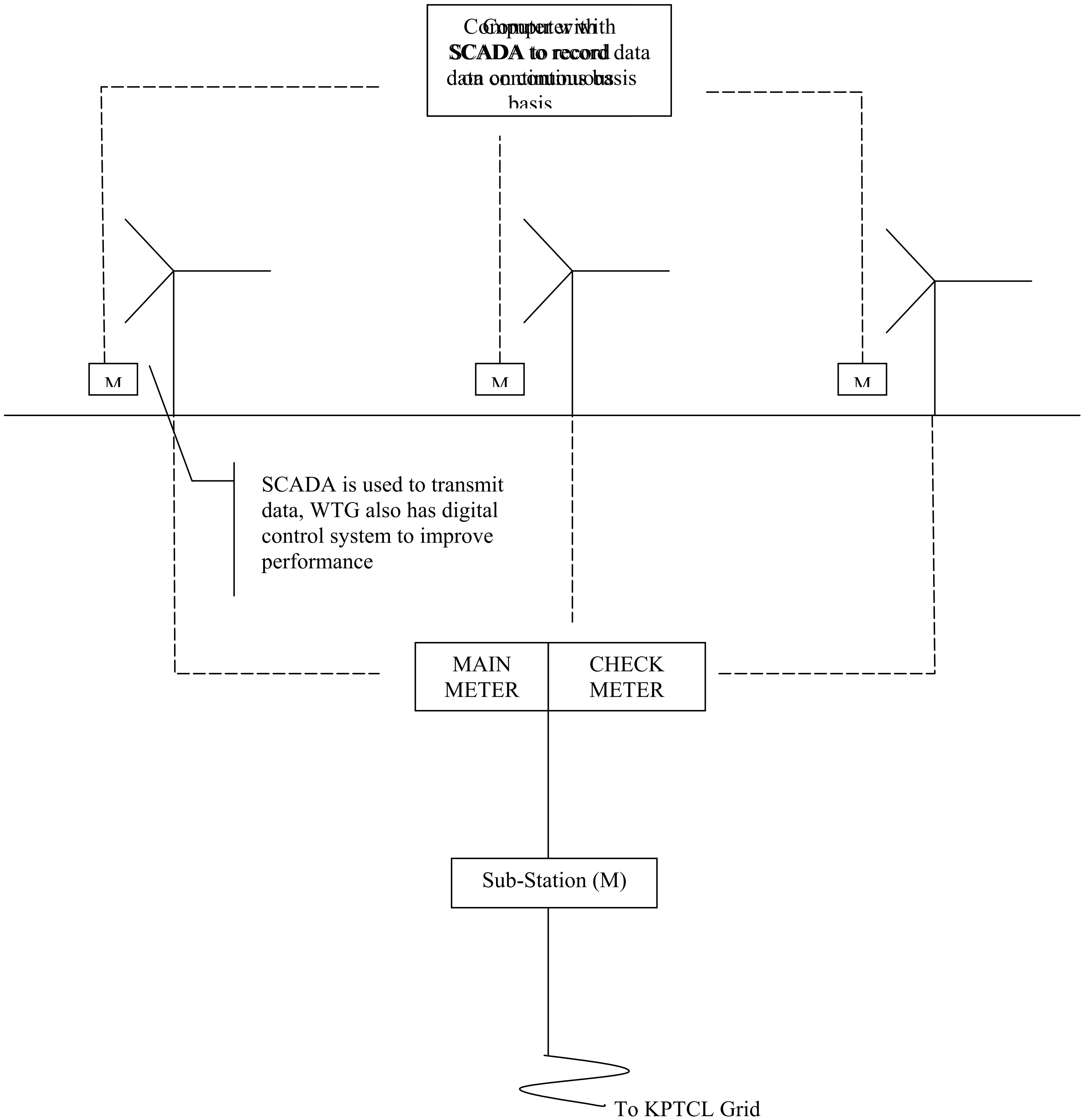
## BASELINE INFORMATION

"***$CO_2$* database for the Indian power sector**", published by the ***Central Electricity Authority, Ministry of Power, Government of India*** under technical support and assistance from GTZ (Gesellschaft Fur Technische Zimmernaurbeit), the German Agency for Technical Co-operation has been utilised. The weblink for Version 3.0 is given below:

http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm

## Annex 4
## MONITORING INFORMATION

### Metering and Evacuation Arrangement in the Project




M: indicates a metering arrangement

KARNATAKA P[illegible]WER TRANSMISSION CORPORATION LIMITE[illegible]

DIVISION : DAVANGERE MONTH: JULY YEAR:2005

Multiplying Constant (MC)for 0.2 class accuracy: 22500 "PENDING PPA"

| 01. NAME OF THE GENERATING COMPANY (Type of Generator :Synchronus Generator | M/S.MINERAL ENTERPRISES (3.0MW) WIND POWER PROJECT AT JOGIMATTI WINDZONE 33KV METERING POINT AT CHITRADURGA DISTRICT-VVS SITE | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 02. ENERGY METER READINGS. | MAIN METER READINGS | | | | | | | | CHECK METER READINGS | | | | | | | |
| RR.NO: VVS - 28 | KWH EXPORT | KWH IMPORT | KVARH EXPORT | | KVARH IMPORT | | | | KWH EXPORT | KWH IMPORT | KVARH EXPORT | | KVARH IMPORT | | | |
| | | | lag | lead | lag | lead | | | | | lag | lead | lag | lead | | |
| 03. Final meter reading as on 01-08-2005 | 171.81 | 0.49 | 5.71 | 1.23 | 0.57 | 0.15 | | | 171.83 | 0.23 | 5.67 | 1.24 | 0.32 | 0.14 | | |
| 04. Initial meter reading as on 01-07-2005 | 121.85 | 0.48 | 4.21 | 1.22 | 0.57 | 0.14 | | | 121.84 | 0.27 | 4.17 | 1.22 | 0.32 | 0.13 | | |
| 05. Difference (Final - Initial readings) | 49.96 | 0.01 | 1.5 | 0.01 | 0 | 0.01 | | | 49.99 | 0.01 | 1.5 | 0.02 | 0 | 0.01 | | |
| 06. Energy generated (ExportX22500 & ImportX22500) | 1124100 | 225 | 33750 | 225 | 0 | 225 | | | 1124775 | 225 | 33750 | 450 | 0 | 225 | | |
| 07. Total export Generated | 1124100 | | | | | | | | 1124775 | | | | | | | |
| 08 Transmission losses | 18507 | | | | | | | | 17671 | | | | | | | |
| 09. Net export Generated | 1105593 | | | | | | | | 1107104 | | | | | | | |
| 10. Energy to be billed ( Net Export-115%Import) | 1105335 | | | | | | | | 1106846 | | | | | | | |

(S Thiyagarajar)
Representative of the company

Asst. Executive Engineer
KPTCL
Asst. Executive Engineer (Ele.) [illegible]

Executive Engineer
KPTCL
Executive Engineer (Ele.)
T.L. & S.S. [illegible]
Davangere-577 005.

## Annex 5
## Plant Load Factor trends in Karnataka[18]

| Year | Upto 1995 | 1995-96 | 1996-97 | 1997-98 | 1998-99 | 1999-2000 | 2000-01 | 2001-02 | 2002-03 | 2003-04 |
|---|---|---|---|---|---|---|---|---|---|---|
| Generation (MWh) | - | 315.6 | 7,250.6 | 11,715.9 | 26,620.3 | 39,465.9 | 72,263.6 | 92,859.3 | 175,108.5 | 306,675.7 |
| Installed capacity (MW) | 0.6 | 2.6 | 5.9 | 17.1 | 19.7 | 34.3 | 44.7 | 68.7 | 124.3 | 209.2 |
| Incremental capacity (MW) | | 2 | 3.3 | 11.2 | 2.6 | 14.6 | 10.4 | **24** | **55.6** | **84.9** |
| Annual PLF (%) | | 1.4 | 14.0 | 7.8 | 15.4 | 13.1 | 18.45 | 15.43 | 16.08 | 16.73 |
| Incremental PLF (%) | | | 24.0 | 4.6 | 65.4 | 10.0 | 36.0 | **9.8** | **16.9** | **17.7** |

**Analysis**
In the above table, operating details for wind power projects in Karnataka is available for a total of 9 years from 1995 to 2004. This data has been analysed to yield information on existing as well as projected plant load factors.

The data mentioned above has been converted to yield trend analysis reports for the following three schedules:

1. Gross or realised PLF on an annual basis (shown as pink line in the graph below)

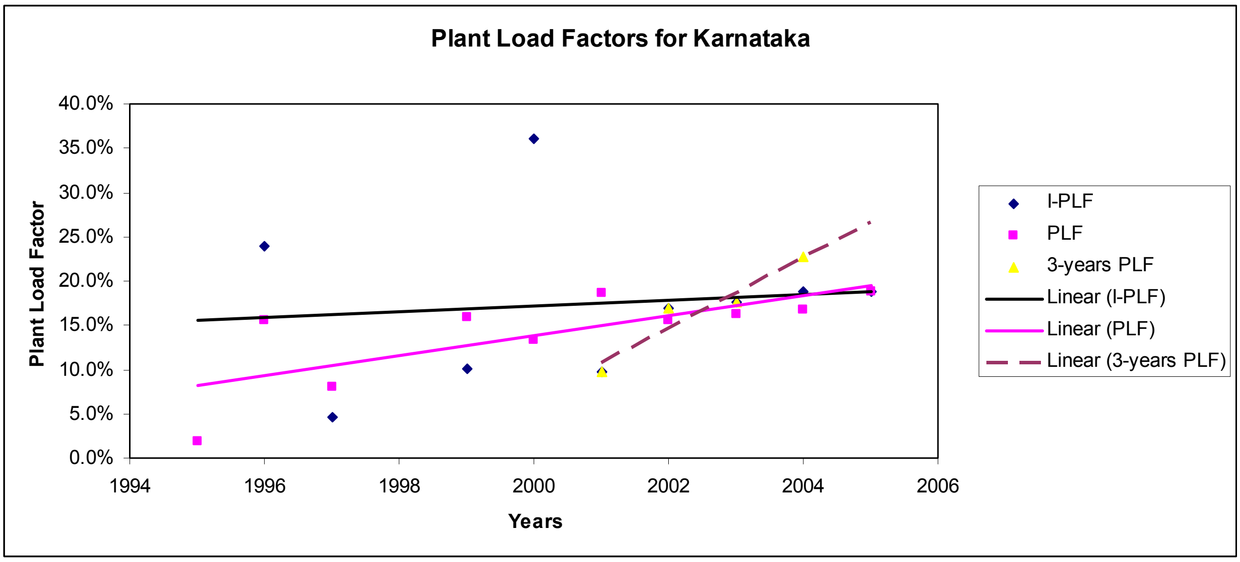
2. Incremental PLF (shown as black line in the graph below), which is derived for *additional generation* every year as a percentage of net incremental addition to capacity in that year. This PLF value was considered to be conservative, as it included possible additional generation of power in the existing capacity as part of new capacity as well.

3. Incremental PLF for only the last 3 years (2001-02 to 2003-04). This is because nearly 79% of total installed capacity as of March, 2004 came only in the previous 3 years (shown as a brown dotted line in the graph below).

[18] http://mnes.nic.in/annualreport/2002_2003_English/ch5_pg4.htm (for capacity additions from 1995-96 to 2001-02)

http://mnes.nic.in/annualreport/2002_2003_English/ch5_pg5.htm (for generation data from 1995-96 to 2001-02)

http://mnes.nic.in/annualreport/2003_2004_English/ch5_pg3.htm (for capacity addition and generation data from 2002-03 to 2003-04)




What the above figure purports to demonstrate is the trend of actual capacity utilisation for wind power projects in Karnataka. A look at the schedules above shows a generally gentle gradient for the trend lines for both actual as well as incremental PLF with the incremental PLF smoother than the actual PLF.

However, for the last 3 years prior to the proposed CDM project, the incremental PLF has grown steadily. Interestingly, extending the trend generated for the 3 preceding years to 2004-5, the projected PLF yields 22.7%. The key reasons for the increasing PLF are:

- Technological improvements in the form of introduction of higher capacity wind turbines, the introduction of gearless and synchronous Wind Energy Generators by Enercon, which the proposed CDM project is using.

- Improvements in infrastructure for evacuation of power, with the constitution of the Karnataka Electricity Regulatory Commission leading to better response from KPTCL

- Improvement in the operations and maintenance of the wind parks, with equipment suppliers like Enercon, Suzlon and others offering turnkey installation and commissioning as well as taking on complete operations and maintenance responsibilities.

Reverting to the proposed CDM project, the project developers made use of this PLF data to arrive at the conclusion of 23% effective PLF for their project. While from a *top-down (9 years)* view the trend for wind power in Karnataka yielded values near 20%, incremental PLF for the past 3 years yielded 22.7%.

As against this, a bottom up estimate could well consider a historical PLF in 2003-4 to be around 17.7% as the starting point, and apply a 5% performance enhancement for capacity utilisation that could be conservatively attributable to the advantages of gearless wind power generation over the standard gear-box fitted wind turbine generators.

As explained in section A.4.2 and B.5 of the PDD for the proposed CDM project, the geared WTGs with asynchronous generators consume higher power (by way of auxiliary consumption), especially during start-up. In contrast, gearless WTG have synchronised generators that use very less auxiliary power, thereby leading to higher capacity utilisation. In India, Enercon launched their gearless 600 kW prototype that commanded a higher PLF, with the project developers being one of the first units in India to be installed with

the prototype. Thus, the developers used a mark-up, based on the top-down and bottom up estimates, to arrive at 23% as an indicative PLF for their wind power project.

**Annex 6**

Annexe-3.9

# GOVERNMENT OF KARNATAKA

NO: DE 132 NCE 2003(P)

Karnataka Government Secretariat
M.S.Building.
Bangalore. dated 23.06.2003.

From:
The Principal Secretary to Government.
Energy Department.
Karnataka Government Secretariat.
M.S.Building.
Bangalore - 560 001.

K.E.R.C. BANGALORE
INWARD
NO. 1305
1 JUL 2003

| | |
|---|---|
| CHAIRMAN | |
| SECRETARY | 1/7 |
| CONS (ADM) | |

To:

The Secretary,
Karnataka Electricity RegulatoryCommission,
5th & 7th Floor, Mahalakshmi Chambers,
No.9/2. M.G. Road,
Bangalore-

Sri Suresh

Sir,

Sub: Purchase of electricity from Non-Conventional energy source based of power projects developed being developed in the State-Fixation of tariff in respect of Purchase of Power from Biomass and Windmill power projects - reg.

************

I am directed to state that the Karnataka Power Transmission Corporation Limited proposes to enter Power Purchase Agreements (P.P.A.s) for purchase of energy generated from (1) Wind (2) Biomass at the following rates:-

(1) WIND: Rs.3.25 per kwhr. from Power projects already commissioned and to be commissioned on or before 31st August 2003 and Rs.3.10 per kwhr for Power Project to be commissioned after 31st August 2003.
Annual escalation will be 2% on base tariff.

(2) BIOMASS: Rs.2.80 per kwhr with annual escalation of 2% on base tariff.

Government of Karnataka approves these rates and approves the submission of Power Purchase Agreements (P.P.A.s) for wind and Biomass energy to Karnataka Electricity Regulatory Commission with these rates.

Yours Faithfully,

K.L.Jayaram

(K.L.JAYARAM)
Under Secretary to Government,
Energy Department.

Copy to
The Managing Director,
Karnataka Power Transmission Corporation Ltd.
Kaveri Bhavan,
Bangalore - 9.

## ANNEX 7
## SENSITIVITY ANALYSIS BASED ON PLF AND TAX SHELTER ABSORBED

| | 0% Tax Shelter | | 80% Tax Shelter | | 100% Tax Shelter | |
|---|---|---|---|---|---|---|
| | Without CDM | With CDM | Without CDM | With CDM | Without CDM | With CDM |
| PLF | Equity IRR | | Equity IRR | | Equity IRR | |
| 20.0% | 5.67% | 8.44% | 10.42% | 13.69% | 12.06% | 15.48% |
| 22.0% | 7.23% | 9.90% | 12.21% | 15.34% | 13.92% | 17.18% |
| 23.0% | 7.99% | 10.61% | 13.09% | 16.15% | 14.83% | 18.01% |
| 24.0% | 8.74% | 11.32% | 13.94% | 16.94% | 15.72% | 18.83% |
| 25.0% | 9.48% | 12.01% | 14.79% | 17.73% | 16.60% | 19.64% |
| 26.0% | 10.21% | 12.70% | 15.62% | 18.50% | 17.46% | 20.44% |
| | | | | | | |
| | | | | | | |
| PLF | Project IRR | | Project IRR | | Project IRR | |
| 20.0% | 5.46% | 7.60% | 8.79% | 11.08% | 9.80% | 12.11% |
| 22.0% | 6.67% | 8.71% | 10.04% | 12.21% | 11.04% | 13.24% |
| 23.0% | 7.26% | 9.25% | 10.63% | 12.75% | 11.64% | 13.79% |
| 24.0% | 7.83% | 9.78% | 11.22% | 13.29% | 12.23% | 14.32% |
| 25.0% | 8.39% | 10.30% | 11.79% | 13.82% | 12.80% | 14.85% |
| 26.0% | 8.94% | 10.81% | 12.35% | 14.33% | 13.36% | 15.37% |

- Sensitivity analysis of Equity of the MEL Wind Energy Project has been carried out on the basis of varying:
  - **Plant Load Factor (PLF):** Range has been taken as 23%PLF +/- 3%PLF. This factor has been considered for the following reasons:
    - Any increase or decrease in this factor has a direct bearing on the income of the project and therefore, has an impact on the returns from the project.
  - **Tax shelter**: 0%, 80% and 100% Tax Shelter availed in core business. This factor has been considered for the following reasons:
    - An investment in wind energy generation enjoys accelerated depreciation of 80% in the first year itself.
    - However, typically the income in the first few years cannot absorb the entire depreciation
    - Therefore, wind as a stand-alone investment returns huge losses in the first few years
    - This in turn translates into poor Equity IRR as can be seen from the table above under the column "0% Tax Shelter" (this is wind energy project as a stand-alone investment)
    - However, if investment in wind energy generation is taken up as a part of a larger core business that is posting large *Profits Before Taxes*, the excess depreciation that the wind

investment itself is not able to absorb can be set off against taxes payable by the larger core business.

- This is called Tax Shelter and is treated as inflows into the wind energy investment.
- This in turn translates into increasing the Equity IRR as can be seen from the table above under columns "100% Tax Shelter" (this is wind energy generation project as a part of a larger core business)
- In the above table for an estimated PLF of 23% the Equity IRR increases from 7.99% (0% Tax Shelter) to 14.83% (100% Tax Shelter), a whopping 85% increase only on account of the Tax Shelter.
- Thus, the extent of Tax Shelter availed in the core business has a very high degree of impact on the returns from the wind energy generation project.
- Therefore, this is a valid and an important factor in analysing the sensitivity of the returns from the project.

**Observations:**

***Based on PLF:***

- Keeping the Tax Shelter at 100%, the Equity IRR varies from 12.06% (at 20% PLF) to 17.46% (at 26% PLF)
- As discussed in Annex 5, the PLF prevailing in Karnataka in 2004 at the time of considering this project was just 18%.
- Considering the technological innovations that this project was bringing in, the estimated PLF was placed at 23%, an increase in PLF of 28% over what prevailed!
- At 26% the highest PLF considered in this sensitivity analysis, the expected increase in PLF over the 18% that prevailed would be nearly 45%!!
- It is a very unlikely scenario that PLF would increase by 45% in just 1 year. As discussed in Annex 5, a trend projection over 2001-2004 puts the PLF at 22.67%. Therefore, we would conclude that, it is very unlikely that the PLF would grow by a further 15% over the 22.67% that the trend indicates.
- However, it is very interesting to note that even if the PLF does not reach the estimated 23% but only reaches 22% from the prevailing 18%, revenues from CDM help the Equity IRR reach the benchmark of 16% ROE. This clearly establishes, **the criticality of CDM** to this project.

***Based on Tax Shelter:***

- Keeping the PLF at the estimated 23%, a fall in the amount of Tax Shelter availed to 80% (that is if the core business generates a PBT that can absorb only 80% of the excess depreciation available) leads to a fall of Equity IRR from 14.83% to just 13.09%, a fall of 13.3%!
- At this level of Tax Shelter (80% Tax Shelter), even at the highest level of PLF of 26%, considered in this sensitivity analysis, the Equity IRR does not reach the benchmark of 16% ROE.

- However, what is the likelihood that the ability to absorb the Tax Shelter would be less than the maximum available?

    - The Project Proponent runs a core business that is focused on mining iron and manganese ore and exporting the same.

    - The turnover, income from exports and the Profits before tax for the Project Proponent during the period 2000-2004 is given in the table below[19]:

| Lakh INR | 2000-01 | 2001-02 | 2002-03 | 2003-04 |
|---|---|---|---|---|
| Turnover | 491.53 | 1682.88 | 2014.50 | 14054.07 |
| Exports | 78.16 | 1009.22 | 459.14 | 11355.97 |
| PBT | 19.54 | 32.54 | 35.19 | 2358.37 |

    - MEL had a modest turnover and PBT during 2000-2003, which suddenly zoomed on the back of an extraordinary increase in exports during 2003-04.

    - But for this extraordinary growth in exports, a projection of the trend of the PBT for MEL during 2000-2003 yields a PBT in 2004 of just Rs.44.74 lakhs. However, due to extraordinary exports in 2003-04, the PBT actually zoomed to Rs.2,358 lakhs, an increase of nearly 5,271%!!!.

    - Sustaining this kind of growth in profitability depends on continued opportunities for exports, a very favourable minerals export policy, ability to find new mines, significantly ramp-up operations and maintain a high level of efficiency in operations.

    - Further, a look at the above table reveals that earning from exports has varied significantly from year to year. For example, it increased from Rs.78 lakhs in 2000-01 to Rs.1009 lakhs in 2001-02, but fell sharply to Rs.459 lakhs in 2002-03. This underlines the fact that income from exports is subject to large variations.

    - Thus, we would conclude that there exists a significant probability that the PBT may not remain at the same level and this in turn would affect the ability of the core business to absorb the tax shelter available in full.

    - Thus, the likelihood that only 80% of the Tax Shelter would be actually absorbed in the core business is high.

- However, it is interesting to note that at even if the ability to absorb tax shelter reduces to 80%, and the PLF remains at the estimated 23%, revenues from CDM alone will help boost the Equity IRR from 13.09% to 16.15%, thus **underlining the criticality of CDM revenues to the project**.

[19] Source: Annual Reports of Mineral Enterprises Ltd. for 2001-02, 2002-03 and 2003-04

Thus, overall, we would conclude that both PLF and extent of Tax Shelter availed are very critical to the project, but the chances that the PLF would actually increase from a mere 18% to 26% is very unlikely. Therefore, the estimated PLF of 23% that already represents an increase of 28% over the 18% PLF that existed at that time would prevail.

With respect to the ability to absorb the Tax Shelter, there exists a high probability that there may be a fall leading to a lower than estimated Equity IRR.

However, in both cases **revenue from CDM is critical** to help the project meet the **benchmark of 16% ROE.**