



**CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006**

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**SECTION A. General description of project activity****A.1 Title of the project activity:**

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MRF wind power project in Tamilnadu managed by Enercon India Limited
Version 1.0
30/03/2007

A.2. Description of the project activity:

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Objective of the Project

The project activity is set up to produce clean power from the wind electric converters. The objective is development, design, engineering, procurement, construction, operation and maintenance of MRF Wind Farm of 14.4 MW wind power project (“Project”) in the Indian state of Tamil Nadu. The generated electricity will be wheeled using the state transmission system for captive consumption. The Project will lead to reduced greenhouse gas emissions because it displaces electricity from fossil fuel based electricity generation plants. The project activity puts to use the barren land at Tirunelveli in the state of Tamil Nadu.

The project will help in bridging the demand supply gap by using wind as a source of generating electrical energy.

Nature of Project

The project activity consists of the 18 machines of Enercon make of 800 KW each, totaling to the capacity of 14.4 MW. The Project harnesses renewable resources in the region, thereby displacing non-renewable natural resources thereby ultimately leading to sustainable economic and environmental development. Enercon (India) Ltd (“Enercon” or “EIL”) is the equipment supplier and the operations and maintenance contractor for the Project. The generated electricity will be supplied to MRF for captive consumption.

Contribution to Greenhouse gas emissions reduction

The project activity harnesses wind energy to generate electricity that displaces fossil fuel based electricity generation that would have otherwise been provided by the operation and expansion of the fossil fuel based power plants in southern region electricity grid, thereby leading to reduction in emission of greenhouse gases associated with fossil fuel based electricity generation.

Contribution to sustainable development

The project activity contributes towards sustainable development of the country and the state of Tamil Nadu by reducing the dependency on fossil fuel based electricity generation, which ultimately leads to reduction in greenhouse gas emissions. The project also fulfills several other sustainable development objectives as set out below:



- Contribution towards the policy objectives of Government of India and Government of Tamil Nadu of incremental capacity from renewable sources;
- Contribution towards meeting the electricity deficit in Tamil Nadu;
- CO₂ abatement and reduction of greenhouse gas emissions through development of renewable technology;
- Reducing the average emission intensity (SO_x, NO_x, PM, etc.), average effluent intensity and average solid waste intensity of power generation in the system;
- Conserving natural resources including land, forests, minerals, water and ecosystems; and
- Developing the local economy and create jobs and employment, particularly in rural areas, which is a priority concern for the Government of India;

A.3. Project participants:

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Please list project participants and Party(ies) involved and provide contact information in Annex 1. Information shall be indicated using the following tabular format.

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 (Host)	Private: Enercon India 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.

Note: When the PDD is filled in support of a proposed new methodology at least the host Party(ies) and any known project participant (e.g. those proposing a new methodology) shall be identified.

MRF has authorized Enercon India Limited to take the project through the CDM process.

The contact details of the entities are provided in Annex – 1.

A.4. Technical description of the project activity:**A.4.1. Location of the project activity:**

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A.4.1.1. Host Party(ies):

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The host party to the project activity is the Government of India.

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

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The project is located in the State of Tamil Nadu that forms the part of Southern regional electricity grid.

A.4.1.3. City/Town/Community etc:

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The project is located in Tirunelveli district in the State of Tamil Nadu.

A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):

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The project is located at Keelaveranam, Achankutam and Rajagopalaperi in Tirunelveli district of Tamil Nadu. The location of the units is on the micrositing data to get optimum performance. The project involves 18 units of 800 KW each:

- 13 Units are located at Keelaveranam
- 3 Units are located at Achankutam
- 2 Units are located at Rajagopalaperi

A.4.2. Category(ies) of project activity:

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The project activity is considered under CDM category zero-emissions '**grid-connected electricity generation from renewable sources**' that generates electricity in excess of 15 MW (limit for small scale project). Therefore as per the scope of the project activity enlisted in the 'list of sectoral scopes and related approved baseline and monitoring methodologies (version 02 Mar 05/07:23)', the project activity may principally be categorized in Scope Number 1, Sectoral Scope - Energy industries (renewable/ non-renewable sources).

A.4.3. Technology to be employed by the project activity:

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The Project involves 18 wind energy converters (WECs) of Enercon make (800 kW E-48) with internal electrical lines connecting the Project with local evacuation facility. The WECs generates 3-phase power at 400V, which is stepped up to 33 KV. The Project can operate in the frequency range of 47.5–51.5 Hz and in the voltage range of 400 V \pm 12.5%. The other salient features of the state-of-art-technology are:

- Gearless Construction - Rotor & Generator Mounted on same shaft eliminating the Gearbox.
- Variable speed function – has the speed range of 18 to 33 RPM thereby ensuring optimum efficiency at all times.
- Variable Pitch functions ensuring maximum energy capture.
- Near Unity Power Factor at all times.
- Minimum drawl (less than 1% of kWh generated) of Reactive Power from the grid.
- No voltage peaks at any time.
- Operating range of the WEC with voltage fluctuation of -20 to +20%.
- Less Wear & Tear since the system eliminates mechanical brake, which are not needed due to low speed generator which runs at maximum speed of 33 rpm and uses Air Brakes.
- Three Independent Braking System.
- Generator achieving rated output at only 33 rpm.
- Incorporates lightning protection system, which includes blades.
- Starts Generation of power at wind speed of 3 m/s.



Enercon (India) Ltd has secured and facilitated the technology transfer for wind based renewable energy generation from Enercon GmbH, has established a manufacturing plant at Daman in India, where along with other components the "Synchronous Generators" using "Vacuum Impregnation" technology are manufactured.

A.4.4 Estimated amount of emission reductions over the chosen crediting period:

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Crediting Period for the Project: fixed for 10 years

Years	Annual estimation of emission reductions in tonnes of CO ₂ e
2007-08	16,985
2008-09	25,478
2009-10	25,478
2010-11	25,478
2011-12	25,478
2012-13	25,478
2013-14	25,478
2014-15	25,478
2015-16	25,478
2016-17	25,478
2017-18	8,493
Total estimated reductions (tonnes of CO ₂ e)	254,780
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO ₂ e)	25,478

A.4.5. Public funding of the project activity:

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There is no ODA financing involved in the Project.

SECTION B. Application of a baseline and monitoring methodology

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

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Enercon has other wind power projects located near the project site whose boundary falls within 1 km of the boundary of the project activity. Therefore even though the project capacity is less than 15 MW i.e. the threshold for small scale projects, Enercon has adopted the approved consolidated baseline and monitoring methodology **ACM0002 Version 6.0** (19 May 2006) for the project activity. The titles of these baseline and monitoring methodologies are "Consolidated baseline methodology for grid-connected



electricity generation from renewable sources” and “Consolidated monitoring methodology for grid-connected electricity generation from renewable sources.

B.2 Justification of the choice of the methodology and why it is applicable to the project activity:

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The Project is wind based renewable energy source, zero emission power project connected to the Tamilnadu state grid, which forms part of the Southern regional electricity grid. The Project will displace fossil fuel based electricity generation that would have otherwise been provided by the operation and expansion of the fossil fuel based power plants in Southern regional electricity grid.

The approved consolidated baseline and monitoring methodology ACM0002 Version 6 is the choice of the baseline and monitoring methodology and it is applicable because:

- the Project is grid connected renewable power generation project activity
- the Project represents electricity capacity additions from wind sources
- the Project does not involve switching from fossil fuel to renewable energy at the site of project activity since the Project is green-field electricity generation capacities from wind sources at sites where there was no electricity generation source prior to the Project, and
- the geographical and system boundaries of the Southern electricity grid can be clearly identified and information on the characteristics of the grid is available.

B.3 Description of the sources and gases included in the project boundary

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According to ACM0002, for the baseline emission factor, the spatial extent of the project boundary includes the project site and all power plants connected physically to the electricity system that the CDM project power plant is connected to.

The Indian electricity system is divided into five regional grids, viz. Northern, Eastern, Western, Southern, and North-Eastern. Each grid covers several states. As the regional grids are interconnected, there is inter-state and inter-regional exchange. A small power exchange also takes place with neighbouring countries like Bhutan and Nepal.

The project boundary encompasses the physical extent of the southern regional electricity grid which includes the project site and all power plants connected physically to the electricity system.

Power generation and supply within the regional grid is managed by Regional Load Dispatch Centre (RLDC). The Regional Power Committees (RPCs) provide a common platform for discussion and solution to the regional problems relating to the grid. Each state in a regional grid meets its demand with its own generation facilities and also with allocation from power plants owned by the Central Sector such as NTPC and NHPC etc. Specific quotas are allocated to each state from the Central Sector power plants. Depending on the demand and generation, there are electricity exports and imports between states in the regional grid. The regional grid thus represents the largest electricity grid where power plants can be dispatched without significant constraints and thus, represents the “project electricity system” for the Project. As the Project is connected to the Southern regional electricity grid, the Southern grid is the “project electricity system”.



	Source	Gas	Included?	Justification/ Explanation
Baseline	Electricity generation from power plants connected to the Southern Grid	CO ₂	Included	Main emission source
		CH ₄	Excluded	This source is not required to be estimated for wind energy projects under ACM0002
		N ₂ O	Excluded	This source is not required to be estimated for wind energy projects under ACM0002
Project Activity	Electricity generation from the Project	CO ₂	Excluded	Wind energy generation does not have any direct GHG emissions.
		CH ₄	Excluded	
		N ₂ O	Excluded	

B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

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According to ACM0002, for project activities that do not modify or retrofit an existing electricity generation facility, the baseline scenario is the following:

Electricity delivered to the grid by the project would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described below.

As the Project does not modify or retrofit an existing generation facility, the baseline scenario is the emissions generated by the operation of grid-connected power plants and by the addition of new generation sources. This is estimated using calculation of Combined Margin multiplied by electricity delivered to the grid by the Project.

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 CDM project activity (assessment and demonstration of additionality): >>

Step 0: Preliminary screening based on the starting date of the project activity

If project participants wish to have the crediting period starting prior to the registration of their project activity, they shall:

- Provide evidence that the starting date of the CDM project activity falls between 1 January 2000 and the date of the registration of a first CDM project activity, bearing in mind that only CDM project activities submitted for registration before 31 December 2005 may claim for a crediting period starting before the date of registration.
- Provide evidence that the incentive from the CDM was seriously considered in the decision to proceed with the project activity. This evidence shall be based on (preferably official, legal and/or other corporate) documentation that was available at, or prior to, the start of the project activity.



The Project start date is prior to the date of validation of the PDD. The following evidence will be made available to the validator to demonstrate that CDM benefits were considered while considering investments in these projects:

- The Management Committee of Enercon set out the CDM initiative in 2000 and since then monitored the progress of the CDM initiative. Enercon management had taken a decision to go ahead with the development of the wind farm in Rajasthan in 2002, after duly considering CDM benefits under the Kyoto Protocol.
- In late 2001, Government of Netherlands came out with the CERUPT Tender. Enercon participated in CERUPT tender by offering 15 MW + 15 MW wind farm projects and was selected under the tender. Enercon was not able to conclude the contract with CERUPT and the 15 MW + 15 MW projects were subsequently cancelled. However, this provided Enercon with a considerable experience in the CDM process.
- Enercon appraised its customers in Tamil Nadu about the CDM benefits.
- The letter of intent and O&M agreement entered between the project owner MRF Limited and Enercon contains provisions for sharing of CDM related costs and benefits.

Step 1: Identification of alternatives to the project activity consistent with current laws and regulations

Sub-step 1a. Define alternatives to the project activity:

1. Identify realistic and credible alternative(s) available to the project participants or similar project developers that provide outputs or services comparable with the proposed CDM project activity. These alternatives are to include:

- The proposed project activity not undertaken as a CDM project activity;
- All other plausible and credible alternatives to the project activity that deliver outputs and on services (e.g. electricity, heat or cement) with comparable quality, properties and application areas;
- If applicable, continuation of the current situation (no project activity or other alternatives undertaken).

Alternative(s) available to the project participants include:

- (a) The Project is not undertaken as a CDM project activity.
- (b) Setting up of comparable fossil fuel fired or hydro power projects for meeting the electricity demand.
- (c) Continuation of the current situation, i.e. rely on grid imports for meeting the electricity requirement.

Sub-step 1b. Enforcement of applicable laws and regulations

2. The alternative(s) shall be in compliance with all applicable legal and regulatory requirements, even if these laws and regulations have objectives other than GHG reductions, e.g. to mitigate local air pollution. This sub-step does not consider national and local policies that do not have legally-binding status.
3. If an alternative does not comply with all applicable legislation and regulations, then show that, based on an examination of current practice in the country or region in which the law or regulation applies, those applicable legal or regulatory requirements are systematically not enforced and that



non-compliance with those requirements is widespread in the country. If this cannot be shown, then eliminate the alternative from further consideration.

4. If the proposed project activity is the only alternative amongst the ones considered by the project participants that is in compliance with all regulations with which there is general compliance, then the proposed CDM project activity is not additional.

There are no legal and regulatory requirements that prevent Alternatives (a), (b) and (c) from occurring.

Proceed to Step 2 (Investment analysis) or Step 3 (Barrier analysis). (Project participants may also select to complete both steps 2 and 3.)

Step 2: Investment Analysis

Determine whether the proposed project activity is the economically or financially less attractive than other alternatives without the revenue from the sale of certified emission reductions (CERs). To conduct the investment analysis, use the following sub-steps:

Sub-step 2a. - Determine appropriate analysis method

1. Determine whether to apply simple cost analysis, investment comparison analysis or benchmark analysis (sub-step 2b). If the CDM project activity generates no financial or economic benefits other than CDM related income, then apply the simple cost analysis (Option I). Otherwise, use the investment comparison analysis (Option II) or the benchmark analysis (Option III).

Sub-step 2b. – Option I. Apply simple cost analysis

2. Document the costs associated with the CDM project activity and demonstrate that the activity produces no economic benefits other than CDM related income.

Sub-step 2b. – Option II. Apply investment comparison analysis

3. Identify the financial indicator, such as IRR, NPV, cost benefit ratio, or unit cost of service (e.g., levelized cost of electricity production in \$/kWh or levelized cost of delivered heat in \$/GJ) most suitable for the project type and decision-making context.

Sub-step 2b. – Option III. Apply benchmark analysis

4. Identify the financial indicator, such as IRR, NPV, cost benefit ratio, or unit cost of service (e.g., levelized cost of electricity production in \$/kWh or levelized cost of delivered heat in \$/GJ) most suitable for the project type and decision context.

Option I – Simple cost analysis is not applicable as the project activity provides economic benefit in the form of relief from HT tariff that would have been paid by MRF for drawing power from the state grid in the absence of the project activity.

Enercon proposes to use **Option III – Benchmark analysis**. The project has been financed through a deferred payment scheme under which MRF is required to make small upfront payment and the balance amount is paid in monthly instalments over a 20 year period. As per the deferred payment arrangement MRF is required to endorse the insurance policy on the project assets in favour of the supplier and also hypothecate the project assets in favour of the supplier or a bank or financial institution identified by the supplier. Based on the above understanding, the financing arrangement for the project can be termed similar to that of a lease. Further since no equity investment by the project proponent is envisaged under the deferred payment arrangement, it is not possible to compute the equity IRR for the project. Accordingly the financial indicator identified for the benchmark analysis is the pre-tax return on capital employed (“ROCE”) or the project IRR.



We have used the principles followed by CERC (Central Electricity Regulatory Commission) to determine the appropriate level of ROCE for Indian power projects for arriving at the benchmark level of IRR applicable in the project activity context. CERC in its discussion paper dated June 2003 had said *“We considered it appropriate to adopt the cost of equity approach for the present, though we consider the cost of capital approach as preferable in principle. The changeover to ROCE could be brought about after the interest rates are stabilised and benchmarking of debt/equity is perfected.”*

In the same discussion paper, CERC had mentioned that the applicable level of ROCE could be taken at 13% computed as the weighted average of return on equity and cost of debt based on an ROE of 16%, cost of debt of 11% (same as PLR), normative debt equity of 70:30 and an adjustment factor of 0.5% to ROCE to take care of the income-tax element.

In June 2003, when the CERC discussion paper was published, the prime lending rate was in the range of 10.5% to 11.5% (source: Reserve Bank of India weekly statistical supplement on cash reserve ratio and interest rate – 14 June 2003) and accordingly CERC, in its discussion paper, had used the average rate (11%) as the applicable PLR for determining the ROCE. In October 2005, when the project activity was started by MRF (source: MRF Purchase Order), the PLR was in the range of 10.25% - 10.75% (source: Reserve Bank of India weekly statistical supplement on cash reserve ratio and interest rate – 21 October 2005). Accordingly, we have considered the PLR at 10.5% for determining the benchmark ROCE.

Based on the above considerations the benchmark ROCE applicable in case of the project activity, determined using the CERC principles, is 12.7%. If the project has an IRR of less than 12.7%, then it can be considered as additional.

Sub-step 2c. Calculation and comparison of financial indicators (only applicable to options II and III):

5. Calculate the suitable financial indicator for the proposed CDM project activity and, in the case of Option II above, for the other alternatives. Include all relevant costs (including, for example, the investment cost, the operations and maintenance costs), and revenues (excluding CER revenues, but including subsidies/fiscal incentives where applicable), and, as appropriate, non-market cost and benefits in the case of public investors.
6. Present the investment analysis in a transparent manner and provide all the relevant assumptions in the CDM-PDD, so that a reader can reproduce the analysis and obtain the same results. Clearly present critical techno-economic parameters and assumptions (such as capital costs, fuel prices, lifetimes, and discount rate or cost of capital). Justify and/or cite assumptions in a manner that can be validated by the DOE. In calculating the financial indicator, the project's risks can be included through the cash flow pattern, subject to project-specific expectations and assumptions (e.g. insurance premiums can be used in the calculation to reflect specific risk equivalents).
7. Assumptions and input data for the investment analysis shall not differ across the project activity and its alternatives, unless differences can be well substantiated.
8. Present in the CDM-PDD submitted for validation a clear comparison of the financial indicator for the proposed CDM activity and:
 - (a) The alternatives, if Option II (investment comparison analysis) is used. If one of the other alternatives has the best indicator (e.g. highest IRR), then the CDM project activity can not be considered as the most financially attractive;



- (b) The financial benchmark, if Option III (benchmark analysis) is used. If the CDM project activity has a less favourable indicator (e.g. lower IRR) than the benchmark, then the CDM project activity cannot be considered as financially attractive.

The key assumptions used for calculating the benchmark (pre-tax project IRR) are set out below.

Tariff

HT consumers in Tamil Nadu are required to pay a demand charge (fixed) which is based on their connected load and an energy charge (variable) linked to the amount of electricity consumed. In case of captive supply from wind power projects i.e. the project activity; the electricity generated is infirm and seasonal in nature and can not be adjusted to the requirements of captive demand, therefore MRF has to continue to rely on grid supply. The electricity supplied by the project activity provides relief only from the energy charge payable by MRF; MRF would continue to bear the demand charge as it was doing prior to the project activity. Evidence that there is no reduction in contract demand/demand charge prior to and after implementation of the project activity is available for the validator for verification.

Accordingly we have used the energy charge component of the applicable HT tariff for MRF as the revenue line item for our investment analysis.

Other Assumptions	
Capacity of Machines in kW	800
Number of Machines	18
Project Capacity in MW	14.40
Project Commissioning Date	31-Mar-06
Project Cost per MW (Rs. In Millions)	47.2
Operations	
Plant Load Factor	21.67%
Insurance Charges @ % of capital cost	0.18%
Operation & Maintenance Cost base year @ % of capital cost	1.25%
% of escalation per annum on O & M Charges	5.0%
Tariff	
HT Tariff for Tamil Nadu (source: TNEB)	3.68
Wheeling charge (% of Gross generation)	5%
Project Cost	
Land and Infrastructure, Generator & Electrical Equipments, Mechanical Equipments, Civil Works, Instrumentation & Control, Other Project Cost, Pre operative Expenses, etc.	Rs Million
Total Project Cost	679



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	Deferred Payment	
Means of Finance		
Deferred Payment terms		
Rs. 5.0 million on or before 31 March 2006		
Balance Rs. 679 million 240 consecutive monthly instalments		
Monthly Instalment amounts		
April 2006 – March 2007	80.53	Million
April 2007 – March 2008	80.24	Million
April 2008 – March 2009	79.94	Million
April 2009 – March 2010	79.63	Million
April 2010 – March 2011	79.30	Million
April 2011 – March 2012	78.95	Million
April 2012 – March 2013	78.59	Million
April 2013 – March 2014	78.21	Million
April 2014 – March 2015	77.81	Million
April 2015 – March 2016	77.39	Million
April 2016 – March 2026	9.89	Million

Working capital	
Receivables (no of days)	45
O & m expenses (no of days)	30
Working capital interest rate	12%

CER Revenues	
CER Price in US\$	-
Exchange rate Rs./US\$*	43.59

* RBI reference rate as of 15 March 2007

Crediting period starts	1-Aug-07
Length of Crediting period	10

Baseline Emission Factor for Southern Region (tCO ₂ /GWh)	932.04
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The IRR for the Project without CDM revenues is 10.2% and with CDM revenues is 11.5%.

Sub-step 2d. Sensitivity analysis (only applicable to options II and III):

9. Include a sensitivity analysis that shows whether the conclusion regarding the financial attractiveness is robust to reasonable variations in the critical assumptions. The investment analysis provides a



valid argument in favor of additionality only if it consistently supports (for a realistic range of assumptions) the conclusion that the project activity is unlikely to be the most financially attractive (as per step 2c para 8a) or is unlikely to be financially attractive (as per step 2c para 8b).

Sensitivity analysis of the Project IRR to the Plant Load Factor (the most critical assumption) has been carried out considering a plant load factor of 24.69% (applicable PLF for tariff setting considered by TNERC as per TNERC discussion paper on “Tariff Related Issues for Non Conventional Energy Sources”). Plant Load Factor is the key variable encompassing variation in wind profile, variation in off-take (including grid availability) including machine downtime. The Project IRRs at the stated PLF are as follows:

	PLF at 24.69%
Project IRR without CER revenues	12.6%
Project IRR with CER revenues	14.0%

As can be seen from above, the Project is not the most financially attractive (as per step 2c para 8a) we proceed to Step 4 (Common practice analysis).

Step 4. Common practice analysis

Sub-step 4a. Analyze other activities similar to the proposed project activity:

1. Provide an analysis of any other activities implemented previously or currently underway that are similar to the proposed project activity. Projects are considered similar if they are in the same country/region and/or rely on a broadly similar technology, are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, etc. Other CDM project activities are not to be included in this analysis. Provide quantitative information where relevant.

Sub-step 4b. Discuss any similar options that are occurring:

2. If similar activities are widely observed and commonly carried out, it calls into question the claim that the proposed project activity is financially unattractive (as contended in Step 2) or faces barriers (as contended in Step 3). Therefore, if similar activities are identified above, then it is necessary to demonstrate why the existence of these activities does not contradict the claim that the proposed project activity is financially unattractive or subject to barriers. This can be done by comparing the proposed project activity to the other similar activities, and pointing out and explaining essential distinctions between them that explain why the similar activities enjoyed certain benefits that rendered it financially attractive (e.g., subsidies or other financial flows) or did not face the barriers to which the proposed project activity is subject.
3. Essential distinctions may include a serious change in circumstances under which the proposed CDM project activity will be implemented when compared to circumstances under which similar projects were carried out. For example, new barriers may have arisen, or promotional policies may have ended, leading to a situation in which the proposed CDM project activity would not be implemented without the incentive provided by the CDM. The change must be fundamental and verifiable.



We analyze the extent to which wind energy projects have diffused in the electricity sector in Tamil Nadu. In 2004 – 05, electricity generation from wind sources was 2,426 GWh and the total electricity available at bus bar in the state of Tamil Nadu was 51,486 GWh. Thus wind generation works out to 4.7% of total electricity available to the state of Tamil Nadu. Clearly, electricity generation from wind is not a common practice in Tamil Nadu.

A comparison of installed capacities of wind generation sources between year 2000 and 2005 indicates that during the period 2000 to 2005 about 938 MW of wind generating capacity was added in Tamil Nadu (Source: Central Electricity Authority, General Reviews of 2004-05 and 1999-00). Currently, there are approximately 827 MW wind energy projects in Tamil Nadu that are in various stages of CDM development and more are expected to follow. Therefore wind power project development is substantially dependent on CDM and thus is not a common practice.

Sub-steps 4a and 4b are satisfied.

Step 5. Impact of CDM registration

Explain how the approval and registration of the project activity as a CDM activity, and the attendant benefits and incentives derived from the project activity, will alleviate the economic and financial hurdles (Step 2) or other identified barriers (Step 3) and thus enable the project activity to be undertaken.

Registering the project activity as a CDM activity provides a significant amount of revenue, improving the project’s cash flow and improving the project IRR by 1.3%. The revenues from sale of the Certified Emission Reductions would enhance the viability of the project and would partially offset the risks associated with the possible changes in policy, wind regime, project implementation risks (time and cost overruns), etc. Further, CER revenues will be high quality cash flows coming from creditworthy parties and denominated in foreign currency. The CDM revenues will attract new players to wind investments in Tamilnadu, as they provide compensation for the regulatory and project risks implicit in the wind power projects.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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According to the approved baseline methodology ACM0002, the emission reductions **ER_y** by the project activity during a given year “y¹” is

$$ER_y = BE_y - PE_y - Ly.....(1)$$

Where: **BE_y** is the baseline emissions
PE_y is project activity emissions and;
Ly is the amount of emissions leakage resulting from the project activity.

¹ Throughout the document, the suffix y denotes that such parameter is a function of the year y, thus to be monitored at least annually.



Baseline Emissions for the amount of electricity supplied by project activity, BE_y is calculated as

$$BE_y = EG_y * EF_y \dots\dots\dots(2)$$

where EG_y is the electricity supplied to the grid, EF_y is the CO₂ emission factor of the grid as calculated below.

The emission factor EF_y of the grid is represented as a combination of the Operating Margin (OM) and the Build Margin (BM). Considering the emission factors for these two margins as $EF_{OM,y}$ and $EF_{BM,y}$, then the EF_y is given by:

$$EF_y = w_{OM} * EF_{OM,y} + w_{BM} * EF_{BM,y} \dots\dots\dots(2)$$

with respective weight factors w_{OM} and w_{BM} (where $w_{OM} + w_{BM} = 1$).

The Operating Margin emission factor

As per ACM0002, dispatch data analysis should be the first methodological choice. However, this option is not selected because the information required to calculate OM based on dispatch data is not available in the public domain for the Southern electricity regional grid.

The Simple Operating Margin approach is appropriate to calculate the Operating Margin emission factor applicable in this case. As per ACM 0002 the Simple OM method can only be used where low cost must run resources constitute less than 50% of grid generation based on average of the five most recent years. The generation profile of the Southern grid in the last five years is as follows:

Generation in GWh	2004-05	2003-04	2002-03	2001-02	2000-01
Low cost/must run sources					
Hydro	24,951	16,943	18,288	26,260	29,902
Wind & Renewables	3,256	1,865	1,607	1,456	1,262
Nuclear	4,408	4,700	4,390	5,244	4,331
Other sources					
Coal	99,010	98,435	92,053	84,032	83,292
Diesel	2,434	3,295	4,379	4,155	2,868
Gas	12,428	14,214	13,950	10,331	7,132
Total Generation	146,487	139,451	134,667	131,478	128,787
Low cost/must run sources	32,615	23,508	24,285	32,960	35,496
Low cost/must run sources	22%	17%	18%	25%	28%

Source: Table 3.4 of CEA General Review 2004-05, 2003-04, 2002-03, 2001-02, 2000-01

From the available information it is clear that low cost/must run sources account for less than 50% of the total generation in the Southern grid in the last five years. Hence the Simple OM method is appropriate to calculate the Operating Margin Emission factor applicable.



Build Margin Emission Factor

The Build Margin emission factor $EF_{BM,y}$ (tCO₂/GWh) is given as the generation-weighted average emission factor of the selected representative set of recent power plants represented by the 5 most recent plants or the most recent 20% of the generating units built (summation is over such plants specified by k):

$$EF_{BM,y} = [\sum_i F_{i,m,y} * COEF_i] / [\sum_k GEN_{k,m,y}] \dots \dots \dots (5)$$

The summation over i and k is for the fuels and electricity generation of the plants in sample m mentioned above.

The choice of method for the sample plant is the most recent 20% of the generating units built as this represents a significantly larger set of plants, for a large regional electricity grid have a large number of power plants connected to it, and is therefore appropriate.

The Central Electricity Authority, Ministry of Power, Government of India has published a database of Carbon Dioxide Emission from the power sector in India based on detailed authenticated information obtained from all operating power stations in the country. This database i.e. The CO₂ Baseline Database provides information about the Operating Margin and Build Margin Emission Factors of all the regional electricity grids in India. The Operating Margin in the CEA database is calculated ex ante using the Simple OM approach and the Build Margin is calculated ex ante based on 20% most recent capacity additions in the grid based on net generation as described in ACM0002. We have, therefore, used the Operating Margin and Build Margin data published in the CEA database, for calculating the Baseline Emission Factor.

Combined Margin Emission Factor

As already mentioned, baseline emission factor (EF_y) of the grid is calculated as a combined margin (CM), calculated as the weighted average of the operating margin (OM) and build margin (BM) factor. In case of wind power projects default weights of 0.75 for EF_{OM} and 0.25 for EF_{BM} are applicable as per ACM0002. No alternate weights are proposed.

Using the values for operating margin and build margin emission factors provided in the CEA database and their respective weights for calculation of combined margin emission factor, the baseline carbon emission factor (CM) is 932.04 tCO₂e/GWh or 0.93204 tCO₂e/MWh.

Project Emissions:

The project activity uses wind power to generate electricity and hence the emissions from the project activity are taken as nil.

$$PE_y = 0$$

Leakage:



Emissions Leakage on account of the project activity is ignored in accordance with ACM0002.

$$L_y = 0$$

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

>>

Data / Parameter:	<i>EF_{OM,y}</i>						
Data unit:	tCO ₂ e/MWh						
Description:	Operating Margin Emission Factor of Southern Regional Electricity Grid						
Source of data used:	“CO ₂ Baseline Database for Indian Power Sector” published by the Central Electricity Authority, Ministry of Power, Government of India. The “CO ₂ Baseline Database for Indian Power Sector” is available at www.cea.nic.in						
Value applied:	<table border="1"> <tr> <td>2002 – 03</td> <td>0.9970</td> </tr> <tr> <td>2003 – 04</td> <td>1.0094</td> </tr> <tr> <td>2004 – 05</td> <td>1.0038</td> </tr> </table>	2002 – 03	0.9970	2003 – 04	1.0094	2004 – 05	1.0038
2002 – 03	0.9970						
2003 – 04	1.0094						
2004 – 05	1.0038						
Justification of the choice of data or description of measurement methods and procedures actually applied :	Operating Margin Emission Factor has been calculated by the Central Electricity Authority using the simple OM approach in accordance with ACM0002.						

Data / Parameter:	<i>EF_{BM,y}</i>
Data unit:	tCO ₂ e/MWh
Description:	Build Margin Emission Factor of Southern Regional Electricity Grid
Source of data used:	“CO ₂ Baseline Database for Indian Power Sector” published by the Central Electricity Authority, Ministry of Power, Government of India. The “CO ₂ Baseline Database for Indian Power Sector” is available at www.cea.nic.in
Value applied:	0.7180
Justification of the choice of data or description of measurement methods and procedures actually applied :	Build Margin Emission Factor has been calculated by the Central Electricity Authority in accordance with ACM0002.

B.6.3 Ex-ante calculation of emission reductions:

>>

Ex-ante calculation of emission reductions is equal to ex-ante calculation of baseline emissions as project emissions and leakage are nil.

Baseline emission factor (combined margin)



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= 932.04 tCO₂e/GWh

Annual electricity supplied to the grid by the Project
 = 14.4 MW (Capacity) x 21.67% (PLF) x 8760 (hours) / 1000 GWh
 = 27.335 GWh

Annual baseline emissions
 = 932.04 tCO₂e/GWh x 27.335 GWh
 = 25,478 tCO₂e

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

>>

Years	Estimation of project activity emissions (tCO ₂ e)	Estimation of baseline Emissions (tCO ₂ e)	Estimation of Leakage (tCO ₂ e)	Estimation of overall emission reductions (tCO ₂ e)
2007-08	0	16,985	0	16,985
2008-09	0	25,478	0	25,478
2009-10	0	25,478	0	25,478
2010-11	0	25,478	0	25,478
2011-12	0	25,478	0	25,478
2012-13	0	25,478	0	25,478
2013-14	0	25,478	0	25,478
2014-15	0	25,478	0	25,478
2015-16	0	25,478	0	25,478
2016-17	0	25,478	0	25,478
2017-18	0	8,493	0	8,493
Total (tonnes of CO₂e)	0	254,780	0	254,780

B.7 Application of a monitoring methodology and description of the monitoring plan:**B.7.1 Data and parameters monitored:**

Data / Parameter:	EGy
Data unit:	MWh (Mega-watt hour)
Description:	Net electricity supplied to the grid by the Project
Source of data to be used:	Electricity supplied by the project activity to the grid as per tariff invoices raised by TNEB on MRF.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Annual electricity supplied to the grid by the Project = 14.4 MW (Capacity) x 21.67% (PLF) x 8760 (hours) MWh = 27335.40 MWh
Description of measurement methods and procedures to be applied:	Net electricity supplied to the grid will be measured by the two way export meter. The procedures for metering and meter reading will be as per the provisions of the wheeling and banking arrangement.
QA/QC procedures to be	QA/QC procedures will be implemented pursuant to wheeling and banking arrangement.



applied:	.
Any comment:	

B.7.2 Description of the monitoring plan:

>>

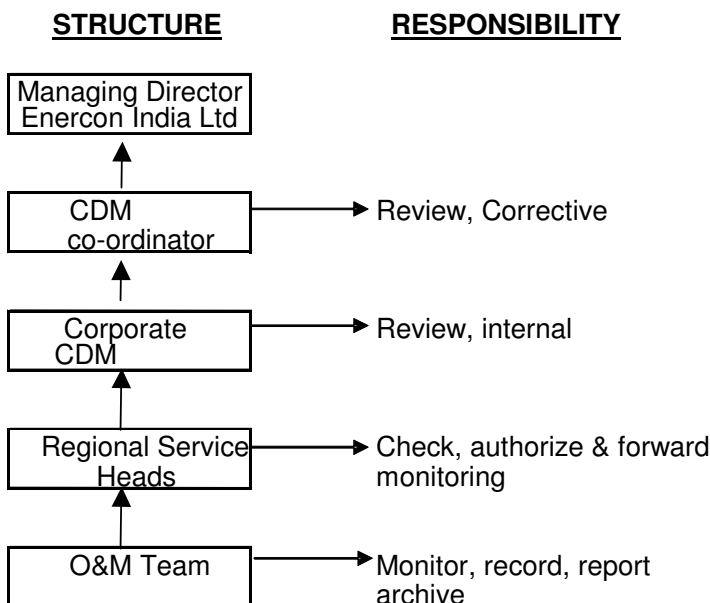
Approved monitoring methodology ACM0002 / Version 06 Sectoral Scope: 1, “Consolidated monitoring methodology for zero-emissions grid-connected electricity generation from renewable sources”, by CDM - Meth Panel is proposed to be used to monitor the emission reductions.

This approved monitoring methodology requires monitoring of the following:

- Electricity generation from the project activity; and
- Operating margin emission factor and build margin emission factor of the grid, where *ex post* determination of grid emission factor has been chosen

Since the baseline methodology is based on *ex ante* determination of the baseline, the monitoring of operating margin emission factor and build margin emission factor is not required.

The sole parameter for monitoring is the electricity supplied to the grid. The Project is operated and managed by Enercon (India) Ltd. The operational and management structure implemented by Enercon is as follows:



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

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Date of completion: 30/03/2007

Name of responsible person/entity: PricewaterhouseCoopers Private Limited (Not a Project Participant)



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:

>>
26/10/2005, being the date of purchase order

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

>>
20 years

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

The project activity will use fixed crediting period.

C.2.1. Renewable crediting period

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

>>

C.2.1.2. Length of the first crediting period:

>>

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>
01/08/2007, being the expected date of the registration of the project.

C.2.2.2. Length:

>>
10 years

SECTION D. Environmental impacts

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D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

>>
Enercon appointed Care Sustainability to conduct rapid environmental impact assessment study to assess the impact of the project on the local environment.



Environmental Impact Assessment (EIA) of this project is not an essential regulatory requirement, as it is not covered under the categories as described in EIA Notification of 1994 or the Amended Notification of 2006. However, Enercon conducted the EIA to study impacts on the environment resulting from the project activity.

The EIA study included identification, prediction and evaluation of potential impacts of the CDM activities on air, water, noise, land, biological and socio-economic environment within the study area. The ambient air concentrations of Suspended Particulate Matter, Respirable Particulate Matter, Oxides of Nitrogen, Sulphur dioxide and Carbon Monoxide were monitored and were found under limits as specified by CPCB. The noise levels were observed through out the study period and were found to be in the permissible range as specified by the state pollution control board and National Ambient Air Quality Standards. Water quality monitoring studies were carried out for determination of physico-chemical characteristics of bore wells. The ph level of water was found to be under the specified limits.

The site does not involve any sensitive archaeological monuments as per the Archaeological Survey of India. No Historical and Cultural Monuments have been affected due to project location. The project area consists of some grass shrubs and does not have much to offer aesthetically. However, construction of wind power mills with pleasing architectural design that blends with the landscape will have a positive impact on the aesthetics of the present surrounding of the site.

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:

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EIA demonstrated that there is no major impact on the environment due to the installation and operation of the windmills. The local ecology is not likely to get impacted by this type of project activity. The local population confirmed that there is no noise or dust nuisance due to windmills. The EIA also ruled out any adverse impacts due to the project activity.

SECTION E. Stakeholders' comments

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

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The comments from local stakeholders were invited through a local stakeholder meeting conducted at Hotel Shakuntla International, Tirunelveli on 06th December 2006. A local newspaper advertisement was placed in Dinamani on 18th November 2006 inviting the local stakeholders for the meeting.

E.2. Summary of the comments received:

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The comments from local villagers included:

- The nature of benefits that local stakeholders will get
- Impact on the grazing of local cattle
- Impact on any migratory patterns of birds or fauna



- Impact on water availability; distance of the tube wells from the Project site
- Addressing safety issues by Enercon, incidence of accidents
- Noise disturbance

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

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Report on how due account was taken of the comments received is provided in the minutes of Stakeholder Consultation meeting conducted at Tirunelveli provided in appendix-2.

**Annex 1****CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY.**

Organization:	Enercon (India) Limited
Street/P.O.Box:	Kolsite House, Plot No. 31, Shah Industrial Estate, Veera Desai Road, Andheri (West)
Building:	
City:	Mumbai
State/Region:	Maharashtra
Postfix/ZIP:	400 053
Country:	India
Telephone:	+91-22-5522 7794
FAX:	+91-22-5692 1175
E-Mail:	a.raghavan@enerconindia.net
URL:	
Represented by:	
Title:	Associate Vice President
Salutation:	Mr.
Last Name:	Raghavan
Middle Name:	
First Name:	A
Department:	Corporate
Mobile:	+91-98200 45724
Direct FAX:	+91-22-5692 1175
Direct tel:	+91-22-5522 7794
Personal E-Mail:	a.raghavan@enerconindia.net



Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No ODA financing has been used in the project activity.

**Annex 3****BASELINE INFORMATION**

The Operating Margin data for the most recent three years and the Build Margin data for the Southern Region Electricity Grid as published in the CEA database are as follows:

Simple Operating Margin

	tCO ₂ e/GWh
Simple Operating Margin - 2002-03	997.02
Simple Operating Margin - 2003-04	1,009.37
Simple Operating Margin - 2004-05	1,003.76
Average Operating Margin of last three years	1,003.38

Build Margin

	tCO ₂ e/GWh
Build Margin	717.99

Combined Margin calculations

	Weights	tCO ₂ e/GWh
Operating Margin	0.75	1003.38
Build Margin	0.25	717.99
Combined Margin		932.04

Detailed information on calculation of Operating Margin Emission Factor and Build Margin Emission Factor is available at www.cea.nic.in.



Annex 4

MONITORING INFORMATION

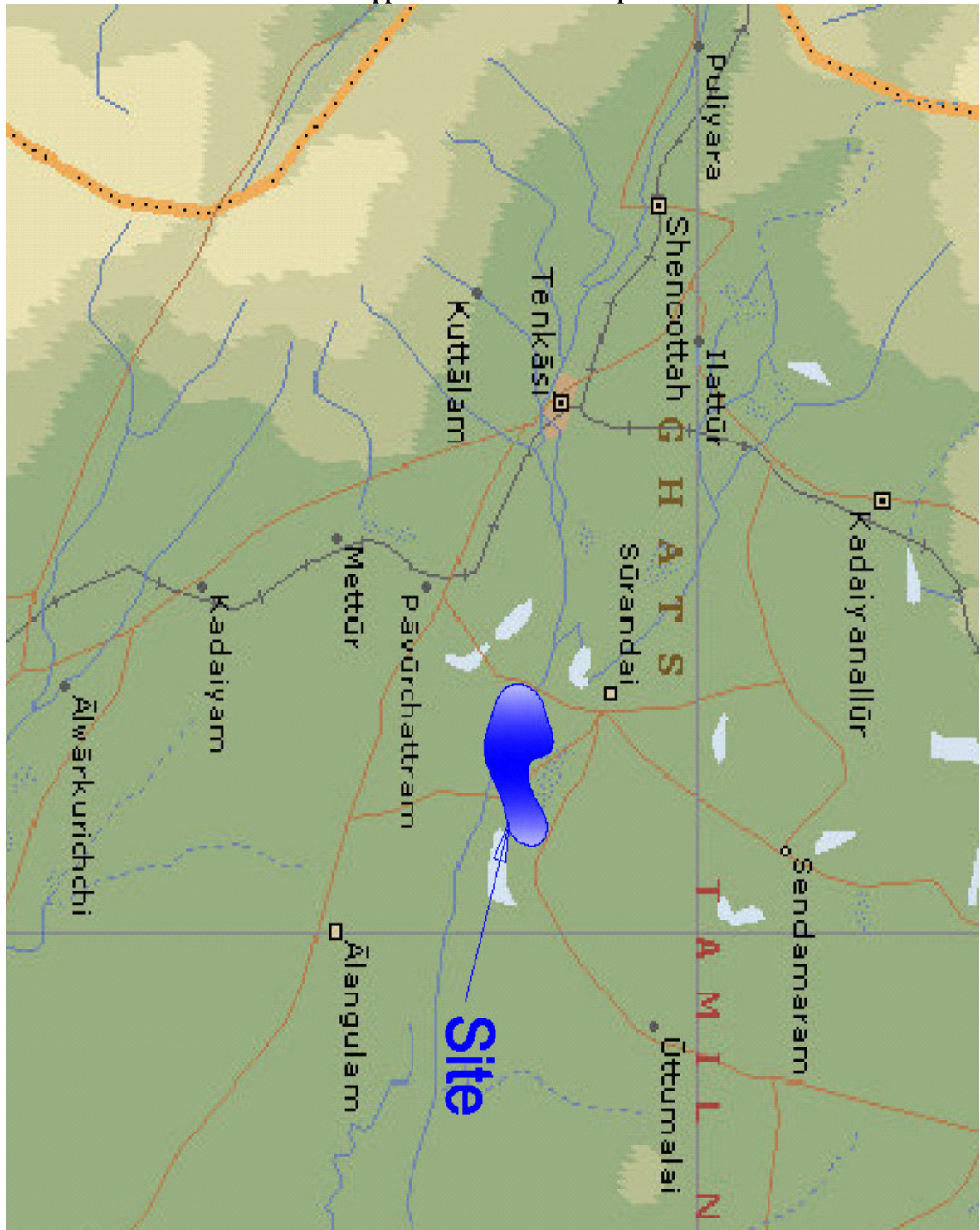
- **Metering:** Electricity supplied to the grid is metered through the two way export meter installed by TNEB at the high voltage side of the step up transformer installed at the Project Site.
- **Metering Equipment:** Metering equipment is an electronic trivector meter of accuracy class 0.5 required for the Project. The meter is installed and owned by TNEB. The metering equipment is maintained in accordance with electricity standards prevalent in Tamil Nadu.
- **Meter Readings:** The monthly meter reading is taken jointly by the parties for the last month. At the conclusion of each meter reading an appointed representative of TNEB and Enercon sign a document indicating the number of Kilowatt-hours indicated by the meter.
- **Inspection of Energy Meters:** The two way export meter and all associated instruments, transformers installed at the Project are of 0.5 accuracy class. The meter is jointly inspected and sealed on behalf of the Parties and is not to be interfered with by either Party except in the presence of the other Party or its accredited representatives.
- **Meter Test Checking:** The meter is tested for accuracy with reference to a portable standard meter. The portable standard meter is also owned by TNEB. The meter is deemed to be working satisfactorily if the errors are within specifications for meters of 0.5 accuracy class. The consumption registered by the meter alone holds good for the purpose of metering electricity supplied to the grid as long as the error in the meter is within the permissible limits.

If during the meter test checking,

- The meter is found to be beyond permissible limits of error, the meter shall be immediately calibrated and the correction applied to the reading registered by the meter to arrive the correct reading of energy supplied for metering electricity supplied to the grid for the period from the last month's meter reading up to the current test. Meter reading for the period thereafter till the next monthly reading shall be as per the calibrated meter.



Appendix 1 – Location Map





Appendix 2 – Minutes of stakeholder consultation meeting

Minutes of CDM meeting held at (RAMA Hall) Hotel Shakunthala International, Tirunelveli on 06.12.2006.

MEETING PRESIDED BY

1. Mr. Rajamuniyandi – TNEB (S.E. Wind farms)
2. Mr. Rajsekar – TNEB (A.D.E. Wind farms)
3. Mr. Sankaran – Panchayath President, Nanguneri
4. Mr. Arumugam – Retd. DRO.
5. Mr. Arumugam – Panchayath President, Kadangulam
6. Mr. Muthukrishnan – Councilor, Nanguneri
7. Mr. Anandan – Manager, Enercon.

AGENDA OF THE MEETING IS FIXED AS FOLLOWS:

1. Welcome speech.
2. Description of Clean Development Mechanism by the Invitees.
3. Queries and responses from the proponent and the stakeholders.
4. Description of the project by Enercon Service person.
5. Vote of thanks.

Welcome Speech:

Mr. Suresh from Enercon India Ltd welcomed all the people who had come to take part in the meeting. Soon after the welcome speech **Mr. Iniyavan** of Enercon India Ltd took charge of the stage and addressed the invitees to speak about the project and the invitees were honored by gifts.

Description of the project by the invitees:

1. **Mr. Anandan** of Enercon elucidated about the Kyoto protocol and CDM to the villagers. He also brought to light that the ozone layer is getting depleted due to poisonous gases emitted by using fossil fuel energy sources. In his speech he also spoke about the carbon levels in the atmosphere is increasing each year. He opined that Wind energy is the boon to our environment and that it doesn't spoil our environment, more over wind power projects in remote villages has increased employment opportunities and per capita income to such villagers.
2. **Mr. Rajamuniyandi** of TNEB spoke about the green revolution and the impact of wind energy development. He also specified that Tamil Nadu bags first place in India with respect to wind energy development. More over he also enlightened the villagers that 1900 MW of electricity alone is being generated using wind energy generators in Tirunelveli region at present.
3. **Mr. Rajsekar** of TNEB explained about the difference between Thermal, Nuclear power plants and Wind power plants. He also enlightened about the installation of 58 Kw wind energy converters in Tamil Nadu region in the year 1988. He spoke about the technological advancements in the wind energy generators and quality of electricity supplied nowadays. He also told that the wind power projects are displacing the energy which otherwise could have come from the other sources.
4. **Mr. Sankaran** Panchayath President of Nanguneri spoke about the advancements in the villages after the installation of wind projects. He opined that after coming of Wind projects in the villages the access to the nearest villages has become easy and more number of employment



opportunities and economic opportunities are being created such as casual labours, securities to the installation sites, drivers and technicians.

5. **Mr. Arumugam** – Panchayath President of Kadangulam was also of the same opinion that Wind power projects in the remote villages have brought prosperity to such villages and has increased the per capita income of a people in the village and also the transportation facility has improved.
6. **Mr. Muthukrishnan** – Councilor of Nanguneri. In his speech he brought to light that the wind projects has not affected drinking water and the projects are being installed on waste barren lands where as even grazing of cattle is also not affected. Moreover he also stated that only after the coming of these wind projects the unused waste barren lands are being bought from the villagers which also helps the villager economically and many marriages in the villages are done only by selling such waste lands.
7. **Mr. Arumugam** – Retd. DRO communicated to the villagers about the advantages of wind power projects and also enlightened the public regarding the myths about Wind mills prevailing in that locality such as cows not milching due to the noise of the Wegs and various others. He explained using various examples of the advantages of Wegs and also the comparison of fossil fuel and other energy sources and their hazard ness to our environment.

Queries and responses from the proponent and the stakeholders

1. **What are the benefits of the wind power projects the stake holders have observed?**

The villagers have got employment opportunities, economic opportunities and the accessibility to the villages have become easier.

2. **Has the project affected the grazing of local cattle?**

The installation of WEGs is in waste barren land and hence has not affected the cattle grazing.

3. **Has the project affected any migratory patterns of birds or fauna?**

The project does not fall under migratory patterns of birds or fauna

4. **During construction and erection has any incident of accident or damage occurred?**

As to date no such incidents of accidents have occurred.

5. **Does the project help in improving the electricity supply to the villagers or the neighborhood areas?**

The fluctuation of power supply has decreased and there is continuous uninterrupted supply of electricity.

6. **Have you observed any noise disturbances from the project during construction and operation of the project?**

Disturbances of such kind have not occurred to date.

7. **Do Enercon take care of safety issues?**

Enercon India Ltd is very keen in taking care of safety issues and there are sufficient safety instruments in order to avoid any incident of accidents.
