

WIND POWER PROJECT BY HZL IN KARNATAKA



Document Prepared By EKI Energy Services Limited

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Prepared By	Bhaskar Dutta Manager- Operations EKI Energy Services Limited
Contact	EnKing Embassy, Office No. 201, Plot 48, Scheme 78, Part 2 Vijay Nagar, Near brilliant Convention Centre, Indore- 452010 Madhya Pradesh, India Website: www.enkingint.org Email ID: bhaskar@enkingint.org T: +91 731 42 89 086, M: +91 9109916710

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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

Hindustan Zinc Ltd. (HZL), a vertically integrated natural resources enterprise, headquartered at Udaipur, Rajasthan having broad operations ranging from exploration, mining, and ore processing to smelting of non-ferrous metals is the owner and project proponent of the proposed project activity.

The project activity is a 34.4 MW wind power project consisting of 43 WTGs of individual capacity 0.8 MW sourced from Enercon India Limited at Gadag in Karnataka, India. The electricity generated from the wind farm is exported to the regional electricity grid and sold to the state electricity utility.

Since, wind power is Green House Gas (GHG) emissions free, the power generated prevents the anthropogenic greenhouse gas GHG emissions generated by the fossil fuel based thermal power stations comprising coal, diesel, furnace oil and gas.

The commissioning details of the WTGs are mentioned in the section 2.1 of this report.

Technical Specifications of WTG's involved in the project activity are as follows:

E-48 SL TECHNICAL DATA

Rated capacity: 800 kW

Rotor diameter: 53 m

Hub height: 75 m

Rotor with Pitch Control

Type: Upwind rotor with active pitch control

Direction of rotation: Clockwise

Number of blades: 3

Swept area: 2198 m²

Blade material: Fiberglass (reinforced epoxy) with integral lightning protection

Rotor speed: Variable, 12-29 rpm

Tip speed: 80 m/s max.

Pitch control: Continuous variable pitching mechanism

Generator: Synchronous - Type

This is a multi-pole variable speed generator. Due to this and Power electronics the Gear Box which steps up the speed to meet the speed of Induction Generator is eliminated resulting in reduced transmission losses, and elimination of wear and tear of the Gear Box and oil leakage associated with it.

Hub: Casted Steel

Bearings: Tapered roller bearings

Grid Feeding: AC-DC-AC through Convertor – Invertor

Braking System: 3 independent Aero Brakes with power back up supply.

Yaw Control: Active through adjustment gears, friction damping

Cut-in Wind Speed: 3 m/s

Rated Wind Speed: 12 m/s

Tower: E-48 SL– Concrete, 74 m height

There is no technology transfer involved in the project activity.

Total emission reduction achieved in this monitoring period

During the Current Monitoring Period from 01/12/2013 to 31/12/2016 (First and last date included) the project activity has supplied 160,950.215 MWh of electricity, and thus contributing to the GHG reductions 149,571 tCO₂e.

1.2 Sectoral Scope and Project Type

The project activity falls under the following Sectoral scope and Project Type:

Sectoral Scope : 01 - Energy industries (renewable / non-renewable sources)
Project Type : I - Renewable Energy Projects
Project Category : Grid-connected electricity generation from renewable sources
 ACM0002- Version 06

1.3 Project Proponent

Organization name	Hindustan Zinc Limited
Contact person	Mr. V. Jayaraman
Title	VP & Head (EOHS)
Address	CPP-CLZS, Chanderiya Lead Zinc Smelter, Putholi, Chittorgarh - 312021, Rajasthan, India
Telephone	91-1472-257950
Email	v.jayaraman@vedanta.co.in

1.4 Other Entities Involved in the Project

Organization name	EKI Energy Services Limited
Role in the project	Project Consultant
Contact person	Manish Dabkara
Title	CEO & MD
Address	EnKing Embassy, Office No 201, Plot 48, Scheme 78, Part 2, Vijay Nagar, Indore- 452010, Madhya Pradesh, India.
Telephone	+91-731-4289086
Email	manish@enkingint.org

1.5 Project Start Date

Start date of the project activity is the earliest date of interconnection with the grid i.e. 17-12-2007. This is the date of earliest commissioning of 5*0.8 MW=4MW Wind Project activity by Hindustan Zinc Limited.

The commissioning details have been mentioned in section 2.1 of this report.

1.6 Project Crediting Period

Start Date of Current Crediting period: 17/12/2007

Crediting period: 17/12/2007 – 16/12/2017 (Renewable)

1.7 Project Location

The project activity is located at Gadag district in Karnataka. The site is composed of elevated plains. The nearest airport is Hubli Airport wherein daily flights from Bangalore and Mumbai are operated. The project activity lies between the following geographical coordinates:

Latitude: 15°15 '43"- 15°25'0" N

Longitude: 75°31'15" - 75°36'57" E

Host party: India

Region/State/Province: Karnataka

District: Gadag

Villages: Kurthkoti and Malasamudra

Location Details for Gadag, Karnataka Wind Power Project

S.No	Village Name	Loc. Nos.	Co-ordinates	Control Cabinet Nos.
1	Kurthkoti	142	(560306.2,1697983.0)	2109
2		143	(560242.5,1698162.0)	2103
3		144	(560169.4,1698362.0)	2111
4		145	(560111.1,1698550.0)	2116
5		146	(560055.0,1698770.0)	2088
6		147	(559943.4,1698979.0)	1831
7		148	(559880.9,1699154.0)	2383
8		149	(559808.2,1699356.0)	1689
9		150	(559735.9,1699555.0)	1819
10		151	(559648.5,1699744.0)	2417
11		159N	(559134.0,1701147.0)	2458
12		160	(559635.9,1701209.0)	2413
13		161N	(559277.0,1700745.0)	2437
14		162N	(559363.0,1700575.0)	2448
15	Mallasamudra	182	(560701.4,1699680.0)	2165
16		183	(560639.0,1699884.0)	2312

17	Kurthkoti	184	(560568.9,1700094.0)	2295
18		185	(560483.9,1700292.0)	2315
19		186	(560410.8,1700478.0)	2229
20		187	(560336.7,1700674.0)	2283
21		188N	(559913.0,1700644.0)	2488
22		189	(560188.4,1701079.0)	2395
23		190	(560100.1,1701256.0)	2381
24		191	(560016.9,1701450.0)	2435
25		192N	(559489.0,1701639.0)	2489
26	Mallasamudra	213	(560311.5,1702131.0)	2501
27		214	(560383.5,1701931.0)	2500
28		215	(560455.8,1701742.0)	2427
29		216	(560529.4,1701535.0)	2436
30		217	(560603.1,1701334.0)	2449
31		218N	(561154.0,1701214.0)	2491
32		219N	(561221.0,1701637.0)	2451
33		220	(560821.4,1700734.0)	2327
34		221	(560876.2,1700531.0)	2321
35		222	(560965.2,1700339.0)	2299
36		223	(561022.0,1700147.0)	2360
37		224	(561109.8,1699947.0)	2347
38		225	(561185.8,1699741.0)	2366
39		253	(561084.6,1701400.0)	2499
40	Kurthkoti	150A	(559253.0,1699492.0)	2434
41		160A	(559156.0,1700914.0)	2419
42		149A	(559324.0,1699293.0)	2447
43		151A	(559457.0,1699936.0)	2408

The project location is highlighted in the map below.



1.8 Title and Reference of Methodology

Title of the baseline methodology: “Consolidated methodology for grid-connected electricity generation from renewable sources”.

Title of the monitoring methodology: “Consolidated monitoring methodology for zero-emissions grid-connected electricity generation from renewable sources”.

Reference: ACM0002, Version 06 (19th May, 2006), Sectoral scope: 1.

It has been referred from the list of approved methodologies for CDM project activities in the UNFCCC CDM website (<http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html>)

Tool: Tool for the demonstration and assessment of additionality (Version 04)

1.9 Other Programs

The project was registered as a CDM project activity with the UNFCCC on 15th January 2009 under the approved consolidated baseline methodology- ACM0002 Version 06.

CDM project ID: 1824 (<http://cdm.unfccc.int/Projects/DB/BVQI1208874936.63/view>)

1.10 Sustainable Development

The project activity has contributed to sustainable development in the region as follows:

Social well-being

- The project activity has led to alleviation of poverty by establishing direct and indirect benefits through employment generation and improved economic activities by strengthening of local grid of the state electricity utility.
- The infrastructure in and around the project area has also improved due to project activity. This includes development of road network and improvement of electricity quality, frequency and availability as the electricity is fed into a deficit grid.

Economic well-being

- The generated electricity is fed into the southern regional grid through local grid, thereby improving the grid frequency and availability of electricity to the local consumers (villagers & sub-urban habitants) which will provide new opportunities for industries and economic activities to be setup in the area thereby resulting in greater local employment, ultimately leading to overall development.
- The project activity also leads to diversification of the national energy supply, which is dominated by conventional fuel based generating units.

Environmental well-being

- The project utilizes wind energy for generating electricity which otherwise would have been generated through alternate fossil fuel based power plants, contributing to reduction in specific emissions (emissions of pollutant/unit of energy generated) including GHG emissions.
- As wind power projects produce no end products in the form of solid waste (ash etc.), they address the problem of solid waste disposal encountered by most other sources of power.
- Being a renewable resource, using wind energy to generate electricity contributes to resource conservation. Thus the project causes no negative impact on the surrounding environment contributing to environmental well-being.

Technological well-being

- The project activity leads to the promotion of Wind Electric Generators (WTGs) into the region (demonstrating the success of wind based renewable energy generation), which is fed into the

nearest sub-station (part of the Southern Regional Grid), thus increasing energy availability and improving quality of power under the service area of the substation. Hence the project leads to technological well-being.

2 IMPLEMENTATION STATUS

2.1 Implementation Status of the Project Activity

The project activity has been exporting electricity to the grid continuously since commissioning. The commissioning details of the WTGs are mentioned in the table below.

Sr. No.	No. of machines commissioned	Commissioning date	Certificate No.
1	10	25-06-08	EEE/TL&SS/GDG/425-35 dt.26/06/2008
2	8	30-03-08	EEE/TL&SS/GDG/2453-63 dt.31/03/2008
3	6	31-05-08	EEE/TL&SS/GDG/276-86 dt.02/06/2008
4	10	17-03-08	EEE/TL&SS/GDG/2364-74 dt.17/03/2008
5	5	17-12-07	EEE/TL&SS/GDG/1733-42 dt.18/12/2007
6	4	28-07-08	EEE/TL&SS/GDG/661-70 dt.29/07/2008

Technology

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

E-48 SL TECHNICAL DATA

Rated capacity	: 800 kW
Rotor diameter	: 53 m
Hub height	: 75 m
Rotor Type	: Upwind rotor with active pitch control
Direction of rotation	: Clockwise
Number of blades	: 3
Blade material	: Fiberglass (reinforced epoxy) with integral lightning Protection
Tip speed	: 80 m/s max
Pitch control	: Continuous variable pitching mechanism

This is a multi-pole variable speed generator. Due to this and Power electronics, the Gear Box which steps up the speed to meet the speed of Induction Generator is eliminated resulting in reduced transmission losses, and elimination of wear and tear of the Gear Box and oil leakage associated with it.

Hub	: Casted Steel
Bearings	: Tapered roller bearings
Grid Feeding	: AC-DC-AC through Convertor - Invertor
Braking System	: 3 independent Aero Brakes with power back up supply.
Yaw Control	: Active through adjustment gears, friction damping

Cut-in Wind Speed	: 3 m/s
Rated Wind Speed	: 12 m/s
Tower	: E-48 SL – Concrete, 74 m height

All the WTGs are in operation and no abnormal circumstance occurred during this monitoring period. The project promoter signed operation and maintenance agreements with the O & M contractor of the wind turbines. The performance of the turbines, safety in operation and scheduled / breakdown maintenances is the responsibility of O & M contractor and are organized and monitored by them, hence the authority and responsibility of project management on site lies with the O & M contractor will maintains all the data / records for the project monitoring. Enercon is the O&M contractor for the project activity.

During the monitoring period no such events or situations occurred which will cause impact on the actual operation of the project activity. No abnormal circumstance occurred during this monitoring period. Enercon operation and maintenance activities are ISO certified and all the events are recorded in the log book available at the project site. As a part of regular maintenance the machines are stopped for mechanical and electrical maintenance.

As per the VCS guidelines 'if the energy generating equipment is transferred from another activity, leakage is to be considered'. In the project activity, there is no transfer of energy generating equipment and therefore the leakage from the project activity is considered as zero. There are no changes like project proponent or other entities during the monitoring period

Feeder details of the WTGs are as follows:

All the WTGs of the project participant are connected through a single 33 KV feeder line to Harti Sub-station. No other WTGs are connected to the 33 KV feeder line connected to S/s name Harti

2.2 Deviations

2.2.1 Methodology Deviations

Not Applicable.

2.2.2 Project Description Deviations

According to point 2 of paragraph 3.6.1 of the VCS Standard Version 3.4, 'Where the deviation does not impact the applicability of the methodology, additionality or the appropriateness of the baseline scenario, and the project remains in compliance with the applied methodology, the deviation shall be described and justified in the monitoring report. This shall include a description of when the changes occurred and the reasons for the changes.'

The Monitoring plan described in the CDM registered PDD includes parameters like EG_{43} and EG_{VCB} . However, these parameters are not be utilized in the calculation of the emission reductions, as emission reductions has been claimed against the net electricity supplied to the State Electricity Grid and are calculated from the B-Forms issued by Hubli Electricity Supply Company Limited. So these parameters has been removed from the data and parameters monitored, since these does not have direct impact upon the project activity emission reductions. A monthly meter reading taken jointly by state utility and PP representative is recorded in the B-Forms issued by Hubli Electricity Supply Company Limited (State Electricity Board). The net

electricity exported to the grid is the difference of export, import and transmission losses measured through the main meter. The invoices rise on the basis of B- Form and after cross verification the payment issued by DISCOM. These values are used in ER calculation which can be cross verified from invoices.

2.3 Grouped Project

Not Applicable, as this is not a Grouped project.

2.4 Safeguards

2.4.1 No Net Harm

The project activity does not involve any major construction activity. It primarily requires the installation of the WTGs, 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 power project activity operations do not result in direct air pollution, noise pollution. Please refer below web link for the same.

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

2.4.2 Local Stakeholder Consultation

The project proponents organized stakeholders meeting in order to take into account the concerns of the nearby villagers regarding the project implementation. As a part of continuous feedback from stakeholders, there were no other major comments or protest raised by the stakeholders and they were totally in support for setting up of these kinds of projects in the region.

The PP has also placed a grievance register onsite, where-in the stakeholders can put down his/her complain and the same if found genuine will be addressed immediately.

3 DATA AND PARAMETERS

3.1 Data and Parameters Available at Validation

Data / Parameter	EF _{OM,y}
Data unit	tCO ₂ /MWh
Description	Operating Margin emission factor for Southern regional grid
Source of data	Referred from CO ₂ Baseline Database for the Indian Power Sector prepared by Central Electricity Authority, Version 3.0.
Value applied	1.004 tCO ₂ /MWh

Justification of choice of data or description of measurement methods and procedures applied	CEA has Calculated it as per ACM0002 with 3 years vintage data (2004-05, 2005-06 and 2006-07) and option of ex ante calculation based on Simple Operating Margin Method. Computed once during PDD finalization.
Purpose of the data	Baseline calculations
Comments	-

Data / Parameter	EF_{BM,y}
Data unit	tCO ₂ /MWh
Description	Build Margin emission factor for Southern regional grid
Source of data	Referred from CO ₂ Baseline Database for the Indian Power Sector prepared by Central Electricity Authority, Version 3.0.
Value applied	0.7054 tCO ₂ /MWh
Justification of choice of data or description of measurement methods and procedures applied	CEA has Calculated it as per ACM0002 for the year 2005-06. The build margin is calculated in this database as the average emissions intensity of the 20% most recent capacity additions in the grid based on net generation and option of ex ante calculation. Computed once during PDD finalization.
Purpose of the data	Baseline calculations
Comments	-

Data / Parameter	EF_y
Data unit	tCO ₂ /MWh
Description	Combined Margin emission factor for Southern regional grid
Source of data	Estimated figure based on 75% of OM and 25% of BM values, Version 3.0.
Value applied	0.9293 tCO ₂ /MWh
Justification of choice of data or description of measurement methods and procedures applied	CEA has calculated it as per ACM0002 with 3years vintage data and option of ex ante calculation based on "75% of OM and 25% of BM values approach. Computed once during PDD finalization.
Purpose of the data	Baseline calculations
Comments	-

3.2 Data and Parameters Monitored

Data / Parameter	EG_y
Data unit	MWh
Description	Net quantity of electricity exported to KPTCL facility

Source of data	Joint Meter Reading Sheets
Description of measurement methods and procedures to be applied	Electricity exported to KPTCL facility will be measured at the main meter connected to the incoming feeder of KPTCL facility. The procedures for metering will be as per the provisions of the power purchase agreement.
Frequency of monitoring/recording	Calculated monthly
Value monitored	160,950.215 MWh
Monitoring equipment	Energy Meters of Accuracy class 0.2 s
QA/QC procedures to be applied	Regular calibration of all the meters undertaken at required intervals and faulty meters replaced immediately. The KPTCL meter calibrated once in a year. Detailed schedule of Calibration of meters used during the monitoring period has been mentioned in Appendix 1
Purpose of the data	Baseline calculation
Calculation method	Net Electricity Exported = Electricity Exported – 115% of Electricity Imported – Transmission losses¹ Net electricity generated calculated from the readings of electricity exported to the grid and electricity imported from the grid indicated by the main meter connected to the incoming feeder of KPTCL. The Delivered Energy metered by the Parties at the high voltage side of the step up transformer installed at the Receiving Station. The electricity generated by the Project metered by the Parties at the high voltage side of the step up transformer installed at the Project Site. The WTGs of a single customer (HZL in this case) at a particular site are connected to a Vacuum Circuit Breaker metering yard (VCB) which in turn connects to a feeder that ultimately leads to the shared main KPTCL meter at the substation maintained by Wind World India Limited. Data monitoring takes place at the VCB metering yard and WTG (through SCADA system). The electricity metered at the KPTCL meter is proportionally divided among the customers connected to the meter on the basis of the prorata readings taken at the VCB end. The emission reduction calculations are done on the basis of the KPTCL Main meter reading
Comments	The data will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whichever occurs later.

¹ It is to be noted here that electricity imported from the grid has been adjusted to 115% of the monitored value as per guideline of Karnataka Electricity Regulatory Commission (KEREC).

Data / Parameter	EG _{y, Export}
Data unit	MWh
Description	Quantity of electricity exported to KPTCL facility
Source of data	Joint Meter Reading Sheets
Description of measurement methods and procedures to be applied	Electricity exported to KPTCL facility will be measured at the main meter connected to the incoming feeder of KPTCL facility. The procedures for metering will be as per the provisions of the power purchase agreement.
Frequency of monitoring/recording	Measured & Recording continuously and Reporting monthly
Value monitored	162,193.547MWh
Monitoring equipment	Energy Meters of Accuracy class 0.2s
QA/QC procedures to be applied	Regular calibration of all the meters undertaken at required intervals and faulty meters replaced immediately. The KPTCL meter calibrated once in a year. Detailed schedule of Calibration of meters used during the monitoring period has been mentioned in Appendix 1 It is noted here that a delay in calibration frequency has been observed for the months of July to October 2014 and Oct 2015 to Oct 2016 has been observed, hence maximum permissible error factor has been applied on export values as per the accuracy class of meters to retain conservativeness.
Purpose of the data	Baseline calculation
Calculation method	-
Comments	The data will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whichever occurs later.

Data / Parameter	EG _{y, Import}
Data unit	MWh
Description	Quantity of electricity imported from KPTCL facility
Source of data	Joint Meter Reading Sheets
Description of measurement methods and procedures to be applied	Electricity imported from KPTCL facility will be measured at the main meter connected to the incoming feeder of KPTCL facility. The procedures for metering will be as per the provisions of the power purchase agreement.
Frequency of monitoring/recording	Measured & Recording continuously and Reporting monthly
Value monitored	139.864.MWh

Monitoring equipment	Energy Meters of Accuracy class 0.2s
QA/QC procedures to be applied	Regular calibration of all the meters undertaken at required intervals and faulty meters replaced immediately. The KPTCL meter calibrated once in a year. Detailed schedule of Calibration of meters used during the monitoring period has been mentioned in Appendix 1 It is noted here that a delay in calibration frequency has been observed for the months of July to October 2014 and Oct 2015 to Oct 2016 has been observed, hence maximum permissible error factor has been applied on import values as per the accuracy class of meters to retain conservativeness.
Purpose of the data	Baseline calculation
Calculation method	-
Comments	The data will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whichever occurs later.

3.3 Monitoring Plan

The monitoring plan has been devised as per approved consolidated monitoring methodology ACM0002 - "Consolidated monitoring methodology for zero-emissions grid-connected electricity generation from renewable sources".

The methodology requires monitoring of the following parameters:

1. Electricity generation from the proposed project activity;
2. Data needed to recalculate the operating margin emission factor, if needed, based on the choice of the method to determine the operating margin (OM), consistent with "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (ACM0002);
3. Data needed to recalculate the build margin emission factor, if needed, consistent with "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (ACM0002);

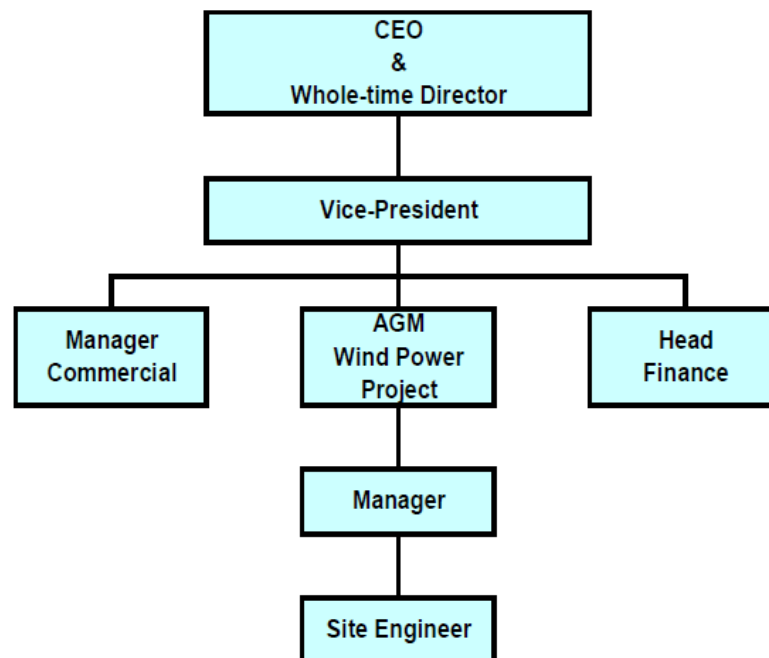
For the project activity to establish its creditable emission reduction, it has to record the actual electricity generation, which would displace equivalent units of electricity at the operating and build margin of the grid. Since, the simple OM emission factor is calculated based on a 3 year average, based on the most recent statistics available at the time of PDD preparation, its updation based on ex post monitoring is not required. For BM calculation, option 1 (refer ACM0002) has been chosen, which is calculated ex ante based on the most recent information, hence its monitoring is also not required. Hence, under the monitoring protocol for the project it is required to monitor and record the electricity generated and exported by the wind farm to the regional grid.

Operation and Maintenance

To ensure trouble free operations and efficient generations through all the wind turbines, HZL has entered into a comprehensive Operation and Maintenance agreement with the manufactures of the turbines for a period of 10 years. The contractor WWIL, under the O&M contract with HZL is responsible for the operation and maintenance of the project activity.

Authority and Responsibility

The authority and responsibility of project management as well as registration, monitoring, measurement and reporting lies with HZL. HZL has formulated a Project Team to ensure proper and continuous monitoring of the performance of turbines and generation of power.



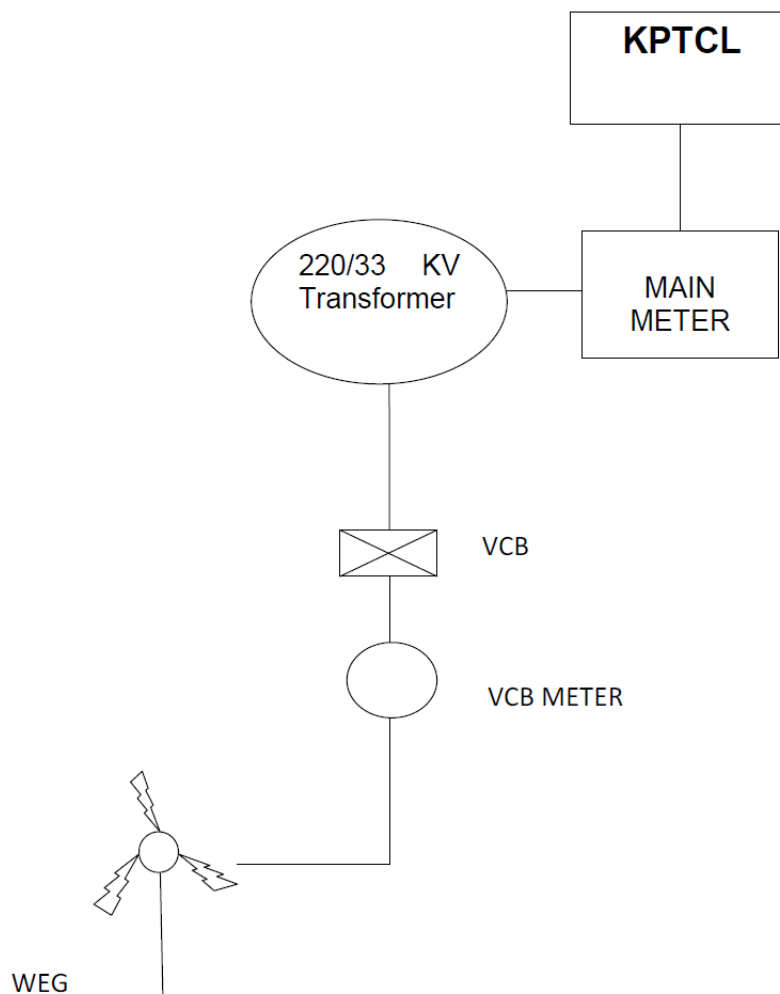
The general conditions set out for metering, recording, meter readings, meter inspections, Test & Checking and communication shall be as per the PPA (power purchase agreement) with HESCOM .

Metering

The Delivered Energy shall be metered by the Parties at the high voltage side of the step up transformer installed at the Receiving Station. The electricity generated by the project shall be metered by the Parties at the high voltage side of the step up transformer installed at the Project Site. The WTGs of a single customer (HZL in this case) at a particular site are connected to a Vacuum Circuit Breaker metering yard (VCB) which in turn connects to a feeder that ultimately leads to the shared main KPTCL meter at the substation maintained by WWIL. Data monitoring takes place at the VCB metering yard and WTG (through SCADA system). The electricity

metered at the KPTCL meter is proportionally divided among the customers connected to the meter on the basis of the prorata readings taken at the VCB end. The emission reduction calculations are done on the basis of the KPTCL Main meter reading.

General arrangement of WTG, VCB and Main meter is shown below:



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

Meter Readings

The monthly meter readings (both main and check meters) at the Project Site and the Receiving Station shall be taken simultaneously and jointly by the Parties on the first day of the following month at 12 Noon. The recorded metering data shall be downloaded through meter recording instrument.

Inspection of Energy Meters

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

Records

O&M Contractor WWIL will maintain an accurate and up-to-date operating log at the wind farm site with records of:

- i. Hourly logs of real and reactive power generation, frequency, transformer tap position, bus voltage(s), Main meter and Back up meter readings and any other data mutually agreed.
- ii. Any unusual conditions found during operation/inspections
- iii. Chart and printout of event loggers, if any, for system disturbances/outages
- iv. All the records will be preserved for 2 years beyond the crediting period.

Billing

The billing will be on monthly basis. The Hubli Electricity Supply Company Limited will be billed by HZL based on statement given by SLDC/Hubli Electricity Supply Company Limited at the end of each month for the energy supplied.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

The baseline emissions (BE_y in tCO_2e) are the product of the baseline emissions factor (EF_y in tCO_2/MWh) times the electricity supplied by the project activity to the grid (EG_y in MWh) as described in registered PDD.

$$BE_y = EF_y * EG_y$$

Where,

BE_y - baseline emissions, tCO_2e

EG_y - Net Quantity of Electricity supplied to KPTCL facility

EF_y - grid emission factor, i.e 0.9293 t CO₂/MWh (it has been fixed ex-ante for 1st renewable crediting period)

$$EG_y = EG_{y, \text{Export}} - EG_{y, \text{Import}} - \text{Transmission loss}$$

$$= 162,193,547.5 - 139,864.72 - 1,103,467.756$$

$$= 160,950,215 \text{ kWh}$$

$$= 160,950.215 \text{ MWh}$$

And;

$$BE_y = EG_y * EF_y$$

$$= 160,950.215 * 0.9293$$

$$= 149,571 \text{ tCO}_2\text{e (Round down to nearest integer)}$$

4.2 Project Emissions

There are no project emissions from the project activity.

4.3 Leakage

There are no leakage emissions from the project activity.

4.4 Net GHG Emission Reductions and Removals

Year	Baseline emissions or removals (tCO ₂ e)	Project emissions or removals (tCO ₂ e)	Leakage emissions (tCO ₂ e)	Net GHG emission reductions or removals (tCO ₂ e)
2013	3,741	0	0	3,741
2014	51,605	0	0	51,605
2015	45,570	0	0	45,570
2016	48,655	0	0	48,655
Total	149,571	0	0	149,571

It is to be noted here that as per the estimated emission reduction to be achieved from the project activity for the current monitoring period is 200,809 tCO₂e, whereas actual emission reductions achieved are 149,571 tCO₂e, which is approximately 26% lower than the estimated emission reductions. The generation of electricity depends upon many other climatic conditions, and not within the control of the project participant. The lower generation during the current verification period is hence due to certain natural conditions and hence acceptable.

APPENDIX 1: METER CALIBRATION DETAILS

Particular	Meter Serial No.	Accuracy Class	Calibration Date	Validity	Calibration Date	Validity	Calibration Date	Validity
Metering Point- 1								
Main Meter	07022944	0.2 s	23/07/2013	22/07/2014	20/10/2014	19/10/2015	27/10/2016	26/10/2017
Check Meter	07022903	0.2 s	23/07/2013	22/07/2014	20/10/2014	19/10/2015	27/10/2016	26/10/2017
Metering Point- 2								
Main Meter	07022908	0.2 s	23/07/2013	22/07/2014	20/10/2014	19/10/2015	27/10/2016	26/10/2017
Check Meter	07022915	0.2 s	23/07/2013	22/07/2014	20/10/2014	19/10/2015	27/10/2016	26/10/2017
Metering Point- 3								
Main Meter	06760786	0.2 s	23/07/2013	22/07/2014	20/10/2014	19/10/2015	27/10/2016	26/10/2017
Check Meter	06767587	0.2 s	23/07/2013	22/07/2014	20/10/2014	19/10/2015	27/10/2016	26/10/2017

It is noted here that a delay in calibration frequency has been observed for the months of July to October 2014 and Oct 2015 to Oct 2016, hence maximum permissible error factor has been applied on export, import and transmission losses values as per the accuracy class of meters to retain conservativeness for the respective months.

APPENDIX 2: BREAKDOWN DETAILS FOR THE CURRENT MONITORING PERIOD

Gen. Date	Breakdown Remark	Breakdown Hrs.
01-Apr-2014	Preventive Check	0.20
01-Apr-2014	Elec SafetyChainStop	0.20
01-Apr-2014	Pitch BatterySurveillance2	12.30
01-Apr-2014	Preventive Check	0.40
01-Apr-2014	Line Breakdown due to	0.10

	Earthfault	
01-Apr-2014	Line Breakdown due to Earthfault	0.10
02-Apr-2014	Elec FB YawCW Error	6.40
02-Apr-2014	Pitch Akku1Voltage LowStop	6.00
02-Apr-2014	Elec FB GeneratorFan	0.10
03-Apr-2014	Preventive Check	0.10
07-Apr-2014	Rep Pitch FreqConvPitch2 ErrStop	0.70
07-Apr-2014	Rep Pitch CANComFail	0.60
07-Apr-2014	Elec UPSBattChange	3.40
11-Apr-2014	Rep Pitch CANComFail	6.90
11-Apr-2014	IDRV Audit	1.10
12-Apr-2014	Theft	3.70
02-May-2014	Shut Down Taken By EB	24.00
02-May-2014	Shut Down Taken By EB	24.00
02-May-2014	Shut Down Taken By EB	24.00
02-May-2014	Shut Down Taken By EB	24.00
02-May-2014	Shut Down Taken By EB	10.30
02-May-2014	Shut Down Taken By EB	24.00
02-May-2014	Shut Down Taken By EB	24.00
02-May-2014	Shut Down Taken By EB	24.00