



Verified Carbon Standard

GRID CONNECTED WIND ELECTRICITY GENERATION IN TAMIL NADU, INDIA



Document Prepared by EKI Energy Services Limited

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Project Title	Grid-Connected Wind Electricity Generation Project in Tamil Nadu, India
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CONTENTS

- 1 PROJECT DETAILS..... 4**
 - 1.1 Summary Description of the Project 4
 - 1.2 Sectoral Scope and Project Type..... 4
 - 1.3 Project Eligibility..... 4
 - 1.4 Project Design 5
 - 1.5 Project Proponent 5
 - 1.6 Other Entities Involved in the Project 5
 - 1.7 Ownership..... 6
 - 1.8 Project Start Date 6
 - 1.9 Project Crediting Period 7
 - 1.10 Project Scale and Estimated GHG Emission Reductions or Removals 7
 - 1.11 Description of the Project Activity 8
 - 1.12 Project Location..... 11
 - 1.13 Conditions Prior to Project Initiation 14
 - 1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks 14
 - 1.15 Participation under Other GHG Programs 14
 - 1.16 Other Forms of Credit..... 15
 - 1.17 Additional Information Relevant to the Project..... 15

- 2 SAFEGUARDS 16**
 - 2.1 No Net Harm 16
 - 2.2 Local Stakeholder Consultation 17
 - 2.3 Environmental Impact 18
 - 2.4 Public Comments 18
 - 2.5 AFOLU-Specific Safeguards 18

- 3 APPLICATION OF METHODOLOGY..... 19**
 - 3.1 Title and Reference of Methodology 19
 - 3.2 Applicability of Methodology 19
 - 3.3 Project Boundary 22
 - 3.4 Baseline Scenario 24
 - 3.5 Additionality 27

3.6	Methodology Deviations	33
4	QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS	33
4.1	Baseline Emissions	33
4.2	Project Emissions	39
4.3	Leakage.....	39
4.4	Net GHG Emission Reductions and Removals	39
5	MONITORING	41
5.1	Data and Parameters Available at Validation.....	41
5.2	Data and Parameters Monitored.....	42
5.3	Monitoring Plan.....	44
APPENDIX	46

1 PROJECT DETAILS

1.1 Summary Description of the Project

The project activity under consideration has been promoted by National Enterprises, referred to as the project proponent throughout this document. The project activity involves the setting up of two numbers of WTGs of cumulative capacity of 3.3 MW (2 X 1.65 MW). The envisaged net electricity generation quantum from the project to the tune of 7,938 MWh on an annual basis exported to the nearest grid substation of Tamil Nadu Electricity Board, a part of national grid of India. The basic purpose of the initiative is to generate clean energy through renewable energy source and supply the power to the grid. The power generated by the project displaces an equivalent quantity of power generated by grid by a majority of fossil fuel combustion, thus contributing to the cause of conservation of the conventional sources of energy.

The project activity is estimated to supply an annual average electricity of 7,938 MWh during the current Crediting period to the Indian Grid with an annual average reduction of 7,419 tCO_{2e} during the same period. The total emission reductions during the current crediting period are estimated as 74,190 tCO_{2e}.

Sl.No.	Capacity (MW)	WTG Supplier	HTSC Number	Date of Commissioning	WTG Location
1	1.65	Vestas	2570	30-March-2008	Village-Samugarangapuram
2	1.65		2595	31-March-2008	

1.2 Sectoral Scope and Project Type

Project Type: Renewable energy project (Small Scale)

Sectoral Scope 1: Energy industries (renewable - / non-renewable sources)

This project is not grouped project because there is no addition other project activity.

This is non-AFLOU type of project.

1.3 Project Eligibility

As per the Voluntary Carbon Standard, Methodologies for baseline estimation and formulation of monitoring plan include methodologies specified by the¹ :

- Clean Development Mechanism (CDM) of United Nations Framework Convention on Climate Change (UNFCCC)

¹ <http://www.v-c-s.org/methodologies.html>

- California Climate Action Registry

For the GHG abatement project activity under consideration, the project proponent chooses to apply an appropriate methodology as specified by Appendix B to the simplified modalities and procedures for small scale CDM project activities². The project activity under consideration fits into the following type and category:

- Type: Type I – Renewable Energy Projects
- Category: I.D. ‘Grid Connected Renewable Energy Generation’

The applicability criteria pertaining to the above for the project activity under consideration are quoted and addressed in section 3.2 of the VCS PD.

1.4 Project Design

The project involves setting up a wind farm of 3.3 MW (“Project) in the state of Tamil Nadu, India. Hence, the project has been designed to include a single installation of an activity and is not a grouped activity

Eligibility Criteria

Not Applicable as the Project activity is not a grouped Project activity.

1.5 Project Proponent

Organization name	National Enterprises
Contact person	Mr.Charanjit Singh Grewal
Title	Proprietor
Address	National Enterprises P.O.- Box No.44 Barabil, Keonjhar Orrisa Pin- 758035
Telephone	067067-275521
Email	gapsponge@tahoo.co.in

1.6 Other Entities Involved in the Project

² <https://cdm.unfccc.int/methodologies/SSCmethodologies/index.html>

Organization name	EKI Energy Services Limited
Role in the project	Project Consultant
Contact person	Sumant Saurabh
Title	Executive
Address	EKI Energy Services Limited, EnKing Embassy, Plot 48, Scheme 78 Part-2, Behind Vrindavan Hotel, Vijay Nagar, Indore-452010, Madhya Pradesh, India
Telephone	+91-9709873780
Email	sumant@enkingint.org

1.7 Ownership

As per VCS Program Definitions version 4, the project ownership is the legal right to control and operate the project activities.

National Enterprises is the project proponent (PP) of project activity and they have the legal right to control and operate the project activities.

The ownership of the project promoter of the wind-farms and the WTGs can be established by means of the clearances, approvals and agreements. The project activity under consideration complies with the applicable regional and national level legal and regulatory requirements for installation and operation of wind-farms. The same is listed as follows:

SI.No.	Clearance/Approval/Agreement	Date of issue
1	Land sale Deed	19-February-2008
2	Commissioning certificates	30- March-2008 & 31-March-2008
3	Power Purchase Agreement	24-April-2008
4	Clearance from TNEB Board	05-March-2008

- A contractual arrangement with the owner of the plant, equipment or process that grants all reductions/removals to the proponent

Not Applicable

1.8 Project Start Date

As per relevant guidelines of Voluntary Carbon Standard 2007.1, “project start date” is defined as: “Date on which the project began reducing or removing GHG emissions”

For the GHG abatement project activity under consideration, the project start date, i.e., the date on which the project began reducing GHG emissions by renewable energy based power generation is the earliest of the dates of the commissioning of the WTGs by the State Electricity Authority i.e., TNEB. As per

information furnished in the table in Section 1.1 of this PD, it is established that the project start date for the project activity is 30- March-2008.

1.9 Project Crediting Period

The Project is undergoing renewal of its crediting period. This is the 2nd crediting period.

The crediting period of the project activity is for 10 years (Renewable for maximum 2 times).

The first crediting period was 01-January-2010 to 31-December-2019.

The second crediting period will be 01-January-2020 to 31-December-2029 (both dates inclusive)

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	√
Large project	Not Applicable

Year	Estimated GHG emission reductions or removals (tCO _{2e})
01 st January 2020 to 31 st December 2021	7419
01 st January 2021 to 31 st December 2022	7419
01 st January 2022 to 31 st December 2023	7419
01 st January 2023 to 31 st December 2024	7419
01 st January 2024 to 31 st December 2025	7419
01 st January 2025 to 31 st December 2026	7419
01 st January 2026 to 31 st December 2027	7419
01 st January 2027 to 31 st December 2028	7419

01 st January 2028 to 31 st December 2029	7419
Total estimated ERs	74190
Total number of crediting years	10
Average annual ERs	7419

1.11 Description of the Project Activity

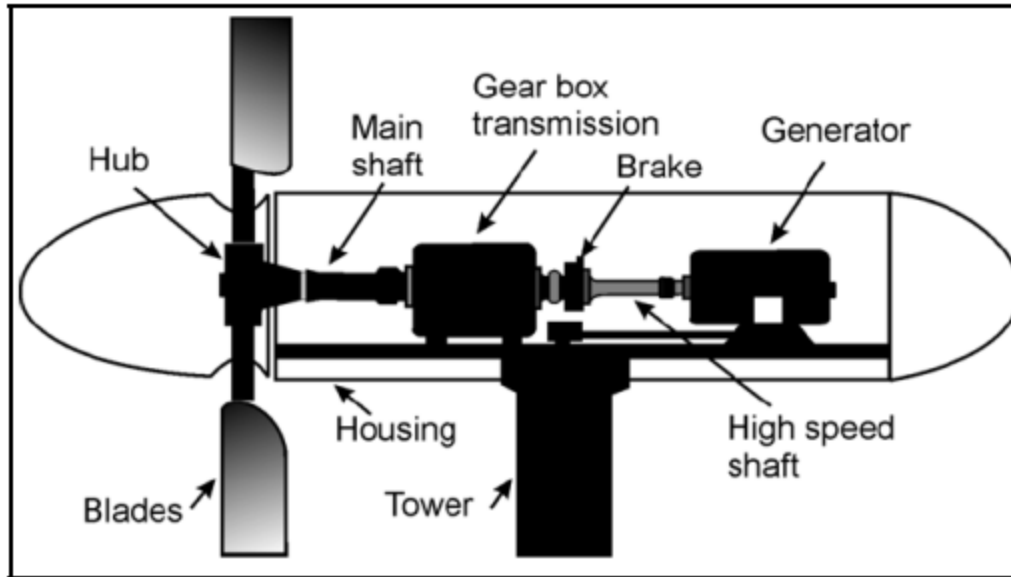
The project activity under consideration has been promoted by National Enterprises, referred to as the project proponent throughout this document. The project activity involves the setting up of two numbers of WTGs of cumulative capacity of 3.3 MW (2 X 1.65 MW). The envisaged net electricity generation quantum from the project to the tune of 7938 MWh on an annual basis would be exported to the nearest grid substation of Tamil Nadu Electricity Board, a part of national grid of India . The basic purpose of the initiative is to generate clean energy through renewable energy source and supply the power to the grid. The power generated by the project displaces an equivalent quantity of power generated by grid by a majority of fossil fuel combustion, thus contributing to the cause of conservation of the conventional sources of energy.

Sl.No.	Capacity (MW)	WTG Supplier	HTSC Number	Date of Commissioning	WTG Location
1	1.65	Vestas	2570	30-March-2008	Village-Samugarangapuram
2	1.65		2595	31-March-2008	

The project involves generation of electrical energy using wind, a renewable source of energy. The project activity will generate 7938 MWh of net electricity annually at a Plant Load Factor (PLF) of 27.46% and export the same to the Southern Regional Grid, mainly powered by the fossil fuel fired power plants. The electricity generation from this project will contribute to corresponding GHG emission reductions to the tune of 7,419 tCO_{2e}/year.

Project Technology details:-

In wind energy generation, kinetic energy of wind is converted into mechanical energy and subsequently into electrical energy. Wind has considerable amount of kinetic energy when blowing at high speeds. This kinetic energy when passes through the blades of the wind turbines, it is converted into mechanical energy and rotates the wind blades. When the wind blades rotate, the connected generator also rotates, thereby producing electricity.



Major Mechanical Parts of a Wind Turbine

Technical specification of the Wind Turbines Generator (V 82 – 1650 kW) used in the project activity has been detailed below:

Features of WTG		
Sr. No.	Particulars	Specifications
Main Specifications		
1.	Rotor Diameter	82 m
2.	Number of blades	3
3.	Power Control	Active Stall
4.	Rotational Speed (Synchronous)	14.4 rpm
5.	Rotor Position	Upwind
6.	Nominal Power	1650 kW
7.	Hub Height	78 m
Rotor		
8.	Rotor Diameter	82m
9.	Tilt Angle	5°
10.	Swept area	5281 m ²
Blade		
11	Material	Fibre/Epoxy/Wood
12	Blade length	40 m
13	Blade profile	FFA-W3,NACA63.4
14	Air Brake	Full Blade
Hub		
15	Type	Spherical

16	Material	EN-GJS-400-18U-LT
Main Shaft		
17	Type	Forged Shaft and flange
18	Material	34 CrNiMo6
Main Bearings		
19	Front Bearing	Spherical roller bearings
Main Gear Box		
20	Gear Ratio	1:70.2
21	Mechanical Power	1800 kW
Couplings		
22	Gearbox/Generator	Flexible
Generator		
23	Nominal Power	1650 kW
24	Rotational Speed (Synchronous)	1012 rpm at rated power
25	Insulation class	F/B
26	Protection class (IEC 529)	IP54
Machine Frame		
27	Type	Casted front end
28	Material	EN-GJS-400-18U-LT
Yawing System		
29	Yaw bearing	Ball bearing, internal gearing
30	Yaw Motor	6 Nos
31	Yaw gear	6 pcs
32	Gearing ratio	1:1666
33	Yaw brake	Hydraulic disc brakes, 6 pcs
Mechanical Brake		
34	Type	Fail Safe-Hydraulic release
35	Position	Mounted on high speed shaft
36	Number of calipers	1 pc
Tower		
37	Type	Conical tubular
38	Height	75.5m
39	Corrosion protection	Acc. To ISO 12944:C5I
Control System		
40	Manufacturer	Vestas Control systems
41	Type	Microprocessor based

The expected level of performance in terms of electricity generation from the project activity, along with the GHG abatement by the project activity is provided below:

- Installed power generation capacity: 3.3 MW
- Plant Load Factor (PLF) 27.46 %
- Net electricity export to the grid per annum: 7938 MWh
- GHG abatement potential per annum: 7,419 tCO_{2e}

1.12 Project Location

The location of the project activity are as below:-

Village- Samagarangapuram

District-Tirunelveli

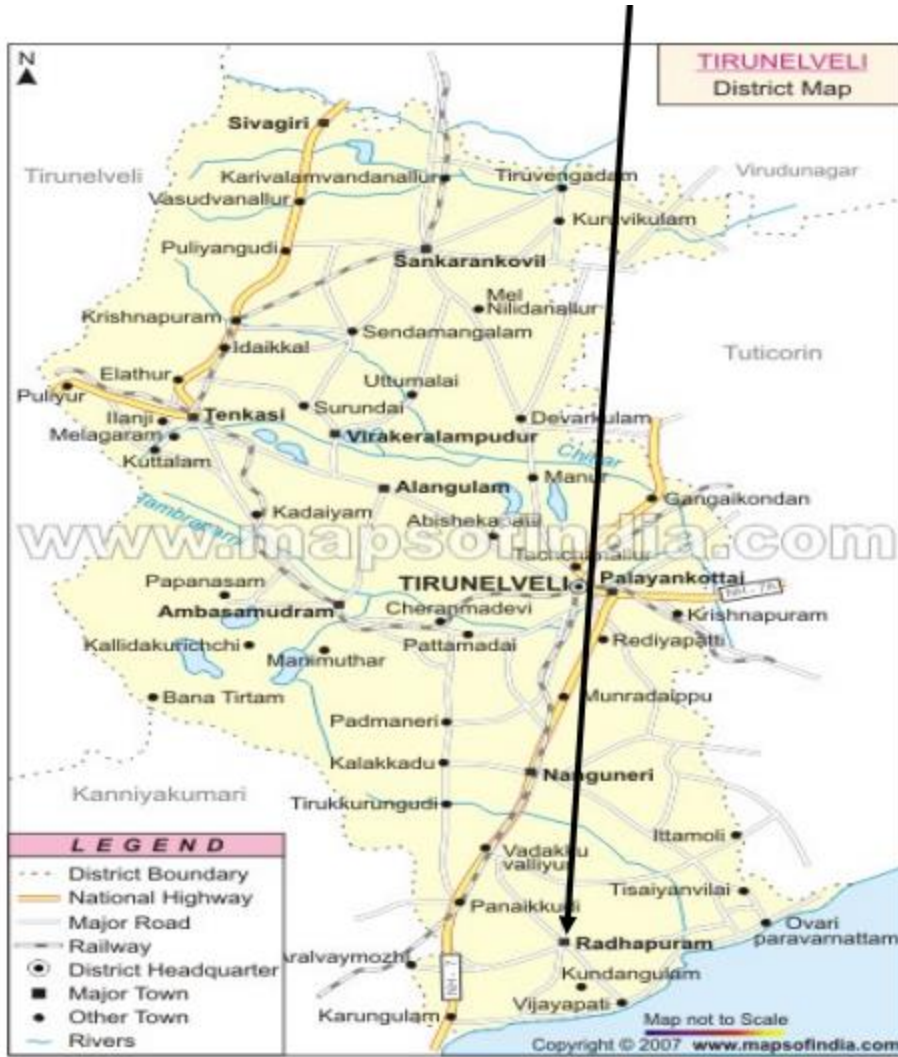
State- Tamilnadu

Country-India

The details pertaining to the location of each individual WTG installed under the project activity has been provided in the following table:

District	Site	HTSC No.	Latitude	Longitude	Local grid sub station
Tirunelveli	Village- Samugarangapuram	2570	N 8° 19'32.7"	E 77° 40'59.2"	TNEB 33 KV (Tirunelveli)
		2595	N 8° 19'59.4"	E 77° 19'27.4"	

Map of the location



1.13 Conditions Prior to Project Initiation

As per the justification provided in Section 3.4 of this document, it can be argued that in the absence of the windmills installed by the project activity, a corresponding quantity of electrical energy would have been generated by the majority of fossil-fuel fired thermal power plants dominating the Southern Regional Electricity Grid of India generation mix. This would result in GHG emissions as per the carbon intensity of the grid-mix. This situation has been identified as the baseline scenario for the project activity in Section 3.4 of this document.

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

The project activity under consideration complies with the applicable regional and national level legal and regulatory requirements for installation and operation of wind-farms. The same is listed as follows:

Sl.No.	Clearance/Approval/Agreement	Date of issue
1	Land sale Deed	19-February-2008
2	Commissioning certificates	30- March-2008 & 31-March-2008
3	Power Purchase Agreement	24-April-2008
4	Clearance from TNEB Board	05-March-2008

Apart from the above, the relevant national laws and regulations pertaining to generation of energy in India are:

- Electricity Act 2003
- National Electricity Policy 2005
- Tariff Policy 2006

1.15 Participation under Other GHG Programs

1.15.1 Projects Registered (or seeking registration) under Other GHG Program(s)

Project was undergoing registration process with UNFCCC under Clean Development Mechanism (CDM) program, PDD was Under preparation stage later does not get registered with UNFCC under Clean Development Mechanism (CDM). The project is now only registered with VCS mechanism with VCS project reference no 498³, the same can be justified by the link provided in the footnote.

1.15.2 Projects Rejected by Other GHG Programs

The Project was undergoing registration process with UNFCCC under Clean Development Mechanism (CDM) Program. The PDD was under preparation stage later didn't get registered with UNFCCC under CDM. The project is now only registered in VCS Mechanism .The project activity is not been rejected by any other GHG Programs.

³ <https://registry.verra.org/app/projectDetail/VCS/498>

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

India is Non-annex1 country and there is no compliance with an emission trading program or to meet binding limits on GHG emissions for this project activity.

As per the registered PDD this project activity is voluntary initiative and it is not to meet any local laws or regulatory compliances. An undertaking has been submitted that PP shall not claim for GHG emission reduction credits for the given crediting period under any other emission-trading program or GHG binding limits.

1.16.2 Other Forms of Environmental Credit

PP declares that emission reductions generated from the project activity will not be double counted (i.e. issuance of other form of environmental credit like under CDM) for the particular crediting period, which is being claimed under VCS mechanism. PP has submitted an undertaking to the VVB that they shall not claim for GHG emission reduction credits for the given period under any other emission – trading program.

The project is only registered with VCS mechanism with VCS project reference no 498. Project Proponent has submitted undertaking for not availing other forms of environmental credit for the same crediting period under consideration. The Project proponent is not claiming any REC benefits for this particular project activity during the entire crediting period which can be justified by the REC registry of India⁴. The same can be verified by the registry link which has been provided in the footnote.

1.17 Additional Information Relevant to the Project

Leakage Management

The project activity involves generation of electricity through WTGs (Wind Turbine Generators,) Further Wind based electricity generation is not associated with any kind of leakages.

Commercially Sensitive Information

Not Applicable

Sustainable Development

The contribution of the project activity to the sustainable development can be substantiated as follows

Social Well Being

- Harnessing renewable energy by means of a clean power generation technology

⁴ <https://www.recregistryindia.nic.in/>

- No requirement of relocation or rehabilitation as there is no human displacement attributable to the project activity
- Provision of employment and business opportunities for local populace during installation, commissioning and operational phases
- Development of road network, transportation facilities and other infrastructure development initiatives

Economic Well Being

- Contribution towards grid stability and abridging the demand-supply gap in the Indian Electricity Grid
- Creation of business opportunities for local stakeholders

Technological Well Being

- Employment of clean power generation technology by harnessing wind energy potential
- Reduction in transmission and distribution losses from power plants in the grid to remote areas

Environmental Well Being

- GHG abatement by displacement of electricity generated by the fossil fuel dominated grid-mix
- Contribution to causes of mitigation of climate change and global warming
- No environmental disturbance or ecological imbalance caused to the surroundings, over total project lifetime
- Contribution towards reduction in the levels of SO_x, NO_x, and SPM associated with combustion of fossil fuels for power generation

[Further Information](#)

Not Applicable

2 SAFEGUARDS

2.1 No Net Harm

The project activity does not involve any major construction activity. It primarily requires the installation of the wind power project, interfacing the generators with the State Electricity Board by setting up HT transmission lines and installation of other accessories.

The report on “Developmental Impacts and Sustainable Governance Aspects of Renewable Energy Projects” prepared by MNRE dated September 2013. This report clearly mentioned that wind project

activity operations do not result in direct air pollution, noise pollution. Please refer below web link for the same⁵.

The project meets all the local laws and regulations of India. Further, socio-economic impacts are indirect but positively related to the project activity. So, the project activity, does not involve any potential negative environmental and socio-economic impacts.

Thus, there is no any significant impact due to implementation of project activity on air, water, soil quality and ambience are envisaged due to the project activity.

2.2 Local Stakeholder Consultation

The feedback received from various stakeholders have served as valuable inputs justifying the Project Proponent's initiative of clean power generation and simultaneous contribution to sustainable development of the region. Various stakeholders directly or indirectly associated with the project activity were approached and appraised about the various aspects of the project activity by the representatives of the project promoters through a stake-holder meeting, as summarised below:

Stakeholder's Consultation Meeting Details	
Date	24-November-2009
Place	Thandaiyarkulam, Tirunelveli, Tamil Nadu
Mode of Invitation	<u>Public Notice and Personal Letters of Invitation to the individual stakeholders</u>
1	<p>Welcome Speech:</p> <p>The organisers welcomed the various stakeholders and briefed them on the meeting agenda and the points to be discussed, also highlighting the utility and importance of the exercise.</p>
2	<p>Introduction to climate change mechanisms (including VCS):</p> <p>The organisers explained the various climate change mechanisms: compliance based (Clean Development Mechanism) and voluntary (Voluntary Carbon Standard) to the various stakeholders in the light of global concerns on global warming and climate change. The contribution of renewable energy projects like wind-mills towards solution of such problems by means of GHG abatement as well as sustainable development of the region was also discussed.</p>
3	<p>Speech by the Project Promoting Entity:</p> <p>The representative from the project promoting organisation highlighted their commitment towards clean energy generation and environment protection by means of this diversification from its core area of activity. The pertinent issues of fossil-fuel depletion, environment pollution abatement, energy security and development of the host nation were also discussed. Furthermore, the various beneficial aspects of the</p>

⁵ <http://164.100.94.214/sites/default/files/uploads/report-on-developmental-impacts-of-RE.pdf>

	project activity towards socio-economic development of the region on a local level and the host country on a national level were highlighted.
4	<p>Interactive (Question & Answer) Session:</p> <p>Upon requests by the stakeholders, the mechanism of environmental pollution and damage from fossil-fuel combustion was explained. Upon being asked, the stakeholders highlighted the various benefits in their lives attributable to the project activity by means of generation of employment and business opportunities as well as the provision of improved infrastructure and superior amenities in the vicinity of their place of dwelling. The stakeholders were also of the opinion that there were no possible negative impacts of the project activity on their lives. Instead, they were of the opinion that more of such projects should be actively promoted on account of associated environmental as well as socio-economic benefits.</p>
5	<p>Conclusion and Vote of Thanks:</p> <p>The stakeholders were thanked for rendering their valuable time and providing crucial comments and suggestions on the project activity that further fortified the commitment of the project proponent in promoting the noble initiative.</p>
<p>Note: Relevant documents relating to stakeholder consultation will be submitted to the Validator during the Validation exercise.</p>	

2.3 Environmental Impact

In line with the Environmental Impact Assessment (EIA) notification S.O. 1533, dated 14th September 2006 issued by Ministry of Environment & Forests (MoEF), Govt. of India, wind projects are not included in the list of projects that are required to get Prior Environmental Clearance (EC) either from State or Central Govt. authorities. As the project activity under consideration is a wind power generation project, it does not fall under the purview of EIA notification and therefore the EIA study need not be conducted for it.

2.4 Public Comments

No negative comments have been received on project activity from any of the local stakeholders consulted. As all comments were very positive about the project, no further action is required. There were no further comments raised by the stakeholders and they were totally in support for setting up of these kinds of projects in the region. The local stakeholders expressed their support to the project. The meeting was concluded by vote of thanks to all the participants.

2.5 AFOLU-Specific Safeguards

Not Applicable ,as the Project activity is not an AFLOU Project activity.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

As per the Indicative simplified baseline and monitoring methodologies for selected small-scale VCS project activity categories, Type I.D Version 18 has been used.

Title: “Grid connected renewable electricity generation”.

Reference: AMS I D, Version 18⁶

It has been referred from the list of approved methodologies for CDM project activities in the UNFCCC/CDM⁷ website

The approved methodology uses

- “Tool to calculate the emission factor for an electricity system”⁸ Version 7.0 for determination of the baseline scenario,
- “Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion”⁹ Version 03.0 for determining project emissions
- Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period Version 03.0.1¹⁰

3.2 Applicability of Methodology

The methodology AMS.I.D Version 18 is being applied for the project activity. The reasons for the choice of project type and category for the project activity are as follows:

Applicability Criterion	Project Case
1. This methodology comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal and renewable biomass: <ul style="list-style-type: none"> a) Supplying electricity to a national or a regional grid. b) Supplying electricity to an identified consumer facility via national/regional grid through a contractual arrangement such as wheeling. 	The project activity is a Renewable Energy Project i.e. Wind Power Project which falls under applicability criteria option 1(a) i.e., “Supplying electricity to a national or a regional grid”. Hence the project activity meets the given applicability criterion.

⁶ <https://cdm.unfccc.int/methodologies/DB/W3TINZ7KKWCK7L8WTFQQOFQQH4SBK>

⁷ <https://cdm.unfccc.int/methodologies/SSCmethodologies/approved>

⁸ <https://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-07-v7.0.pdf>

⁹ <https://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-03-v3.pdf>

¹⁰ <https://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-11-v3.0.1.pdf>

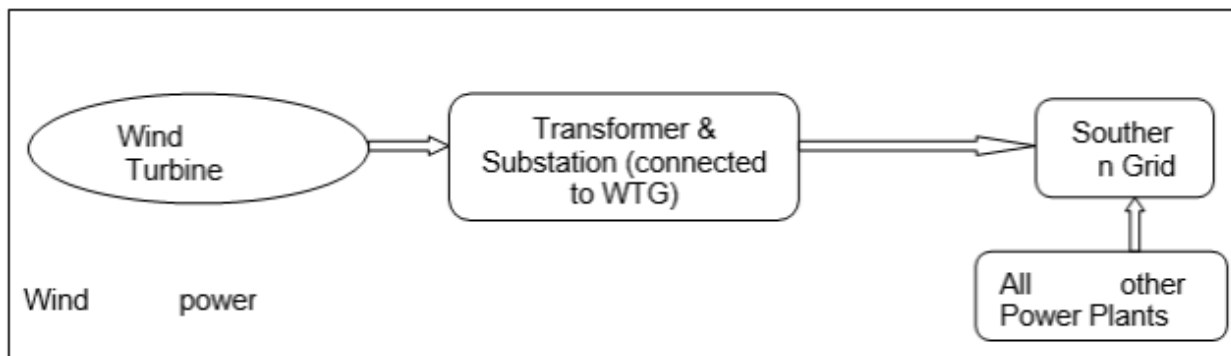
Applicability Criterion					Project Case
2. Illustration of respective situations under which each of the methodology (i.e. “AMS-I.D.: Grid connected renewable electricity generation”, “AMS-I.F.: Renewable electricity generation for captive use and mini-grid” and “AMS-I.A.: Electricity generation by the user) applies is included below					The 1st option of Table 1 “Scope of AMS-I.D., AMS-I.F. and AMS-I.A. based on project types” of AMS I.D. Version 18, EB 61 is applicable.
	Project Type	AMS-I.A	AMS-I.D	AMS-I.C	
1	Project supplies electricity to a national/regional grid		√		
2	Project displaces grid electricity consumption (e.g. grid import) and/or captive fossil fuel electricity generation at the user end (excess electricity may be supplied to a grid)				
3	Project supplies electricity to an identified consumer facility via national/regional grid (through a contractual arrangement such as wheeling)		√		
4	Project supplies electricity to a mini grid ¹ System where in the baseline all generators use exclusively fuel oil and/or diesel fuel				
5	Project supplies electricity to household users (included in the project boundary) located in off grid areas				
3. This methodology is applicable to project activities that: <ul style="list-style-type: none"> a. Install a Greenfield plant; b. Involve a capacity addition in (an) existing plant(s); c. Involve a retrofit of (an) existing plant(s); b) Involve a rehabilitation of (an) existing plant(s)/unit(s); or c) Involve a replacement of (an) existing plant(s). 					The project is installation of new wind based electricity generation plants (not addition to existing system). Option (a) is applicable.
4. Hydro power plants with reservoirs that satisfy at least one of the following conditions are eligible to apply this methodology: <ul style="list-style-type: none"> a. The project activity is implemented in an existing reservoir with no change in the volume of reservoir; b. 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 					The project is wind power project and thus the criterion is not applicable to this project activity.

Applicability Criterion	Project Case
definitions given in the project emissions section, is greater than 4 W/m ² ; c. 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/m ² .	
5. If the new unit has both renewable and non-renewable components (e.g. a wind/diesel unit), the eligibility limit of 15 MW for a small-scale CDM project activity applies only to the renewable component. If the new unit co-fires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15 MW.	The project activity is a 3.3 MW wind electricity generation. Unit does not co-fire fossil fuels. Hence the criterion is not applicable to the project activity.
6. Combined heat and power (co-generation) systems are not eligible under this category	The Project activity is a renewable wind energy project and is not a combined heat and power system. Hence the criteria is not applicable to the project activity
7. In the case of project activities that involve the capacity 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 ¹ from the existing units.	The project activity is Greenfield and there is no existing power generation facility at the site. Hence the criteria is not applicable to the project activity
8. In the case of retrofit, rehabilitation or replacement, to qualify as a small-scale project, the total output of the retrofitted, rehabilitated or replacement power plant/unit shall not exceed the limit of 15 MW.	Not applicable, the wind project is a Green field project activity and this project is not the enhancement or up gradation project.
9. In the case of landfill gas, waste gas, wastewater treatment and agro-industries projects, recovered methane emissions are eligible under a relevant Type III category. If the recovered methane is used for electricity generation for supply to a grid then the baseline for the electricity component shall be in accordance with procedure prescribed under this methodology. If the recovered methane is used for heat generation or cogeneration other applicable Type-I methodologies such as “AMS-I.C.: Thermal energy production with or without electricity” shall be explored.	The Project activity is a renewable wind power project and is not a landfill gas, waste gas, wastewater treatment and agro-industries projects or recovered methane emissions project. Hence the criteria is not applicable to the project activity
10. In case biomass is sourced from dedicated plantations, the applicability criteria in the tool “Project emissions from cultivation of biomass” shall apply	The Project activity is a renewable wind power project and is not a biomass project. Hence the criteria is not applicable to the project activity.
Applicability conditions of “Tool to calculate the emission factor for an electricity system”	
11. This tool may be applied to estimate the OM, BM and/or CM when calculating baseline emissions for a project activity that substitutes grid electricity that is where a project activity supplies electricity to a grid or a project activity that results in savings of electricity that would have been provided by the grid (e.g. demand-side energy efficiency projects).	This condition is applicable. OM, BM and CM are estimated using the tool under section 4.1 for calculating baseline emissions.

Applicability Criterion	Project Case
12. Under this tool, the emission factor for the project electricity system can be calculated either for grid power plants only or, as an option, can include off grid power plants. In the latter case, the conditions specified in “Appendix 2: Procedures related to off grid power generation” should be met. Namely, the total capacity of off-grid power plants (in MW) should be at least 10 per cent of the total capacity of grid power plants in the electricity system; or the total electricity generation by off-grid power plants (in MWh) should be at least 10 per cent of the total electricity generation by grid power plants in the electricity system; and that factors which negatively affect the reliability and stability of the grid are primarily due to constraints in generation and not to other aspects such as transmission capacity.	Since the project activity is grid connected, this condition is applicable and the emission factor has been calculated accordingly.
13. In case of CDM projects the tool is not applicable if the project electricity system is located partially or totally in an Annex I country.	The project activity is located in India, a non-Annex I country. Therefore, this criterion is not applicable for the project activity.
14. Under this tool, the value applied to the CO2 emission factor of biofuels is zero.	The project activity is a grid connected wind power project and not a hydro power plant. Therefore, this criterion is not applicable for the project activity.

In this project, total electricity generation capacity of 2 windmills is 3.3 MW, which is less than the limit of 15 MW of maximum output capacity as specified in Annex-II “Simplified Modalities & Procedures for Small Scale CDM Project Activities” for Type (I) project activities: renewable energy project activities with a maximum output capacity equivalent to up to 15 megawatts (or an appropriate equivalent) (decision 17/CP.7, paragraph 6 (c) (i)). Thus, this project reduces anthropogenic emissions by sources and its maximum output capacity is less than 15 MW. Therefore it confirms to this category thereby qualifying as a small-scale project activity.

3.3 Project Boundary



Project boundary has been ascertained using para 18 of AMS I.D. – “The spatial extent of the project boundary includes the project power plant and all power plants connected physically to the electricity system that the CDM project power plant is connected to”.

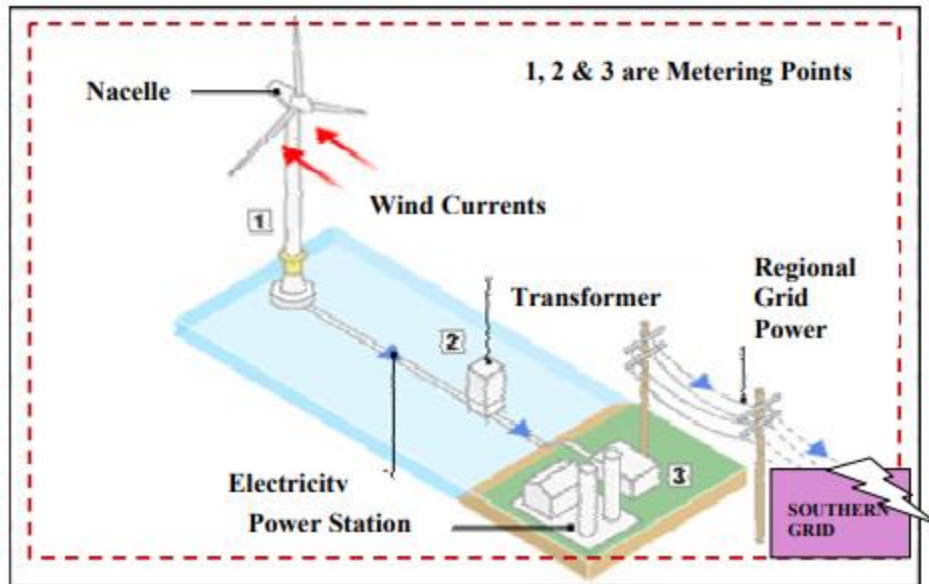
The project boundary includes the wind turbine generator, sub-stations, grid and all power plants connected to grid. The proposed project activity will evacuate power to the INDIAN grid. Therefore the entire INDIAN grid and all connected power plants have been considered in the project boundary for the proposed CDM project activity.

The GHG sources and sinks included in the project boundary are given in the table below:

Source		Gas	Included?	Justification/Explanation
Baseline	CO ₂ emissions from electricity generation in fossil fuel fired power plants connected to the grid that are displaced due to the project activity.	CO ₂	Yes	Main emission source
		CH ₄	No	This source is not required to be estimated for wind energy projects under AMS I.D. version 18
		N ₂ O	No	This source is not required to be estimated for wind energy projects under AMS I.D. version 18
Project	Greenfield Wind Power Project Activity.	CO ₂	No	Not applicable for wind projects
		CH ₄	No	Wind energy generation does not have any indirect GHG emissions
		N ₂ O	No	Not applicable for wind projects

Project boundary specified is that encompasses the physical, geographical site of the renewable generation source. This includes the wind turbine installation, pooling and sub-stations. The proposed project activity evacuates the power to the Southern Regional Grid. Therefore, all the power plants contributing electricity to the Southern Regional Grid¹¹ are taken in the connected (project) electricity system for the purpose of baseline estimation.

¹¹ Now under Indian Grid



3.4 Baseline Scenario

Updated baseline for the second crediting period in line with the “Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period.” Version 03.0.1.

This tool provides a stepwise procedure to assess the continued validity of the baseline and to update the baseline at the renewal of a crediting period, as required by paragraph 284 to 287 of Project Standard version 03.0

The tool stipulates the following steps to be carried out.

Step 1: Assess the validity of the current baseline for the next crediting period

Step 1.1: Assess compliance of the current baseline with relevant mandatory national and/or sectoral policies

The baseline scenario remains unchanged and is in compliance with all the relevant mandatory national and/or sectoral policies.

Step 1.2: Assess the impact of circumstances

The baseline scenario identified at the validation of the project activity was the electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid connected power plants and by the addition of new generation sources into the grid. Thus this project activity was a voluntary investment which intends to replace equivalent amount of electricity at grid from renewable source. PP was not bound to incur this investment; hence absence of project activity (i.e. the investment) does not lead to any continued baseline practice for PP within their scope whereas the continued

operation of the project activity would continue to replace equivalent amount of electricity at grid. Hence, the same baseline as identified in the previous crediting period is still valid for the project.

Nevertheless, there is an impressive growth attained by the Indian Power Sector within the recent years, the installed capacity has grown from mere 1,713 MW in 1950 to 370,047 MW as on 31-03-2020, consisting of 230,809.57 MW Thermal, 86,759.19 MW RES and 6,780 MW Nuclear. Sector wise details of installed capacity are shown in Table provided below. However, it is evident from Table 11 below that the installed capacity is predominantly coal based and therefore, is a major source of carbon dioxide emissions in India. Hence, there exists scope for reducing the CO₂ emissions in the country by increased use of renewable energy sources. Furthermore, project participant has considered the latest available CO₂ Baseline Database (CEA database, version 16) at the time of requesting renewal of the crediting period for establishing the baseline emission factor, which itself considered all the new circumstances. Hence, the new circumstances do not have an impact on the baseline emission. As per below table, the fossil fuel based thermal power generation is dominant over the renewable based power generation, thus baseline scenario remains same as original.

Table 1: Sector- wise installed capacity (MW) as on 31-March-2020 (CEA Database version 16)

Sector	Thermal				Nuclear	Hydro	RES	Grand Total
	Coal	Gas	Diesel	Total				
State	65366.50	7118.71	363.93	72849.14	0.00	29878.80	2347.93	105075.86
Private	76518.00	10580.60	273.70	87372.30	0.00	3394.00	73661.40	164427.70
Central	58820.00	7237.91	0.00	66057.91	6780.00	12126.42	1632.30	86596.63
All India	200704.50	24937.22	637.63	226289.34	6780.00	45399.22	77641.63	356100.19

Thus, current baseline remain same and there is no impact if circumstances, existing at the time of requesting renewal of crediting period.

Step 1.3: Assess whether the continuation of the use of current baseline equipment(s) or an investment is the most likely scenario for the crediting period for which renewal is requested

As explained in step 1.2, the baseline scenario was the electricity import/generation from the power plants connected to the electricity grid. The project activity in green field project and there is no any baseline equipment or investment involved in project activity. Therefore this condition is not applicable to the project activity.

Step 1.4: Assessment of the validity of the data and parameters

This step stipulates that “Where emission factors, values or emission benchmarks are used and determined only once for the crediting period, they should be updated, except if the emission factors, values or emission benchmarks are based on the historical situation at the site of the project activity prior to the implementation of the project and cannot be updated because the historical situation does not exist anymore as a result of the CDM project activity.” In the context of the present project activity the emission factor has been updated along with the approach used to calculate the emission factor.

Step 2: Update the current baseline and the data and parameters

As evident from the explanation provided above the baseline scenario remains unchanged. Only the approach used to calculate the baseline emission factor is updated as per the latest version of CEA Database available at the time of PDD submission for renewal.

In line with the project standard version 03.0, the impact of new relevant national and/or sectoral policies and circumstances on the baseline taking into account relevant EB guidance with regard to renewal of the crediting period at the time of requesting renewal of crediting period; and the correctness of the application of an approved baseline methodology for the determination of the continued validity of the baseline or its update, and the estimation of emission reductions for the applicable crediting period.

Impact of the national and/or sectoral policies and circumstances upon the baseline scenario of the project activity

The Government of India enacted the Electricity Act in the year 2003 to harmonize and rationalize the provisions in the existing laws. The Act consolidated the laws relating to generation, transmission, distribution, trading and use of electricity. With the Enactment of the act, the then existing laws viz, The Indian Electricity Act 1910, The Electricity Supply Act, 1948 and The Electricity Regulatory Commissions Act, 1998 were repealed. The Electricity Act 2003 was in force at the time of the completion of the baseline study for the registered PDD.

Section 3 of the said act required the Central Government to prepare the national electricity policy and tariff policy, in consultation with the State Governments and the Authority for development of the power system based on optimal utilization of resources such as coal, natural gas, nuclear substances or materials, hydro and renewable sources of energy. In accordance with the section 3 of the Electricity Act 2003, the Central Government notified the National Electricity Policy ¹² on 12th February 2005 which was in force at the time of completion of the baseline study as stated in the registered PDD of the project activity. This policy has not been revised since then and is currently in force as well.

In addition to the above policies, State Electricity Regulatory Commissions (SERCs) have announced preferential tariffs and Indian Renewable Energy Development Agency (IREDA) provides term loan assistance towards establishing biomass power projects. All these fiscal and financial incentives were in force at the time of completion of the baseline study for the registered PDD of the project activity and still continue to exist.

The state electricity regulatory commission issues tariff order in respect of procurement of power generated from renewables and there is no mandatory national and/or sectoral policies have come into effect that would affect the compliance of the current baseline. Hence, it can be concluded the current baseline complies with all relevant mandatory national and/or sectoral policies that have come into effect after the submission of the project activity for validation and are applicable at the time of requesting renewal of the crediting period.

¹² <http://www.cercind.gov.in/Act-with-amendment.pdf>

However, in spite of the financial incentives given by the government to renewable power projects in India the generation from the low cost must run resources connected to the Southern Grid has not increased to such an extent that this would lead to more than 50% contribution from the low cost must run resources towards the total generation from the Southern Grid.

The approved small scale methodology for Grid connected renewable electricity generation, AMS-I.D. (Version 18) has been used to determine the baseline and the estimation of emission reductions for the applicable crediting period. As referred in the methodology, “Tool to calculate the emission factor for an electricity system” (version 07.0) has been used to determine continued validity of the baseline based on combined margin (CM) calculations.

Parameter	Value	Nomenclature	Source
EF_{grid,CM,y}	0.9346 tCO ₂ /MWh	Combined margin CO ₂ emission factor for the project electricity system in year y	Calculated as the weighted average of the operating margin (0.75) & build margin (0.25) values, sourced from Baseline CO ₂ Emission Database, Version 16.0, Mar 2021 published by Central Electricity Authority (CEA), Government of India
EF_{grid,OM,y}	0.9568 tCO ₂ /MWh	Operating margin CO ₂ emission factor for the project electricity system in year y	Calculated as the last 3 year (2017-18, 2018-19, 2019-20) generation-weighted average, sourced from Baseline CO ₂ Emission Database, Version 16.0, Mar 2021 published by Central Electricity Authority (CEA), Government of India
EF_{grid,BM,y}	0.8682 tCO ₂ /MWh	Build margin CO ₂ emission factor for the project electricity system in year y	Baseline CO ₂ Emission Database, Version 16.0, Mar 2021 published by Central Electricity Authority (CEA), Government of India

3.5 Additionality

Regulatory Surplus Demonstration:

In India, there is no any regulation to install the wind projects and the project activity is a voluntary step taken by PP. In India, the fossil fuel based thermal power generation is dominant over the renewable based power generation, thus baseline scenario remains same as original. As discussed in section 3.4 of VCS PD, there is no any Impact of the national and/or sectoral policies and circumstances upon the baseline scenario of the project activity and project activity is additional as per CDM Tool for the demonstration and assessment of additionality and as per VCS Program rules.

There are no certain laws and regulations which give comparative advantage to more emission intensive technologies or less emission intensive technologies. There are no any Type E+ and E-

policies applicable to the project activity which prevent the implementation of local laws and regulations that would seek to contribute towards climate change mitigation. The project activity is in compliance with local laws and regulations. As explained in section 3.4, the current baseline complies with all relevant mandatory national and/or sectoral policies.

Project Additionality

As per the decision 17/cp.7 paragraph 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. The additionality aspects of the project are discussed below in accordance with Attachment A of appendix B of the simplified M & P for small scale CDM project activities that states:

“Project participants shall 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: a financially more viable alternative to the project activity would have led to higher emissions;
- (b) Technological barrier: a less technologically advanced alternative to the project activity involves lower risks due to the performance uncertainty or low market share of the new technology adopted for the project activity and so would have led to higher emissions;
- (c) Barrier due to prevailing practice: prevailing practice or existing regulatory or policy requirements would have led to implementation of a technology with higher emissions;
- (d) Other barriers: without the project activity, for another specific reason identified by the project participant, such as institutional barriers or limited information, managerial resources, organizational capacity, financial resources, or capacity to absorb new technologies, emissions would have been higher.”

Investment Additionality:

At the project conception stage, an investment analysis was conducted for the project activity under consideration by the project promoter with the equity Internal Rate of Return (IRR) as the financial indicator. IRR is one of the known financial indicators used by banks, financial institutions and project developers for financial evaluation of project feasibility during investment making decisions. At the project conceptualisation stage, the equity IRR for the project activity was calculated and compared with the benchmark or hurdle rate of investment for the approval of project of the project promoter. However, the equity IRR was found to be lesser than the hurdle rate of investment IRR for the project approval. The hurdle rate of investment (cost of equity) has been determined using the Capital Asset Pricing Model (CAPM) considering Beta values of power generating companies in India that were listed in the stock market at the time of this investment.

This is in relevance to the guidance to investment analysis issued in EB 41¹³ (paragraph 11) which 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 an equity IRR”. The project activity is a Greenfield wind power generation project that generates and supplies electricity to the Southern Regional Grid of India. The concept of generation of power through wind power has been conceived by other project developers also in the area concerned where the WTGs under consideration are commissioned. The tool for demonstration and assessment of additionality¹⁰ states that in such cases (where the project has more than one potential developer) the benchmark cannot be based on internal cost of equity hence, company specific parameters (such as company specific beta, etc.) should not be used and shall be based on publicly available data sources which can be clearly validated by the DOE. Accordingly, the cost of equity applicable to the project type has been calculated using publicly available financial data sources and has been considered as the benchmark.

The cost of equity can be computed by the formula shown below:

$$K_e = R_e + B \times R_m - R_f$$

where:

K_e = Cost of equity;

R_f = Risk-free rate of return;

B = Beta;

$R_m - R_f$ = Market risk premium;

Risk free rate:

The risk-free interest rate is the interest rate which is obtained by investing in financial instruments with no default risk, therefore the rate of interest on government bonds are considered as risk free rates. Accordingly the risk free rate has been taken from long dated Indian government bond rates available at the time of project approval by the project promoter. The data on government bond rates is published by Reserve Bank of India¹⁴.

The applicable risk free rate is 7.89 %.

Risk Premium:

¹³ http://cdm.unfccc.int/EB/041/eb41_repan45.pdf

¹⁴ <http://rbidocs.rbi.org.in/rdocs/AnnualReport/PDFs/79542.pdf>

The most common approach for estimating the risk premium is to base it on historical data, in the CAPM, the risk premium is estimated by looking at the difference between average return on stocks and average return on government securities over an extended period of history.

Therefore the risk premium has been calculated as the difference in compounded annual return between the BSE-Sensex and the Government bond rates, i.e. 1999 – 2007. The detailed calculations are presented in the attached excel sheet.

The applicable risk premium is 22.70 %.

Beta:

Beta (β) 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 applicable Beta value has been determined on the basis of the calculated Beta values of power generating companies in India which were listed on the stock exchange at the time of this investment. The table below summarises the beta values:

Company Name	Beta
CESC LTD	1.04
JAI PRAKASH HYDRO	0.66
NEYVELILIGNITE	0.95
RELIANCE INFRASTRUCTURE	0.72
TATA POWER	0.95
NTPC LTD	0.62
GUJARAT INDUSTRIES POWER COMPANT LTD	0.98
BF UTILITIES LIMITED	1.21

Minimum Beta = 0.62

Calculation of benchmark return on equity:

$$\begin{aligned}
 \text{Cost of Equity, } K_e &= R_e + B \times R_m - R_f \\
 &= (7.89 \% + 0.62 * 22.70 \%) \\
 &= 21.93 \%
 \end{aligned}$$

As can be seen, the benchmark cost of equity works out to 21.93 %

The various assumptions in the calculation of the IRR provided above are elucidated below.

Various Assumptions in Calculating Equity IRR:

SI.NO.	Parameters	Unit	Value (per 1.65 MW WTG)	Reference

1	Project Lifetime	Years	20	Proposal/Offer from VWTIPL to the project promoters for WTG supply.
2	Capacity of each individual WTG	MW	1.65	
3	No of WTGs installed	Nos.	2	
4	Estimated annual net generation from each WTG	Lakh kWh	56.57	
5	Tariff for Power sale to the SEB	INR/kWh	2.90	
6	Estimated annual escalation in Tariff	%	0	
7	Total Project Cost:			
A	-Cost of Land	INR Lakhs	1050.06	
B	-Cost of windmills, Tower & Electrical Items	INR Lakhs		
C	-Erection, Commissioning and Civil Work	INR Lakhs	44.94	
D	-Substation charges	INR Lakhs	0	
8	Insurance	INR Lakhs	4.93	
9	O&M Cost of the first year	INR Lakhs	12	
10	Service Tax on O&M cost each year	%	12.36	
11	O&M free for no. of years	Years	2	
12	Annual escalation on O&M cost	%	7.5	
13	Income Tax Rate	%	33.99	http://ezinearticles.com/?Direct-Tax-Rates-in-India-for-AY-2008--2009&id=906600
14	Book Depreciation Rate	%	4.50	As per TNERC Tariff Order
15	Accelerated Depreciation Rate	%	80	Direct Tax Ready Reckoner

The IRR for the project activity is calculated to be:

Name of the company	IRR	Benchmark
National Enterprises	13.39%	21.93 %

Sensitivity Analysis:

A Sensitivity Analysis is conducted to ensure the credibility and robustness of the IRR calculation with reasonable variations in the values of the various assumptions made for the relevant parameters, such that the IRR increases. For the IRR calculation presented above, an increment in the IRR can be a resultant of the increase in the project revenue, attributable to the following scenarios identified and addressed below:

1. Increased Tariff Rate realisation for power sale:

The project promoter has considered a tariff rate of Rs. 2.90/ kWh for the period of 20 years as the power purchase agreement is signed between the project promoter and Tamil Nadu Electricity Board for the same time frame. However, there can be situations, where in the tariff rate might suffer some fluctuations. Hence, a sensitivity analysis is carried by varying the tariff rate by 10% and is tabulated below:

Percentage Change in Tariff	-10%	0%	10%
Tariff Rate(Rs./unit)	2.61	2.90	3.19
IRR without CDM benefits	11.37%	13.39%	15.30%

The IRR does not cross the chosen benchmark even if the tariff rate increases by 10% of the existing value.

2. Increased electricity generation from the project activity, represented by an increment in the Plant Load Factor (PLF)

It can be perceived that financial return of the project activity is highly sensitive to generation. Therefore, variation in generation has been chosen as the parameter based on which the sensitivity analysis has been done. Given below are the results of 10% variation in generation on the returns to the project. The sensitivity analysis carried out for fluctuation in Plant Load Factor (PLF) value is being shown below in a table:

Percentage Change in PLF	-10%	0%	10%
PLF	35.23	39.14%	43.05%
IRR without CDM benefits	11.38%	13.39%	15.29%

The IRR does not cross the chosen benchmark even if the PLF increases by 10% of the existing value.

3. Variation in the project cost

It can be perceived that financial return of the project activity is highly sensitive to the project cost. Therefore, variation in the project cost has been chosen as the parameter based on which the sensitivity

analysis has been done. Given below are the results of 10% variation in the project cost on the returns to the project. The sensitivity analysis carried out for fluctuation in the project cost value is being shown below in a table:

Percentage change in the project cost	-10%	0%	10%
Total Project Cost (in Lacs INR)	1971	2190	2409
IRR without CDM benefits	15.91%	13.39%	11.44%

The IRR does not cross the chosen benchmark even if the Project Cost decreases 10% of the existing value.

In view of the above analysis, the proposed project activity is additional and not the same as the baseline scenario.

3.6 Methodology Deviations

Not Applicable

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

As per the approved consolidated Methodology AMS - I.D, version 18:

Baseline emissions include only CO₂ emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity. The methodology assumes that all project electricity generation above baseline levels would have been generated by existing grid-connected power plants and the addition of new grid- connected power plants. The baseline emissions are to be calculated as follows:

$$BE_y = EG_{PJ,y} \times EF_{grid,y}$$

Where:

BE_y = Baseline emissions in year y (tCO₂/yr)

EG_{PJ,y} = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the project activity in year y (MWh/yr)

$EF_{grid,y}$ = Combined margin CO₂ 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” (t CO₂/MWh). The emission factor is also abbreviated as $EF_{grid,CM,y}$ as per tool.

As per para 23 of methodology AMS I.D Version 18, The emission factor shall 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 t CO₂/MWh) of the current generation mix. The data of the year in which project generation occurs must be used.

PP has followed option a) for calculation of grid emission factor.

As per para 26 of AMS I.D methodology Version 18, If the project activity is the installation of a greenfield power plant, then:

$$EG_{PJ,y} = EG_{PJ, Facility,y}$$

Where:

$EG_{PJ, Facility,y}$ = Quantity of net electricity generation supplied by the project plant/unit to the grid in year y (MWh)

As per methodology, combined grid emission factor as per the “Tool to calculate the emission factor for an electricity system” version 07 is calculated as below.

CO₂ Baseline Database for the Indian Power Sector, Version 16, March 2021¹⁵ published by Central Electricity Authority (CEA), Government of India has been used for the calculation of emission reduction.

As per Methodological tool: Tool to calculate the emission factor for an electricity system (Version 07.0, EB 100, Annex 4), following six steps have been followed:

- (a) **Step 1:** Identify the relevant electricity systems;
- (b) **Step 2:** Choose whether to include off-grid power plants in the project electricity system (optional);
- (c) **Step 3:** Select a method to determine the operating margin (OM);
- (d) **Step 4:** Calculate the operating margin emission factor according to the selected method;
- (e) **Step 5:** Calculate the build margin (BM) emission factor;
- (f) **Step 6:** Calculate the combined margin (CM) emission factor.

Step 1: Identify the relevant electricity systems

¹⁵ https://cea.nic.in/wp-content/uploads/baseline/2021/06/User_Guide_ver_16_2021-1.pdf

As described in tool “For determining the electricity emission factors, identify the relevant project electricity system. Similarly, identify any connected electricity systems”. It also states that “If the DNA of the host country has published a delineation of the project electricity system and connected electricity systems, these delineations should be used”.

Keeping this into consideration, the Central Electricity Authority (CEA), Government of India has divided the Indian Power Sector into five regional grids viz. Northern, Eastern, Western, North-eastern and Southern.

However since August 2006, however, all regional grids except the Southern Grid had been integrated and were operating in synchronous mode, i.e. at same frequency. Consequently, the Northern, Eastern, Western and North-Eastern grids were treated as a single grid named as NEWNE grid from FY 2007-08 onwards for the purpose of this CO₂ Baseline Database. As of 31 December 2013, the Southern grid has also been synchronised with the NEWNE grid, hence forming one unified Indian Grid. Since the project supplies electricity to the Indian grid, emissions generated due to the electricity generated by the Indian grid as per CM calculations will serve as the baseline for this project.

Table: Geographical Scope of Indian Electricity Grid

Northern	Eastern	Western	North-Eastern	Southern
Chandigarh	Bihar	Chhattisgarh	Arunachal Pradesh	Andhra Pradesh
Delhi	Jharkhand	Gujarat	Assam	Karnataka
Haryana	Orissa	Daman & Diu	Manipur	Kerala
Himachal Pradesh	West Bengal	Dadar & Nagar Haveli	Meghalaya	Tamil Nadu
Jammu & Kashmir	Sikkim	Madhya Pradesh	Mizoram	Telangana
Punjab	Andaman & Nicobar	Maharashtra	Nagaland	Puducherry
Rajasthan		Goa	Tripura	Lakshadweep
Uttar Pradesh				Telangana
Uttarakhand				

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

Project participants may choose between the following two options to calculate the operating margin and build margin emission factor:

Option I: Only grid power plants are included in the calculation.

Option II: Both grid power plants and off-grid power plants are included in the calculation.

The Project Participant has chosen only grid power plants in the calculation.

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

The calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on one of the following methods, which are described under Step 4:

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

The data required to calculate Simple adjusted OM and Dispatch data analysis OM is not possible due to lack of availability of data to project developers. The choice of other two options for calculating operating margin emission factor depends on generation of electricity from low-cost/ must-run sources. In the context of the methodology low cost/must run resources typically include hydro, geothermal, wind, low cost biomass, nuclear and solar generation.

Share of Must-Run (Hydro/Nuclear) (% of Net Generation)

	2014-15	2015-16	2016-17	2017-18	2018-19
India	16.8%	15.1%	14.6%	14.3%	14.5%

Data Source: Central Electricity Authority (CEA) database Version 16, March 2021

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 Indian grid is less than 50 % of the total generation. Thus the Average OM method cannot be applied, as low cost/must run resources constitute less than 50% of total grid generation.

The simple OM emission factor is calculated as the generation-weighted average CO₂ emissions per unit net electricity generation (tCO₂/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/units.

For the simple OM, the simple adjusted OM and the average OM, the emissions factor can be calculated using either of the two following data vintages:

- (a) **Ex-ante option:** if the ex-ante option is chosen, the emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required. For grid power plants, use 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.

OR

(b) **Ex-post option:** if the ex-post option is chosen, the emission factor is determined for the year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring.

PP has chosen ex-ante option for calculation of Simple OM emission factor using a 3-year generation-weighted average, based on the most recent data available at the time of submission of the PD to the DOE for validation.

OM determined at validation stage will be the same throughout the crediting period. There will be no requirement to monitor & recalculate the emission factor during the crediting period.

Step 4: Calculate the operating margin emission factor ($EF_{grid,OMSimple,y}$) according to the selected method

The operating margin emission factor has been calculated using a 3 year data vintage:

Net Generation in Operating Margin (GWh) (incl. Imports)			
	2017-18	2018-19	2019-20
INDIAN Grid	960,693	995,957	965,009

Simple Operating Margin (tCO ₂ /MWh) (incl. Imports)			
	2017-18	2018-19	2019-20
INDIAN Grid	0.9543	0.9603	0.9555

Weighted Generation Operating Margin	
INDIAN Grid	0.9568

Step 5: Calculate the build margin (BM) emission factor ($EF_{grid,BM,y}$)

As per Methodological tool: “Tool to calculate the emission factor for an electricity system” (Version 07.0, EB 100, Annex 4) para 72:

In terms of vintage of data, project participants can choose between one of the following two options:

(a) **Option 1** - for the first crediting period, calculate the build margin emission factor ex ante based on the most recent information available on units already built for sample group m at the time of PD submission to the DOE for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of

submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

(b) **Option 2** - For the first crediting period, the build margin emission factor shall be updated annually, ex post, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin emissions factor shall be calculated ex ante, as described in Option 1 above. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used.

Option 1 as described above is chosen by PP to calculate the build margin emission factor for the project activity. BM is calculated ex-ante based on the most recent information available at the time of submission of PD and is fixed for the entire crediting period.

Build Margin (tCO ₂ /MWh) (not adjusted for imports)	
	2018-19
INDIAN Grid	0.8682

Step 6: Calculate the combined margin (CM) emission factor ($EF_{grid,CM,y}$)

As per Methodological tool: “Tool to calculate the emission factor for an electricity system” (Version 07.0, EB 100, Annex 4) para 81:

The calculation of the combined margin (CM) emission factor ($EF_{grid,CM,y}$) is based on one of the following methods:

- (a) Weighted average CM; or
- (b) Simplified CM.

PP has chosen option (a) i.e weighted average CM to calculate the combined margin emission factor for the project activity.

The combined margin emissions factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} * W_{OM} + EF_{grid,BM,y} * W_{BM}$$

$EF_{grid,BM,y}$ = Build margin CO₂ emission factor in year y (t CO₂/MWh)

$EF_{grid,OM,y}$ = Operating margin CO₂ emission factor in year y (t CO₂/MWh)

W_{OM} = Weighting of operating margin emissions factor (per cent)

W_{BM} = Weighting of build margin emissions factor (per cent)

The following default values should be used for W_{OM} and W_{BM} :

For wind project activities: $W_{OM} = 0.75$ and $W_{BM} = 0.25$ (owing to their intermittent and non-dispatchable nature) for the first crediting period and for subsequent crediting periods. Since project activity meets above criteria, the above weightage has been considered for OM and BM.

$$\begin{aligned} \text{Therefore, } EF_{\text{grid,CM,y}} &= 0.9568 * 0.75 + 0.8682 * 0.25 \\ &= 0.9346 \text{ tCO}_2/\text{MWh} \end{aligned}$$

Baseline emission factor (EF_y):

The baseline emission factor is calculated using the combined margin approach as described in Step 6 above:

$$\text{Therefore, } EF_{\text{grid,y}} = EF_{\text{grid,CM,y}} = 0.9346 \text{ tCO}_2/\text{MWh}$$

$$\text{Baseline Emission (BE}_y) = EG_{\text{PJ,y}} \times EF_{\text{grid,y}}$$

$$\text{Baseline Emission (BE}_y) = 7,938 \text{ MWh} \times 0.9346 \text{ tCO}_2\text{e/MWh}$$

$$\text{Baseline Emission (BE}_y) = 7,419 \text{ tCO}_2\text{e (annually)}$$

4.2 Project Emissions

As the project activity is a wind power project, there are no anthropogenic emissions by sources of GHGs within the project boundary as a result of the project activity. Hence there are no project emissions to be considered. $PE_y = 0$

4.3 Leakage

There are no anthropogenic emissions identified by sources outside the project boundary due to the project activity. Furthermore, the equipments (WTGs) used by the project activity are newly procured and hence not transferred from another project. Thus, there are no leakage emissions attributable to the project activity. Hence, $LE_y = 0$

4.4 Net GHG Emission Reductions and Removals

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y$$

Where

ER_y	=	Emission reductions in year y (t CO ₂ e)
BE_y	=	Baseline emissions in year y (t CO ₂ e)
PE_y	=	Project emissions in year y (t CO ₂ e)
LE_y	=	Leakage emissions in year y (t CO ₂ e)

As mentioned in section 4.2 and 4.3 the project activity involves zero project and leakage emissions, hence

$$ER_y = BE_y - 0 - 0$$

$$ER_y = BE_y$$

$$BE_y = EG_{PJ,y} \times EF_{grid,y}$$

$$BE_y = 7,983 \text{ MWh} \times 0.9346 \text{ tCO}_2\text{e/MWh}$$

$$BE_y = 7,419 \text{ tCO}_2\text{e}$$

Year	Estimated baseline emissions or removals (tCO _{2e})	Estimated project emissions or removals (tCO _{2e})	Estimated leakage emissions (tCO _{2e})	Estimated net GHG emission reductions or removals (tCO _{2e})
01-January-2020 to 31-December-2020	7,419	0	0	7,419
01-January-2021 to 31-December-2021	7,419	0	0	7,419
01-January-2022 to 31-December-2022	7,419	0	0	7,419
01-January-2023 to 31-December-2023	7,419	0	0	7,419
01-January-2024 to 31-December-2024	7,419	0	0	7,419
01-January-2025 to 31-December-2025	7,419	0	0	7,419
01-January-2026 to 31-December-2026	7,419	0	0	7,419
01-January-2027 to 31-December-2027	7,419	0	0	7,419
01-January-2027 to 31-December-2028	7,419	0	0	7,419

01-January-2029 to 31-December-2029	7,419	0	0	7,419
Total	7,4190	0	0	74,190

5 MONITORING

5.1 Data and Parameters Available at Validation

Data / Parameter	Operating margin emission factor (inclusive of imports) - $EF_{grid,OM,y}$
Data unit	tCO ₂ / MWh
Description	Operating Margin CO ₂ emission factor of the grid
Source of data	CO ₂ Baseline Database for the Indian Power Sector, User Guide (Version 16, Date: March, 2021) ¹⁶
Value applied	0.9568
Justification of choice of data or description of measurement methods and procedures applied	Information available from authorised government agencies – National standard value has been calculated by Central Electricity Authority (CEA) as per guidelines of the ‘Tool to calculate the emission factor for an electricity system
Purpose of Data	To calculate Baseline Emission
Comments	The parameter has been calculated ex-ante and are remain fixed for the entire duration of the crediting period of the project activity. The relevant data are recorded in electronic form and the same can be archived for two years beyond the crediting period.

Data / Parameter	Build margin emission factor - $EF_{grid,BM,y}$
Data unit	tCO ₂ / MWh
Description	Bulid Margin CO ₂ emission factor of the grid
Source of data	CO ₂ Baseline Database for the Indian Power Sector, User Guide (Version 16, Date: March, 2021) ¹⁷

¹⁶ https://cea.nic.in/wp-content/uploads/baseline/2021/06/User_Guide_ver_16_2021-1.pdf

¹⁷ https://cea.nic.in/wp-content/uploads/baseline/2021/06/User_Guide_ver_16_2021-1.pdf

Value applied	0.8682
Justification of choice of data or description of measurement methods and procedures applied	Information available from authorised government agencies – National standard value has been calculated by Central Electricity Authority (CEA) as per guidelines of the ‘Tool to calculate the emission factor for an electricity system
Purpose of Data	To calculate Baseline Emission
Comments	The parameter has been calculated ex-ante and are remain fixed for the entire duration of the crediting period of the project activity. The relevant data are recorded in electronic form and the same can be archived for two years beyond the crediting period.

Data / Parameter	Combined Margin Emission Factor - $EF_{grid,CM, y}$
Data unit	tCO ₂ / MWh
Description	CO ₂ Baseline Database for the Indian Power Sector, User Guide (Version 16, Date: March, 2021) ¹⁸
Source of data	CO ₂ Baseline Database
Value applied	0.9346
Justification of choice of data or description of measurement methods and procedures applied	Information available from authorised government agencies – National standard value has been calculated by Central Electricity Authority (CEA) as per guidelines Tool to calculate the emission factor for an electricity system’
Purpose of Data	To calculate Baseline Emission
Comments	The parameter has been calculated ex-ante and remains fixed for the entire duration of the crediting period of the project activity. The relevant data are recorded in electronic form and the same can be archived for two years beyond the crediting period.

5.2 Data and Parameters Monitored

Data / Parameter	$EG_{BL,y}$
Data unit	MWh/Year

¹⁸ https://cea.nic.in/wp-content/uploads/baseline/2021/06/User_Guide_ver_16_2021-1.pdf

Description	Net Electricity Exported by the two WTGs to the Southern Regional Electricity Grid ¹⁹ in the year y
Source of data	Monthly Electricity Export Invoices raised to regional electricity utility company for the two WTGs
Description of measurement methods and procedures to be applied	<p>The data is calculated using certain measured and estimated parameters. (Measured parameters viz. import of electricity from the grid, export of electricity to the grid and the reactive power generated and estimated parameters viz. transmission losses) in a way as described in section 5.3 of PD. The Energy Meters (Tri vector meter of accuracy class 0.5) installed at the substation and the WTG switch yard measures the variable on a continuous basis. These are two-way meters. Utility officials take the readings (joint meter reading) on these meters on monthly basis and the same reading is used to determine the net power exported to the grid and determine the extent of mitigation of GHG over a period of time. A detail on metering and measurement methods is given in section 5.3 of the PD.</p> <p>Metering equipment: Tri vector Energy Meter</p> <p>Accuracy Class: 0.5 or 0.2</p> <p>Data type: Estimated (using meter readings) Archiving: Electronic</p> <p>Recording Frequency: Monthly</p> <p>Responsibility: The O&M operator is responsible for the regular recording of data.</p> <p>Calibration Frequency: The meters are calibrated by the State Utility testing division annually.</p>
Frequency of monitoring/recording	Monthly & Continuously.
Value applied	7,938
Monitoring equipment	Tri vector Energy Meter
QA/QC procedures to be applied	The project activity emission reductions are based on the net electricity supplied ($EG_{BL,y}$) by the individual WTG. $EG_{BL,y}$ is referred from the monthly invoice raised by the PP to State Utility Department based on the monthly JMR Report issued by State Electricity Department to the Project Proponent. The main meter at the sending end of the sub-station are sealed by and are in the custody of State Electricity Department. The main meter is used

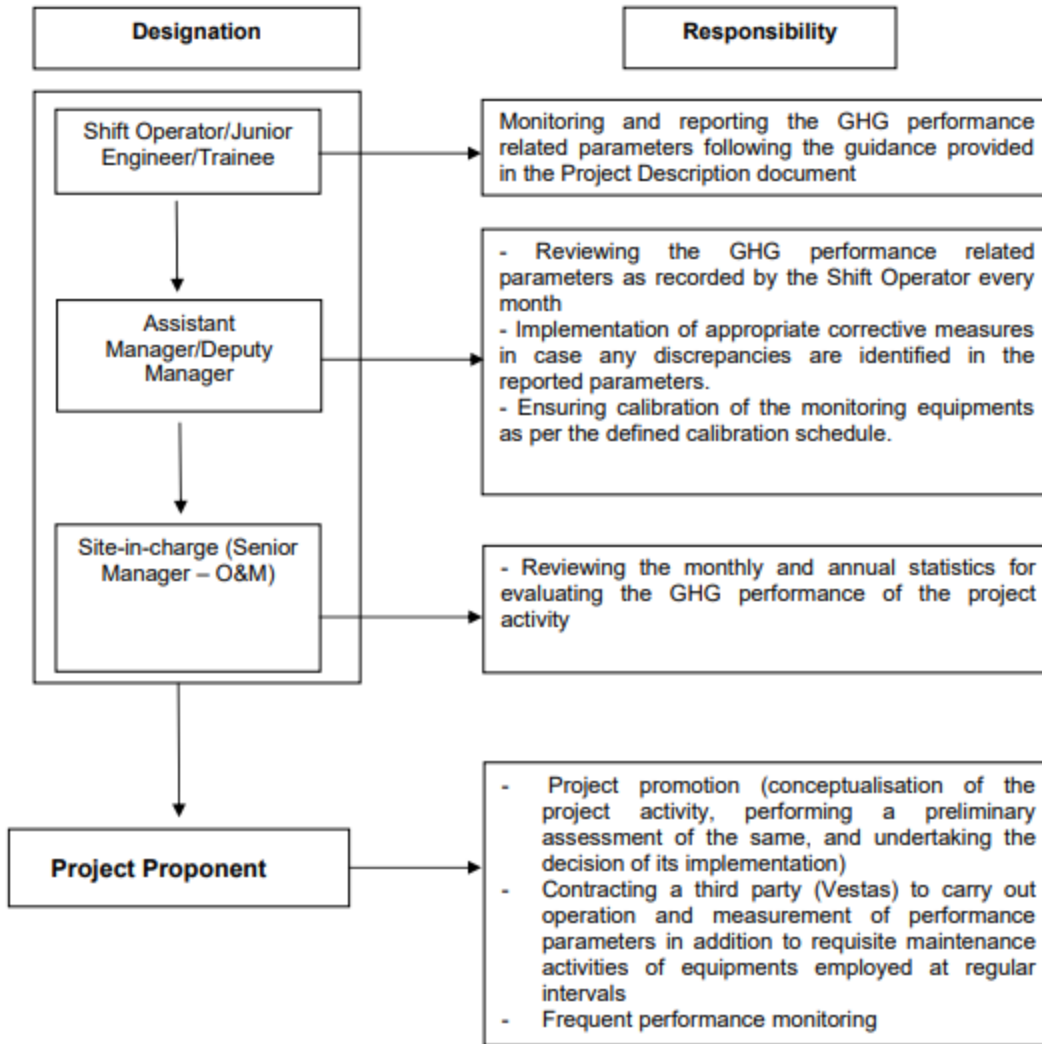
¹⁹ Now under Indian grid

	for the monitoring purpose of the said parameter and the same is in line with the State electricity regulatory commission guideline.
Purpose of data	To Determine baseline emissions
Calculation method	NA
Comments	The relevant data are recorded in electronic form and the same along with the electricity bills can be archived for two years beyond the crediting period.

5.3 Monitoring Plan

The project activity falls in the technology measure as described in the paragraph 1 of the Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories. The applicable simplified baseline and monitoring methodology for selected small scale CDM project activities AMS I.D. version 18 requires monitoring of the following.

- Metering the electricity generated by the renewable technology
- Wind based electricity generation is not associated with any kind of leakages. Hence, the sole parameter for monitoring is the electricity supplied to the grid. The Project is operated and managed by Vestas. 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. The accuracy of monitoring parameter is ensured by adhering to the calibration and testing procedure as set in the power purchase agreement. The project adheres to all the mandatory regulatory and statutory requirements at the state as well as national level. The operational and management structure implemented by National Enterprises along with Vestas is as follows



The daily generation report is sent to National Enterprises by Vestas. The daily generation report contains data on grid availability, machine availability and generation of electricity. National Enterprises reviews the machine availability from the generation report. The monitored data is maintained both as soft and hard copies in the form of photo copies of generation report, issued by TNEB every month showing export and import of energy. The copies of such TNEB generation report are primary document relating to actual number of units fed to the grid and are maintained for 10 + 2 (crediting + 2 years) years. Daily generation reports from Vestas are compiled into monthly reports and saved electronically for 10+2 years (crediting + 2 years).

APPENDIX

Use appendices for supporting information. Delete this appendix (title and instructions) where no appendix is required.