

49.5 MW WIND POWER PROJECT BY FFCEL IN PAKISTAN



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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

The project activity titled “**49.5 MW Wind Power Project by FFCEL in Pakistan**” is validated under Voluntary Carbon Standard (VCS), version number 3.4. This monitoring report covers the activity from 16-05-2013 to 30-11-2014.

The project proponent, **FFC Energy Limited** (hereafter referred to as the “FFCEL”) is a subsidiary of Fauji Fertilizer Company Limited (hereafter referred to as the “FFC”). FFCEL has setup a 49.5 MW wind energy power project at Jhampir, Distt – Thatta, Sindh, Pakistan.

The project activity is renewable power generation from wind and supply of the power to the grid. The total installed capacity of the project activity is 49.5 MW equipped with 33 Wind Turbine Generators (WTGs) of 1.5 MW installed capacity each.

Technology specifications¹:

Parameter	Values
Rotor	
Number of blades	3
Rotor speed	9.9-17.3 rpm
Rotor diameter	77 m
Swept area	4,657 square meters
Power regulation	Pitch
Rated power from	13 m/s
Cut-in wind speed	3.5 m/s
Cut-out wind speed	25 m/s
Survival wind speed	50.1 m/s (at 85 m hub height)
Pitch regulation	Individual electromotive pitch
Total weight	c. 35,000 kg
Blades	
Blade length	37.5 m
Material	Glass fibre-reinforced plastic
Blade Weight	c. 6,500 kg
Gearbox	
Type	Combined planetary and spur gear
Gear ratio	1 : 104
Weight	c. 14,000 kg
Oil quantity	350 l
Oil change	Semi-annual check, change as required
Main shaft bearing	Self-aligning roller bearing
Generator	
Power	1,500 kW (adjustable)
Voltage	690 V
Type	Double-fed asynchronous generator, air-cooled
Speed	1,000 - 1,950 rpm $\pm$ 10 %
Enclosure class	IP 54
Coupling	Multiple steel disc, insulated
Efficiency	Efficiency c. 95 % at full load, (electrical system overall)

¹ http://www.nordex-online.com/en/produkte-service/wind-turbines/s77-15-mw/product-data-sheet-s77-15mw.html?no_cache=1

Weight	c. 7,000 kg
Power factor	0.9 ind. to 0.95 cap.
Yaw system	
Yaw bearing	Four-point bearing
Brake	Hydraulic disc brake with 10 calipers
Yaw drive	4 induction motors
Speed	c. 0.75 °/s
Control System	
Type	Microprocessor
Grid connection	Via IGBT converter
Scope of monitoring	Remote monitoring of more than 300 different parameters, e.g. temperature sensors, hydraulic sensors, pitch parameters, vibration, speed, generator torque, wind speed and direction, etc.
Recording	Production data, event list, long and short-term trends
Brake	
Design	Three independent systems, fail safe (individual pitch)
Operational brake	Electromotive blade pitch
Secondary brake	Disc brake
Tower	
Type	Modular steel cylindrical tower with upper segment conical, Total 4 Segments
Hub height	Tubular tower 80 m, Class IEC 2a

The project activity got commissioned on 16th May 2013. Thus, this has been considered as the start date of the project. The main purpose of the project activity is to reduce Greenhouse Gas (GHG) emission by power generation from wind. In the monitoring period, **141,433 tCO₂** emission reductions have been achieved by generating power through this project activity.

1.2 Sectoral Scope and Project Type

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

Project Type: Non-Grouped

1.3 Project Proponent

Organization name	M/s.FFC Energy Limited
Contact person	Brig. Muhammad Naeem SI(M) Retd.
Title	Designation: Project Director – FFCEL Wind Power Project
Address	FFC SONA Tower, 156 the Mall, Rawalpindi, Pakistan
Telephone	Work Phone: +92-51-8457501
Email	mnaeem@ffc.com.pk

1.4 Other Entities Involved in the Project

There is no other entity involved in the project activity.

1.5 Project Start Date

As per VCS standard, version 3.4, the project start date is the date on which the project began generating GHG emission reductions. The project activity achieved commercial operations date on 16th May 2013 and started supplying power to the grid and thus began generating GHG

emission reductions. Therefore, Project Start Date is 16th May 2013 (Day: 16, Month: May, Year: 2013).

1.6 Project Crediting Period

Crediting Period Start Date: 16/05/2013 (Day: 16, Month: May, Year: 2013)

Crediting Period End Date: 15/05/2023 (Day: 15, Month: May, Year: 2023)

Total number of years of the crediting period: 10 years

1.7 Project Location

Project is located at Jhimpir, District Thatta, Sindh, Pakistan. Geo-coordinates of individual WTGs are provided below²:

Turbine No	Easting 'E' (M)	Northing 'N' (M)
T-01	397089	2773257
T-02	397226	2773647
T-03	396806	2773917
T-04	396621	2774104
T-05	397843	2774073
T-06	397505	2774307
T-07	397367	2773072
T-08	397621	2772897
T-09	396548	2773623
T-10	396936	2774702
T-11	397131	2774562
T-12	398397	2773482
T-13	398881	2773222
T-14	398183	2773155
T-15	398398	2772974
T-16	398657	2772798
T-17	399243	2773093
T-18	400099	2772348
T-19	398288	2772430
T-20	398900	2772607
T-21	398603	2772209
T-22	398891	2772011
T-23	399157	2771828
T-24	399473	2771610
T-25	399758	2771414
T-26	400348	2771824
T-27	399286	2772390
T-28	399583	2772208
T-29	399782	2771962
T-30	399846	2772687
T-31	399534	2772901
T-32	400120	2771238
T-33	397624	2773479

The above mentioned geo-coordinates are provided in Universal Transverse Mercator (UTM) system. The applicable grid zone³ is 42 R.

² Layout plan dated 7/11/2012 prepared for “49.5 MW wind power project at Jhimpir”

³ <http://www.dmap.co.uk/utmworld.htm>

The project location has been highlighted on the map of Pakistan⁴:-



⁴ <http://www.mapsofworld.com/pakistan/>

1.8 Title and Reference of Methodology

**ACM 0002 - Grid-connected electricity generation from renewable sources (Large-Scale)⁵
Version – 15.0**

Title and reference of tools applied to the project activity:

Tool for the demonstration and assessment of additionality, version 7.0.0

<http://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-01-v7.0.0.pdf>

1.9 Other Programs

Emission Trading Programs and other Binding Limits:

The project participant confirmed that net GHG emission reductions or removals generated during this monitoring period have not been used for any compliance under any programs or mechanisms.

Other forms of Environmental Credit:

The Project participant confirmed that the project activity has not sought or received another form of GHG related environmental credit, including renewable energy certificates during this monitoring period.

Participation under other GHG programs:

The project participant confirmed that the project is not registered under any other programs.

2 IMPLEMENTATION STATUS

2.1 Implementation Status of the Project Activity

This project has an installed capacity of 49.5 MW and generated 222.976 GWh of net electricity generation during the crediting period 16-05-2013 to 30-11-2014. The above energy potential is harnessed by installing 33 number of Nordex S77-rated capacity 1.5 MW machines.

There are no outages during the current monitoring period which have directly impacted the GHG emission reductions.

2.2 Deviations

2.2.1 Methodology Deviations

There is no methodology deviation involved during the current monitoring period.

2.2.2 Project Description Deviations

There is no project description deviation involved during the current monitoring period.

⁵ <http://cdm.unfccc.int/methodologies/DB/MPY3HVJIMTKE5P0UNTYE827D6Q7EHB>

2.3 Grouped Project

There is no grouping involved in the project activity.

3 DATA AND PARAMETERS

3.1 Data and Parameters Available at Validation

Data / Parameter	$EF_{grid,OMy}$
Data unit	tCO ₂ /MWh
Description	Operating margin CO ₂ emission factor for grid in the year y
Source of data	<i>Pakistan Energy Yearbook published by Ministry of Petroleum & Natural Resources</i>
Value applied:	0.7625
Justification of choice of data or description of measurement methods and procedures applied	Calculated ex ante as per "Tool to calculate the emission factor for an electricity system, ver. 04.0" as 3-year generation-weighted average of latest three years, 2011,2012, 2013, data obtained from Pakistan Energy Yearbook published by Ministry of Petroleum & Natural Resources, Hydrocarbon Development Institute of Pakistan.
Purpose of Data	Calculation of baseline emissions
Comments	Computed once during VCS-PD finalization (ex-ante) and will remain same throughout the crediting period.

Data / Parameter	$EF_{grid,BMy}$
Data unit	tCO ₂ /MWh
Description	Build margin CO ₂ emission factor for grid in the year y
Source of data	<i>Pakistan Energy Yearbook published by Ministry of Petroleum & Natural Resources</i>
Value applied:	0.2496
Justification of choice of data or description of measurement methods and procedures applied	Calculated ex ante as per "Tool to calculate the emission factor for an electricity system, ver. 04.0" based on the most recent year 2013 data available from Pakistan Energy Yearbook published by Ministry of Petroleum & Natural Resources, Hydrocarbon Development Institute of Pakistan.
Purpose of Data	Calculation of baseline emissions
Comments	Computed once during VCS-PD finalization (ex-ante) and will remain same throughout the crediting period.

Data / Parameter	$EF_{grid,CM,y}$
Data unit	tCO ₂ /MWh
Description	Combined margin CO ₂ emission factor for grid in the year y
Source of data	Calculated weighted average combined margin using equation – $EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$ The default values for w_{OM} and w_{BM} are taken as applicable to wind power generation project activities as $w_{OM} = 0.75$ and $w_{BM} = 0.25$.
Value applied:	0.6343
Justification of choice of data or description of measurement methods and procedures applied	Calculated ex ante as per “Tool to calculate the emission factor for an electricity system, ver. 04.0” as follows: $EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$
Purpose of Data	Calculation of baseline emissions
Comments	Computed once during VCS-PD finalization (ex-ante) and will remain same throughout the crediting period.

3.2 Data and Parameters Monitored

Data / Parameter	$EG_{export,y}$
Data unit	MWh
Description	Electricity exported to the grid by the project activity in year y
Source of data	Joint monthly meter reading report
Description of measurement methods and procedures to be applied	Energy meters installed at Jhampir 132 kV line and Nooriabad 132 kV line measures the export and import of electricity on continuous basis. Meter readings are taken and verified, once in a month, jointly by the representatives of NTDC and the representative of FFCEL. Meter readings taken from both feeders will be added to arrive at electricity exported to the grid by the project activity in year y.
Frequency of monitoring/recording	Measured continuously, read monthly, Value Applied is the measured quantity in the present monitoring period
Value applied:	223421
Monitoring equipment	Energy Meter
QA/QC procedures to be applied	The data is cross-checked with the invoices raised in case sale of the electricity and electricity bills in case of captive use. As per NEPRA grid code, meters shall be calibrated atleast once in two years to verify meter accuracy. The metering points to record net electricity exported to grid are at the Jhampir -132 kV line and Nooriabad – 132 kV line.

	The metering system has an accuracy class of 0.2 or better and is located within the substation. Under the provisions of EPA, as part of metering system of wind farm, two independent energy meters have been installed at each feeders (Jhampir and Nooriabad) in the substation (i) Metering System and (ii) Back-up Metering System. These meters are of identical type and accuracy class. The Metering System and the Back-Up Metering System is jointly sealed by NTDC and FFCEL. Metering system is used for billing purposes. In case the Metering System has a failure, the Back-Up Metering System is used for the same purpose. In case the Metering System has a failure, the data from the Back-Up Metering System shall be used for emission reduction calculation.
Purpose of data	Calculation of baseline emissions
Calculation method	$EG_{\text{export},y} = EG_{\text{export},y, \text{Jhampir}} + EG_{\text{export},y, \text{Nooriabad}}$ $EG_{\text{export},y, \text{Jhampir}}$ = Electricity exported to the grid measured at Jhampir 132 kV line $EG_{\text{export},y, \text{Nooriabad}}$ = Electricity exported to the grid measured at Nooriabad 132 kV line
Comments	The data will be archived in electronic and physical form for the crediting period + 2 years

Data / Parameter	$EG_{\text{import},y}$
Data unit	MWh
Description	Electricity imported from the grid by the project activity in year y
Source of data	Joint monthly meter reading report
Description of measurement methods and procedures to be applied	Energy meters installed at Jhampir 132 kV line and Nooriabad 132 kV line measures the export and import of electricity on continuous basis. Meter readings are taken and verified, once in a month, jointly by the representatives of National Transmission & Despatch Company (NTDC) and the representative of FFCEL. Meter readings taken from both feeders will be added to arrive at electricity imported from the grid by the project activity in year y.
Frequency of monitoring/recording	Measured continuously, read monthly, Value Applied is the measured quantity in the present monitoring period
Value applied:	445
Monitoring equipment	Energy Meter
QA/QC procedures to be applied	The data is cross-checked with the invoices raised in case sale of the electricity and electricity bills in case of captive use. As per National Electric Power Regulatory Authority (NEPRA) grid code, meters shall be calibrated atleast once in two years to verify meter accuracy.

	The metering points to record net electricity exported to grid are at the Jhampir -132 kV line and Nooriabad – 132 kV line. The metering system has an accuracy class of 0.2 or better and is located within the substation. Under the provisions of Energy Purchase Agreement (EPA), as part of metering system of wind farm, two independent energy meters have been installed at each feeders (Jhampir and Nooriabad) in the substation (i) Metering System and (ii) Back-up Metering System. These meters are of identical type and accuracy class. The Metering System and the Back-Up Metering System is jointly sealed by NTDC and FFCEL. Metering system is used for billing purposes. In case the Metering System has a failure, the Back-Up Metering System is used for the same purpose. In case the Metering System has a failure, the data from the Back-Up Metering System shall be used for emission reduction calculation.
Purpose of data	Calculation of baseline emissions
Calculation method	$EG_{import,y} = EG_{import,y, Jhampir} + EG_{import,y, Nooriabad}$ $EG_{import,y, Jhampir}$ = Electricity imported from the grid measured at Jhampir 132 kV line $EG_{import,y, Nooriabad}$ = Electricity imported from the grid measured at Nooriabad 132 kV line
Comments	The data will be archived in electronic and physical form for the crediting period + 2 years

Data / Parameter	$EG_{PJ,y}$
Data unit	MWh
Description	Quantity of net electricity supplied to the grid as a result of the implementation of the project activity in year y
Source of data	Joint monthly meter reading report
Description of measurement methods and procedures to be applied	Energy meter installed at Jhampir 132 kV line and Nooriabad 132 kV line measures the export and import of electricity on continuous basis. Meter readings are taken and verified, once in a month, jointly by the representatives of NTDC and the representative of FFCEL. The net electricity supplied to the grid is calculated by subtracting the import of the electricity from the export of the electricity.
Frequency of monitoring/recording	Measured continuously, read monthly, Value Applied is the measured quantity in the present monitoring period
Value applied:	222976
Monitoring equipment	Energy Meter
QA/QC procedures to be applied	The data is cross-checked with the invoices raised in case sale of the electricity and electricity bills in case of captive use.

	As per NEPRA grid code, meters shall be calibrated atleast once in two years to verify meter accuracy. The metering points to record net electricity exported to grid are at the Jhampir -132 kV line and Nooriabad – 132 kV line. The metering system has an accuracy class of 0.2 or better and is located within the substation. Under the provisions of EPA, as part of metering system of wind farm, two independent energy meters have been installed at each feeders (Jhampir and Nooriabad) in the substation (i) Metering System and (ii) Back-up Metering System. These meters are of identical type and accuracy class. The Metering System and the Back-Up Metering System is jointly sealed by NTDC and FFCEL. Metering system is used for billing purposes. In case the Metering System has a failure, the Back-Up Metering System is used for the same purpose. In case the Metering System has a failure, the data from the Back-Up Metering System shall be used for emission reduction calculation.
Purpose of data	Calculation of baseline emissions
Calculation method	Net electricity fed to the grid is calculated as $EG_{BL,y} = EG_{export,y} - EG_{import,y}$
Comments	The data will be archived in electronic and physical form for the crediting period + 2 years

3.3 Monitoring Plan

Monitoring of emission reductions has been carried as per the applied methodology in the project activity i.e. ACM0002, version 15.0, which requires monitoring of the following relevant parameters:

- $EF_{grid,CM,y}$: Combined margin CO₂ emission factor for the grid in the year y
- $EG_{PJ,y}$: Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year y

Since the project proponent has chosen ex-ante determination of CO₂ emission factor for the grid, the monitoring of operating margin emission factor and build margin emission factor is not required. Further, wind based electricity generation is not associated with any kind of leakages. Hence, the sole parameter for monitoring is the electricity produced and supplied to the grid by the project activity.

The general conditions set out for metering, recording, meter readings, meter inspections, test & checking and communication has been carried out as per the Power Purchase Agreement signed by the project proponent with National Electric Power Regulatory Authority.

The personnel appointed by the project owner are in charge of the monitoring plan.

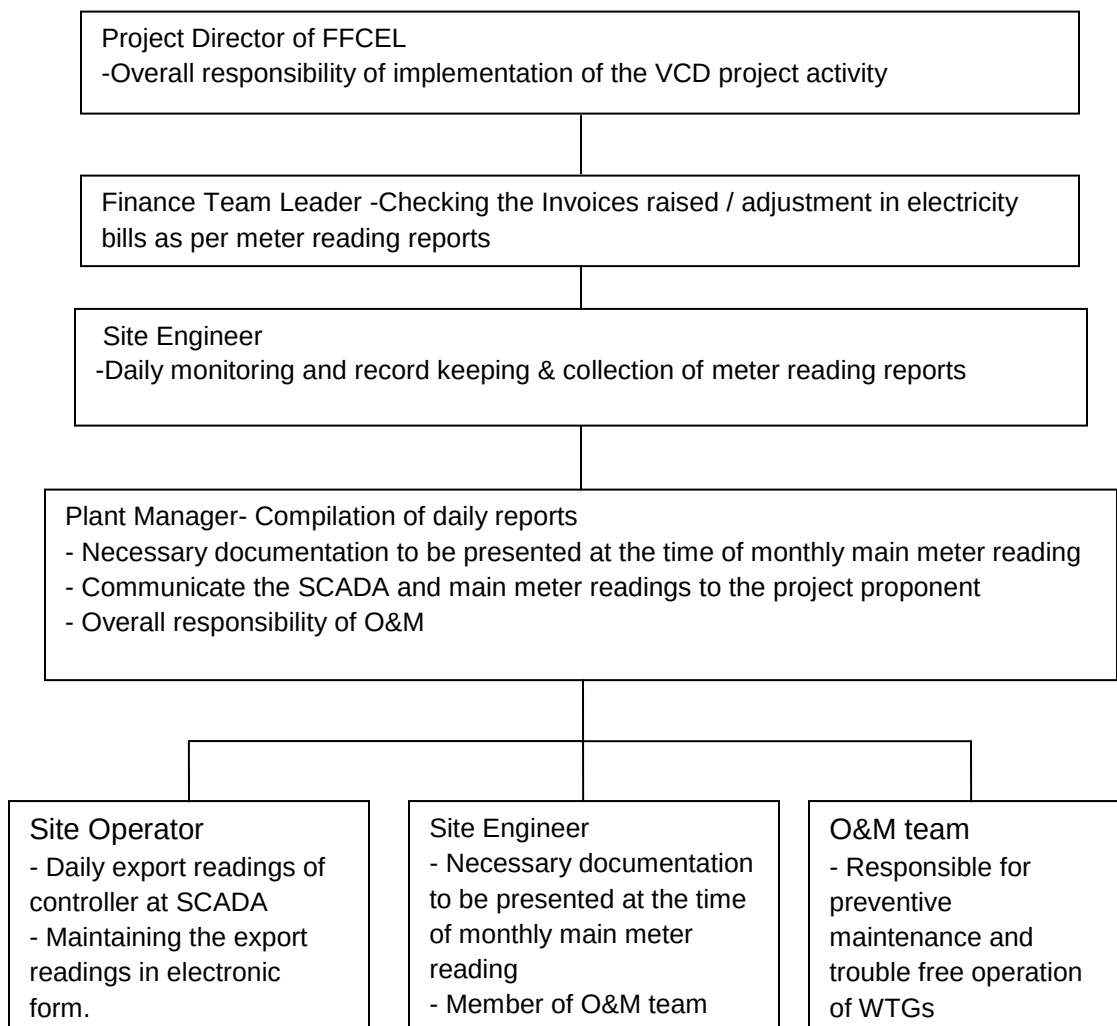
1. Monitoring objects

The main monitoring object is the electricity delivered to the grid.

2. Management structure

The project owner has appointed personnel to carry out the monitoring plan.

The personnel structure along with assigned responsibility is as follows:



3. Monitoring equipment and installation

The meters are installed at the interconnection point to the grid for monitoring the electricity delivered to the grid. The accuracy of the meters and the calibration is according to National standards.

4. Data collection

The project owner and the grid company are responsible for checking the meters. During the monitoring period it was ensured that all meters are sealed and without damages.

5. Meters maintenance and calibration

As per NEPRA grid code, meters shall be calibrated at least once in two years to verify meter accuracy. All meters were calibrated on 30/07/2012 and hence the schedule date for meter calibration was 29/07/2014. There was a delay in calibration of meters and these meters got calibrated on 13/09/2014. The results of the delayed calibration do not show any errors in the measuring equipments hence in line with CDM validation and verification standard, Version 07.0, maximum permissible error i.e. 0.2% has been applied in a conservative manner to the period (30/07/2014 to 12/09/2014) not covered by calibrated meters. PP has applied error to July-2014, August-2014 and September-2014 as a conservative approach.

The meters have been sealed after calibration. Neither the project owner, FFCEL nor the Power Purchaser, NTDC had unsealed or changed the meters in the absence of the other party.

There was no instance of meter failures or error found to be outside acceptable limits of accuracy during the present monitoring period.

6. QA/QC procedures:

The meters have been jointly inspected and sealed and have not been interfered by either project owner, FFCEL or Power Purchaser, NTDC without the presence of the other party.

7. Data archiving:

Data from monthly metering reports have been archived in electronic and physical form for the entire crediting period plus two years.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

The baseline emission calculation for the project activity is attributable to the CO₂ Emission that could have been produced by the fossil fuel based power plants in absence of the proposed project activity. Therefore the amount electricity supplied to the national grid will be multiplied by the grid emission factor to calculate the baseline emissions reduced by the proposed project activity.

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

BE_y Baseline emissions in year y (tCO₂)

$EG_{PJ,y}$ Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh/yr); equal to $EG_{facility,y}$ - Quantity of net electricity generation supplied by the project to the grid in year y (MWh)

$EF_{grid,CM,y}$ Combined margin CO₂ emissions factor in year y (tCO₂/MWh)

Sl. No	Monitoring Period	Emission Factor, (EF _y) (tCO ₂ /MWh)	Net Electricity delivered to the grid, (EG _y) (MWh) ⁶	Baseline Emissions, (BE _y) (tCO ₂ e)
1	16/05/2013 to 31/05/2013	0.6343	12640	8018
2	Jun-13	0.6343	14512	9205
3	Jul-13	0.6343	19194	12175
4	Aug-13	0.6343	13973	8863
5	Sep-13	0.6343	10302	6535
6	Oct-13	0.6343	4923	3123
7	Nov-13	0.6343	6473	4106
8	Dec-13	0.6343	7527	4774
9	Jan-14	0.6343	10457	6633

⁶ The schedule date for meter calibration was 29/07/2014 however meters got calibrated on 13/09/2014. The results of the delayed calibration do not show any errors in the measuring equipments hence in line with CDM validation and verification standard, Version 07.0, maximum permissible error i.e. 0.2% has been applied in a conservative manner to the period (30/07/2014 to 12/09/2014) not covered by calibrated meters. PP has applied error to July-2014, August-2014 and September-2014 as a conservative approach.

10	Feb-14	0.6343	6408	4065
11	Mar-14	0.6343	6792	4308
12	Apr-14	0.6343	8274	5248
13	May-14	0.6343	14539	9222
14	Jun-14	0.6343	20405	12943
15	Jul-14	0.6343	22528	14289
16	Aug-14	0.6343	16761	10632
17	Sep-14	0.6343	16052	10182
18	Oct-14	0.6343	4780	3032
19	1/11/2014 to 30/11/2014	0.6343	6436	4082
Total			222976	141433

4.2 Project Emissions

There are no project emissions associated with the power generation from wind power project. Hence, $PE_y = 0$ (where, PE_y is Project Emissions)

4.3 Leakage

No leakage emissions are considered for the proposed project activity since no energy generating equipment is transferred from another activity and/or the existing equipment is transferred to another activity.

Thus, $L_y = 0$ (where, L_y is Leakage)

4.4 Net GHG Emission Reductions and Removals

$$ER_y = BE_y - PE_y - L_y$$

BE_y = Baseline Emissions as calculated in Section 4.1

PE_y = Project emissions = 0

L_y = Leakages = 0

So $ER_y = BE_y$

$ER_y = 141433 \text{ tCO}_2\text{e}$

Thus the total Emission Reduction of **141,433 tCO₂** is achieved by the project activity from 16-05-2013 to 30-11-2014.

The vintage year – wise emission reduction is tabulated below:

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	56798	0	0	56798
2014	84635	0	0	84635
Total	141433	0	0	141433

APPENDIX X: METER CALIBRATION

The energy meters are properly maintained with regular calibration schedules to ensure accuracy. The details of calibration of meters during the current monitoring period are as follows:

Year	2012	
Feeder	Jhimpir	
Calibration Date		
Meter Details	Main Meter	Back up Meter
Serial No.	41507169	41510586
Meter make	ISKRA, Slovenia	ISKRA, Slovenia
Accuracy Class	0.2s	0.2s
Calibration Result	The meter errors are within the limit & the performance of both the meters were found satisfactory	
Reference	Calibration certificate dated 30/07/2012	

Year	2012	
Feeder	Nooriabad	
Calibration Date		
Meter Details	Main Meter	Back up Meter
Serial No.	41507148	41510585
Meter make	ISKRA, Slovenia	ISKRA, Slovenia
Accuracy Class	0.2s	0.2s
Calibration Result	The meter errors are within the limit & the performance of both the meters were found satisfactory	
Reference	Calibration certificate dated 30/07/2012	

Year	2014	
Feeder	Jhimpir	
Calibration Date	13/09/2014	
Meter Details	Main Meter	Back up Meter
Serial No.	41507169	41510586
Meter make	ISKRA, Slovenia	ISKRA, Slovenia
Accuracy Class	0.2s	0.2s
Calibration Result	The meter errors are within the limit & the performance of both the meters were found satisfactory	
Reference	Calibration certificate dated 13/09/2014	

Year	2014	
Feeder	Nooriabad	
Calibration Date	13/09/2014	
Meter Details	Main Meter	Back up Meter
Serial No.	41507148	41510585
Meter make	ISKRA, Slovenia	ISKRA, Slovenia
Accuracy Class	0.2s	0.2s
Calibration Result	The meter errors are within the limit & the performance of both the meters were found satisfactory	
Reference	Calibration certificate dated 13/09/2014	