Project design document form

(Version 10.1)

BASIC INFORMATION	
Title of the project activity	Wind power project in Tirunelveli Tamilnadu
Scale of the project activity	☐ Large-scale ☒ Small-scale
Version number of the PDD	06
Completion date of the PDD	31/05/2018
Project participants	Vaayu Renewable Energy (Tapti) Private Limited[1] (Private)
Host Party	India
Applied methodologies and standardized baselines	Grid connected renewable electricity generation, AMS I.D., Version 16
Sectoral scopes linked to the applied methodologies	01- Energy industries (renewable - / non-renewable sources)
Estimated amount of annual average GHG emission reductions	16,360 tCO_2e

[1] Ownership of project activity has been changed from 'Vish Wind Infrastructure LLP' to 'Vaayu Renewable Energy (Tapti) Private Limited." as per the purchase order dated 17/05/2013.

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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The project activity is set up to produce clean power from the wind energy converters (WEC's). The project activity involves supply, erection, commissioning and operation of 10 machines of rated capacity 800 kW each. The machines are Wind World E-53 make.

During post registration phase, the ownership of project activity has been transferred from 'Vish Wind Infrastructure LLP' to 'Vaayu Renewable Energy (Tapti) Private Limited' as per the purchase order dated 17/05/2013.

Originally, the electricity generated by project activity was being supplied to the state grid.

Further from 15/06/2013 onwards, electricity is being supplied to SRF Limited through third party sale agreement (as per TANGEDCO statements). As per present arrangement, the electricity generated by the project activity is being pooled through Tamil Nadu state distribution & transmission network first (part of southern grid which is now part integrated Indian grid) and then further supplied to SRF Limited.

Purpose of the Project Activity

The purpose of the project activity is to utilize renewable wind energy for generation of electricity. The project activity replaces anthropogenic emissions of greenhouse gases (GHG's) into the atmosphere, which is estimated to be approximately 16,360 tCO_2e per year, by displacing the equivalent amount of electricity generation through the operation of existing fuel mix in the grid comprising mainly fossil fuel based power plants and future capacity expansions connected to the grid.

In the absence of the project activity, equivalent amount of electricity would have been generated from the connected/ new power plants in the southern grid, which are/ will be predominantly based on fossil fuels. Whereas the operation of Wind Energy Converters (WEC's) is emission free and no emissions occur during the lifetime of the project activity. As per the applicable methodology the baseline scenario for the project activity is the grid based electricity system, which is also the pre-project scenario.

Wind World (India) Limited (hereafter referred as "WWIL")[3] is the equipment supplier and the operations and maintenance contractor for the project activity. The project activity is owned by Vaayu Renewable Energy (Tapti) Private Limited. WWIL is having the responsibility of operation and maintenance of the wind farm.

PP has no prior experience in renewable energy project. This is the first investment of PP in renewable energy sector in the state of Tamil Nadu.

Contribution to sustainable development

Ministry of Environment and Forests[4], Government of India has stipulated the social well being, environmental well being, economic well being and technological well being as the four indicators for sustainable development in the host country approval eligibility criteria for Clean Development Mechanism (CDM) projects[5].

The project activity contributes to sustainable development in the following manner:

1. **Social well being:**

- The candidate CDM project has resulted in investment in rural sector thereby creating employment opportunities for the skilled, semi skilled and unskilled manpower available in and around project location.
- The project activity has led to the development of supporting infrastructure such as road network etc., in the wind park location, which also provides access to the local population.

[3] With effect from 01/01/2013 name of Enercon (India) Limited has been changed to 'Wind World (India) Limited'.

[4] Ministry of Environment and Forest, web site: http://envfor.nic.in/division/clean-development-mechanism-interim-approval-criteria

[5] http://cdmindia.nic.in/host_approval_criteria.htm

- Use of a renewable source of energy reduces the dependence on imported fossil fuels and associated price variation thereby leading to increased energy security.

2. Economic well being:

- The project activity requires temporary and permanent, skilled and semi-skilled manpower at the wind farm; this will create additional employment opportunities in the region.
- The generated electricity will be fed into the Southern grid through local grid, thereby improving the grid frequency and availability of electricity to the local consumers (villagers & sub-urban habitants) which will provide new opportunities for industries and economic activities to be setup in the area thereby resulting in greater local employment, ultimately leading to overall development.

3. Technological well being:

- Increased interest in wind energy projects will further push R&D efforts by technology providers to develop more efficient and better machinery in future.

4. Environmental well being:

- The project activity involves use of renewable energy source for electricity generation instead of fossil fuel based electricity generation which would have emitted gaseous, liquid and/or solid effluents/wastes.
- Being a renewable resource, using wind energy to generate electricity contributes to resource conservation. Thus the project causes no negative impact on the surrounding environment contributing to environmental well-being.

All the above - discussed points are the contributions of the project activity for the sustainable development.

A.2. Location of project activity

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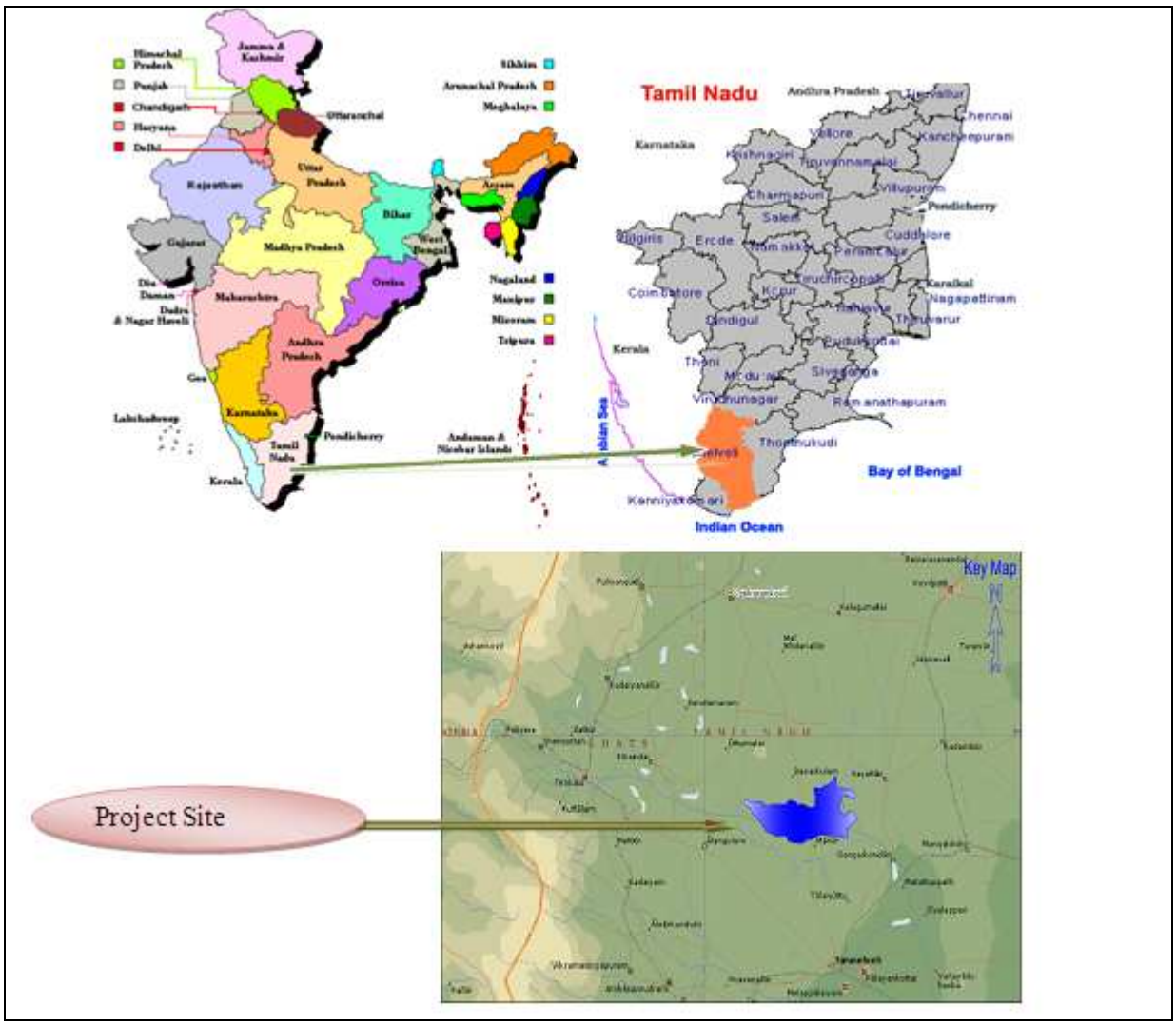
The project is located across villages in Vagaikulam, Kattarankulam and Melelanthaikulam of Tirunelveli Taluk, in Tirunelveli District of Tamil Nadu state in India. Tirunelveli railway station is about 25 kms away from the site. Nearest airport is at Tuticorin about 70 kms from the site. The project consists of 10 numbers of WWIL make E-53 WECs of 800 kW each. The latitude and longitude of the project activity are given below:

WEC Serial No.	Location No.	Village	Latitude	Longitude
1	V152	Vagaikulam	N 8°53'57.9"	E 77°37'38.2"
2	V168	Vagaikulam	N 8°54'06.2"	E 77°38'04.3"
3	60	Kattarankulam	N 8°54'45.0"	E 77°40'47.7"
4	62	Kattarankulam	N 8°54'55.5"	E 77°40'58.7"
5	116	Kattarankulam	N 8°54'33.1"	E 77°40'31.1"
6	119	Kattarankulam	N 8°55'11.9"	E 77°40'25.4"
7	121	Kattarankulam	N 8°55'22.2"	E 77°40'39.6"
8	122	Kattarankulam	N 8°55'13.8"	E 77°40'37.7"
9	131	Melelanthaikulam	N 8°56'10.8"	E 77°41'21.4"
10	128	Melelanthaikulam	N 8°55'34.8"	E 77°41'10.5"

The physical location of the project activity is shown below:



A.3. Technologies/measures

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The type and category of project activity as per Appendix B to the simplified modalities and procedures for small-scale CDM project activities are as under:

Sectoral Scope: I, Energy Industries (renewable/non-renewable sources).
Project Type: I, Renewable energy projects
Project Category: Electricity generation for a system

The project activity comprises of 10 WECs of WWIL model E-53. The project uses technology that is environmentally clean and safe since there are no GHG emissions associated with the electricity generation from the windmills.

The WECs generates 3-phase power at 400V, which is stepped up to 33 KV. The project activity can operate in the frequency range of 47.5–51.5 Hz and in the voltage range of 400 V ± 12.5%. The average life time of the WEC is around 20 years as per the industry standards. The other salient features of the state-of-art-technology are:

E 53 Specifications

Turbine model	WWIL E- 53
Rated power	800 KW
Rotor diameter	53 m

Hub height	75 m
Turbine Type	Gearless horizontal axis wind turbine with variable rotor speed
Power regulation	Independent electromechanical pitch system for each blade.
Cut in wind speed	2.5 *m/s*
Rated wind speed	12 *m/s*
Cut out Wind speed	28-34 m/s
Extreme Wind Speed	59.5 *m/s*
Rated rotational speed	32 rpm
Operating range rot. speed	12-29 rpm
Orientation	Upwind
No of Blades	3
Blade Material	Fibre Glass Epoxy reinforced with integral lightning protection
Gear box type	Gear less
Generator type	Synchronous generator
Braking	Aerodynamic
Output Voltage	400 V
Yaw System	Active yawing with 4 electric yaw drives with brake motor and friction bearing
Tower	74 m concrete

There is no technology transfer involved in the project activity.

A.4. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
India (host)	Vaayu Renewable Energy (Tapti) Private Limited (Private)	No

A.5. Public funding of project activity

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There is no public funding from Annex 1 countries and no diversion of Official Development Assistance (ODA) is involved in the project activity.

A.6. History of project activity

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NA

A.7. Debundling

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According to appendix C[6] of simplified modalities and procedures for small-scale CDM project activities, 'debundling' is defined as the fragmentation of a large project activity into smaller parts. A small-scale project activity that is part of a large project activity is not eligible to use the simplified modalities and procedures for small-scale CDM project activities.

According to Para 2 of appendix C

A proposed small-scale project activity shall be deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or an application to register another small-scale CDM project activity:

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

The project participant hereby confirm that there is no registered small scale project activity within the previous two years with them in the same project category and technology whose project boundary is within 1 km of the project boundary of the proposed small scale activity. Thus the project is not a de-bundled component of any other large-scale project activity.

SECTION B. Application of selected methodologies and standardized baselines

B.1. Reference to methodologies and standardized baselines

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The project activity is a small scale CDM project activity based on Appendix B of the simplified modalities and procedures for small-scale CDM project activities. The project activity conforms to the following category:

Sectoral Scope : 'Energy industries (renewable - / non-renewable sources)' (1)
Project Type : TYPE I - RENEWABLE ENERGY PROJECTS
Category : I.D. Grid connected renewable electricity generation
Reference [7] : AMS I.D., Version 16, EB 54.

Tool: Tool to calculate the emission factor for an electricity system – Version 02.1.0

B.2. Applicability of methodologies and standardized baselines

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The comparisons of the project activity to the technology/measures specified in methodology AMS-I.D are given in the following table:

AMS I.D Applicability Criteria	Compliance of The Proposed Project Activity
This category comprises renewable energy generation units, such as photovoltaics, hydro, tidal/wave, wind, geothermal and renewable biomass that supply electricity to a national or a regional grid. Project activities that displace electricity from an electricity distribution system that is or would have been supplied by at least one fossil fuel fired generating unit shall apply AMS-IF.	The Project is wind based renewable electricity generation, supplies electricity to state grid/ third party through southern grid, which now part of the Indian integrated grid. As per clarification (Ref No-SSC_466) [8] of applied methodology AMS I.D version 16, the applicability condition of third party sale for project activity is justified.

[6] http://cdm.unfccc.int/Projects/pac/howto/SmallScalePA/sscdebund.pdf

[7] http://cdm.unfccc.int/methodologies/DB/Q3VOK1HPBFTLSP7ZXFMY8R8Y4BEVJX

[8] https://cdm.unfccc.int/filestorage/D/R/E/DRECVTZ4U2H0M95YBKQXFLWGS8AP31/Final%20response.pdf?t=TlR8cDcwam5lfDCNDUd2DWFG5veDILi8n7WY

This methodology is applicable to project activities that (a) install a new power plant at a site where there was no renewable energy power plant operating prior to the implementation of the project activity (Greenfield plant); (b) involve a capacity addition; (c) involve a retrofit of (an) existing plant(s); or (d) involve a replacement of (an) existing plant(s).	The project activity is the installation of new wind energy converters (WEC's) at a site where no renewable power plant was operating prior to project activity. The project is a Greenfield project.
Hydro power plants with reservoirs that satisfy at least one of the following conditions are eligible to apply this methodology: • The project activity is implemented in an existing reservoir with no change in the volume of reservoir; • The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the Project Emissions section, is greater than 4 W/m2; • The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the Project Emissions section, is greater than 4 W/m2.	This condition is not relevant, as the project activity is not the installation of a hydro power plant.
In the case of biomass power plants, no other biomass types than renewable biomasses are to be used in the project plant.	This condition is not relevant, as the project activity is not the installation of a biomass power plant.
If the unit has both renewable and non-renewable components (e.g. a wind/diesel unit), the eligibility limit of 15MW for a small-scale CDM project activity applies only to the renewable component. If the unit added co-fires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15MW.	The project activity has only renewable energy component and the capacity is less than 15 MW (8 MW)
Combined heat and power (co-generation) systems are not eligible under this category.	The project activity is not a co-generation
In the case of project activities that involve the	This condition is not relevant, as the project activity does not involve capacity additions.

addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be physically distinct from the existing units.	
In the case of retrofit or replacement, to qualify as a small scale project, the total output of the retrofitted or replacement unit shall not exceed the limit of 15 MW.	This condition is not relevant, as the project activity does not involve retrofit measures or modifications.

The description provided in table above shows that the project activity satisfies the applicable conditions of the methodology, AMS ID. The project activity is a small scale activity as the capacity is 8 MW which is less than 15 MW ceiling capacity for the project to be considered under small scale activity as per the simplified modalities and procedures of the UNFCCC and the project capacity will remain same for the entire crediting period.

B.3. Project boundary, sources and greenhouse gases (GHGs)

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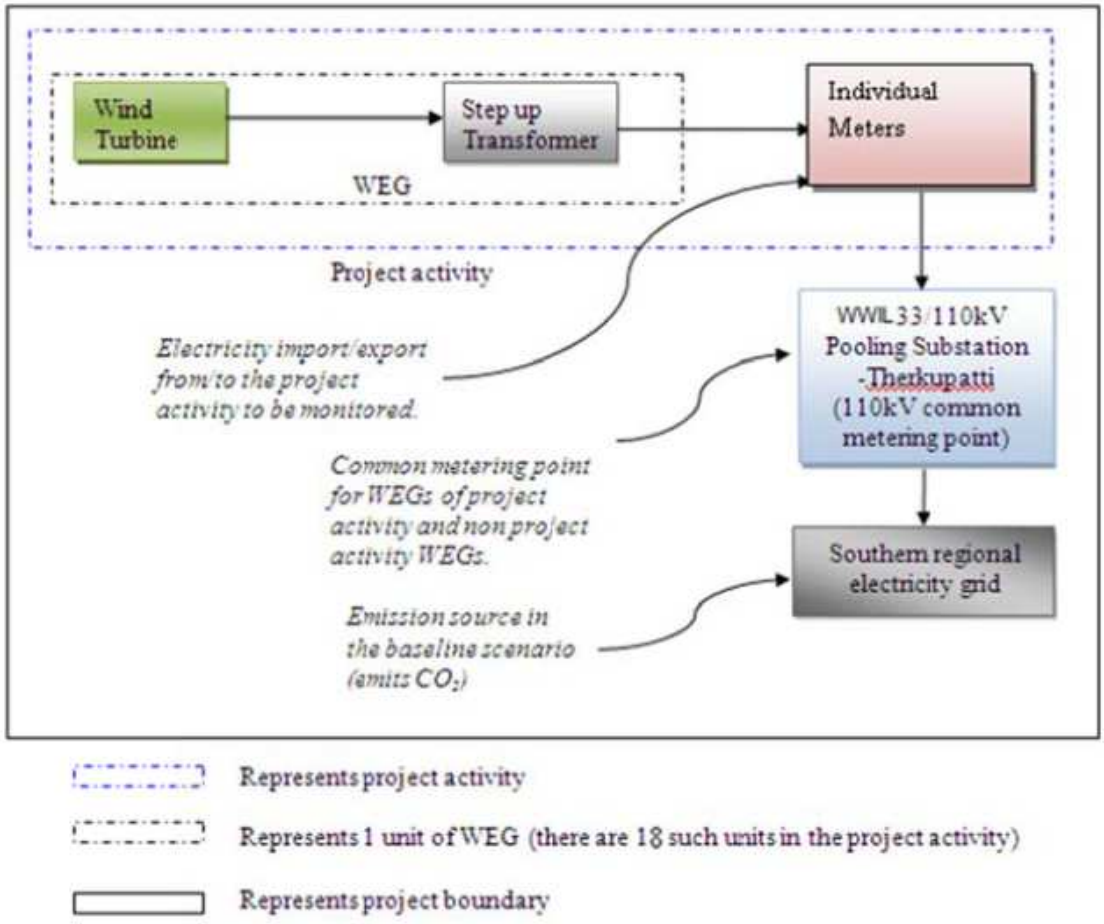
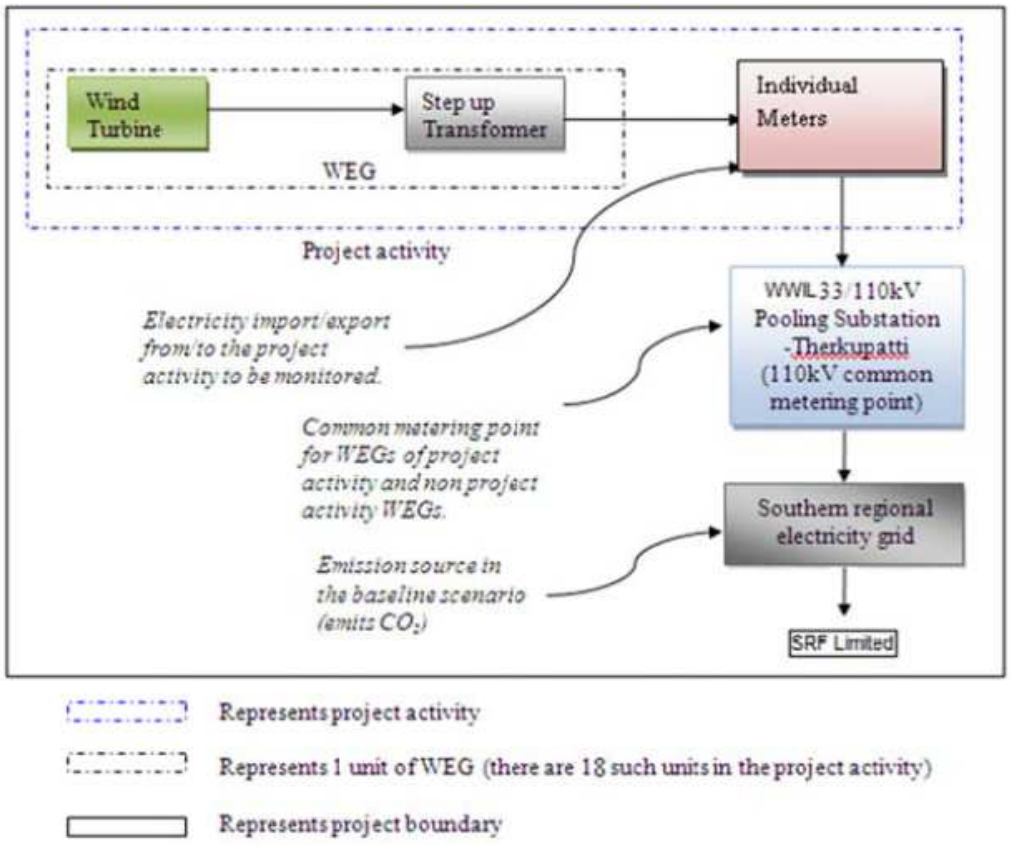
As per the applied methodology the project boundary is the physical, geographical site of the renewable generation source. The project boundary thus comprises of WEC's and connected transformers, metering equipments, substation and the connected electricity grid used to transmit the generated electricity. The connected grid is southern grid/ third party[9].

Flow diagram of the project boundary- Prior to Third Party Sale (15/06/2013):

[9] Prior to 15/06/2013, the electricity was being supplied to southern grid (now part of integrated Indian grid) and from 15/06/2013 onwards, electricity will be supplied to third party (SRF Limited) as per third party supply agreement.



Flow diagram of the project boundary- Post third party sale (15/06/2013):



	Source	GHG	Included?	Justification/Explanation
Baseline	CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity.	CO_2	Yes	In the baseline scenario, the electricity would have been sourced from the Southern grid which in turn would be connected to fossil fuel fired power plants which emit CO_2.
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
Project activity	For geothermal power plants, fugitive emissions of CH_4 and CO_2 from non-condensable gases contained in geothermal steam.	CO_2	No	The present project activity is a greenfield wind power project. Hence, not relevant
		CH_4	No	
		N_2O	No	
	CO_2 emissions from combustion of fossil fuels for electricity generation in solar thermal power plants and geothermal power plants	CO_2	No	The present project activity is a greenfield wind power project. Hence, not relevant
		CH_4	No	
		N_2O	No	
	For hydro power plants, emissions of CH_4 from the reservoir.	CO_2	No	The present project activity is a greenfield wind power project. Hence, not relevant
		CH_4	No	
		N_2O	No	

B.4. Establishment and description of baseline scenario

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In spite of significant growth in electricity generation over the years, the shortage of power continues to exist in India primarily on account of growth in demand for power, outstripping the growth in generation and generating capacity addition. Therefore in the absence of the project activity, equal amount of electricity would have been generated from the operation of existing fuel mix in the grids comprising mainly fossil fuel based power plants and future capacity expansion connected to the grids.

Establishing Baseline:

As per Appendix B of the simplified M&P for small-scale CDM project activities of the UNFCCC the project activity falls under category AMS I.D – "Grid connected renewable electricity generation."

Para 10, 11 and 12 of the AMS ID version 16 are relevant for baseline determination. Therefore baseline under section B.4 is determined using para 10, 11 and 12 of the approved methodology AMS ID version 16.

As per paragraph 10 of applied methodology-

If the project activity is the installation of a new grid-connected renewable power plant/unit, the baseline scenario is the electricity delivered to the grid by the project activity that otherwise would have been generated by the operation of grid-connected power plants and by the addition of new generation sources.

The project activity is a new grid connected power plant supplying electricity to state utility/ third party[10] (SRF Limited) through southern grid, hence as per the applied methodology the baseline scenario for the project activity is the electricity delivered to the grid by the WEC's that otherwise would have been generated by the operation of grid-connected power plants and by the addition of new generation sources.

As per paragraph 11 of applied methodology-

The baseline emissions are the product of electrical energy baseline $EG_{BL, y}$ expressed in MWh of electricity produced by the renewable generating unit multiplied by the grid emission factor.

$BE_y = EG_{BL, y} * EF_{CO2, grid, y}$

Where:

BE_y = Baseline emissions in year y tCO_2.

$EG_{BL, y}$ = Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year y (MWh)

EF_{CO2} = CO_2 emission factor in year y, tCO_2/MWh

The baseline emissions for the project activity are the electricity generated by the project activity multiplied by the emission factor of the concerned grid. The project activity is connected to TNEB grid which is the part of southern grid hence southern grid is considered as baseline grid and emission factor of southern grid is used for the calculation of baseline emissions.

As per para 12 of applied methodology-

The Emission Factor can be calculated in a transparent and conservative manner as follows:

(a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the 'Tool to calculate the Emission Factor for an electricity system'.

OR

(b) The weighted average emissions (in kg CO_2e/kWh) of the current generation mix. The data of the year in which project generation occurs must be used.

We have used option (a) combined margin consisting of operating margin (OM) and build margin (BM) according to the procedures prescribed in the "Tool to calculate the emission factor for an electricity system", version 02.1.0, as the applicable emission factor for determining baseline emissions.

[10] Please refer section 'A' above for detail of electricity supply.

The baseline emissions and emission reductions from the project activity are estimated based on the amount of electricity exported by the project activity to the southern grid multiplied by the emission factor of the southern grid calculated as the combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) factors.

Variable	Data Source
$EG_{BL, y}$ – Net electricity exported to the grid/third party.	Records maintained by project proponents
Parameter	**Data Source**
$EF_{OM, y}$ = Operating Margin Emission Factor (tCO_2/MWh)	CEA Database for CO_2 emission factor, version 5.0
$EF_{BM, y}$ = Build Margin Emission Factor (tCO_2/MWh)	CEA Database for CO_2 emission factor, version 5.0
$EF_{CO2, grid, y}$ – Grid Emission Factor	Calculated as the weighted average of the operating margin and build margin

B.5. Demonstration of additionality

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The project activity has been conceived as a CDM project since its inception. The project start date is 10 July 2010 and the PP has intimated UNFCCC on dated 19 Oct 2010 and DNA on dated 27 Oct 2010 about the project activity initiative within six months of the start date and received the acknowledgment both from UNFCCC & DNA. The acknowledgement from UNFCCC and Indian DNA has been provided to the DoE for verification.

The baseline scenario for the project activity is grid based electricity generation and in India there are no policies and circumstances which can prevent the implementation of baseline scenario.

Additionality:

The project activity reduces anthropogenic emissions of greenhouse gases that would have occurred in absence of the project activity. As per the decision 17/cp.7[12] Para 43, a CDM project activity is additional if anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in the absence of the registered CDM project activity.

Referring to attachment A to appendix B[13] document of "indicative simplified baseline and monitoring methodologies for selected small scale CDM project activity categories", project participants are required to provide an explanation to show that the project activity would not have occurred anyway due to at least one of the following barriers:

a) Investment barrier
b) Technological barrier
c) Barrier due to prevailing practice
d) Other barriers

The additionality has been discussed based on the Annex 34[14] (EB 35). Some of the key barriers are discussed below:

[12] http://unfccc.int/resource/docs/cop7/13a02.pdf#page=36
[13] http://cdm.unfccc.int/Projects/pac/ssclistmeth.pdf
[14] http://cdm.unfccc.int/EB/035/eb35_repan34.pdf

Investment Barrier

Investment barrier: *a financially more viable alternative to the project activity would have led to higher emissions;*
Best practice examples include but are not limited to, the application of investment comparison analysis using a relevant financial indicator, application of a benchmark analysis or a simple cost analysis (where CDM is the only revenue stream such as end-use energy efficiency). It is recommended to use national or global accounting practices and standards for such an analysis.

Simple cost analysis is not applicable as the project activity sells electricity to the Utility and obtains economic benefits in the form of electricity tariffs.

The alternative to the project activity is continuation of current situation i.e. no project activity, in that case equivalent amount of electricity would have been produced by the grid electricity system. This option will not require capital investment. Hence **investment comparison analysis** (option II) cannot be applied.

The Project Proponent proposes to use **Option III – Benchmark Analysis.** The guidance to investment analysis issued in EB 41 (paragraph 11) states that in cases where a benchmark approach is used the applied benchmark shall be appropriate to the type of IRR calculated. Weighted average costs of capital (WACC) are appropriate benchmarks for a project IRR. Required/expected returns on equity (Cost of Equity) are appropriate benchmarks for equity IRR.

The tool for demonstration and assessment of additionality [para-5, sub step 2(b)] states that in cases where the project has more than one potential developer, the benchmark shall be based on parameters that are standard in the market, considering the specific characteristics of the project type.

The project activity is financed through 100% equity (own funds) hence equity IRR is the appropriate benchmark for the project proponent.

The benchmark Cost of equity for the project is **16.40%**
The project participant used following parameters for investment analysis as per the information available at the time of project decision making. Due to third party sale agreement, tariff has been changed and accordingly the investment analysis has been revised as shown below:

Assumptions	Values	References
Capacity of Machines in KW	800	WWIL Offer Letter
Number of Machines	10	WWIL Offer Letter
Project Capacity in MW	8	WWIL Offer Letter
Expected Project Commissioning Date	30 September 2010	WWIL Offer Letter
Project Cost Per MW (in INR Million)	59.34	WWIL Offer Letter
Operations		
Plant Load Factor	24.70%	PLF assessed by a third party
Insurance Charges @ % of Capital Cost	0.12%	Normative
O&M Cost @ % of Capital Cost in Base Year	1.30%	WWIL Offer Letter
% of Escalation in O&M Charges in Each Year	6%	WWIL Offer Letter
Tariff		
Base Year Tariff (INR/kWH)	3.39	TNERC Tariff Order

Third party sale Tariff-Rs/KWh[15]	5.10	As per third party sale agreement 04 May 2013 (10 years), Fixed without escalation
Tariff post term of PPA (third party sale agreement 04 May 2013 (10 years)[16]	Cost+19.85% return on equity	
Total Project Cost (INR Million)	474.70	WWIL Offer Letter
Means of Finance (INR Million)		
Own Source (Equity)	100%	The project is 100% equity project
Debt	0%	
Depreciation rates		
Depreciation as per IT Act	80%	Depreciation as per IT Act
Additional depreciation	20%	Additional depreciation
Total depreciation on Wind Energy Converters	**100%**	
Book Depreciation Rate (Straight Line Method basis)		
On all assets	4.50%	
Book Depreciation up to (% of asset value)	90%	
Income Tax		
Income Tax Rate	30.90%	Income Tax Rates For The Financial Year 2010-11

The project activity is not registered under REC (Renewable Energy Certificates) scheme.[17]

Debt Equity Ratio: This is the first investment by PP and there are no existing debts in the company. The project is 100% equity financed; hence we have considered 100% equity in the financial calculations.

Plant Load Factor: As per EB 48, annex 11, Plant load factor validated by independent third party source can be used for investment analysis. Plant load factor for the project activity is taken from a third party assessment report. The plant load factor for the project site as determined by the third party is 24.70%.

Salvage Value: The project is depreciated up to 90% of the project cost (except for land that is non depreciable item); therefore we have considered land cost and 10% of the remaining value as salvage in the cash flow for computing equity IRR.

The post tax equity IRR for the Project without CDM revenues is 14.83% i.e. less than the benchmark.

Sensitivity Analysis:
The following sensitivity analysis has been conducted to check the robustness of the financial attractiveness of the project without CDM revenue by using Guidance on the Assessment of Investment Analysis, version-03, Annex-58, EB 51.

[15] Tariff applicable prior to third party sale agreement

[16] Tariff applicable post third party sale agreement

[17] https://www.recregistryindia.nic.in/index.php/general/publics/registered_regens

The project viability is affected by the following cost parameters more than 20% during its complete life time of 20 years:

- Cost of WECs
- Plant Load Factor
- O&M Charges
- Tariff

The details for each sensitive parameter and sensitivity analysis are provided as:

Capital Cost

The capital cost for the project activity is taken from the offer provided by the WEC supplier and hence capital cost is subjected to the variation of +/-10%. Therefore we have considered it appropriate to conduct sensitivity on capital cost.

Capital Cost [In Millions]	**(-10%) 427.23**	**(Base Value) 474.7**	**(+10%) 522.17**
Equity IRR	16.61%	14.83%	13.42%

The equity IRR crosses the benchmark at negative variation of around 9% in capital cost for the project activity. Further as per the purchase order placed by PP, the total project cost is INR 440.00 million which is 7.30% below than the project cost used at the time of decision making. Since purchase orders are already placed, the negative variation of 9.0 % is not realistic.

Plant Load Factor

Plant Load Factor is the key variable encompassing variation in wind profile, variation in off-take (including grid availability) including machine downtime. The PLF of 24.70% is based on the third party assessment report which is in line with Annex 11 of EB 48. However to check the robustness of the financial model, sensitivity on PLF is conducted at ±10%. The sensitivity beyond this range will not be reasonable assumption to make as the PLF is taken from third party assessment report.

Sensitivity is summarized in below table:

PLF	**(-10%) 22.23%**	**(Base Value) 24.70%**	**(+10%) 27.17%**
Equity IRR	13.51%	14.83%	16.16%

The equity IRR for project activity does not cross the benchmark even at +10% PLF variation. The equity IRR for project activity cross the benchmark at PLF (27.64%) variation of 11.90%, which is not realistic. Moreover PP has also analysed actual generation data of last 5 year (December 2012 to November 2017) achieved for project activity. The average observed annual PLF for project activity from 2012-2017 was 22.90% which is lower as compared to estimated third party PLF.

Operation and Maintenance cost

In the financial analysis of the project activity we have taken the O&M cost as per the offer letter provided by the WEC supplier. Since the O& M agreement is yet to be signed with O&M contractor the actual O&M cost is not available to PP. Hence being conservative, PP has done sensitivity on ±50% in O&M and 6% escalation in O&M yearly.

By varying the O&M cost by ±50% the equity IRR has following value:

O&M (% of capital cost)	**(-50% decrease in base value & at 6% escalation) 0.65%**	**(Base Value) 1.30%**	**(+50% increase in base value & at 6% escalation) 1.95%**
Equity IRR	15.51%	14.83%	14.15%

From the above sensitivity analysis it is clear that a decrease of 50% in O&M, the IRR for the project activity is 15.51% which is below than the benchmark.

Tariff

By varying the Tariff by 10% the equity IRR has following value:

Tariff (INR/kWh)	(-10%)	(Base Value)	(+10%)
Equity IRR	13.17%	14.83%	16.41%

Post registration of project activity, ownership of project has been changed from 'Vish Wind Infrastructure LLP.' to 'Vaayu Renewable Energy (Tapti) Private Limited' as per the purchase order dated 17/05/2013. During the change of ownership, PPA of project activity has also been changed. Post change of ownership electricity generated from project activity will be used for third party sale to SRF Limited @5.10 INR./Unit instead of sale to state utility. A third party sale agreement has been signed between new PP 'Vaayu Renewable Energy (Tapti) Private Limited' & 'SRF Limited' dated 04/05/2013.

PP has analyzed three possible scenarios to calculate applicable tariff after the completion of term (10 years) of third party sale agreement:-

1. Fixed tariff as determined by TNERC (20.3.2009) in its order prevailing at the time of project initiation i.e. 3.39 INR/kWh.

   This is the most likely scenario since TNERC fixed the tariff for 20 years and while going for renewal of PPA with state authority, the applicable tariff would be determined based on the date of commissioning of project activity. Since the project commissioning date falls under the regime of tariff order dated 20.3.2009, applicable tariff after completion of ten years would be 3.39 INR/kWh

2. Renewal of current PPA at tariff as mentioned in third party sale agreement i.e. @ 5.10 INR/kWh.

3. Further as per 'cost + return on equity (19.85%, pre-tax)' approach as mentioned in TNERC tariff order based on which commission calculates tariff and using assumptions that are valid to the project activity. As per this approach, average tariff post end of third party sale agreement comes out to be 8.35 INR/kWh.

PP has analysed all the three options and conservatively maximum IRR (14.83%) of project activity comes out at tariff of 8.35 INR/kWh. However tariff for project is fixed for 10 years term of PPA, though being conservative PP has done +/- 10% sensitivity analysis on tariff throughout the project life (20 Years). At 10% increase in tariff (i.e. at the tariff of 9.18 INR/kWh) post term of third party sale agreement, the equity IRR comes out as 16.41 % which barely cross benchmark of 16.40%. Hence it is not realistic scenario.

It is clear from the above analysis that project is not financially attractive even after varying the sensitive parameters in the optimistic directions realistically. The investment analysis clearly shows that the project is not a financially attractive option for the project proponent. Hence the project activity is additional.

B.6. Estimation of emission reductions

B.6.1. Explanation of methodological choices

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According to the approved methodology AMS I D (Version 16) Emission Reductions are calculated as:-

$ER_y = BE_y – PE_y – LE_y$ …… (1)

Where:

BE_y	Baseline Emissions in year *y* (t CO_2e/yr)
PE_y	Project Emissions in year *y* (t CO_2e/yr)

LE_y Leakage Emissions in year *y* (t CO_2e/yr)
ER_y Emission Reduction in year y (t CO_2e/yr)

Estimation of Baseline Emissions:

As per the paragraph 11 of applied methodology the baseline emissions are the product of electrical energy baseline $EG_{BL, y}$ expressed in kWh of electricity produced by the renewable generating unit multiplied by an emission factor.

$BE_y = EG_{BL, y} * EF_{CO2, grid, y}$ …… (2)

Where:

BE_y = Baseline emissions in year y tCO_2.

$EG_{BL, y}$ = Energy baseline in year y MWh.

$EF_{CO2, grid, y}$ = CO_2 emission factor in year y, tCO_2/MWh.

The project activity is located in the state of Tamil Nadu which falls under southern grid which is now part integrated Indian grid. Therefore as per the paragraph 12 of the applied methodology baseline emission factor is calculated as combined margin consisting of a combination of operating margin and build margin factors according to the procedures prescribed in the latest tool for calculating the emission factor for an electricity system, version 02.1.0. The steps of calculation are as follows:

STEP 1. Identifying the relevant electricity systems:

The Indian electricity system is divided into two regional grids, viz. (1) Northern, Eastern, Western, North-Eastern and (2) Southern grid. 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.

According to "Tool to calculate the emission factor for an electricity system" version 02.1.0, (1) If the project electricity system is located partially or totally in Annex-I countries, then the tool is not applicable (2) If a connected electricity system is located partially or totally in Annex-I countries, then the emission factor of that connected electricity system should be considered zero.

However both the applicability criteria are not applicable for the project activity since the project activity will supply the electricity to the southern grid of host country India, which is a not a part of Annex- I country hence the "Tool to calculate the emission factor for an electricity system" is applicable for the project activity. 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 activity. As the project activity is connected to the southern regional electricity grid, the southern grid is the "project electricity system".

STEP 2. Choose whether to include off-grid power plants in the project electricity system (optional):

Option I is opted for the project activity i.e. only grid power plants are included in the calculation.

STEP 3. Select a method to determine the operating margin (OM):

According to the tool, the calculation of the operating margin emission factor is based on one of the following methods:

(a) Simple OM, or
(b) Simple adjusted OM, or
(c) Dispatch data analysis OM, or
(d) Average OM.

Any of the four methods can be used for calculating OM, The simple adjusted OM and dispatch data analysis OM cannot be currently applied in India due to lack of necessary data however, the simple OM method (option a) can only be used if low cost/must-run resources constitute less than 50% of total grid generation in: 1) average of the five most recent years, or 2) based on long-term averages for hydroelectricity production.

The Share of Low Cost / Must-Run (% of Net Generation) in the generation profile of the different grids in India in the last five years is as follows:

	2004-05	**2005-06**	**2006-07**	**2007-08**	**2008-09**
NEWNE	16.84%	18.0%	18.5%	19.0%	17.3%
South	21.61%	27.0%	28.3%	27.1%	22.8%
India	18.01%	20.1%	20.9%	21.0%	18.6%

Source: CO2 Baseline Database for the Indian Power Sector – Central Electricity Authority

The above data clearly shows that the percentage of total grid generation by low cost/must run plants (on the basis of average of five most recent years) for the southern regional grid is less than 50 % of the total generation. Hence the Simple OM method can be used to calculate the Operating Margin Emission factor. The average operating margin method cannot be applied, as low cost/ must run resources in southern grid constitute less than 50% of total grid generation.

The project proponents choose an ex ante option for calculation of the OM with a 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation, without requirement to monitor and recalculate the emissions factor during the crediting period.

STEP 4. Calculate the operating margin emission factor according to the selected method:

The simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost / must-run power plants / units. It may be calculated:

- Based on the net electricity generation, and a CO_2 emission factor of each power unit. (Option A), or
- Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system (option B)

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 CO_2 Baseline Database provides information about the Combined Margin Emission Factors of all the regional electricity grids in India. The Combined Margin in the CEA database is calculated ex ante using the guidelines provided by the UNFCCC in the "Tool to calculate the emission factor for an electricity system". We have, therefore, used the Combined Margin data published in the CEA database, for calculating the Baseline Emission Factor.

The CEA database uses the option A i.e. data on net electricity generation and CO_2 emission factor for each power unit, the average efficiency of each power unit and the fuel type(s) used in each power unit, to calculate the OM of the different regional grids.

The simple OM emission factor is calculated based on the net electricity generation of each power unit and an emission factor for each power unit, as follows:

$$EF_{grid,OMsimple,y} = \Sigma (EG_{m,y} \times EF_{EL,m,y}) / \Sigma EG_{m,y}$$

Where:

$EF_{grid,OMsimple,y}$	Simple operating margin CO_2 emission factor in year y (tCO_2/MWh)
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
$EF_{EL,m,y}$	CO_2 emission factor of power unit m in year y (tCO2/MWh)
m	All power units serving the grid in year y except low-cost / must-run power units
y	The relevant year as per the data vintage chosen in step 3

The emission factor of each power unit m has been determined as follows:

$$EF_{EL,m,y} = (\Sigma FC_{i,m,y} \times NCV_{i,y} \times EF_{CO2,I,y}) / EG_{m,y}$$

Where:

$EF_{EL,m,y}$	CO_2 emission factor of power unit m in year y (tCO_2/MWh)
$FC_{i,m,y}$	Amount of fossil fuel type i consumed by power unit m in year y (Mass or volume unit)
$NCV_{i,y}$	Net calorific value (energy content) of fossil fuel type i in year y (GJ / mass or volume unit)
$EF_{CO2,I,y}$	CO_2 emission factor of fossil fuel type i in year y (tCO_2/GJ)
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
m	All power units serving the grid in year y except low-cost / must-run power units
i	All fossil fuel types combusted in power unit m in year y
y	The relevant year as per the data vintage chosen in step 3

STEP 5. Identify the group of power units to be included in the build margin:

The sample group of power units m used to calculate the build margin consists of either:

(a) The set of five power units that have been built most recently, or
(b) The set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

Project participants should use the set of power units that comprises the larger annual generation.
Accordingly, the CEA database calculates the build margin as the average emissions intensity of the 20% most recent capacity additions in the grid based on net generation.

The build margin emission factor has been calculated ex-ante based on the most recent information available on units already built for sample group m at the time of CDM-PDD submission to the DOE for validation. This option does not require monitoring the emission factor during the crediting period.

STEP 6. Calculate the build margin emission factor:

The build margin emissions factor is the generation-weighted average emission factor of all power units m during the most recent year y for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = (\Sigma EG_{m,y} \times EF_{EL,m,}) / \Sigma EG_{m,y}$$

Where:

$EF_{grid,BM,y}$	Build margin CO_2 emission factor in year y (tCO_2/MWh)
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)

$EF_{EL,m,y}$	CO_2 emission factor of power unit m in year y (tCO_2/MWh)
m	Power units included in the build margin
y	Most recent historical year for which power generation data is available

The CO_2 emission factor of each power unit m ($EF_{EL,m,y}$) is determined as per the procedures given in step 4 (a) for the simple OM, using option A1 for *y* most recent historical year for which power generation data is available, and using for *m* the power units included in the build margin.

STEP 7. Calculate the combined margin emissions factor:

The emission factor *EFy* 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 *EFy* is given by:

$$EFy = w_{OM} * EF_{grid,OM,y} + w_{BM} * EF_{grid,BM,y}$$

Where:

$EF_{grid,BM,y}$	Build margin CO_2 emission factor in year y (tCO_2/MWh)
$EF_{grid,OM,y}$	Operating margin CO_2 emission factor in year y (tCO_2/MWh)
w_{OM}	Weighting of operating margin emissions factor (%)
w_{BM}	Weighting of build margin emissions factor (%)

(where $w_{OM} + w_{BM} = 1$).

According to "**Tool to calculate the emission factor for an electricity system",** the weights for OM and BM are 0.75 and 0.25 respectively.

Using the values for operating and build margin emission factor provided in the CEA database and their respective weights for calculation of combined margin emission factor, the baseline carbon emission factor (CM) is 0.94515 tCO_2e/MWh.

Project Emissions:
As per AMS I.D. version 16.0 (Eb-54), for most renewable energy project activities, PEy = 0. However, for the following categories of project activities, project emissions have to be considered following the procedure described in the most recent version of ACM0002.

- Emissions related to the operation of geothermal power plants (e.g. non-condensable gases, electricity/fossil fuel consumption)
- Emissions from water reservoirs of hydro power plants

Since project activity is wind power project hence as per the applied methodology the emissions from the project activity are taken as nil.

PE_y = 0..... (3)

Leakage:
Since no equipment is transferred from another project activity or that any existing equipment is transferred to another activity, leakage as per AMS ID is taken as zero.

LE_y = 0..... (4)

Details of Baseline data:

Data of Operating and Build Margin for the three financial years from 2006-07 to 2008-09 has been obtained from -

The CO_2 Baseline Database for the Indian Power Sector
Ministry of Power: Central Electricity Authority (CEA), Version 5
Key baseline information is reproduced in Appendix 4.
The detailed excel sheet is available at:
http://www.cea.nic.in/tpeandce.html

B.6.2. Data and parameters fixed ex ante

Data/Parameter	$EF_{OM,y}$
Data unit	tCO_2e/MWh
Description	Operating Margin Emission Factor of Southern Regional Electricity Grid
Source of data	"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(s) applied	0.98756
Choice of data or measurement methods and procedures	Calculated by using 3 years vintage (2006-2007, 2007-2008 and 2008-09) data obtained from "CO_2 Baseline Database for Indian Power Sector" version 5.0, published by the Central Electricity Authority, Ministry of Power, Government of India, which is based on the tool "Tool to calculate the emission factors for an electricity system".
Purpose of data	Baseline emission calculations
Additional comment	Value is fixed ex-ante for entire crediting period.

Data/Parameter	$EF_{BM,y}$
Data unit	tCO_2e/MWh
Description	Build Margin Emission Factor of Southern Regional Electricity Grid
Source of data	"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(s) applied	0.81792
Choice of data or measurement methods and procedures	2008-09 data obtained from "CO_2 Baseline Database for Indian Power Sector" version 5.0, published by the Central Electricity Authority, Ministry of Power, Government of India, which is based on the tool "Tool to calculate the emission factors for an electricity system".
Purpose of data	Baseline emission calculations
Additional comment	Value is fixed ex-ante for entire crediting period.

Data/Parameter	$EF_{CO2,grid,y}$
Data unit	tCO_2e/MWh
Description	Combined Margin Emission Factor of Southern Regional Electricity Grid

Source of data	Combined Margin Emission Factor ($EF_{CM,y}$) is calculated as the weighted average of Operating Margin Emission Factor ($EF_{OM,y}$) and Build Margin Emission Factor ($EF_{BM,y}$). The "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(s) applied	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. Combined Margin Emission Factor (EFy or $EF_{CM,y}$) : 0.94515 Refer Appendix – 4 for comprehensive calculation of Combined Margin Emission Factor.
Choice of data or measurement methods and procedures	Combined Margin Emission Factor has been calculated by the Central Electricity Authority in accordance with CDM methodologies: ACM0002, and Tool to Calculate the emission Factor for an Electricity System.
Purpose of data	Baseline emission calculations
Additional comment	Value is fixed ex-ante for entire crediting period.

B.6.3. Ex ante calculation of emission reductions

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The baseline emissions are calculated as:

$BE_y = EG_{BL,y} * EF_{CO2,grid,y}$

The annual electricity supplied to grid/third party by the project activity is calculated as:

= Installed capacity * operating hours * PLF

$EG_{BL,y}$ = 8 * 8760 * 24.70% = 17309.76 MWh

Baseline emission factor (combined margin) = 0.94515 tCO_2e/MWh

Hence baseline emissions are:

BE_y = 17309.76 MWh * 0.94515 tCO_2e/MWh = 16360 tCO_2e

Project emissions and leakage emissions for the project activity are zero.

Hence emission reductions are calculated as:

$ER_y = BE_y – PE_y – LE_y$
= 16,360 - 0 - 0
= 16,360 tCO_2e/year

The emission reductions from the project activity are estimated to be **16,360 tCO_2e/year**.

B.6.4. Summary of ex ante estimates of emission reductions

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
Year 1[18]	16,360	0	0	16,360
Year 2	16,360	0	0	16,360
Year 3	16,360	0	0	16,360
Year 4	16,360	0	0	16,360
Year 5	16,360	0	0	16,360
Year 6	16,360	0	0	16,360
Year 7	16,360	0	0	16,360
Year 8	16,360	0	0	16,360
Year 9	16,360	0	0	16,360
Year 10	16,360	0	0	16,360
Total	163,600	0	0	163,600
Total number of crediting years	10 Years			
Annual average over the crediting period	16,360	0	0	16,360

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data/Parameter	**$EG_{BL, y}$**
Data unit	MWh (Mega-watt hour)
Description	Net Electricity Exported to the grid/third party[19] by the project activity.
Source of data	Monthly statement showing the electricity generated through windmills issued by Tamil Nadu Electricity Board (TNEB)/ Tirunelveli Electricity Distribution Circle, Tirunelveli (or TANGEDCO).
Value(s) applied	Annual net electricity exported to the grid/third party by the Project Activity = 8.0 MW (Capacity) x 24.70% (PLF) x 8760 (hours) MWh = 17309.76 MWh
Measurement methods and procedures	Net electricity exported by the wind mills will be calculated by the TNEB and neither the Project Participant nor the Project Participant representatives have any role in the same. Value of $EG_{BL,y}$ is shown in monthly statement provided by TNEB. Net electricity exported ($EG_{BL, y}$) to the grid/third party value is used in calculation of emission reduction of the project activity.
Monitoring frequency	Monthly basis

[18] Year 1 begins from the date of registration and each year extends for 12 months.

[19] Prior to 15 June 2013 electricity was supplied to state grid and from 15 June 2013 electricity will be supplied to third party (SRF Limited) as per the third party supply agreement & TANGEDCO monthly statements though there is no change in monitoring parameters or monitoring plan. Further QA/QC procedure is updated in case of third party sale due to change in project design.

QA/QC procedures	The recording frequency will be on monthly basis. The monitoring of the data parameters will be on continuous basis. *Cross checking of net electricity export prior to third party sale of electricity (prior to 15 June 2013):-* Value of $EG_{BL,y}$ as indicated in monthly statement provided by TNEB/TANGEDCO can be crosschecked with the invoices raised by PP to TNEB/TANGEDCO and or sales receipts either in the form of a cheque or the bank statement indicating the payment made by the TNEB. *Cross checking of net electricity export post third party sale of electricity (from 15 June 2013):-* The electricity generated by the project activity is supplied to the industrial unit of the third party (SRF Limited), where electricity from other sources is also consumed. Hence, the electricity bill raised by state utility to the third party does not have the figure of net electricity export specifically for the project activity. Bill reflects the cumulative consumption figure by the industrial unit (including the value of the project activity along with other sources of electricity), based on which the invoice is raised (which also shows a cumulative figure). Hence, cross-checking of net electricity export specifically for the project activity through the invoice is not feasible. Further, net electricity export can only be cross verified with the readings of LCS meters, which are fitted at the controller panel of each WEC and measure the electricity generation of each WEC, minus electricity import from the grid & transmission losses. The aggregate of electricity recorded at LCS meters is always higher than the net electricity export recorded at HTSC meters owing to transmission and transformation loss. Hence, in order to ensure conservativeness, the net export value as mentioned in the monthly statement provided by electricity board (document issued/validated by State Government Authority) would be used for emission reduction calculation.
Purpose of data	Baseline emission calculations
Additional comment	The data will be archived both in electronic and hard paper format for crediting period + 2 years.

Data/Parameter	**$EG_{Export,y}$**
Data unit	MWh (Mega-Watt hour)
Description	Electricity exported by project activity to grid/third party recorded at 33kV metering point (Cluster meter)
Source of data	Monthly statement showing the electricity generated through windmills given by Tamilnadu Electricity Board (TNEB)/ Tirnunelveli Electricity Distribution Circle, Tirunelveli, (or TANGEDCO).
Value(s) applied	Annual electricity export to the grid/third party by the Project Activity = 17309.76 MWh

Measurement methods and procedures	There is a bi-directional tri-vector energy meter (also called as Cluster Meter) of accuracy class 0.2s adjacent to the individual wind turbine. At one location, 2 wind turbines of the same investor are connected to a single meter too. Thus there are 9 meters connected to the 10 WEC of the project activity. Apart from the individual cluster meter, there is a main and check meter of accuracy class 0.2s located at the WWIL pooling station. The main and check meter connected at this pooling station has both, the project activity as well as the non-project activity wind turbines connected to it. The electricity export as well as the electricity imported by the project activity wind mills are recorded at the cluster meter as well as at the main and check meter of the WWIL pooling station on a monthly basis, in the presence of representatives of TNEB and the Project Participant. Based on this monthly recording, the TNEB representatives apportion the transmission line losses amongst the various wind turbines (project activity as well as non-project activity) to deduce the net electricity supplied by the individual wind turbines to the grid. The net electricity supplied to the grid/third party, so deduced, is indicated in the 'Monthly Statement of Energy' issued by TNEB. The procedure for such apportioning is conducted and controlled by the TNEB and neither the Project Participant nor the Project Participant representatives have any role in the same. The metering equipment is duly approved, calibrated and sealed by TNEB and is in complete control of TNEB only. Based on the 'Monthly Statement of Energy' issued by state utility/third party, the Project Participant prepares the invoice and submits it to the TNEB for payment. The payment is made by the state utility/ third party to the Project Participant either in the form of a cheque or online transfer (RTGS transfer). Refer section B.7.3 for an illustration of the provisions for measurement methods.
Monitoring frequency	Monthly

QA/QC procedures	In accordance with section 4, clause (i) of the Power Purchase agreement (PPA) signed with state utility (TNEB), "*The metering arrangements with facilities to record export and import of energy shall be provided in accordance with the Central Electricity Authority (Installation and Operation of meters) Regulations 2006. The periodicity of testing, checking, calibration ect will be governed by the regulations issued by Central Electricity Authority (CEA) in this regard*". The national guidelines issued by the Central Electricity Authority, Ministry of Power, Government of India Notification No. 502/70/CEA/DP&D dated 17/03/2006 which is considered as national standard, mentions that "All interface meters shall be tested at least once in five years." Hence, all the meters (project activity cluster meters as well as main & check meter at WWIL pooling sub-station) are calibrated by state utility once in 5 years[20] and records are available with PP.
Purpose of data	Baseline emission calculations
Additional comment	The data will be archived both in electronic and hard paper format for crediting period + 2 years.

Data/Parameter	**$EG_{Import,y}$**
Data unit	MWh (Mega-Watt hour)
Description	Electricity imported by project activity from the grid recorded at 33kV metering point (Cluster meter)
Source of data	Monthly statement showing the electricity generated through windmills as given by Tamilnadu Electricity Board (TNEB)/ Tirnunelveli Electricity Distribution Circle, Tirunelveli).
Value(s) applied	Annual electricity import from the grid by the Project Activity =0 MWh (assumed)

[20] http://www.cea.nic.in/reports/regulation/meter_reg.pdf, Page 12, English version

Measurement methods and procedures	There is a bi-directional tri-vector energy meter (also called as Cluster Meter) of accuracy class 0.2s adjacent to the individual wind turbine. At one location, 2 wind turbines of the same investor are connected to a single meter too. Thus there are 9 meters connected to the 10 WEC of the project activity. Apart from the individual cluster meter, there is a main and check meter of accuracy class 0.2s located at the WWIL pooling station. The main and check meter connected at this pooling station has both, the project activity as well as the non-project activity wind turbines connected to it. The electricity export as well as the electricity imported by the project activity wind mills are recorded at the cluster meter as well as at the main and check meter of the WWIL pooling station on a monthly basis, in the presence of representatives of TNEB and the Project Participant. Based on this monthly recording, the TNEB representatives apportion the transmission line losses amongst the various wind turbines (project activity as well as non-project activity) to deduce the net electricity supplied by the individual wind turbines to the grid. The net electricity supplied to the grid/third party, so deduced, is indicated in the 'Monthly Statement of Energy' issued by TNEB. The procedure for such apportioning is conducted and controlled by the TNEB and neither the Project Participant nor the Project Participant representatives have any role in the same. The metering equipment is duly approved, calibrated and sealed by TNEB and is in complete control of TNEB only. Based on the 'Monthly Statement of Energy' issued by state utlity/ third party, the Project Participant prepares the invoice and submits it to the TNEB for payment. The payment is made by the state utility/ third party to the Project Participant either in the form of a cheque or online transfer (RTGS transfer). Refer section B.7.3 for an illustration of the provisions for measurement methods.
Monitoring frequency	Monthly

QA/QC procedures	In accordance with section 4, clause (i) of the Power Purchase agreement (PPA) signed with state utility (TNEB), "*The metering arrangements with facilities to record export and import of energy shall be provided in accordance with the Central Electricity Authority (Installation and Operation of meters) Regulations 2006. The periodicity of testing, checking, calibration ect will be governed by the regulations issued by Central Electricity Authority (CEA) in this regard*". The national guidelines issued by the Central Electricity Authority, Ministry of Power, Government of India Notification No. 502/70/CEA/DP&D dated 17/03/2006 which is considered as national standard, mentions that "All interface meters shall be tested at least once in five years." Hence, all the meters (project activity cluster meters as well as main & check meter at WWIL pooling sub-station) are calibrated by state utility once in 5 years[21] and records are available with PP.
Purpose of data	Baseline emission calculations
Additional comment	The data will be archived both in electronic and hard paper format for crediting period + 2 years.

Data/Parameter	$\sum EC_{Controller,project}$
Data unit	MWh (Mega-watt hour)
Description	Net generation by 10 WECs of project activity, as measured at the WECs controller meter (LCS)
Source of data	Monthly controller generation report (LCS) sourced from E-Care portal.
Value(s) applied	-
Measurement methods and procedures	The value is monitored continuously and recorded daily by the online monitoring station at the site. In addition to the daily generation report, monthly generation reports are also available at monitoring station. This value will be used to calculate net electricity export to the grid for the period during which date of crediting period is not in line with the billing cycle date. This value will be used for cross checking of net electricity export post third party sale of electricity. Refer section B.7.3 for an illustration of the provisions for measurement methods.
Monitoring frequency	Monthly
QA/QC procedures	All the LCS meters are auto calibrated. In case of any fault WEC stops automatically and meter is replaced immediately.
Purpose of data	Baseline emission calculations
Additional comment	The data will be archived in electronic form for crediting period + 2 years.

B.7.2. Sampling plan

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Not Applicable

[21] http://www.cea.nic.in/reports/regulation/meter_reg.pdf , Page 12, English version

B.7.3. Other elements of monitoring plan

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The Project is operated and managed by Wind World (India) Limited. They follow the documentation practices to ensure the reliability and availability of the data for all the activities as required from the identification of the site, wind resource assessment, logistics, finance, construction, commissioning and operation of the wind power project.

This approved monitoring methodology requires monitoring of the following:

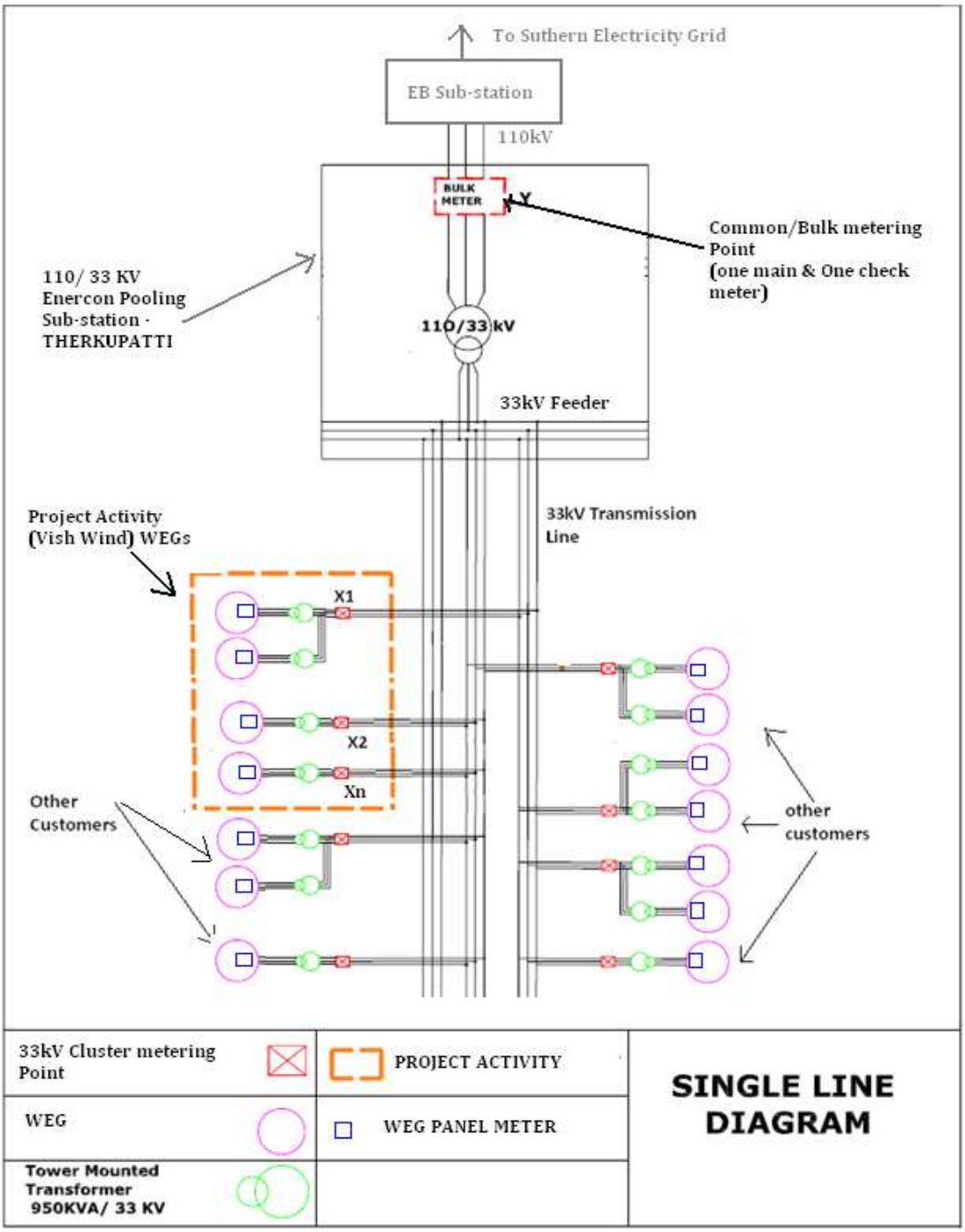
- Electricity generation from the project activity; and
- Operating margin emission factor and build margin emission factor of the grid

Since ex-ante approach has been followed for the project activity, monitoring of the emission factor value is not required. Value of operating margin, build margin & combine margin has been fixed throughout the crediting period. Further, wind based electricity generation is not associated with any kind of leakages. Hence, the sole parameter for monitoring is the electricity generated by the project and supplied to the grid/third party.

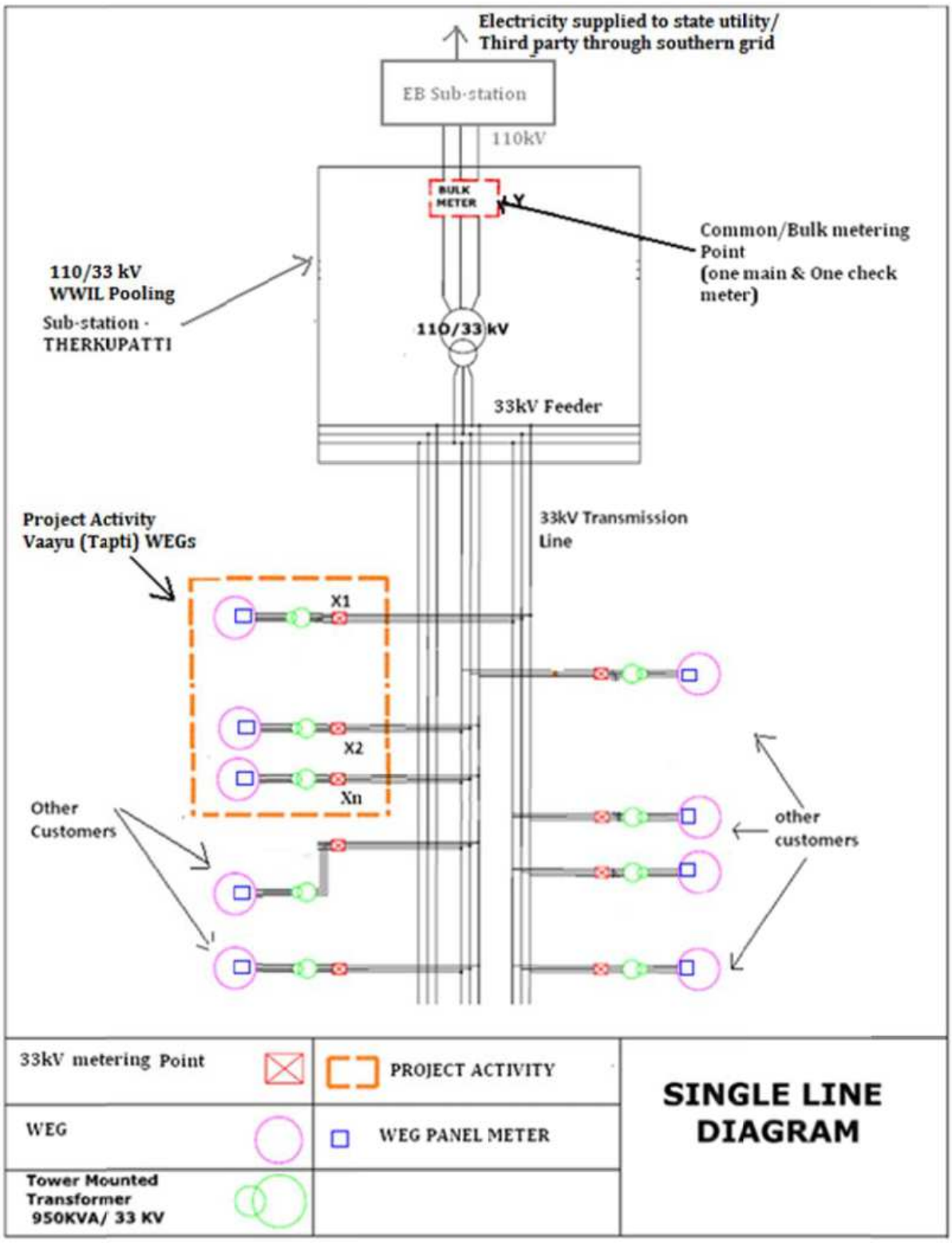
The Project is operated by Wind World (India) Limited and managed by the PP. The operational and maintenance contract for the project is with Wind World (India) Limited. Wind World (India) Limted is an ISO 9001:2000 certified Quality Management system from Germanischer Lloyd. Wind World (India) Limited follows the documentation practices to ensure the reliability and availability of the data for all the activities as required from the identification of the site, wind resource assessment, logistics, finance, construction, commissioning and operation of the wind power project.

Description of metering arrangement for project activity:-

Single Line diagram of Metering arrangement for project activity is shown in below picture:-



Single Line diagram (Prior to Third Party Sale i.e.15/06/2013)



Single Line diagram (Post third party dale i.e. 15/06/2013)

From the above line diagram it is clear metering system for the project activity consists of clusters of individual metering points at 33kV at project site. Each 33kV metering points will have one main and check meter of 0.2s of accuracy class which is exclusively be connected to WECs of the project activity i.e. there will be no WECs of other project owners that are connected to these metering point. There are total 9 individual metering points at 33kV for project activity.

In addition the 33kV metering points there is one set of main & check meter of 0.2s accuracy class at 110kV WWIL Pooling sub-station (common/Bulk metering point) where all the WECs of project activity and non-project activity are connected.

Monitoring information

Monthly statement showing the electricity generated through windmills given by Tamilnadu Electricity Board (TNEB)/ Tirnunelveli Electricity Distribution Circle, Tirunelveli) contains the following data:-

1. Electricity Export (EG_{export})
2. Electricity Import (EG_{import})
3. Line Loss between 33 kV and 110 kV metering points
4. Net Export /Generation to the Grid/third party by the project WECs

There is a bi-directional tri-vector energy meter (also called as TNEB Meter) of accuracy class 0.2s adjacent to the individual wind turbine. Apart from the individual TNEB meter, there is a main and check meter of accuracy class 0.2s located at the WWIL pooling station. The main and check meter connected at this pooling station has both, the project activity as well as the non-project activity wind turbines connected to it. The electricity export as well as the electricity import by the project activity wind mills are recorded at the TNEB meter as well as at the main and check meter of the WWIL pooling station on a monthly basis, in the presence of representatives of TNEB and the Project Participant. Based on this monthly recording, the TNEB representatives apportion the transmission line losses amongst the various wind turbines (project activity as well as non-project activity) to deduce the net electricity supplied by the individual wind turbines to the grid/ third party. The net electricity supplied to the grid/ third party, so deduced, is indicated in the 'Monthly Statement of Energy' issued by TNEB. The procedure for such apportioning is conducted and controlled by the TNEB and neither the Project Participant nor the Project Participant representatives have any role in the same. Since the substation is under the supervision of WWIL, so during the joint meter reading people of WWIL are also present. The Joint meter reading is taken by the officials of TNEB and based of this JMR, TNEB representatives apportion the transmission line losses amongst the various wind turbines (project activity as well as non-project activity) to deduce the net electricity supplied by the individual wind turbines to the grid. Based on the 'Monthly Statement of Energy' issued by TNEB, the Project Participant prepares the invoice and submits it to the state utility/ third party for payment.

The recording and monitoring of the readings of both the meters i.e. TNEB Meters & Main & Check meters at WWIL Pooling substation is done on monthly basis.

PP will forgo the generation in the calculation of emission reduction for that particular month if the start date of the crediting period does not match with the start date of the energy generation as per the monthly statement and will start the monitoring period from the next monthly statement.

Net electricity exported by the wind mills will be calculated by Electricity Board independently. Either Wind World (India) Limited or PP doesn't have any role or control on calculation of net electricity generation/export.

Calibration Frequency:

As per the registered monitoring plan calibration frequency of the meters is annual. In accordance with section 4, clause (i) of the Power Purchase agreement (PPA) signed with state utility (TNEB), "*The metering arrangements with facilities to record export and import of energy shall be provided in accordance with the Central Electricity Authority (Installation and Operation of meters) Regulations 2006. The periodicity of testing, checking, calibration ect will be governed by the regulations issued by Central Electricity Authority (CEA) in this regard*".

Hence, in accordance with the guidelines issued by Central Electricity Authority (CEA), Ministry of Power, Government of India Notification[22] No. 502/70/CEA/DP&D dated 17/03/2006/19/ which is considered as per prevailing national standard "All interface meters shall be tested at least once in five years."

[22] http://www.cea.nic.in/reports/regulation/meter_reg.pdf , Page 12, English version

Procedure of apportioning:-

In case the date of registration or start date of the crediting period of the project activity does not match with the date of joint meter report or billing cycle, the net electricity exported to the grid for that month will be done based upon the meter reading of the controller meter (also known as Local Control System (LCS) meter) located in the WEC tower and will be calculated as follows:-

Net electricity export to the grid by a WEC @ SEB meter for n no. of days =

$$\frac{\text{Daily controller generation of that WEC for n no. of days} * \text{Total Net export of that WEC @ SEB meter for a month}}{\text{Monthly controller generation of that WEC for that month}}$$

Procedure for data uncertainty:-

1) In case the main meter at 110kV is not in service due to maintenance, repair, testing, defective display, the same will be either replaced/repaired or calibrated immediately. During this interim period the generation from the Check Meter shall be used during that period.

2) In case the check meter at 110kV is not in service due to maintenance, repair, testing, defective display, the same will be either replaced/repaired or calibrated immediately. However, in that case the recording of the electricity generation will not be affected as it will be taken from the main meter.

3) During the calibration if the main meter at 110kV is found to be outside the permissible limits of the error and if the main meter readings have been used in JMR, the CERs would be calculated by conservative approach by applying an error factor (–ve) on the export value and (+ve) on the import & line loss values as recorded in the monthly statements as identified during the calibration. The error shall be applied for all the measured values taken during the period between the scheduled date of calibration and actual date of calibration. The main meter would be calibrated or replaced immediately with new calibrated meter.

4) During the calibration if the check meter at 110kV is found to be outside the permissible limits of the error and if the check meter readings have been used in JMR, the CERs would be calculated by conservative approach by applying an error factor (–ve) on the export value and (+ve) on the import & line loss values as recorded in the monthly statements as identified during the calibration. The error shall be applied for all the measured values taken during the period between the scheduled date of calibration and actual date of calibration. The check meter would be calibrated or replaced immediately with new calibrated meter.

5) During the calibration if both main meter and check meters at 110kV is found to be outside the permissible limits of the error, the CERs would be calculated by conservative approach by applying an error factor (–ve) on the export value and (+ve) on the import & line loss values as recorded in the monthly statements as identified during the calibration. The error shall be applied for all the measured values taken during the period between the scheduled date of calibration and actual date of calibration. The main meter and check meter would be calibrated or replaced immediately with new calibrated meter.

6) During the calibration if the cluster meter at 33kV is found to be outside the permissible limits of the error, the CERs would be calculated by conservative approach by applying an error factor (–ve) on the export value and (+ve) on the import & line loss values as recorded in the monthly statements as identified during the calibration. The error shall be applied for all the measured values taken during the period between the scheduled date of calibration and actual date of calibration. The cluster meter would be calibrated or replaced immediately with new calibrated meter.

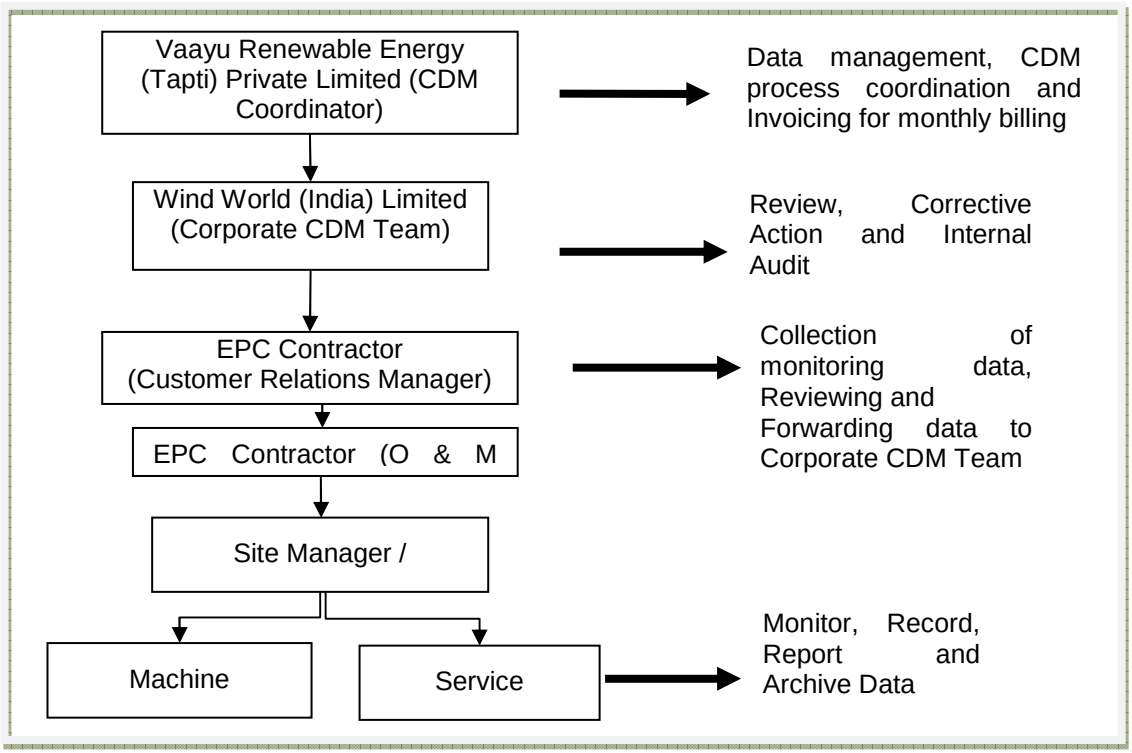
7) In case the cluster meter at 33kV is not in service due to maintenance, repair, testing, defective display or operate outside the permissible limit of error, the same will be either replaced/repaired or calibrated immediately and then the net electricity export will be calculated by state utility pursuant to provision of PPA.

Training and maintenance requirements:

Training on the machine is an essential pre-requisite, to ensure necessary safety of man and machine. Further, in order to maximize the output from the Wind Energy Converters (WECs), it is extremely essential, that the engineers and technicians understand the machines and keep them in good health. In order to ensure, that WWIL service staff is deft at handling technical snags on top of the turbine, the necessity of ensuring that they are capable of climbing the tower with absolute ease and comfort has been established. The WWIL Training Academy provides need-based training to meet the training requirements of WWIL projects.

Monitoring roles and responsibilities

The operational and management structure implemented for data monitoring is as follows:



PP will be monitoring the data sent by the O&M contractor and the data for electricity generated by the project activity will be kept as records for the period of 10+2 years i.e. 2 years beyond the term of crediting period. Wind World (India) Limited is O&M contractor and will be responsible for data recording.

The project proponent is Vaayu Renewable Energy (Tapti) Private Limited will be keeping and monitoring the data for electricity generation and calibration reports post project implementation. Wind World (India) Limited will be the O&M contractor who will be having the responsibility of activities such as maintaining electricity generation records, calibration records and maintenance of the WECs (Wind Energy Converters).

SECTION C. Start date, crediting period type and duration

C.1. Start date of project activity

>>
10/07/2010, being the earliest date of placement of purchase order for the WEC's.

C.2. Expected operational lifetime of project activity

>>
20 years 0 months

C.3. Crediting period of project activity

C.3.1. Type of crediting period

>>
The project proponent has selected the fixed crediting period for the project activity.

C.3.2. Start date of crediting period

>>
01/07/2011 or date of registration of project with UNFCCC whichever is later.

C.3.3. Duration of crediting period

>>
10 Years 0 Months

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>>

As per the Schedule 1 of Ministry of Environment and Forests (Government of India) notification dated January 27, 1994 and EIA Notification (S.O 1533) dated 14th September 2006, a list of activities that require undertaking environmental impact assessment studies [23] has been provided. EIA is not a regulatory requirement in India for wind energy projects and PP does not expect any adverse impacts of the proposed CDM project activity on the environment.

D.2. Environmental impact assessment

>>

The project activity does not fall under the purview of the Environmental Impact Assessment (EIA) notification of the Ministry of Environment and Forest, Government of India. Hence, EIA is not required by the host party.

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

>>

The comments from local stakeholders were invited through a local stakeholder meeting conducted at Tirunelveli District in Tamilnadu on 29 October 2010. A local newspaper advertisement was placed on 14 October 2010 inviting the local stakeholders for the meeting. The personal invitations were also sent to the local villagers.

The meeting was presided over by Mr. Arumugam (Retd. DRO, Tirunelveli), Mr. V. Karuppusamy (Vice Chairman, Manur Panchayath Union), Mr. Chelliah (Ex-President, Manur Village Panchayath), Mr. S. Sundararajan (Foreman, TNEB sub station) and Mr. Rohit Joshi (CDM Team, WWIL, Mumbai).

E.2. Summary of comments received

>>

Overall a positive response was received from the stakeholders. The details of comments/questions were raised during the meeting and the responses provided by the project proponent have been tabulated below:

Name of Villager/ Stakeholder who raised the Query	Query	Reply

[23] http://envfor.nic.in/legis/eia/so1533.pdf

Mr. Siddique (Village- Kurchikulam)	What are the employment opportunities given to the public in this area in wind mill projects?	The public of this region are given employment in civil works like road construction, foundation and building construction. They are also given opportunity to work as security guards.
Mr. M.Selvam (Village –Vagaikulam)	Will installation of Wind machines affect the groundwater level or water level in lakes/ wells nearby to the project?	The foundation level of the wind mills are in depth upto the maximum of 2 meters only and it will not disturb the level of water in the earth while the depth for installation of earth pit will be maximum of 20 feet only and it also doesn't disturb the water level.
Mr. Ganesan (Village- Ataikulam)	What will be the direct and indirect benefits to them from the proposed project activity?	The project would generate local job opportunities, which would help in the overall socio-economic development of the region. Additionally, a number of Corporate Social Responsibility initiatives would be undertaken, which would be identified based on the specific needs of the local populace.

E.3. Consideration of comments received

>>
As described above under E.2, there were no negative comments received.

SECTION F. Approval and authorization

>>
The Designated National Authority of India; National CDM Authority, Ministry of Environment, Forest and Climate Change, Government of India, has granted a letter of approval to the project participant in the said CDM project activity. The issuing date of letter of approval is 06/01/2014 via ministry's letter no. 4/17/2010-CCC.

Appendix 1. Contact information of project participants

Organization name	Vaayu Renewable Energy (Tapti) Private Limited.
Country	India
Address	A-9, Veera Industrial Estate, Veera Desai Road, Andheri (West), WWIL Tower, Mumbai, Maharashtra - 400049
Telephone	+91-22-67067101
Fax	+91-22-67020083/
E-mail	yogeshh.mehra@windworldindia.com
Website	www.windworldindia.com
Contact person	Yogeshh Mehra

Appendix 2. Affirmation regarding public funding

The project activity does not involve any public funding from parties included in Annex 1 countries.

Appendix 3. Applicability of methodologies and standardized baselines

Please refer to section B.2

Appendix 4. Further background information on ex ante calculation of emission reductions

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

	Southern Grid (tCO_2e/MWh)
Simple Operating Margin – 2006-07	0.99912
Simple Operating Margin – 2007-08	0.99062
Simple Operating Margin – 2008-09	0.97293
Average Operating Margin of last three years	0.98756

Build Margin

	Southern Grid (tCO_2e/MWh)
Build Margin- 2008-09	0.81792

Combined Margin Calculations

	Weights	Southern Grid (tCO_2e/MWh)
Operating Margin	0.75	0.98756
Build Margin	0.25	0.81792
Combined Margin		0.94515

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

Appendix 5. Further background information on monitoring plan

Detailed metering information has been provided in section B 7.

Appendix 6. Summary report of comments received from local stakeholders

Detailed summary of comments received from local stakeholders has been provided in section E.2 above.

Appendix 7. Summary of post-registration changes

Following changes are done in registered PDD to reflect the changes post registration changes of registered project activity:

A) Changes to the project design:

- Section A.4: Name of PP has been revised throughout PDD.
- Section B.2: Revision has been made in applicability of methodology in line with present project scenario from 15/06/2013 onwards to reflect the changes to the project design of the registered project activity i.e. reference of third party is added. The project remains grid connected wind power plant as per methodology applicability criteria.
- Section B.3: Project boundary diagram has been revised considering both the scenario (pre & post change of ownership)
- Section B.5: Third party sale tariff and tariff post term of PPA has been incorporated in revised PDD to reflect third party sale scenario. Relevant sections of investment & sensitivity analysis have also been revised.
- Section B.7.3: Correction has been made to make the data measurement procedure more understandable and the single line diagram has been presented under both scenario (pre and post ownership change). Moreover monitoring information has been updated to reflect the changes to the project design of the registered project activity.

B) Changes to the monitoring plan:

- As per the registered monitoring plan calibration frequency of the meters is annual. However, in accordance with the guidelines as stated under section 3.2.3 of CEA Notification No. 502/70/CEA/DP&D dated 17/03/2006/19/ which is considered as per prevailing national standard “All interface meters shall be tested at least once in five years.”
- Accuracy class of energy meters have changed from 0.5s to 0.2s in case of cluster meter throughout revised PDD.
- There is no change in monitoring parameter and only QA/QC procedure has been changed in case of third party sale scenario in section B 7.1 of revised PDD.
- Section B.7.1: Cross checking mechanism of net electricity export values in pre and post third party sale scenario has been provided.
- Section B.7.3: Procedure for monitoring information, data uncertainty, correction in O&M structure, Monitoring roles and responsibilities has been revised to reflect the changes to the project design of the registered project activity

C) Corrections made in the registered PDD:

- There is a correction in the PDD with respect to the change of name of equipment supplier/O&M contractor. With effect from 01/01/2013 name of Enercon (India) Limited has been changed to ‘Wind World (India) Limited’. This change of name has been reported in revised PDD.
- There is a correction in PDD with respect to change in percentage variation range of PLF under sensitivity analysis from 15% to 10% as per Guidance on the Assessment of Investment Analysis, version-03, Annex-58, EB 51.

- Typographical error on Page 42 of registered PDD, 'Source: Bloomberg, Beta snapshots are provided in Appendix 3' has now been corrected as there was no appendix 3 in registered PDD.

- Section B 6.2: Purpose of data has been added in each table as per latest PDD template version 10.1.

- Consistency in abbreviation of WEC (wind turbine converter) instead of WEC/WEG has been done throughout revised PDD.

- Section B.3: Table of sources and greenhouse gases (GHGs) as per latest PDD template has been included in revised PDD.

- Section B.5: PP has corrected typographical error in registered PDD on page 17 section 'Operation and Maintenance cost'. Percentage escalation per annum on O & M Charges has been updated to 6%.

- Under Section A.1 page number 2, section B.4 page number 12 non-functional web-link has been removed. Section B.6.1 Page number 22, non-functional weblink replaced with new weblink.

- Appendix 1 and appendix 2 of registered PDD have now renamed as Annexure 1 and Annexure 2 in revised PDD as appendix 1 and appendix 2 are part of latest PDD template.

- Appendix 1, contact information of the new PP has been added.

- Section B 7.1: Monitoring frequency and Purpose of data has been added in each table as per latest PDD template version 10.1.

Annexure 1: CALCULATION OF BENCHMARK COST OF EQUITY

Selection of Appropriate Benchmark:

In choosing an appropriate benchmark we have based our approach on the principles of financing and investment decision making that are well found in theory and practice of corporate financing worldwide. We have derived from text book on "Corporate Finance Theory and Practice" by Dr. Aswath Damodaran of Stern School of Business, New York University. Dr. Damodaran is one of the foremost authorities in the world in the field of Investment Analysis.

The guidance to investment analysis issued in EB 51 (paragraph 12) states that in cases where a benchmark approach is used the applied benchmark shall be appropriate to the type of IRR calculated. Local commercial lending rates or weighted average costs of capital (WACC) are appropriate benchmarks for a project IRR. Required/expected returns on equity are appropriate benchmarks for equity IRR. Benchmarks supplied by relevant national authorities are also appropriate if the DOE can validate

It is also worthwhile to note that the captioned project is a Greenfield wind power generation project that generates and supplies electricity to the state grid, therefore the project cannot have only one possible project developer. The tool for demonstration and assessment of additionality [para-5, sub step 2(b)] states that in such cases (where the project has more than one potential developer) the benchmark cannot be based on internal cost of equity or WACC and shall be based on parameters that are standard in the market, considering the specific characteristics of the project type. Hence, we have not used company or project specific parameters for the calculation of the benchmark.

Accordingly, the cost of equity applicable to the project type has been considered and calculation of cost of equity is described as follows:-

Cost of Equity:

The expected return on equity has been determined using the Capital Asset Pricing Model (CAPM)[24]. The CAPM economic model is used worldwide to determine the required/expected return on equity based on potential risk of an investment. The CAPM framework is the Nobel award winning work of financial economist Dr. William Sharpe.

Ke = Rf + B x (Rm - Rf)

where:

Ke = Rate of return on equity capital;

Rf = Risk-free rate of return;

B = Beta;

Rm – Rf = Market risk premium;

Risk free rate:

The risk free rate is understood as the rate of return on an asset that is theoretically free of any risks, therefore the yeild rates are considered as risk free rates. Page 188 of text book on "Corporate Finance Theory and Practice" by Dr. Aswath Damodaran[25], Stern School of Business, New York University, describes that the yield rates are suitable indicators of risk free rates when the time horizon for the investment is long term.

[24] The Capital Asset Pricing Model (CAPM) was published in 1964 by William Sharpe, for his work on CAPM Sharpe received the Nobel Prize in 1990. http://www.investopedia.com/articles/06/CAPM.asp

[25] Dr. Damodaran, one of the foremost authorities in the world in the field of Investment Analysis

Accordingly the risk free rate has been taken from yield rates available at the decision making date. This has been considered as it was in the year of investment (i.e in that year, the company had the alternative of this long term risk free investment). The data on risk free rate is published by Reserve Bank of India. (Web-link: http://rbidocs.rbi.org.in/rdocs/Bulletin/PDFs/26CT_BUL110610.pdf)

The applicable risk free rate is 8.38%.

Market Risk Premium:

The most common approach for estimating the market risk premium is to base it on historical data, in the CAPM, the premium is estimated by looking at the difference between average return on stocks and risk free return. It is preferred to use long term premimums, i.e over a period of 25 years, since considering shorter time periods can lead to large standard errors because volatility in stock returns [page 191, Corporate Finance Theory and Practice, Dr. Aswath Damodaran]. It is also preferred to calculate the risk premium based on geometric mean of the returns since arithmetic mean overstates the risk premium. Geometric mean is defined as the compounded annual return over the same period [page 191, Corporate Finance Theory and Practice, Dr. Aswath Damodaran].

Therefore the market risk premium has been calculated as the difference in compounded annual return bewteen the BSE-Sensex (being conservative minimum value out of BSE Sensex, BSE-100, BSE-200 and BSE-500 has been choosen) and the risk free rate applicable at the time of investment decision. The detailed calculations are presented in the attached excel sheet.

The applicable market risk premium = 15.77%- 8.38%

= 7.39%.

Beta:

Beta (B) indicates the sensitivity of the company to market risk factors. Beta represents the market risk for an asset and is calculated as the statistical measure of volatility of a specific asset/investment relative to the movement of a market group. The conventional approach for estimating beta of an investment is a regression of returns on investment against returns on a market index. For companies that are not publicly listed, the beta is determined by referring beta values of publicly listed companies that are engaged in similar types of business. The project activity type is wind power generation; the approach therefore should be to base the beta for the project on the beta values of listed wind power generation companies in India. However, there was only one wind energy company (BF Utility) listed on any stock exchange in India (both BSE- Bombay Stock Exchange and NSE-National Stock Exchange) in year. Therefore, in the absence of adequate data on companies which are exclusively into the exactly same type of business (i.e wind power projects), the next best option for assessing the risk of these projects is to consider the data available on companies which are involved in similar businesses.

The Beta Value represents two types of risk:-

(1) Financial Risk

(2) Business Risk

We have considered beta values of all electricity generating companies in India. The group of companies considered includes renewable as well as conventional power generating companies. It is understood that risky businesses are likely to have higher cost of equity than safer businesses; projects in riskier businesses will have to cover these higher costs. Hence, investors demand a higher return from renewable energy projects than from conventional energy ones, given the higher risks in renewable, including risks of technology, risks from significantly varying and unpredictable resource availability (e.g. wind), and a lower established support base for such projects relative to that for conventional power (e.g. grid connections, bank finance, suppliers, etc.).

Unlevered beta represents the companies that do not carry financial (leverage) risk which is not the case for our project activity. To account for such differences in leverage (debt equity gearing), beta values of reference companies shall be first unlevered.

Since the project activity is 100% equity financed that's why Unlevered Beta has been used while calculating the benchmark.

The applicable Beta value has been determined on the basis of the Beta values of all power generating companies in India which were listed on the stock exchange at the time of this investment. Beta values of individual companies have been sourced from Bloomberg. The table below summarises the beta values:

Company Name	Raw Beta	Unlevered Beta
Tata Power Co Ltd	1.032	**0.73**
BF Utilities Ltd	1.950	**1.07**
Neyveli Lignite Corporation	1.635	**1.24**
Reliance Infrastructure Ltd	1.955	**1.60**
Gujarat Inds Power Co Ltd	1.365	**0.79**
	Average	**1.09**

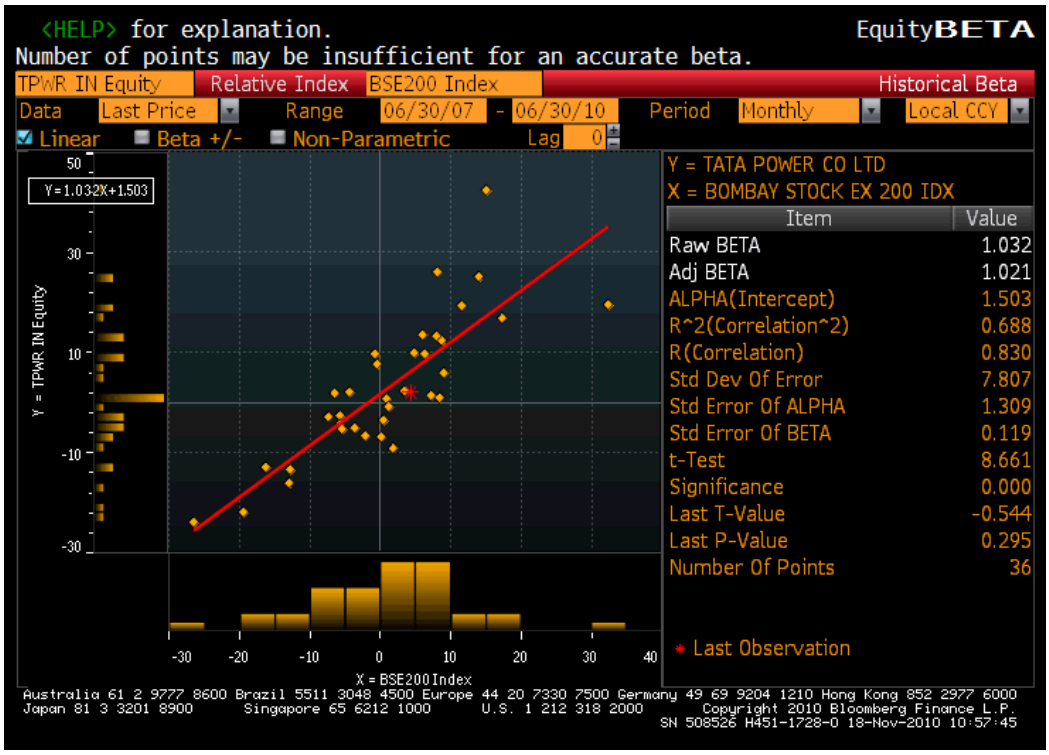
Source: Bloomberg, Beta snapshots are provided in Annexure 2.

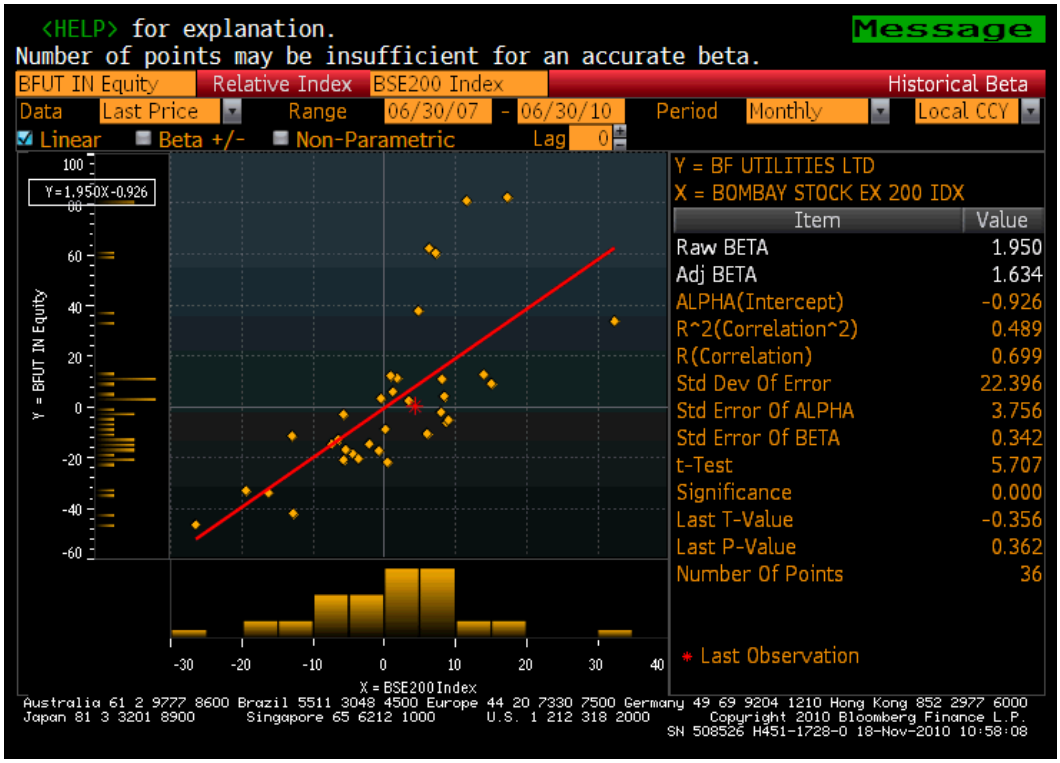
Calculation of Benchmark cost of equity:-

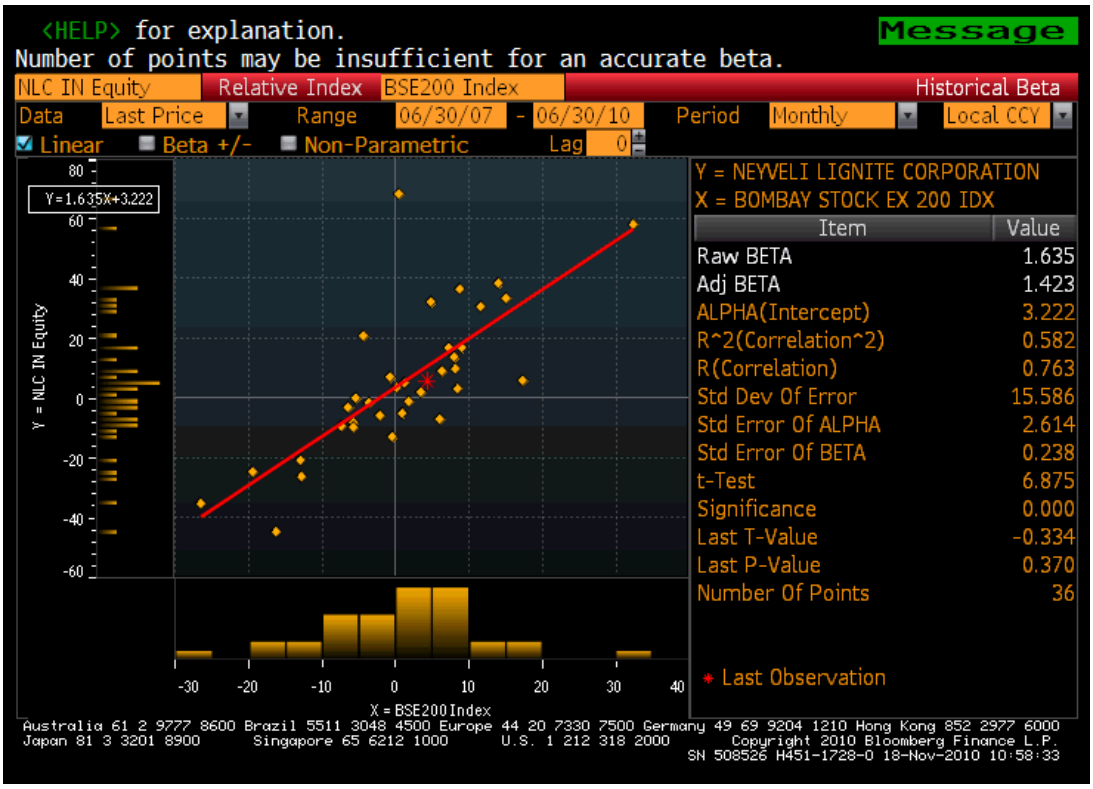
Ke = Rf + B x (Rm - Rf)]

Therefore, cost of equity benchmark, Ke = 8.38% + 1.09 * 7.39% = **16.40%**

Annexure 2: BETA SNAPSHOTS FROM BLOOMBERG



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Number of points may be insufficient for an accurate beta.
NLC IN Equity
Relative Index
BSE200 Index
Historical Beta
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Last Price
Range
06/30/07
- 06/30/10
Period
Monthly
Local CCY
Linear
Beta +/-
Non-Parametric
Lag
0
Y=1.635X+3.222
Y = NLC IN Equity
X = BSE200 Index
Y = NEYVELI LIGNITE CORPORATION
X = BOMBAY STOCK EX 200 IDX
Item
Value
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Adj BETA 1.423
ALPHA(Intercept) 3.222
R^2(Correlation^2) 0.582
R(Correlation) 0.763
Std Dev Of Error 15.586
Std Error Of ALPHA 2.614
Std Error Of BETA 0.238
t-Test 6.875
Significance 0.000
Last T-Value -0.334
Last P-Value 0.370
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Last Observation
Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000
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Copyright 2010 Bloomberg Finance L.P.
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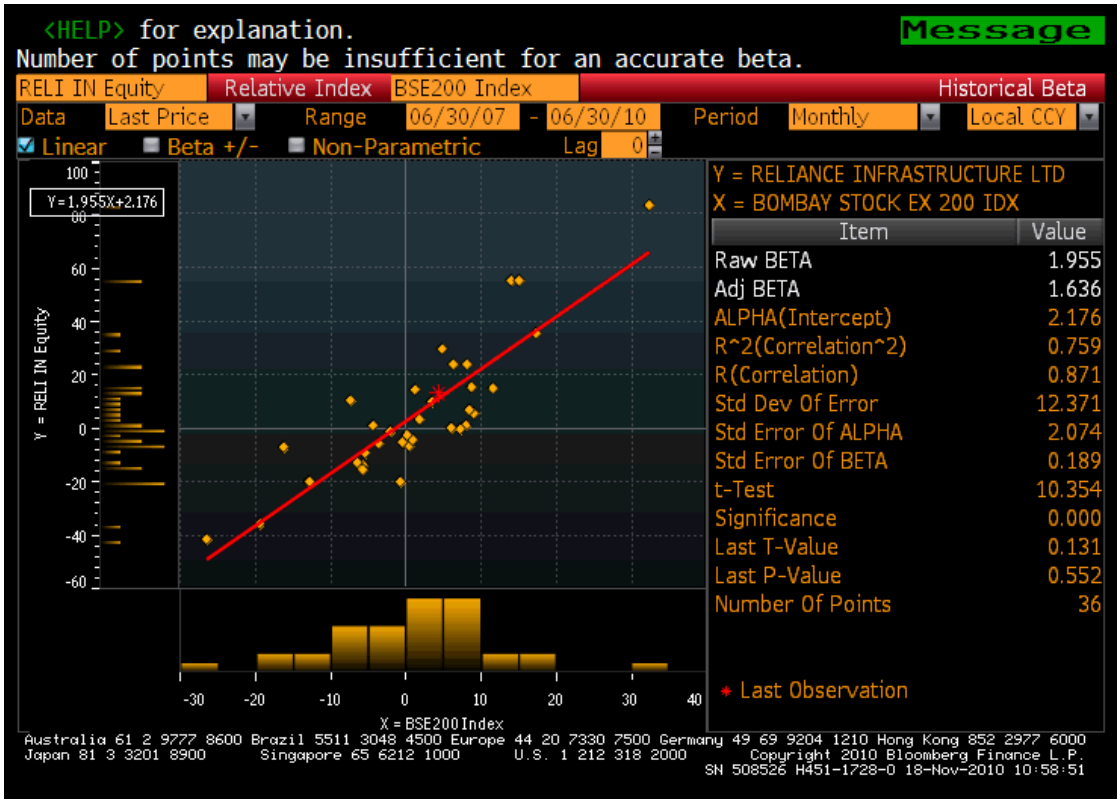
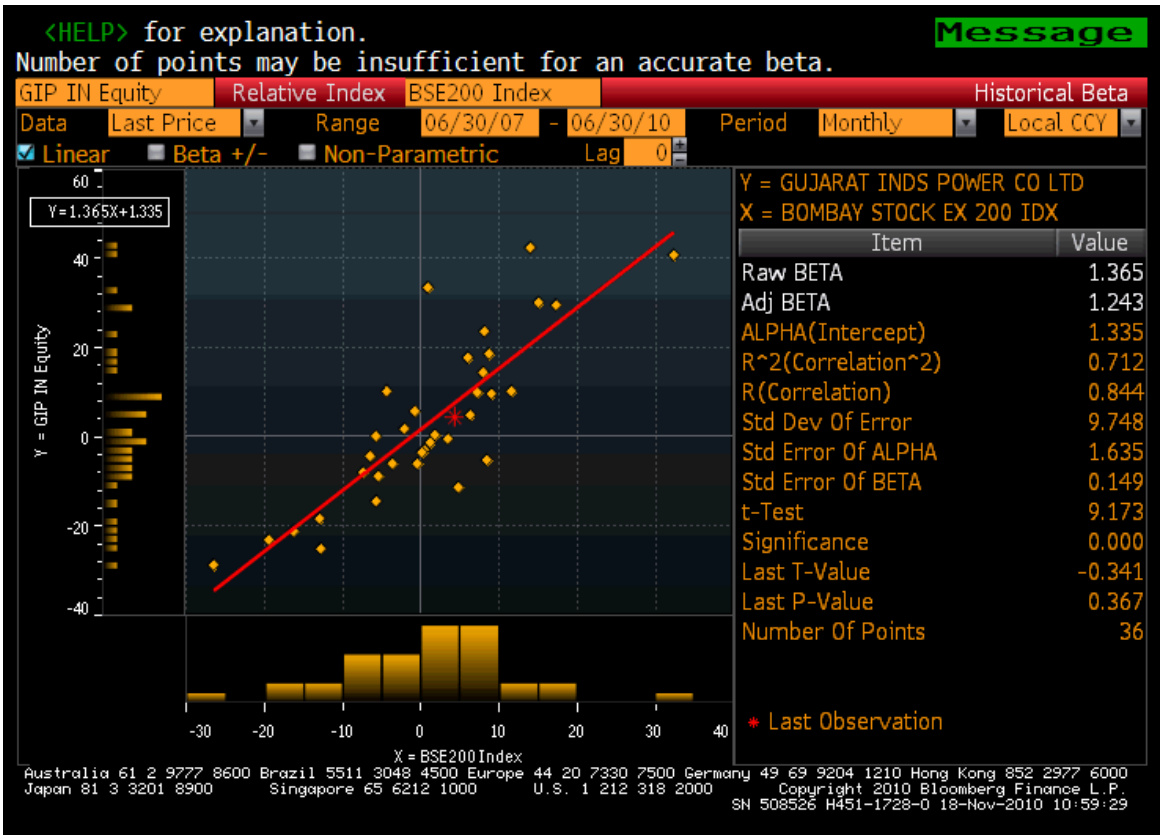

<HELP> for explanation.
Message
Number of points may be insufficient for an accurate beta.
RELI IN Equity
Relative Index
BSE200 Index
Historical Beta
Data
Last Price
Range
06/30/07
- 06/30/10
Period
Monthly
Local CCY
Linear
Beta +/-
Non-Parametric
Lag
0
Y=1.955X+2.176
Y = RELI IN Equity
X = BSE200 Index
Y = RELIANCE INFRASTRUCTURE LTD
X = BOMBAY STOCK EX 200 IDX
Item
Value
Raw BETA 1.955
Adj BETA 1.636
ALPHA(Intercept) 2.176
R^2(Correlation^2) 0.759
R(Correlation) 0.871
Std Dev Of Error 12.371
Std Error Of ALPHA 2.074
Std Error Of BETA 0.189
t-Test 10.354
Significance 0.000
Last T-Value 0.131
Last P-Value 0.552
Number Of Points 36
Last Observation
Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000
Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000
Copyright 2010 Bloomberg Finance L.P.
SN 508526 H451-1728-0 18-Nov-2010 10:58:51


<HELP> for explanation.
Message
Number of points may be insufficient for an accurate beta.
GIP IN Equity
Relative Index
BSE200 Index
Historical Beta
Data
Last Price
Range
06/30/07
-
06/30/10
Period
Monthly
Local CCY
Linear
Beta +/-
Non-Parametric
Lag
0
Y=1.365X+1.335
Y = GIP IN Equity
X = BSE200 Index
Y = GUJARAT INDS POWER CO LTD
X = BOMBAY STOCK EX 200 IDX
Item
Value
Raw BETA 1.365
Adj BETA 1.243
ALPHA(Intercept) 1.335
R^2(Correlation^2) 0.712
R(Correlation) 0.844
Std Dev Of Error 9.748
Std Error Of ALPHA 1.635
Std Error Of BETA 0.149
t-Test 9.173
Significance 0.000
Last T-Value -0.341
Last P-Value 0.367
Number Of Points 36
* Last Observation
Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000
Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000
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SN 508526 H451-1728-0 18-Nov-2010 10:59:29

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Document information

Version	*Date*	*Description*
10.1	28 June 2017	Revision to make editorial improvement.
10.0	7 June 2017	Revision to: • Improve consistency with the “CDM project standard for project activities” and with the PoA-DD and CPA-DD forms; • Make editorial improvement.
09.0	24 May 2017	Revision to: • Ensure consistency with the “CDM project standard for project activities” (CDM-EB93-A04-STAN) (version 01.0); • Incorporate the “Project design document form for small-scale CDM project activities” (CDM-SSC-PDD-FORM); • Make editorial improvement.
08.0	22 July 2016	EB 90, Annex 1 Revision to include provisions related to automatically additional project activities.
07.0	15 April 2016	Revision to ensure consistency with the “Standard: Applicability of sectoral scopes” (CDM-EB88-A04-STAN) (version 01.0).
06.0	9 March 2015	Revision to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Make editorial improvement.
05.0	25 June 2014	Revision to: • Include the Attachment: Instructions for filling out the project design document form for CDM project activities (these instructions supersede the "Guidelines for completing the project design document form" (Version 01.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Appendix 1; • Change the reference number from F-CDM-PDD to CDM-PDD-FORM; • Make editorial improvement.
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	13 March 2012	Revision required to ensure consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Annex 8).
03.0	26 July 2006	EB 25, Annex 15

Version	*Date*	*Description*
02.0	14 June 2004	EB 14, Annex 06b
01.0	03 August 2002	EB 05, Paragraph 12 Initial adoption.

Decision Class: Regulatory
Document Type: Form
Business Function: Registration
Keywords: project activities, project design document