15 MW BUNDLED GRID-CONNECTED WIND ELECTRICITY GENERATION PROJECT IN RADHAPURAM TALUK OF TIRUNELVELI DISTRICT IN TAMIL NADU, INDIA

Document Prepared by EKI Energy Services Limited

Project Title	15 MW Bundled grid-connected wind electricity generation project in Radhapuram Taluk of Tirunelveli District in Tamil nadu, India
Version	03
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Project ID	314[1]
Monitoring Period	28-March-2006 to 27-March-2012 (first and last date included)
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[1] https://registry.verra.org/app/projectDetail/VCS/314

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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

The project activity under consideration entails generation of clean power by harnessing wind energy – a non-conventional renewable energy resource and export ofthe electricity generated to their high-tension industry. The power generated from the wind energy generators (WEGs) would be transmitted to the high-tension industry premises of the company /its subsidiary company by using the transmission lines of Tamil Nadu state Electricity Board. The project proponents have entered into a wheeling agreement[2] with Tamil Nadu Electricity Board for the same. The electricity exported from the project thereby replaces an equivalent amount of power generation at the grid connected power plants which are primarily fossil fuel based. Therefore, the project activity results in an equivalent amount of CO_2 emission reduction which otherwise would have resulted from fossil fuel combustion related to electricity generation at the grid.

The project activity receives wind in two directions, i.e., Southern and North Eastern. Southern direction wind is the main source of power generation and it usually occurs from May to October of every year. The North Eastern wind at the project activity occurs from November to January of every year.

The project activity is a bundled wind energy project with total capacity of 15 MW, comprising of 12 Wind energy generators (WEGs) of same capacity, commissioned in the period 31-March-2003 to 31-March-2006. The relevant details of the individual components of the bundled project activity including the names of the project promoters, the installed wind power generation capacity for each wind turbine and the unique wind turbine number of the wind turbines have been tabulated.

The total GHG emission reductions or removals generated in this monitoring period.

The total emission reductions achieved in this monitoring period i.e., from 28-March-2006 to 27-March-2012 (first and last days included) is 149,672 tCO_2e.

1.2 Sectoral Scope and Project Type

Project Type: I – Renewable Energy Projects

[2] Wheeling means the operation whereby the distribution system and associated facilities of a transmission Licensee or distribution Licensee, as the case may be, are used by another person for the conveyance of electricity on payment of charges to be determined under section 62 of the Electricity Act 2003.An agreement entered into with the state electricity utility with respect to wheeling is wheeling agreement

pg 3, http://www.srldc.org/var/ftp/OpenAccess/serc/TAMILNADU/OpenAccess2005_tn.pdf.

Sectoral Scope: 01 - Energy industries (renewable/ non-renewable sources)

Project Category: AMS I.D. Grid Connected Renewable Electricity Generation' Version 14.

Project is not grouped project activity as per VCS guidelines.

1.3 Project Proponent

Organization name	Sangeeth Textiles Limited
Contact person	Mr. Elango
Title	Managing Director
Address	Ganeshpuram post,Via S.S Kulam, Annur, Coimbatore district, Tamil Nadu, India
Telephone	+91 422-2654101
Email	sales@sangeeth.in, finance@sangeeth.in

Organization name	Sri Mookambiga Spinning Mills Ltd.
Contact person	Mr. Elango
Title	Director
Address	Ganeshpuram post,Via S.S Kulam, Annur, Coimbatore district, Tamil Nadu, India
Telephone	+91 422-2654101
Email	sales@sangeeth.in, finance@sangeeth.in

Organization name	CAV Cotton Mills Ltd.
Contact person	Mr. Elango
Title	Director
Address	Ganeshpuram post,Via S.S Kulam, Annur, Coimbatore district, Tamil Nadu, India
Telephone	+91 422-2654101
Email	sales@sangeeth.in, finance@sangeeth.in

Organization name	Sri VasudevaTextiles Ltd.
Contact person	Mr. Elango
Title	Director
Address	Ganeshpuram post,Via S.S Kulam, Annur, Coimbatore district, Tamil Nadu, India
Telephone	+91 422-2654101
Email	sales@sangeeth.in, finance@sangeeth.in

1.4 Other Entities Involved in the Project

Organization name	EKI Energy Services Limited
Role in the Project	Project Consultant
Contact person	Ankit Sethiya
Title	Deputy Manager
Address	EnKing Embassy, Office No. 201, Plot 48, Scheme 78, Part 2, Vijay Nagar, Indore- 452010 Madhya Pradesh, India
Telephone	0731 428 9086
Email	registry@enkingint.org, ankit.sethiya@enkingint.org

1.5 Project Start Date

The commissioning date for each of the WEGs under the bundled project activity is given in the table below.

Name of the project participant	Survey No.	WEG HT SC No.	Location (Village)	Commissioning Date
Sangeeth Textiles Ltd.	530/1 & 2	1783	Levenjipuram	31-March-2006
	96/3 & 4	550	Irrukkandurai	31-March-2003
	966/2	830	Dhanukarkulam	31-March-2004
Sri Mookambiga Spinning Mills Ltd.	115/1C2,1B	1749	Chettikulam	30-March-2006
	259/2	675	Dhanukkarkulam	04-March-2004
	341/2	676	Dhanukkarkulam	04-March-2004

CAV CottonMills Ltd.	395/2	656	Dhanukkarkulam	24-December-2003
	349/2	655	Dhanukkarkulam	24-December-2003
	1479/2	1659	Irrukkandurai	24-March-2006
Sri VasudevaTextiles Ltd.	135/1,2,3,4A,4B,4C, 4D	1660	Chettikulam	24-March-2006
	99(Part)	548	Irrukkandurai	31-March-2003
	594/1A & 1B	745	Dhanukkarkulam	29-March-2004

The starting date of the project activity is 31-March-2003.

1.6 Project Crediting Period

Project Crediting Period Start date: 28-March-2006
Project Crediting Period End date: 27-March-2016

Total Crediting Period: 10 Years (Fixed crediting period)

1.7 Project Location

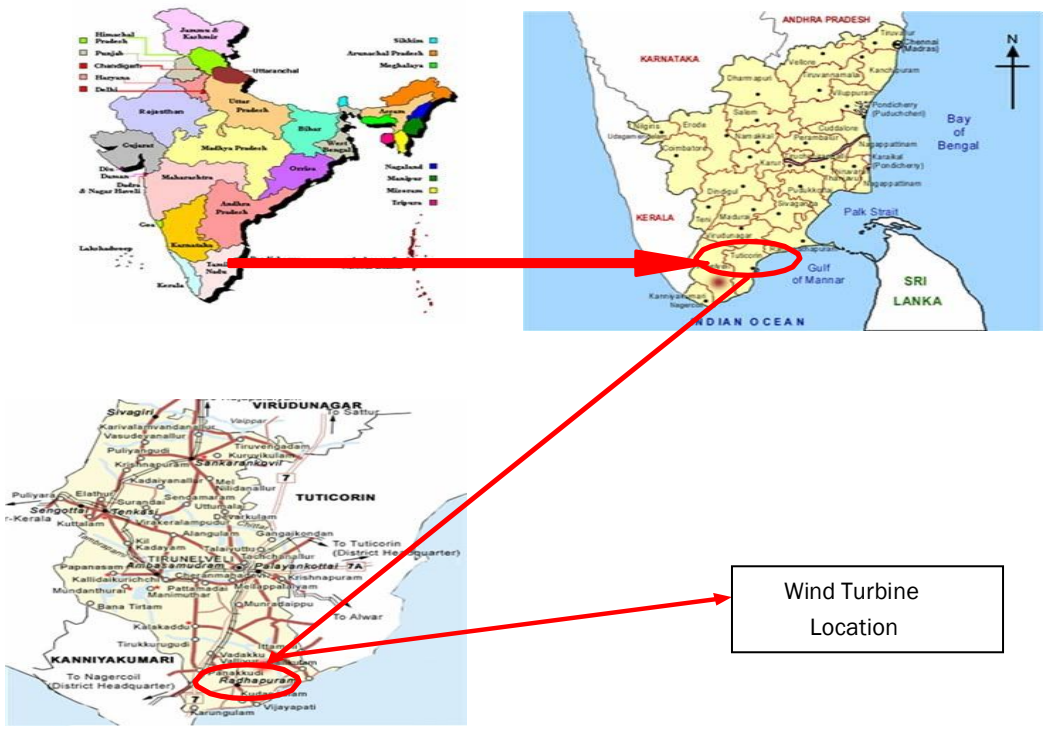
The project activity is located in Radhapuram Taluka, Tirunelveli district of Tamil Nadu State. Detailed information of location provided in below table: -

Sl. No.	Company	Capacity (MW)	HTSC No.	WEG Loc. no	Survey Number	Local Grid Station	Geographical Coordinates
1.	Sangeeth Textiles Ltd.	1.25	1783	S 505	530/1 & 2	Maharajapuram	8°08'56.4 N, 77°35'39.1E
		1.25	550	S 22	96/3(P)	Sankaneri	8°12'44.5 N, 77°40,35.8E
		1.25	830	S 91	966/2(P)	Vadakkankulam	8°14'20.4 N, 77°38'12.8E
2	Sri Mookambiga Spinning Mills pvt Ltd.	1.25	1749	S 711	115/1C2,1P	Maharajapuram	8°10'00.1 N, 77°38'00.6E
		1.25	676	S 72	341/2(P)	Vadakkankulam	8°15'05.6 N, 77°38'28.5E
		1.25	675	S 78	259/2(P)	Vadakkankulam	8°15'24.5 N, 77°38'17.6E
3	CAV Cotton Mills Ltd.	1.25	656	S 74	395/2(P)	Vadakkankulam	8°15'14.6 N, 77°38'06.9E
		1.25	655	S 75	349/2(P)	Vadakkankulam	8°15'15.8 N, 77°38'22E

Sl. No.	Company	Capacity (MW)	HTSC No.	WEG Loc. no	Survey Number	Local Grid Station	Geographical Coordinates
		1.25	1659	S 362	1479/2	Chidambarapuram	8°10'52.0 N, 77°37'56.0E
4	Sri Vasudeva Textiles Ltd.	1.25	1660	S 710	135/1,2,3,4A(P),4B(P),4C(P),4D(P)	Maharajapuram	8°10'11.0 N, 77°37'23.9E
		1.25	548	S 23	99(P)	Kodankulam	8°12'34.5 N ,77°40'37.6E
		1.25	745	S 147	594/1A1B(P)	Sankaneri	8°14'02.2 N, 77°39'58.8E

Table No.1.1: Unique identification numbers of WEGs

Maps depicting the districts and states in which the Wind Projects are located are mentioned below.



1.8 Title and Reference of Methodology

Title: Grid-connected Renewable Electricity Generation

Reference: Category I.D - Renewable Energy Projects[3]: Approved Small Scale Methodology AMS –I.D. / Version 14 of the Appendix B of Simplified Modalities and Procedures (M & P) of Small Scale CDM Project Activities[4]

Tools referenced:

Tool to calculate the emission factor for an electricity system, Version 01.1.

1.9 Participation under other GHG Programs

The project has neither been registered nor seeking registration under any other GHG programs. The project is seeking registration only in VCS program.

1.10 Other Forms of Credit

Emission Trading Programs and Other Binding Limits:

Net GHG emission reductions or removals generated by the Project will not be used for compliance with an emissions trading program or to meet binding limits on GHG emissions in any Emission Trading program or other binding limits.

Other Forms of Environmental Credit:
Not applicable, as the project is not registered in any other GHG mechanism other than VCS. Also, the project activity is not availing any REC benefits and the same can be confirmed from publically available link of REC generators.

1.11 Sustainable Development Contributions

1. **Social Well Being:**

- The project activity leads to alleviation of poverty by establishing direct and indirect benefits through employment generation and improved economic activities i.e., implementation of the project activity consequent employment opportunities for local people and an increase in the business opportunities for contractors, suppliers, erectors. Therein, project activity improves the local economic structure and promotes business opportunities in the country as a whole.

- The project activity leads to development of supporting infrastructure such as road network etc., in the solar park location, which also provides access to the local population.

2. **Environmental well-being:**

- Being a renewable energy resource, using solar PV to generate electricity, contributes to resource conservation. Thus, the project activity causes no negative impact on the surrounding environment contributing to environmental well-being.

3. **Economic well-being:**

[3] http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html

[4] http://cdm.unfccc.int/Reference/COPMOP/08a01.pdf#page=52

- The project activity under consideration requires temporary and permanent, skilled and semi-skilled manpower during construction and operation of solar power project; consequently, it creates additional employment opportunities that ultimately lead to economic well-being of local populace. Additionally, the project activity helps in conservation of fast depleting natural resources (e.g., coal etc.) thereby contributing to the economic well-being of country as a whole.

4. Technological well-being:

- The technology used for electricity generation i.e., wind energy under project activity is environmentally safe and sound as it does not produce greenhouse gases and any toxic or radioactive waste.

Table 1: Sustainable Development Contributions

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
1)	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable

2 SAFEGUARDS

2.1 No Net Harm

As per the Environmental Impact Assessment (EIA) Notification, Ministry of Environment, Forest and Climate Change (MoEF&CC), Government of India, New Delhi, the 27-January-1994 (Incorporating amendments made on 04-May-1994, 10-Apr-1997, 27-Jan-2000, 13-Dec-2000, 01-Aug-2001 and 21-Nov-2001) - S.O.60 (E), the project does not require EIA submission.

Since the project activity is a wind-based project activity, there is no requirement that the project get clearance from the Pollution Control Board. However, prior to the installation of the wind turbine generators of the project activity, the project proponents got a No Objection Certificate (NOC) from the Tamil Nadu State Electricity Board, Department of Non-Conventional Energy Sources. Copies of NOC from the stateElectricity Board would be provided.

There are no negative impacts on air, water, soil quality and ambience envisaged due to the project activity and no potential negative environmental and socio-economic impacts in this monitoring period. There was no harm identified from the project and hence no mitigations measures are applicable.

Being a renewable resource, using wind energy to generate electricity contributes to natural resource conservation. Thus, the project causes no negative impact on the surrounding environment contributing to environmental well-being.

2.2 Local Stakeholder Consultation

The stakeholder Meeting for the bundled project activity was conducted on 13-July-2009 at Vadakkankulam village near Sankaneri. The stakeholders were invited via personal invitations.

Documents related to the stakeholder meeting would be provided to the validator.
The following were the stakeholders identified for the project activity:

- Elected body of representatives administering the local area (village Panchayat) and the local residents
- Local clubs
- Non-Governmental Organization
- Facility developer and operators

Mr. Venkatesan a representative of M/s Suzlon Energy Ltd, welcomed the stakeholders and project proponents to the Stakeholder Consultation Meeting. He enumerated the benefits of the wind power project.

Later, a brief explanation was made about global warming and the contribution of the VCS wind power project activity in combating the global warming. After the welcome note and the introduction, questionnaires were circulated among the stakeholders to getthe comments from

the stakeholders. The questions in the questionnaires were translated to Tamil so that, the stakeholders would be in a better position to answer the same.

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Mr. Tamil Selvan, site in charge of Wind Farms of the Sangeeth Group attended the stakeholder meeting.

Stakeholder Comments:

Mr. S Sudalaimani said that the employment opportunity increased due to the upcoming of wind power project in that region. He added that the land value increased subsequently along with the improvement in the infrastructure like: roads. This project activity has led to the stabilization of the local grid.

Mr. Murugeswaran said that there is a necessity to bring more awareness among the people about wind mill projects, as the energy demand is increasing year after year.

Mr. K. Kumar said that the job opportunities increased after the wind projects were commissioned in that area.

Mr. G.A Nagarajan said that the job opportunities increased and new roads were laidand the power shortage problem has been reduced after upcoming of the projectactivity. He also said that new factories have opened up in the region after the commissioning of the wind power project.

Mr. K Saravana Kumar said that more wind mills should be erected as wind mills generate clean and pollution free energy.

Mr. Mariappan said that the land value has increased. He also said that the approach to every place is possible due to the roads that were newly laid during the construction of the wind power project. Electricity generation has increased. Employment opportunities have been created for the villagers. He also added that due to the set-up of wind power project activity, trade activity in the region has enhanced.

The local people acknowledged the contribution of the project towards the environment,social and economic well-being of the region and appreciated the initiative undertaken by the Project Proponent for the well-being of the environment. Moreover, they also expressed their thankfulness to the Project Proponents for generation of employment inthe region. They opined

that the power supply scenario in the region got improved after the installation of the wind turbines by the project proponents. They informed that they are at present getting uninterrupted power supply to their houses.

The Project Proponent has received positive comments from the local stakeholders on the project activity, as summarized above. The project proponent has devised a system for continuous local stakeholder interaction during the operation of the project. Local stakeholders are allowed to visit the project site and raise their concern about the project. A grievance register is maintained at the project site in which the feedback and concerns are reported. There is no adverse comment recorded to be reported during the monitoring period under consideration. The copy of grievance register is submitted to the VVB.

2.3 AFOLU-Specific Safeguards

This project is not AFOLU project. Therefore, not applicable.

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

In wind energy generation, kinetic energy of wind blowing at high speeds is converted into mechanical energy while passing through the wind-turbine. The rotation of the turbine blades results in the rotation of the generator mounted on the same shaft, thus generating electricity. As there are no GHG emissions associated with wind electricity generation, the technology is widely recognized as clean technology.

An upwind[5] Horizontal axis wind turbine (HAWT)[6] is used in the project activity to generate power.

The important components of a windmill are as follows:

- **Main Tower:** This is what holds the windmill up into the airflow.
- **Blades:** The blades are basically the sails of the system. They are flatobjects connected to the center shaft that converts the push of the wind into a circular motion. When the wind forces the blades to move, it has transferredsome of its energy to the rotor
- **Rotor:** The blades and the hub together
- **Pitch:** Blades are turned or pitched out of the wind to control the rotor speed and

[5] A type of wind turbine in which the rotor faces the wind

[6] A type of wind turbine in which the rotor faces the wind

keep the rotor from turning in winds that are too high or too low to produce electricity

- **Nacelle:** It sits atop the tower and contains the gear box, shafts, generator, controller and brake.

- **Main Shaft:** The wind turbine shaft is connected to the center of the rotor. When the rotor spins, the shaft spins as well. In this way, the rotor transfers mechanical rotational energy to the shaft, which enters an electrical generator at the other end.

- **Gear Box:** A gear box magnifies or amplifies the energy output of the rotor. Itis situated directly between the rotor and the generator.

- **Braking:** A disk brake which can be applied mechanically, electrically or hydraulically to stop the rotor in emergencies

- **Generator:** The generator produces electricity from the rotation of the rotor

- **Controller:** the controller starts up the machine at wind speeds of about 8 to 16 miles per hour and shuts off the machine at 55 mph.

- **Anemometer:** Measures the wind speed and transmits wind speed data to the controller

- **Wind vane:** Measures wind direction and communicates with the yaw drive to orient the turbine properly with respect to the wind.

- **Yaw Drive:** This is used to keep the rotor facing into the wind as the wind direction changes. This is a typical requirement of upwind turbine.

- **Yaw Motor:** Powers the yaw drive

- **Stand by battery:** This is a rechargeable battery located in the nacelle. Whenever power supply is there, the battery gets charged up. Whenever there is a grid failure, the same battery is used to bring the rotor blades to 90°position that is braking. It is used to operate the pitch motor.

Wind passes over the blades exerting a turning force. The rotating blades turn a shaft inside the nacelle, which goes into gear box. Gear box increases the rotation speed of the generator, which uses magnetic fields to convert the rotational energy into electrical energy. The electrical power is generated at 690 V. A step up transformer is connected to the wind turbine which converts the electricity from the generator to match the voltage of the

substation, i.e., to 11kV, later it is stepped up to 33kV to match the voltage of local grid.

Furthermore, the specifications of the various WEGs employed by the project activity are presented below:

Sl. No	Particulars	Specifications
		Suzlon S64 (1250kW) WEG
Rotor		
1.	Diameter	64 m
2.	No. of Rotor Blade	3
3.	Orientation	Upwind/Horizontal axis
4.	Rotational Speed	13.9/20.8 rpm
5.	Rotational direction	Clockwise
6.	Rotor Blade Material	GRP
7.	Swept Area	3218 m2
8.	Hub Height	65 m
9.	Regulation	Pitch Regulated
Operational Data		
10.	Cut in Wind Speed	3 m/s
11.	Rated Wind Speed	13 m/s
12.	Cut off Wind Speed	25 m/s
Gear Box		
13.	Type	Integrated 3 stage 1planetary and 2 helical
14.	Gear Ratio	1:74.917
15.	Manufacturer	Flender-Winergy
16.	Nominal Load	1390 kW
17.	Type of Cooling	Oil cooling system, Forced Lubrication
Generator		
18.	Type	Asynchronous 4/6 pole
19.	Make	Siemens
20.	Rotational Speed	1010/1515 RPM
21.	Rated Output	250/1250 kW
22.	Rated Voltage	690 V
23.	Frequency	50 Hz
24.	Insulation	Class “H”
25.	Enclosure Class	IP 56
26.	Cooling System	Air Cooled
Operating Brakes		
26.	Aerodynamic Brake	3 Independent systems with blade pitching
27.	Mechanical Brake	Spring powered disk brakes, hydraulically released, failsafe
Yaw Drive		
28	Method of Operation	4 Active Electrical yaw motors
29	Bearing Type	Polyamide slide bearing

The operational lifetime of the project activity is 20 years. The wind power produced being GHG neutral will not only displace fossil fuel dominated power but will also reduce the associated emissions with existing power generation plants connected to the Unified Indian Grid of India.

The breakdown details of the project activity have been mentioned in Appendix II of this Monitoring Report. The impact of breakdown on the GHG emission reduction during current monitoring period is justified in section 5.4 of this report. The emission reduction for this monitoring period pro rata comparing with registered VCS PD is 151,969 tCO_2e, whereas actual emission reductions achieved are 149,672 tCO_2e, which is -1.51% less due to low wind, maintenance of WEGs, breakdowns during this monitoring period, project activity is not generating the same. In the current monitoring period wind speed was very low and also falls under lean period.

Moreover, the operation of the project activity(s) during this monitoring period, including any information events that may impact the GHG emission reduction or removals and monitoring is not applicable.

3.2 Deviations

3.2.1 Methodology Deviations

There is no request for methodology deviation applied during current monitoring period.

3.2.2 Project Description Deviations

Deviation 1

This deviation is related to crosschecking with Monthly generation report (MGR) of the project. At the time of registration, as per monitoring plan the Net electricity exported to the grid supposed to be cross checked against the invoice. But at the time of project verification, it is observed that all the energy generated by the WTGs involved in this project activity were fully utilized by own captive use and there was no energy sale during this monitoring period to state electricity board (TNEB) or other third parties. So, PP has provided Monthly generation report for crosschecking of JMR in this monitoring period.

Deviation 2

This deviation is related to apportioning procedure of the project. At the time of registration, apportioning procedure not included in monitoring plan of registered VCS PD. But at the time of project verification, it is observed and included in section 4.3. So, we have included the apportioning procedure in monitoring plan of this monitoring period.

These deviations is of permanent nature and does not have any impact on the project applicability ,scale, baseline scenario and additionality.

3.3 Grouped Projects

This project activity is not a grouped project activity. Hence not applicable.

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Data / Parameter	$EF_{OM,y}$
Data unit	tCO_2e/MWh
Description	Operating Margin Emission Factor of Southern Grid
Source of data	"CO_2 Baseline Database for Indian Power Sector", version 4 published by the Central Electricity Authority, Ministry of Power, Government of India.
Value applied	1.00
Justification of choice of data or description of measurement methods and procedures applied	The data has been taken from official government website of the host country India, which is publicly available. Hence can be trusted as an authentic source of information.
Purpose of Data	Baseline Emission Calculation
Comments	The value is calculated on ex-ante basis and it will remain same throughout the crediting period.

Data / Parameter	$EF_{BM,y}$
Data unit	tCO_2e/MWh
Description	Build Margin Emission Factor of Southern Grid
Source of data	"CO_2 Baseline Database for Indian Power Sector", version 4 published by the Central Electricity Authority, Ministry of Power, Government of India.
Value applied	0.71
Justification of choice of data or description of measurement methods and procedures applied	The data has been taken from official government website of the host country India, which is publicly available. Hence can be trusted as an authentic source of information.
Purpose of Data	Baseline Emission Calculation
Comments	The value is calculated on ex-ante basis and it will remain same throughout the crediting period.

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

Source of data	Combined Margin Emission Factor Southern grid is calculated as per "Tool to calculate the emission factor for an electricity system, version 01.1, EB 35, Annex 12[7]". The combined margin emissions factor is calculated by weights of 75% on OM and 25% on BM are applied while calculating CM.
Value applied	0.927
Justification of choice of data or description of measurement methods and procedures applied	This is a calculated value based on the data that have been taken from official government website of the host country India, which is publicly available. Hence can be trusted as an authentic source of information.
Purpose of Data	Baseline Calculation
Comments	The value is calculated on ex-ante basis and it will remain same throughout the crediting period.

4.2 Data and Parameters Monitored

Data / Parameter	$E_{EXP,i,y}$
Data unit	MWh /Year
Description	Net Power Exported to grid by the WEGs under the project activity in the year y
Source of data	Power Export Bills of the WEGs at regular intervals (monthly)
Description of measurement methods and procedures to be applied	$E_{EXP,i,y}$ will be calculated from the sum of the monthly data that will be measured by an electronic tri-vector portable master meter at the WEG location, by the personnel from TNEB as follows: $E_{EXP,\,i,\,y} = \sum_{m=1}^{12} E_{EXP,\,i,\,m}$ where 'm' stands for each month from January (m=1) to December (m=12) The meter will be an import-export meter provided with a totalizer from which cumulative reading can be taken to yield the net electricity exported to the state grid at the end of every month.
Frequency of monitoring/recording	Continuous Monitoring and Monthly Recording
Value monitored	161,463.092
Monitoring equipment	Monitoring: 3-Phase energy meter is used for monitoring Accuracy Class: 0.5s. The Calibration details of the Energy Meter has been mentioned in Appendix-I of the Monitoring Report.
QA/QC procedures to be applied	The meter reading will be taken on 15th of every month by the personnel from the TNEB, in the presence of representatives from the company. The meter would be sealed by the TNEB. The meter installed is of an accuracy class of 0.5%. The net energy exported

[7] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v1.1.pdf

	by the WEG is obtained by multiplying the Main meter reading with a multiplication factor specific to the master meter. The Main meter will be maintained and calibrated by the Tamil Nadu State Electricity Board State on a regularbasis as per their internal calibration schedule as specified in the wheeling Agreements or as deemed necessary by the Tamil Nadu State Electricity Board and calibration is done using the portable meter. The shift in charge of the power plant will be responsible for verifying the quantumof electricity exported to the grid *vis-à-vis* the net electricitygenerated from the wind power generating unit within the same time period.
Purpose of the data	Calculation of Baseline emissions
Calculation method	NA
Comments	The relevant data will be recorded in electronic form and the same along with the electricity bills will be archived during the crediting period and for two years beyond the crediting period.

4.3 Monitoring Plan

The system in practice to monitor the electrical energy generated and there from the GHG emission reduction quantum from the project activity is provided in the following section.

The project activity essentially involves generation of electricity from wind, the employed WEG converts wind energy into electrical energy and does not use any other fuel for electricity generation. Thus, no special ways and means are required to monitor leakage from the project activity.

- The project activity requires evacuation facilities for sale to grid and the evacuation facility is essentially maintained by the state power utility, TNEB.
- The electricity generation measurements are required by the utility and the project proponents to assess electricity wheeling charges.
- Each WEG is equipped with an integrated electronic meter, the portable master meter connected to the Central Monitoring Station (CMS) through a wireless Radio Frequency (RF) network (PLC). The generation data of individual machine can be monitored as a real-time entity at CMS.
- The energy measurement is carried out on the 15th day of every month in the presence of both parties (a representative of the project proponent and personnel from the state power utility, TNEB). Both parties will sign the recorded reading.
- The metering equipment is maintained in accordance with electricity standards and has the capability of recording hourly and monthly readings and is of accuracy class 0.5%. Records of meter reading are maintained at the head office. The energy meters will be duly approved, tested and sealed by the Tamil Nadu State Electricity Board.

- The energy meter will be calibrated annually by the Tamil Nadu State Electricity Board or as deemed necessary by the board. The calibration would be done using the portable meter annually by the personnel from the TNEB. Copies of periodical calibration certificates will be provided to the validator.
- Ex-ante grid emission factor will be used during the crediting period.

Data is monitored continuously and recording will be done on monthly basis for entire crediting period.

Monitoring roles and responsibilities
Project proponent and wind turbine supplier together will be involved for collecting the monitoring information and data measurements.

The wind power policy of the Tamilnadu state government was neither consistent, nor conducive for the investors in the state for promotion of private sector investment. Additionally, the state government never allowed third party sale of power within the state, leaving only the options of captive consumption (through wheeling and banking) and sale to the grid. The state government also kept the power purchase price (tariff) much lower than other states and lower than the recommended tariff by MNRE, whereas the banking and wheeling charges are higher than other states. This tariff issue also discouraged private sector investment in clean technologies. Such power policies of the state government impediments implementation of clean power projects.

Purpose of monitoring:

The Monitoring and Verification (M&V) procedures define a project-specific standard against which the project's performance (i.e., GHG reductions) and conformance with allrelevant criteria will be monitored and verified. It includes developing suitable data collection methods and data interpretation techniques for monitoring and verification of GHG emissions with specific focus on technical / efficiency / performance parameters.It also allows scope for review, scrutiny and benchmarking of all these information against reports pertaining to M & V protocols.

The M&V Protocol provides a range of data measurement, estimation and collection options/techniques in each case indicating preferred options consistent with good practices to allow project managers and operational staff, auditors, and verifiers to apply the most practical and cost-effective measurement approaches to the project.The aim is to enable this project have a clear, credible, and accurate set of monitoring, evaluation and verification procedures. The purpose of these procedures would be to direct and support continuous monitoring of project performance/key project indicators to determine project outcomes, greenhouse gas (GHG) emission reductions.

The general monitoring principles are based on:

- Frequency: The amount of electricity exported to the grid is monitored continuously and aggregated every month
- Reliability: The reliability of the monitoring system is governed by the accuracy of the measurement system and the quality of the equipment to produce the result. All energy meters will be calibrated on a regular basis by the Tamil NaduState Electricity Board for ensuring reliability of the system. The monitored datais reliable as it is being done by the state utility and also the meters are periodically calibrated. All the meters are of 0.5% accuracy class. The calibration certificates are provided to the validator

- Registration and Reporting: Registration of data would be in the plant records and there from the Electricity Export invoices raised to the SEB. Monthly reports would be prepared stating the net electricity exported and archived by the project proponent. The records pertaining to EB bills are maintained at the registered office of the project proponents.

Roles and Responsibility:

- The project investors have signed an operation and maintenance agreement with the WEG supplier / external O&M Service Providers, contract is for stipulated time period after completion of the that time period, investor may choose other service provider.
- The performance of the turbines, safety in operation and scheduled /breakdown maintenances is the responsibility of O&M Service Providers and are organized and monitored by them. So, the authority and responsibility of project management lies with the O & M Service Providers / Project Proponent Representative.
- Joint meter reading reports shall be taken in the presence of TNEB officials & Investors Representative (e.g., O&M Service Provider), while the Invoices processing shall be done by Investor /Investor's Representative (e.g., O&M Service Provider).

Emergency procedure:

In case Main meter is found to be outside the acceptable limits of accuracy or faulty or not functioning properly, it will be repaired, recalibrated or replaced as soon as possible. In the event that the Main meter is not in service as a result of maintenance, repairs or calibration, the controller meter will be used. In case both are found to be outside the acceptable limits of accuracy or faulty or not functioning properly, both the meters shall be calibrated immediately and the error percentage found in the main meter during its calibration shall be applied to its metered energy data for the entire period since its last calibration to obtain the corrected value of net electricity exported to the grid.

QA / QC procedure:

The TNEB meters are scheduled to be calibrated at least once in every year. The entire responsibility of this task lies with the state utility. The meters have an accuracy class of at least 0.5s. TNEB has an on-site testing & calibration arrangement; hence there is no need to dismantle the meter for calibration. In case the meters are found faulty and hard to calibrate against the prescribed accuracy class the meter will be replaced by the state utility.

Data uncertainties and adjustments

Data uncertainties are likely under following conditions:

In case of error in TNEB meter
It is the common practice in the state of Tamil Nadu not to install check meter therefore at the site there are no check meters installed and readings are being taken directly from main meter & in case of main meter failure, the same shall be calibrated immediately & the correction factor applicable for the main meter shall be used for energy computation. For the period thereafter the measurement shall be continued in accordance with the calibrated main meter.

When records are lost

Tamil Nadu Electricity Board Statements will be used as reference & the same is justified as the TNEB statements are issued on the basis of monitoring values of TNEB energy meter only.

Apportioning Procedures in case the dates of monitoring period do not match with billing cycle dates

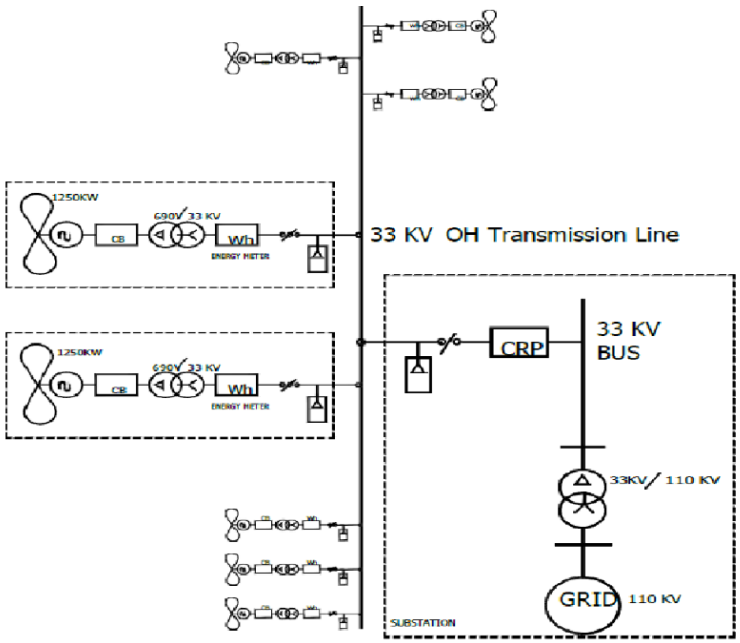
In the event when verification period dates and billing cycle of WEGs in the project activity, do not coincide:

Each WEG is equipped with the integrated electronic meter i.e., controller, which shows reading & the same has been recorded manually daily in Manual Log Books. Controller is connected to Central Monitoring System (CMS, the system continuously monitors the generation from each WEG. A daily consolidated report of the generation data is generated in the form of 'Daily Performance Report' and recorded in electronic and printed form).

In the event when the individual verification period dates and billing cycle dates of the each WEGs in the project activity do not coincide, then the monitoring procedure is being followed as-

X	Sum of generation during partial days of the month recorded at controller meter (kwh) source – Electronic / Manual Log Book
Y	Total generation during the month recorded at controller meter (kwh/month)
Z = X/ Y	Ratio
B	Net Energy export by the WEG as per TNEB Monthly Report on Generation and Consumption
Z*B	Generation of partial days for calculating emission reduction (kwh)

The metering location diagram of the project activity is shown below:



5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

Emission reductions due to project activity are calculated as follows,

$ER_y = BE_y - PE_y$

Where,

ER_y = Emission reductions in year y (tCO_2e/yr)
BE_y = Baseline emissions in year y (tCO_2e/yr)
PE_y = Project emissions in year y(tCO_2e/yr)

The baseline emissions are to be calculated as follows:

$BE_y = EG_{EXP,i,y} * EF_{grid,CM,y}$

Where,

BE_y	=	Baseline Emission in year y (tCO_2/yr)
$EG_{EXP,i,y}$	=	Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh/yr)
$EF_{grid,CM,y}$	=	Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (tCO_2/MWh)

Emission Factor for Southern grid, $\mathbf{EF_{grid,CM,y}}$ = 0.927 tCO_2/MWh

Electricity Supplied to the Southern Grid, $EG_{facility,y}$ = 161,463.09 MWh

Baseline Emission, BE_y = 161,463.09 x 0.927

= 149,672 tCO_2e (ROUNDDOWN)

5.2 Project Emissions

This project activity is grid connected wind power generation. Hence there is no project emission from the project activity.

$PE_y = 0$

5.3 Leakage

The project activity engages neither transferring the energy generating equipment from another activity, nor is the existing equipment transferred to another activity. So, the leakage emissions are not applicable and hence not considered.

$LE_y = 0$

5.4 Net GHG Emission Reductions and Removals

Year	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)
2006 (28-March-2006 to 31-December-2006)	20,754	0	0	20,754
2007 (01-January-2007 to 31-December-2007)	25,008	0	0	25,008
2008 (01-January-2008 to 31-December-2008)	23,287	0	0	23,287
2009 (01-January-2009 to 31-December-2009)	26,224	0	0	26,224
2010 (01-January-2010 to 31-December-2010)	25,625	0	0	25,625
2011 (01-January-2011 to 31-December-2011)	25,101	0	0	25,101
2012 (01-January-2012 to	3,673	0	0	3,673

27-March-2012)				
Total	149,672	0	0	149,672

The actual emission reduction is -1.51% less than the estimated emission reduction for this project. This is a wind power project and so the electricity generation through this project is not under the control of Project Proponent and so the deviation is acceptable.

APPENDIX I: METER CALIBRATION DETAILS

HTSC No.	Meter No.	Make & Class	Date of Calibration	Validity of Calibration	Delay in Calibration
1783	04804608	ELSTER 0.5s	20-December-2007, 05-February-2009, 10-August-2010	19-December-2008, 04-February-2010, 09-August-2011	• 28-March-2006 to 19-December-2007, • 20-December-2008 to 04-February-2009, • 05-February-2010 to 09-August-2010, • 10-August-2011 to 27-March-2012
550	02307242	ABB 0.5s	07-November-2006, 13-October-2008, 10-August-2010	06-November-2007, 12-October-2009, 09-August-2011	• 28-March-2006 to 06-November-2006, • 07-November-2007 to 12-October-2008, • 13-October-2009 to 09-August-2010, • 10-August-2011 to 27-March-2012
830	02329693	ELSTER 0.5s	14-July-2005, 18-January-2008, 10-August-2010	13-July-2006, 17-January-2009, 09-August-2011	• 14-July-2006 to 17-January-2008, • 18-January-2009 to 09-August-2010, • 10-August-2011 to 27-March-2012
1749	04726599	ELSTER 0.5s	24-December-2011	23-December-2012	• 28-March-2006 to 23-December-2011
676	02332456	ELSTER 0.5s	24-December-2011	23-December-2012	• 28-March-2006 to 23-December-2011
675	02332455	ELSTER 0.5s	24-December-2011	23-December-2012	• 28-March-2006 to 23-December-2011
656	04726605	ELSTER 0.5s	24-December-2011	23-December-2012	• 28-March-2006 to 23-December-2011
655	02307248	ELSTER 0.5s	24-December-2011	23-December-2012	• 28-March-2006 to 23-December-2011
1659	02345893	ELSTER 0.5s	24-December-2011	23-December-2012	• 28-March-2006 to 23-December-2011
1660	04726593	ELSTER 0.5s	24-March-2006, 24-July-2008, 10-August-2010	23-March-2007, 23-July-2009, 09-August-2011	• 24-March-2007 to 23-July-2008, • 24-July-2009 to 09-August-2010,

					• 10-August-2011 to 27-March-2012
548	02307239	ABB 0.5s	08-July-2005, 9-November-2006, 13-October-2008, 10-August-2010	07-July-2006, 08-November-2007, 12-October-2009, 09-August-2011	• 08-July-2006 to 08-November-2006, • 09-November-2007 to 12-October-2008, • 13-October-2009 to 09-August-2010, • 10-August-2011 to 27-March-2012
745	02345881	ELSTER 0.5s	12-July-2005, 29-November-2006, 18-December-2008, 10-August-2010	11-July-2006, 28-November-2007, 17-December-2009, 09-August-2011	• 12-July-2006 to 28-November-2006, • 29-November-2007 to 17-December-2008, • 18-December-2009 to 09-August-2010, • 10-August-2011 to 27-March-2012

Error factor for calibration delay is applied in ER sheet for all the above WTGs. And as per calibration results meter is found working ok. Further PP has applied 0.5% error factor in export and import value for complete month of delayed period mentioned in table above. This is in line with the guidelines provided under paragraph 3.4.2 of VCS Validation and Verification manual version 3.2 and Para 366 under section 9.2.6 of CDM Validation and Verification Standard Version 3.0 and Annex 608 Guidelines for Assessing compliance with the calibration frequency; Version 01.

[8] https://cdm.unfccc.int/EB/052/eb52_repan60.pdf

APPENDIX II: MAJOR BREAKDOWN DETAILS

HTSC No.	Date	Breakdown Hours
745	20-July-2009	5.90
1660	27-July-2009	5.10
548	02-August-2009	3.80
745	09-October-2009	5.90
548	10-October-2009	6.20
1660	14-October-2009	9.20
745	01-January-2010	1.70
548	31-January-2010	8.50
1660	18-February-2010	3.90
548	13-April-2010	3.70
745	15-April-2010	1.70
1660	16-May-2010	15.60
745	16-July-2010	4.60
548	04-August-2010	5.20
1660	30-August-2010	5.00
1660	01-November-2010	5.00
745	11-November-2010	3.20
548	15-December-2010	2.90
1660	16-April-2011	9.10
548	28-April-2011	9.20
745	03-May-2011	5.20
1660	05-September-2011	4.20
548	01-September-2011	3.90

745	01-October-2011	1.40
745	05-January-2012	5.40
548	05-January-2012	4.60
1660	16-January-2012	9.20