Monitoring report form

(Version 05.1)

Complete this form in accordance with the Attachment "Instructions for filling out the monitoring report form" at the end of this form.

MONITORING REPORT		
Title of the project activity	Foundation Wind Energy-I Limited 50 MW Wind Farm Project	
UNFCCC reference number of the project activity	9268	
Version number of the monitoring report	1	
Completion date of the monitoring report	28/11/2016	
Monitoring period number and duration of this monitoring period	1 11/04/2015-31/12/2015	
Project participant(s)	Pakistan (host): • Foundation Wind Energy-I Limited United Kingdom of Great Britain and Northern Ireland: • UPM Umwelt-Projekt-Management GmbH	
Host Party	Islamic Republic of Pakistan	
Sectoral scope(s)	Sectoral Scope 1: Energy industries (renewable-/non renewable)	
Selected methodology(ies)	ACM0002, Consolidated Baseline Methodology for grid-connected electricity generation from renewable sources (Version 13.0.0) (EB 67 Annex 13)	
Selected standardized baseline(s)	N/A	
Estimated amount of GHG emission reductions or net GHG removals by sinks for this monitoring period in the registered PDD	64,771tCO_2e	
Total amount of GHG emission reductions or net GHG removals by sinks achieved in this monitoring period	GHG emission reductions or net GHG removals by sinks reported up to 31 December 2012	GHG emission reductions or net GHG removals by sinks reported from 1 January 2013 onwards
	0 tCO_2e	50,373tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

>>

The purpose of the Foundation Wind Energy-I Limited 50 MW Wind Farm Project (hereinafter the "project activity" or the "project" or the "wind farm") is to utilize wind resources for electricity generation through the construction of a wind farm with a total capacity of 50 MW and to deliver the electricity generated from the project to National Transmission & Despatch Company Limited (NTDC) through its central power purchasing agency on behalf of Water and Power Development Authority (WAPDA) distribution companies. By replacing the electricity supplied by the WAPDA grid, which is heavily dominated by fossil fuel fired power plants, with electricity generated from wind power the proposed project activity will achieve obvious greenhouse gas (GHG) emission reductions by avoiding CO_2 emissions.

The project owner is Foundation Wind Energy-I Limited (hereinafter FWEL-I) as mentioned below. The project activity involves the installation and operation of 20 wind turbines with unit capacity of 2,500kW, which will supply an average annual generation of 144,500 MWh to the WAPDA grid. The total installed capacity is 50 MW.

The construction of the project started on 12/08/2013. The project was in full commercial operation on 11/04/2015. Since then, the operation of the project has been continued in accordance with the project design as well as the description in the registered PDD. The CDM registration date was 31 Dec 2012. Along with the first issuance during this monitoring period, the start date of crediting period has been changed to be 11 Apr 2015 (formerly 01 Jan 2014), it has been approved by CDM EB on 13/11/2016. Therefore, the crediting period is 11 Apr 2015 - 10 Apr 2025 (Fixed).

The total emission reductions achieved in this monitoring period are 50,373tCO_2e.

A.2. Location of project activity

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The project is located in the area of Gharo, Kutti Kun New Island in Taluka Mirpur Sakro District Thatta, Province of Sindh, Pakistan within a narrow corridor, spanned by the following coordinates:

	Latitude	Longitude
1.	24º 36' 49.52" N	67º 24' 49.76" E
2.	24º 36' 47.39" N	67º 24' 41.36" E
3.	24º 37' 05.22" N	67º 24' 21.75" E
4.	24º 37' 14.56" N	67º 23' 52.80" E
5.	24º 37' 15.40" N	67º 23' 37.86" E
6.	24º 37' 10.34" N	67º 23' 23.85" E
7.	24º 36' 50.36" N	67º 23' 24.32" E
8.	24º 36' 29.99" N	67º 23' 38.34" E
9.	24º 35' 47.12" N	67º 23' 38.35" E
10	24º 35' 27.60" N	67º 23' 51.89" E
11	24º 35' 47.55" N	67º 24' 20.82" E
12	24º 36' 07.93" N	67º 24' 20.35" E
13	24º 36' 23.63" N	67º 24' 34.82" E
14	24º 36' 20.24" N	67º 24' 50.70" E

The maps below illustrate the project location.

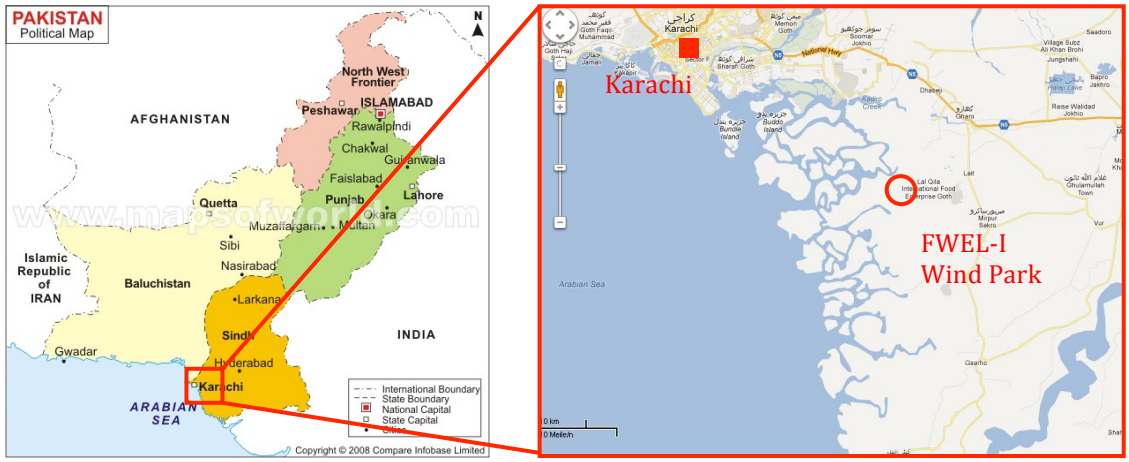

Figure 1: Map of the project location

Figure 2: Map of the project location

A.3. Parties and project participant(s)

Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate whether the Party involved wishes to be considered as project participant (yes/no)
Pakistan (host)	Foundation Wind Energy-I Limited (Private)	No
United Kingdom of Great Britain and Northern Ireland	UPM Umwelt-Projekt-Management GmbH (Private)	No

A.4. Reference of applied methodology and standardized baseline

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Title of the baseline methodology:

Consolidated Baseline Methodology for grid-connected electricity generation from renewable sources (Version 13.0.0).

Reference:

ACM0002, Version 13.0.0 (EB 67 Annex 13)

Furthermore, the following tools have been applied:
Tool to calculate the emission factor for an electricity system, Version 2.2.1 (EB63, Annex 19)
Tool for the demonstration and assessment of additionality, Version 6.0.0 (EB65, Annex 21)

The applied methodology and tools please refer to the UNFCCC CDM website
http://cdm.unfccc.int/methodologies/DB/EY2CL7RTEHRC9V6YQHLAR6MJ6VEU83

A.5. Crediting period of project activity

>>
11 Apr 2015 - 10 Apr 2025 (10yr Fixed)
Along with the first issuance during this monitoring period, the start date of crediting period has been changed to be 11 Apr 2015 (formerly 01 Jan 2014). Such change has been approved by CDM EB on 13/11/2016.

A.6. Contact information of responsible persons/entities

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The contact information of the entity responsible for completing the form is as follows:

UPM Environment Engineering Project Management Consulting (Beijing) Co., Ltd
Room 1306, Guangming Hotel, No. 42 Liangmaqiao Road, Chaoyang District,
Beijing 100022, China
Tel./Fax: +86 010-64680500-13/ +86 010-64680500-21

The entity above is not a project participant listed in Appendix 1.

SECTION B. Implementation of project activity

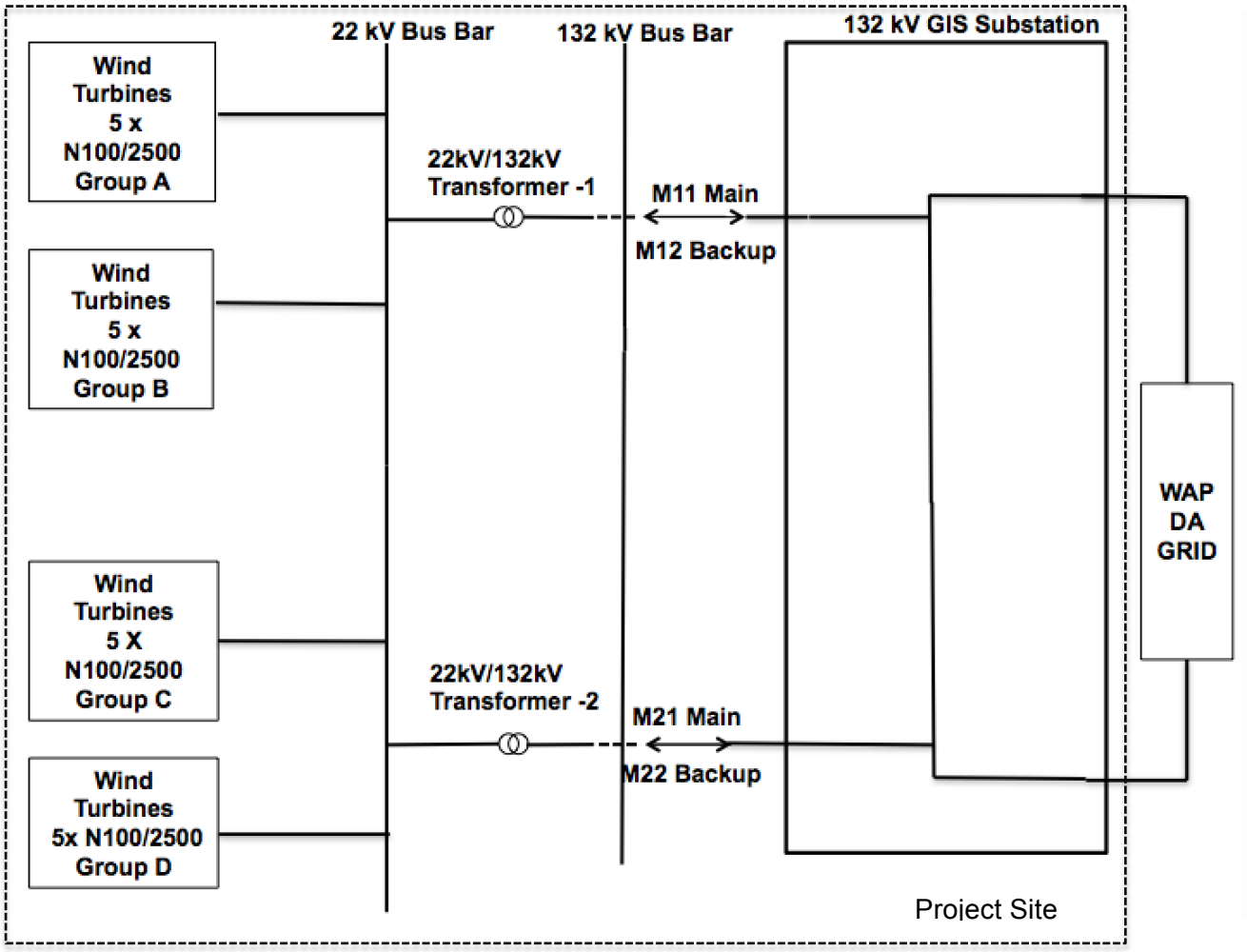
B.1. Description of implemented registered project activity

>>
During the project implementation, 20 units of N100/2500 Gamma version[1] wind turbine generators (WTG) by the German company Nordex have been installed. The Nordex N100/2500 WTG has a capacity of 2.5 MW at a nominal voltage of 660 V and a frequency of 50 Hz. Please see the technical parameters of the wind turbines as follows:

Parameter	
Type	N100/2500 IEC 2a
No. of units	20
No. of blades	3
Rated power [kW]	2,500
Rotor diameter [m]	99.8
Cut-in wind speed [m/s]	3
Cut-out wind speed [m/s]	25
Tip speed [m/s]	77
Rated rotational speed [rpm]	14.9
Manufacturer	Nordex
Lifetime [yrs]	20

[1] Introduction of N100/2500 wind turbines:
http://www.nordex-online.com/en/produkte-service/wind-turbines/n100-25-mw.html?no_cache=1

The wind farm is connected with 132kV Gas Insulated Substation (GIS) via 22kV/132kV transformers.



The construction of the project started on 12/08/2013. The project was in full commercial operation on 11/04/2015. Since then, the operation of the project has been continued in accordance with the project design as well as the description in the registered PDD.

The normal implementation of the project has been maintained and no events or situations which may impact the applicability of the methodology has been observed during this monitoring period.

B.2. Post-registration changes

B.2.1. Temporary deviations from registered monitoring plan, applied methodology or applied standardized baseline

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No temporary deviations from registered monitoring plan or applied methodology have been applied during this monitoring period.

B.2.2. Corrections

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No corrections to project information or parameters fixed at validation have been approved during this monitoring period or submitted with this monitoring report.

B.2.3. Changes to start date of crediting period

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Along with this first issuance, the start date of crediting period has been changed to be 11/04/2015 (was 01/01/2014).
Such change has been approved by CDM EB on 13/11/2016.

B.2.4. Inclusion of a monitoring plan to the registered PDD that was not included at registration

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N/A

B.2.5. Permanent changes from registered monitoring plan, applied methodology or applied standardized baseline

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The Project is implemented as the registered PDD and no permanent changes.

B.2.6. Changes to project design of registered project activity

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The Project is implemented as the registered PDD and no changes.

B.2.7. Types of changes specific to afforestation or reforestation project activity

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N/A

SECTION C. Description of monitoring system

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The monitoring system is designed in accordance with the requirements of methodology ACM0002, “Grid-connected electricity generation from renewable sources” (Version 13.0.0).

1. Monitoring objects
The main monitoring objects are the electricity delivered to the grid and the grid emission factor.

2. Management structure
A CDM department set up by the project owner has appointed personnel to carry out the monitoring plan. The personnel structure is as follows:

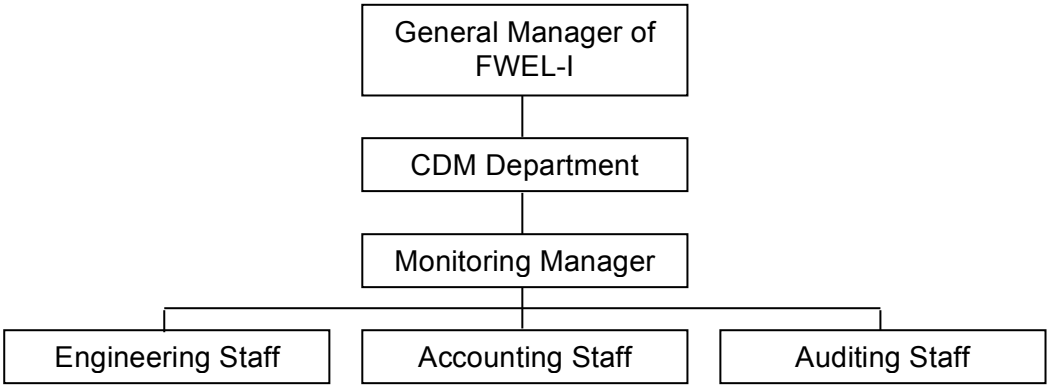


Figure 3: Monitoring organogram

A monitoring manager is appointed to supervise the implementation of the monitoring plan, while further staff, including engineering staff, accounting staff and (internal) auditing staff, are appointed to carry out the monitoring plan.

- The engineering staff is responsible for data collection (such as meter readings), daily maintenance of equipment and the emission reduction calculation.
- The accounting staff is responsible for the process of power transactions with the power grid company and power sale receipts keeping.
- The auditing staff is responsible for reviewing the data and receipt collected, ensuring the veracity and transparency of them.

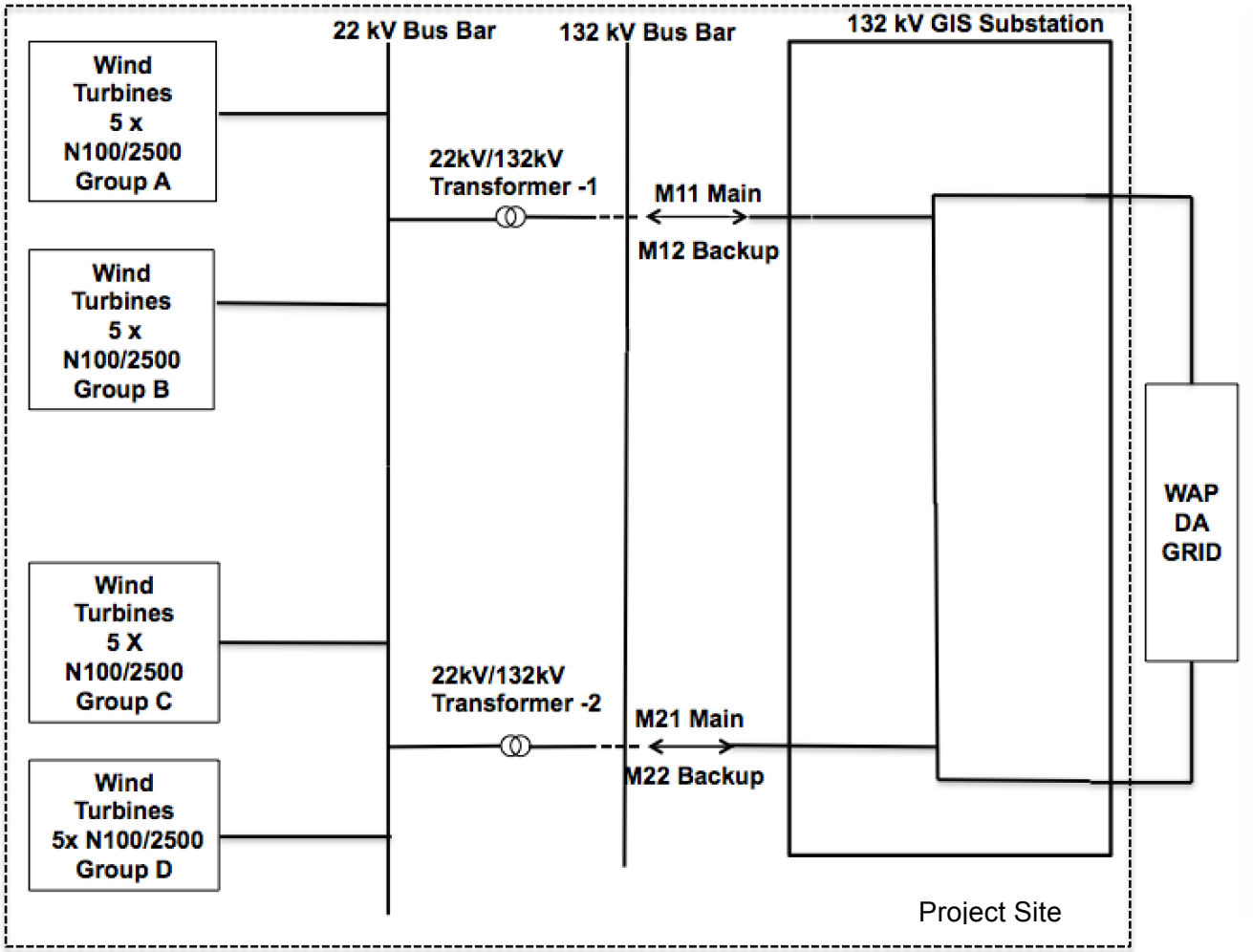
3. Monitoring equipment and installation

Four electricity meters are adopted in the monitoring system of the project. The meters have been installed at the interconnection point to the grid for monitoring the electricity delivered to the grid.

Two bidirectional electricity meters with the accuracy of 0.2s (M11 and M21) are installed as the main meters at the output side of the 132 kV substation to monitor the electricity exported to and imported from the grid by the project activity. Another two bidirectional electricity meters of the same accuracy of 0.2s (M12 as backup meter for M11; M22 as backup meter for M21) are also installed as the backup meters of the main meters of M11 and M21 at the 132 kV substation.

The emission reductions are calculated based on records of the main meters, and can be cross-checked with electricity sales & purchase receipts.

The monitoring system is illustrated as follows:



Net electricity generation supplied by the project to the grid during the year y ($EG_{facility,y}$) equals to the difference between electricity exported to the grid ($EG_{export,y}$) and electricity imported from the grid ($EG_{import,y}$) by the project in year y.

All of four meters M11, M12, M21 and M22 have been calibrated annually according to the relevant industrial standard. Testing and calibration of all the energy meters have been carried out by the grid. FWEL-I is not authorized to do anything with energy meters. Calibrating frequency of the meters is once per year.

4. Data recording, collection and reporting

The monitoring staffs are responsible for the measurement of electricity by reading the meters on-site according to the EPA. Every month, the monitored data has been archived electronically, at the same time the paper document has been archived. The project owner keeps the receipts of power sales/purchase. The monitoring plan has been carried out mainly by the CDM department and conducted by the appointed personnel. All key documents have been kept collectively. For convenience of auditing, the project owner provides the index of project document and monitoring report. The project owner has a copy of all the paper documents.

The monitored data will be kept during the whole crediting period and 2 years after the end of the crediting period or until the last issuance of CERs, whichever occurs later.

5. Emergency procedures for monitoring system

Electricity measured by the main meter alone should suffice for the purpose of billing and emissions reduction verification as long as the error in the main meter is within the permissible limits. However, should either the project owner or the grid company find the function of the main meter abnormal or broken-down, the other party and the authorized meter inspection institution need to be informed immediately to address the issues and make the meter function normally again as soon as possible. In addition, should any previous monthly readings of the main meter be inaccurate by more than the allowable error, or be functioned improperly, the electricity generated by the project shall be determined by:

a) First, by reading the backup main meter, unless a test by either party reveals it is inaccurate;
b) If the backup also meter fails to function normally, the project owner and the grid company shall jointly estimate the correct reading in a conservative manner;
c) If the project owner and the grid company fail to mutually estimate of the correct reading, the readings will be taken as zero, it is conservative.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante or at renewal of crediting period

Not applicable.

D.2. Data and parameters monitored

Data / Parameter:	$EG_{facility,y}$
Unit:	MWh

Description:	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y
Measured/ Calculated / Default:	Measured and Calculated
Source of data:	Continuous measurement, directly measured by the main meter or the backup meter installed at the output side of the 132 kV substation The following parameters are measured: (i) The quantity of electricity supplied by the project plant/unit to the grid ($EG_{export,y}$); and (ii) The quantity of electricity delivered to the project plant/unit from the grid ($EG_{import,y}$) Difference between $EG_{export,y}$ and $EG_{import,y}$ is taken as $EG_{facility,y}$
Value(s) of monitored parameter:	

11/04/2015-30/04/2015	7,233
01/05/2015-31/05/2015	10,918
01/06/2015-30/06/2015	8,018
01/07/2015-31/07/2015	16,603
01/08/2015-31/08/2015	16,048
01/09/2015-30/09/2015	8,384
01/10/2015-31/10/2015	5,143
01/11/2015-30/11/2015	4,924
01/12/2015-31/12/2015	3,755
Total	81,026

Where,
- The values of $EG_{export,y}$ is as follows:

Meters	M11 (back up M12)	M21 (back up M22)	Total Wind Turbines
11/04/2015-30/04/2015	3,681	3,558	7,239
01/05/2015-31/05/2015	5,554	5,371	10,925
01/06/2015-30/06/2015	3,904	4,137	8,041
01/07/2015-31/07/2015	7,782	8,828	16,610
01/08/2015-31/08/2015	8,016	8,036	16,052
01/09/2015-30/09/2015	4,429	3,973	8,402
01/10/2015-31/10/2015	2,530	2,634	5,164
01/11/2015-30/11/2015	2,321	2,642	4,963
01/12/2015-31/12/2015	1,806.14	2,021.6	3,819.93[2]
Total	40,023	41,200	81,216

- The values of $EG_{import,y}$ is as follows:

Meters	M11 (back up M12)	M21 (back up M22)	Total Wind Turbines
11/04/2015-30/04/2015	3	3	6

[2] During the second calibration of the meters, meters were tested off-load one by one using testing/ calibration equipment. The grid was energized and plant was in operation. At the time of testing only one energy meter was disconnected from grid and at the same time other three meters (Main & Back-up) were measuring the energy export and import. Required power injected through the testing/calibration equipment into energy meters during testing/calibration can't be considered as actual import or export.. it shall be deducted from the readings taken before and after the test at the time of joint monthly meter reading from import and export. for Dec 2015.

The total power exported for Dec 2015 is 3,827.74MWh, incl. the total power exported during second calibration, i.e. 7.81MWh. So, the net total power exported in Dec 2015 should be 3,819.93MWh (= 3,827.74MWh – 7.81MWh);

	01/05/2015-31/05/2015	5	2	7
	01/06/2015-30/06/2015	12	11	23
	01/07/2015-31/07/2015	3	4	7
	01/08/2015-31/08/2015	2	2	4
	01/09/2015-30/09/2015	10	8	18
	01/10/2015-31/10/2015	12	9	21
	01/11/2015-30/11/2015	21	18	39
	01/12/2015-31/12/2015	32.55	32.68	65.23[3]
	Total	101	90	191
Monitoring equipment:	Equipment: Meter M11 (Main meter) Type: ISKRA MT-860 Accuracy class: 0.2S Serial number: 41512999 Dates of last calibrations: 17/12/2014, 21/12/2015 Calibration frequency: No more than 2 years Calibration Validity: 2 years Equipment: Meter M12 (Back up meter for M11) Type: ISKRA MT-860 Accuracy class: 0.2S Serial number: 41513021 Dates of last calibrations: 17/12/2014, 21/12/2015 Calibration frequency: No more than 2 years Calibration Validity: 2 years Equipment: Meter M21 (Main meter) Type: ISKRA MT-860 Accuracy class: 0.2S Serial number: 41513000 Dates of last calibrations: 17/12/2014, 21/12/2015 Calibration frequency: No more than 2 years Calibration Validity: 2 years Equipment: Meter M22 (Back up meter for M21) Type: ISKRA MT-860 Accuracy class: 0.2S Serial number: 41513018 Dates of last calibrations: 17/12/2014, 21/12/2015 Calibration frequency: No more than 2 years Calibration Validity: 2 years			
Measuring/ Reading/ Recording frequency:	Measured continuously and recorded monthly			
Calculation method (if applicable):	$EG_{facility,y} = EG_{export,y} - EG_{import,y}$			
QA/QC procedures:	Monitoring equipments are tested and maintained in accordance with the relevant technical codes. The net on-grid electricity generation can be cross-checked by electricity sales & purchase receipts.			
Purpose of data:	Baseline emission calculation			
Additional comment:	None			

[3] See footnote 2. The total power imported for Dec 2015 is 65.23MWh, incl. the total power imported during second calibration, i.e. 7.73MWh. So, the net total power imported in Dec 2015 should be 57.5MWh (= 65.23MWh – 7.73MWh). However, to be conservative, the total power imported for Dec 2015, i.e. 65.23MWh is used for emission reduction calculation.

Data / Parameter:	$EF_{grid,CM,y}$
Unit:	tCO_2e/MWh
Description:	Grid Emission factor of WAPDA grid
Measured/ Calculated / Default:	Calculated
Source of data:	Calculated as per "Tool to calculate the emission factor for an electricity system" Version 3.0 and the latest data available from the Pakistan Energy Yearbook 2012, 2013 and 2014, Ministry of Petroleum & Natural Resources
Value(s) of monitored parameter:	0.6217
Monitoring equipment:	NA
Measuring/ Reading/ Recording frequency:	Calculated annually as per "Tool to calculate the emission factor for an electricity system" Version 3.0 and the latest data available from the Pakistan Energy Yearbook 2012, 2013 and 2014, Ministry of Petroleum & Natural Resources
Calculation method (if applicable):	Calculated annually as per "Tool to calculate the emission factor for an electricity system" Version 3.0 and the latest data available from the Pakistan Energy Yearbook 2012, 2013 and 2014, Ministry of Petroleum & Natural Resources
QA/QC procedures:	Appropriateness of the data is reviewed and changes are applied annually by the FWEL-I. It will be recalculated annually.
Purpose of data:	Baseline emission calculation
Additional comment:	The latest data available from the Pakistan Energy Yearbook 2012, 2013 and 2014 is used.

Data / Parameter:	$FC_{i,y}$
Unit:	Mass unit
Description:	Amount of fossil fuel type *i* consumed in the project electricity system in year **y**
Measured/ Calculated / Default:	Default
Source of data:	Pakistan Energy Yearbook 2012, 2013 and 2014, Ministry of Petroleum & Natural Resources
Value(s) of monitored parameter:	Refer to ER sheet
Monitoring equipment:	NA
Measuring/ Reading/ Recording frequency:	NA
Calculation method (if applicable):	NA
QA/QC procedures:	NA
Purpose of data:	Baseline emission calculation
Additional comment:	None

Data / Parameter:	$NCV_{i,y}$
Unit:	GJ/Mass unit
Description:	Net calorific value (energy content) of fossil fuel type i in year y

Measured/ Calculated / Default:	Default
Source of data:	IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC
Value(s) of monitored parameter:	Refer to ER sheet
Monitoring equipment:	NA
Measuring/ Reading/ Recording frequency:	NA
Calculation method (if applicable):	NA
QA/QC procedures:	NA
Purpose of data:	Baseline emission calculation
Additional comment:	None

Data / Parameter:	$EF_{CO2,y}$
Unit:	tCO_2/GJ
Description:	CO_2 emission factor of fossil fuel type i used in power unit m in year y
Measured/ Calculated / Default:	Default
Source of data:	IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC
Value(s) of monitored parameter:	Refer to ER sheet
Monitoring equipment:	NA
Measuring/ Reading/ Recording frequency:	NA
Calculation method (if applicable):	NA
QA/QC procedures:	NA
Purpose of data:	Baseline emission calculation
Additional comment:	None

Data / Parameter:	EG_y
Unit:	MWh
Description:	Net electricity generated by the power unit of electricity system in year y
Measured/ Calculated / Default:	Default
Source of data:	Pakistan Energy Yearbook 2012, 2013 and 2014, Ministry of Petroleum & Natural Resources
Value(s) of monitored parameter:	Refer to ER sheet
Monitoring equipment:	NA

Measuring/ Reading/ Recording frequency:	NA
Calculation method (if applicable):	NA
QA/QC procedures:	NA
Purpose of data:	Baseline emission calculation
Additional comment:	None

Data / Parameter:	$\eta_{m,y}$
Unit:	-
Description:	Average net energy conversion efficiency of power unit m in year y
Measured/ Calculated / Default:	Default
Source of data:	The default values provided in the table in Annex 1 of the Tool to calculate the emission factor of an electricity system
Value(s) of monitored parameter:	Refer to ER sheet
Monitoring equipment:	NA
Measuring/ Reading/ Recording frequency:	NA
Calculation method (if applicable):	NA
QA/QC procedures:	NA
Purpose of data:	Baseline emission calculation
Additional comment:	None

D.3. Implementation of sampling plan

>>
N/A

SECTION E. Calculation of emission reductions or GHG removals by sinks

E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

>>

Baseline emissions (BE_y) are calculated as follows:

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

Where:

BE_y	Baseline emission in year y (tCO_2e)
$EG_{facility,y}$	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y (MWh)
$EF_{grid,CM,y}$	Combined margin CO_2 emission factor of the WAPDA grid in year y (tCO_2/MWh)

$EF_{grid,y}$ Grid Emission factor of WAPDA grid in year y (tCO_2/MWh), equals to $EF_{grid,CM,y}$

Calculation of the grid emission factor

To calculate the second factor of equation to calculate the baseline emissions, the *Tool to calculate the emission factor for an electricity system* has to be used. Following the tool, this factor is calculated as a combined margin (CM), consisting of the simple average of the operating margin emission factor (OM) and the build margin (BM) emission factor:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \cdot w_{OM} + EF_{grid,BM,y} \cdot w_{BM}$$

With the input values:

$EF_{grid,CM,y}$	Combined margin grid emission factor in year *y* (tCO_2/MWh)
$EF_{grid,OM,y}$	Operation margin grid emission factor in year *y* (tCO_2/MWh)
$EF_{grid,BM,y}$	Build margin grid emission factor in year *y* (tCO_2/MWh)
w_{OM}	Weighting of operation margin factor (%)
w_{BM}	Weighting of build margin factor (%)

For the calculation of these input values, the *Tool to calculate the emission factor for an electricity system* describes six steps:

STEP 1. Identify the relevant electricity systems.
STEP 2. Choose whether to include off-grid power plants in the project electricity system (optional).
STEP 3. Select a method to determine the operating margin (OM).
STEP 4. Calculate the operating margin emission factor according to the selected method.
STEP 5. Calculate the build margin (BM) emission factor.
STEP 6. Calculate the combined margin (CM) emissions factor.

Step 1: Identify the relevant electricity systems

The Pakistani DNA has not published any delineation of the project electricity system and a connected electricity system. Moreover, the criteria provided in the "Tool to calculate the emission factor for an electricity system" under Step 1 do not result in a clear grid boundary as

1) there is no official data for market prices for electricity over periods of time in Pakistan
2) there is no official data available with regard to the operation of the transmission line between different electricity systems.

In such cases, the "Tool to calculate the emission factor for an electricity system" suggests "to use a regional grid definition in the case of large countries with layered dispatch systems (e.g. provincial/regional/national)" to distinguish a connected electricity system. As a provincial grid definition may be too narrow, the national grid definition should be used by default, as per the tool.

Pakistan comprised two electricity grids, the Karachi Electricity Supply Company (KESC) grid, which supplies Karachi city and adjoining areas of Sindh and Balochistan, and the national electricity grid, managed by the *Water and Power Development Authority (WAPDA)*. The national grid covers the whole of Pakistan, except the city of Karachi, which is supplied by the KESC grid.

The Pakistan Energy Yearbook, which is annually published by the Government of Pakistan, Ministry of Petroleum and Natural Resources, provides the official data for energy generation in

Pakistan for KESC and WAPDA. Further does it mention the IPPs (Independent Power Producers), which deliver their generated power either to WAPDA or KESC[4].

The project is connected to the national electricity grid (WAPDA). According to the *Tool to calculate the emission factor for an electricity system,* the project electricity system can be identified as the national grid by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity (e.g. the renewable power plant location or the consumers where electricity is being saved) and that can be dispatched without significant transmission constraints.

Although the two grids are interconnected for occasional supply from the national grid to the smaller KESC grid, electricity imports and exports are not foreseen during standard operation. According to the definitions in the above-mentioned tool, the KESC grid can be identified as connected electricity system.
Since none of the two grids is physically connected to foreign grids, electricity imports to the national grid can therefore be excluded.

Electricity exports are not subtracted from the electricity generation data, as advised in the *Tool to calculate the emission factor for an electricity system.*

Step 2: Choose whether to include off-grid power plants in the project electricity system (optional)
According to Option I of step 2, off-grid power plants are not included in the calculation.

Step 3: Select a method to determine the operating margin (OM)
Four alternatives for the calculation of OM are given in the tool:

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

The simple OM method (option a) can only be used if low-cost/must-run resources[5] constitute less than 50% of total grid generation in: 1) average of the five most recent years, or 2) based on long-term averages for hydroelectricity production.

As calculated with the data available from the Pakistan Energy Yearbooks published by the Government of Pakistan, Ministry of Petroleum & Natural Resources, the share of low-cost/must-run resources has constituted less than 50% of total grid generation in average of the five most recent years:

2009	35.76%
2010	35.98%
2011	41.46%

[4] On the website of the Private Power & Infrastructure Board, Government of Pakistan, Ministry of Water & Power (http://www.ppib.gov.pk/N_commissioned_ipps.htm) it is mentioned which IPPs deliver their generated power to which electricity system (WAPDA or KESC). Currently only two IPPs (Gul Ahmed, Karachi, and Tapal Energy, Karachi) deliver to KESC, while the other IPPs deliver to WAPDA. In 1998, as part of the government's privatization policy, the National Transmission & Despatch Company (NTDC) "was organized to take over all the properties, rights and assets obligations and liabilities of 220 KV and 500KV Grid Stations and Transmission Lines/Network Transmission Lines/Network owned by Pakistan Water and Power Development Authority (WAPDA) (See http://www.ntdc.com.pk). IPPs commissioned under the 2002 power policy are therefore mentioned as delivering their generated power to NTDC.

[5] Low-cost/must-run resources are defined as power plants with low marginal generation costs or power plants that are dispatched independently of the daily or seasonal load of the grid. They typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation. If coal is obviously used as must-run, it should also be included in this list, i.e. excluded from the set of plants.

2012	39.23%
2013	39.82%
2014	39.51%

As this requirement is met according to the Energy Yearbooks of 2010 - 2014, the simple OM method (option a) is applicable.

For the calculation of $EF_{grid,OM,y}$, *ex post* calculation is chosen in the registered PDD. As per the tool,

> *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. If the data required to calculate the emission factor for year y is usually only available later than six months after the end of year y, alternatively the emission factor of the previous year y-1 may be used. If the data is usually only available 18 months after the end of year y, the emission factor of the year proceeding the previous year y-2 may be used. The same data vintage (y, y-1 or y-2) should be used throughout all crediting periods.*

For the project, the *ex post* option is chosen. This means, that each monitoring report would have to include the latest calculation of the operation margin emission factor. The factor for the year proceeding the previous year (*y-1*) will be used for the calculations.

Step 4: Calculate the operating margin emission factor according to the selected method
The simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/units.

Two ways of calculation are described in the tool[6]:

> *Option A: Based on the net electricity generation and a CO_2 emission factor of each power unit; or*
> *Option B: Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system.*

Whereas Option B can only be applied if:

a) *The necessary data for Option A is not available; and*
b) *Only nuclear and renewable power generation are considered as low-cost/must-run power sources and the quantity of electricity supplied to the grid by these sources is known; and*
c) *Off-grid power plants are not included in the calculation (i.e., if Option I has been chosen in Step 2).*

The exact operation and emission factor data is not available for all connected power plants, only nuclear and hydro power have been considered as low-cost/must-run resources in Step 3 and Option I has been chosen in Step 2. Option B can therefore be chosen to calculate the OM emission factor using the total net electricity generation, emission and utilization data for each fuel type. The necessary data can be found in the present Pakistan Energy Yearbooks.

The calculation of the OM emission factor is based on the net electricity supplied to the grid by all power plants serving the system, not including the low-cost/must-run power plants. To carry out the calculation, the tool provides the following formula:

$$EF_{grid,OMsimple,y} = \frac{\sum_i \left(FC_{i,y} \cdot NCV_{i,y} \cdot EF_{CO_2,i,y}\right)}{EG_y}$$

[6] Cited from *Tool to calculate the emission factor for an electricity system*, v.2.2.1

Where:

$EF_{grid,OMsimple,y}$	Simple operating margin CO_2 emission factor in year y (tCO_2/MWh)
$FC_{i,y}$	Amount of fossil fuel type *i* consumed in the project electricity system in year *y* (mass or volume unit)
$NCV_{i,y}$	Net calorific value (energy content of fossil fuel type *i* in year *y* (GJ/mass or volume unit)
$EF_{CO_2,i,y}$	CO_2 emission factor of fossil fuel type i in year *y* (tCO_2/GJ)
EG_y	Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost/most-run power plants/units, in year *y* (MWh)
i	All fossil fuel types combusted in power sources in the project electricity system in year y
y	The relevant year as per the data vintage.

As a result of this calculation[7], the simple operation margins for the year 2015 is:

$$EF_{grid,OM,2015} = 0.7422 \frac{tCO_2e}{MWh}$$

Step 5: Calculate the build margin (BM) emission factor

For the terms of data vintage, the tool offers two options[8]:

> ***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 CDM-PDD 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.*
>
> ***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.*

For the proposed project, option 2 is chosen and the build margin is updated every year of the first crediting period. Therefore, the latest figures are calculated in each monitoring report.

Capacity additions from retrofits of power plants should not be included in the calculation of the build margin emission factor.

The sample group of power units *m* used to calculate the build margin should be determined as per the following procedure from the *Tool to calculate the emission factor for an electricity system*[9], consistent with the data vintage selected above:

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[7] All relevant input values and calculations have been provided to the DOE(s) during verification.

[8] Cited from *Tool to calculate the emission factor for an electricity system*, v.2.2.1.

[9] Cited from *Tool to calculate the emission factor for an electricity system*, v.2.2.1

a) Identify the set of five power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently ($SET_{5\text{-}units}$) and determine their annual electricity generation ($AEG_{SET\text{-}5\text{-}units}$, in MWh);

(b) Determine the annual electricity generation of the project electricity system, excluding power units registered as CDM project activities (AEG_{total}, in MWh). Identify the set of power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise 20% of AEG_{total} (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) ($SET_{\geq 20\%}$) and determine their annual electricity generation ($AEG_{SET\text{-}\geq 20\%}$, in MWh);

(c) From $SET_{5\text{-}units}$ and $SET_{\geq 20\%}$ select the set of power units that comprises the larger annual electricity generation (SET_{sample}); Identify the date when the power units in SET_{sample} started to supply electricity to the grid. If none of the power units in SET_{sample} started to supply electricity to the grid more than 10 years ago, then use SET_{sample} to calculate the build margin. In this case ignore steps (d), (e) and (f).

Otherwise:

(d) Exclude from SET_{sample} the power units which started to supply electricity to the grid more than 10 years ago. Include in that set the power units registered as CDM project activities, starting with power units that started to supply electricity to the grid most recently, until the electricity generation of the new set comprises 20% of the annual electricity generation of the project electricity system (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) to the extent is possible. Determine for the resulting set ($SET_{sample\text{-}CDM}$) the annual electricity generation ($AEG_{SET\text{-}sample\text{-}CDM}$, in MWh);
If the annual electricity generation of that set is comprises at least 20% of the annual electricity generation of the project electricity system (i.e. $AEG_{SET\text{-}sample\text{-}CDM} \geq 0.2 \times AEG_{total}$), then use the sample group $SET_{sample\text{-}CDM}$ to calculate the build margin. Ignore steps (e) and (f).

Otherwise:

(e*) Include in the sample group $SET_{sample\text{-}CDM}$ the power units that started to supply electricity to the grid more than 10 years ago until the electricity generation of the new set comprises 20% of the annual electricity generation of the project electricity system (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation);*

(f) The sample group of power units m used to calculate the build margin is the resulting set ($SETsample\text{-}CDM\text{-}>10yrs$).

Calculation of $EF_{grid,BM,2015}$

Step (a)

The five power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and for which official data about their annual electricity generation is available, are:

$SET_{5\text{-}units}$:

No.	Power Unit	Commission Date	Electricity generation 2014 (MWh)[10]
1	UCH-II POWER	Year 2014	547,670.00

[10] Pakistan Energy Yearbook 2014, Ministry of Petroleum & Natural Resources

2	NEW JABBAN	Year 2014	38,450.00
3	GOMAL ZAM	Year 2014	6,290.00
4	Jinnah	Year 2013	297,090.00
5	AKHP	Year 2013	332,950.00

$AEG_{SET\text{-}5\text{-}units}$ = 1,222,450 MWh

Step (b)

According to Pakistan Energy Yearbook 2014, Ministry of Petroleum & Natural Resources, the annual electricity generation of the project electricity system, excluding power units registered as CDM project activities (AEG_{total}) has been calculated as:

AEG_{total} = 92,938,220 MWh

The set of power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise 20% of AEG_{total} and for which official data about their annual electricity generation is available, are:

$SET_{\geq 20\%}$:

No.	Power Unit	Commission Date	Electricity generation 2014 (MWh)[11]
1	UCH-II POWER	Year 2014	547,670.00
2	NEW JABBAN	Year 2014	38,450.00
3	GOMAL ZAM	Year 2014	6,290.00
4	Jinnah	Year 2013	297,090.00
5	AKHP	Year 2013	332,950.00
6	KKHP	Year 2012	261,340.00
7	Liberty Power Tech	13/01/2011	774,400.00
8	Halmore Power	16/06/2011	504,260.00
9	Foundation Power	16/05/2011	1,358,340.00
10	Hub Power, Narowal	22/04/2011	1,562,000
11	CHASNUPP-II	27/01/2011	2,386,000.00
12	SAPPHIRE ELECTRIC	04/10/2010	761,420.00
13	NISHAT CHUNIAN Power	21/07/2010	1,084,500.00
14	NISHAT POWER LTD	09/06/2010	1,503,490.00
15	ORIENT POWER LTD	24/05/2010	540,510.00
16	SAIF POWER LTD	27/04/2010	723,180.00
17	ENGRO ENERGY LTD	27/03/2010	1,440,930.00
18	ATLAS POWER LTD	18/12/2009	1,518,930.00
19	ATTOCK GEN	17/03/2009	1,242,940.00
20	GHAZI BAROTHA	01/07/2003	7,016,410.00

$AEG_{SET\text{-}\geq 20\%}$, = 23,901,100 MWh

Step (c)
$SET_{\geq 20\%}$ comprises the larger annual electricity generation and is therefore SET_{sample}.
SET_{sample}. Started to supply electricity on 01/07/2003 – more than 10 years ago – therefore it will be proceeded with step (d).

[11] Pakistan Energy Yearbook 2014, Ministry of Petroleum & Natural Resources

Step (d)
As no power units registered as CDM project activities could be included, after excluding power units which started to supply electricity to the grid more than 10 years ago, the resulting set $SET_{sample-CDM}$

$SET_{sample-CDM}$:

No.	Power Unit	Commission Date	Electricity generation 2014 (MWh)[12]
1	UCH-II POWER	Year 2014	547,670.00
2	NEW JABBAN	Year 2014	38,450.00
3	GOMAL ZAM	Year 2014	6,290.00
4	Jinnah	Year 2013	297,090.00
5	AKHP	Year 2013	332,950.00
6	KKHP	Year 2012	261,340.00
7	Liberty Power Tech	13/01/2011	774,400.00
8	Halmore Power	2011/6/16	504,260.00
9	Foundation Power	2011/5/16	1,358,340.00
10	Hub Power, Narowal	2011/4/22	1,562,000
11	CHASNUPP-II	2011/1/27	2,386,000.00
12	SAPPHIRE ELECTRIC	2010/10/4	761,420.00
13	NISHAT CHUNIAN Power	2010/7/21	1,084,500.00
14	NISHAT POWER LTD	2010/6/9	1,503,490.00
15	ORIENT POWER LTD	2010/5/24	540,510.00
16	SAIF POWER LTD	2010/4/27	723,180.00
17	ENGRO ENERGY LTD	2010/3/27	1,440,930.00
18	ATLAS POWER LTD	2009/12/18	1,518,930.00
19	ATTOCK GEN	2009/3/17	1,242,940.00

$AEG_{SET-sample-CDM}$ = 16,884,690 MWh

The annual electricity generation of $SET_{sample-CDM}$ does not comprise at least 20% of AEG_{total}. Therefore it will be proceeded with steps (e) and (f).

Step (e) & (f)
Step (e) and (f) result in following set:

$SET_{sample-CDM->10yrs}$:

No.	Power Unit	Commission Date	Electricity generation 2014 (MWh)[13]
1	UCH-II POWER	Year 2014	547,670.00
2	NEW JABBAN	Year 2014	38,450.00
3	GOMAL ZAM	Year 2014	6,290.00
4	Jinnah	Year 2013	297,090.00
5	AKHP	Year 2013	332,950.00
6	KKHP	Year 2012	261,340.00

[12] Pakistan Energy Yearbook 2014, Ministry of Petroleum & Natural Resources

[13] Pakistan Energy Yearbook 2014, Ministry of Petroleum & Natural Resources

7	Liberty Power Tech	13/01/2011	774,400.00
8	Halmore Power	16/06/2011	504,260.00
9	Foundation Power	16/05/2011	1,358,340.00
10	Hub Power, Narowal	22/04/2011	1,562,000
11	CHASNUPP-II	27/01/2011	2,386,000.00
12	SAPPHIRE ELECTRIC	04/10/2010	761,420.00
13	NISHAT CHUNIAN Power	21/07/2010	1,084,500.00
14	NISHAT POWER LTD	09/06/2010	1,503,490.00
15	ORIENT POWER LTD	24/05/2010	540,510.00
16	SAIF POWER LTD	27/04/2010	723,180.00
17	ENGRO ENERGY LTD	27/03/2010	1,440,930.00
18	ATLAS POWER LTD	18/12/2009	1,518,930.00
19	ATTOCK GEN	17/03/2009	1,242,940.00
20	GHAZI BAROTHA	01/07/2003	7,016,410.00

According to the *Tool to calculate the emission factor for an electricity system,* the build margin emissions factor is the generation-weighted average emission factor of all power units *m* during the most recent year *y*, for which electricity generation data is available. It can be calculated using the following formula:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \cdot EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

Where:

$EF_{grid,BM,y}$	Build margin CO_2 emission factor in year y (tCO_2/MWh).
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh).
$EF_{EL,m,y}$	CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh).
m	Power units included in the build margin.
y	Most recent historical year for which electricity generation data is available.

As a result of this calculation[14], the build margin for 2015 is:

$$EF_{grid,BM,2015} = 0.2604 \ \frac{tCO_2e}{MWh}$$

As described above, the combined margin emission factor for an electricity system is calculated using the following formula:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \cdot w_{OM} + EF_{grid,BM,y} \cdot w_{BM}$$

The weighting factors w_{OM} and w_{BM} are defined by the *Tool to calculate the emission factor for an electricity system:*

> *Wind and solar power generation 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;*

Therefore, the combined emission factor for the national grid in Pakistan is:

[14] All relevant input values are provided to the DOE(s) during verification.

$$EF_{grid,CM,2015} = 0.7422 \frac{tCO_2e}{MWh} \cdot 0.75 + 0.2604 \frac{tCO_2e}{MWh} \cdot 0.25 = 0.6217 \frac{tCO_2e}{MWh}$$

The $EG_{facility,y}$ during this monitoring period is as follows:

Monitoring period	$EG_{facility,y}$ (MWh)
11/04/2015-30/04/2015	7,233
01/05/2015-31/05/2015	10,918
01/06/2015-30/06/2015	8,018
01/07/2015-31/07/2015	16,603
01/08/2015-31/08/2015	16,048
01/09/2015-30/09/2015	8,384
01/10/2015-31/10/2015	5,143
01/11/2015-30/11/2015	4,924
01/12/2015-31/12/2015	3,755
Total	81,026

During the monitoring period,
$BE_y = EG_{facility,y} \times EF_{grid,CM,y}$
= 81,026MWh × 0.6217 tCO_2/MWh = 50,373 tCO_2e

E.2. Calculation of project emissions or actual net GHG removals by sinks

>>
As per methodology ACM0002 (Version 13.0.0), for a wind power project, $PE_y = 0$.

E.3. Calculation of leakage

>>
As per methodology ACM0002 (version 13.0.0), no leakage emissions are considered for a wind power project. The sources of main emissions potentially giving rise to leakage are neglected.

E.4. Summary of calculation of emission reductions or net GHG removals by sinks

Item	Baseline emissions or baseline net GHG removals by sinks (t CO_2e)	Project emissions or actual net GHG removals by sinks (t CO_2e)	Leakage (t CO_2e)	GHG emission reductions or net GHG removals by sinks (t CO_2e) achieved in the monitoring period		
				Up to 31/12/2012	From 01/01/2013	Total amount
Total	50,373	0	0	0	50,373	50,373

E.5. Comparison of actual emission reductions or net GHG removals by sinks with estimates in registered PDD

Item	Values estimated in ex ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (t CO_2e)	64,771tCO_2e (= 89,214tCO_2e/yr*265d/365d)	50,373tCO_2e

E.6. Remarks on difference from estimated value in registered PDD

>>

The actual emission reductions achieved during the current monitoring period are less than stated in the registered PDD of the project.

Appendix 1. Contact information of project participants and responsible persons/entities

Project participant and/or responsible person/ entity	☒ Project participant ☐ Person/entity responsible for completing the CDM-MR-FORM
Organization name	UPM Umwelt-Projekt-Management GmbH
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Project participant and/or responsible person/ entity	☒ Project participant ☐ Person/entity responsible for completing the CDM-MR-FORM
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Project participant and/or responsible person/ entity	☐ Project participant ☒ Person/entity responsible for completing the CDM-MR-FORM
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Document information

Version	*Date*	*Description*
05.1	4 May 2015	Editorial revision to correct version numbering.
05.0	1 April 2015	Revisions to: • Include provisions related to delayed submission of a monitoring plan; • Provisions related to the Host Party; • Remove reference to programme of activities; • Overall editorial improvement.
04.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1; • Change the reference number from *F-CDM-MR* to *CDM-MR-FORM*; • Editorial improvement.
03.2	5 November 2013	Editorial revision to correct table in page 1.
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	28 May 2010	EB 54, Annex 34. Initial adoption.

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