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	Khe Bo Hydropower Project	
UNFCCC reference number of the project activity	9036	
Version number of the monitoring report	01.0	
Completion date of the monitoring report	22/12/2016	
Monitoring period number and duration of this monitoring period	Monitoring period number: 02 Duration: first and last days included (01/09/2014 – 30/11/2016: 822 days)	
Project participant(s)	Viet Nam Power Development Joint Stock Company	
Host Party	Viet Nam	
Sectoral scope(s)	Energy Industries (renewable energy)	
Selected methodology(ies)	ACM0002, version 13.0.0 Consolidated baseline methodology for grid-connected electricity generation from renewable resources	
Selected standardized baseline(s)	NA	
Estimated amount of GHG emission reductions or net GHG removals by sinks for this monitoring period in the registered PDD	545,935 tCO_2	
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	464,773 tCO_2

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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The proposed Khe Bo Hydropower Project in Nghe An Province (hereinafter referred to as "the Project") is developed by Viet Nam Power Development Joint Stock Company. Khe Bo Hydropower Project is developed on the Ca River, in Tuong Duong District, Nghe An Province in central Viet Nam.

The project is implemented to generate renewable electricity by utilizing water resource of the Ca River, which will be transmitted to the Viet Nam National Electricity Grid.

The Project is a new-built accumulation reservoir hydropower plant that involves the construction of a dam, intake, penstock, power house, and tailwater. The total installed capacity of the Project is 100 MW and the reservoir surface area at full level of the project is 9.6 km^2. Therefore, the power density is estimated to be 11.05 W/m^2. During this second monitoring period (from 01/09/2014 to 30/11/2016 including first and last days), the actual electricity exported to the Grid by the project was 836,224 MWh (adjusted) with the actual plant load factor of 42.79%[1]. Therefore the total emission reductions achieved over the monitoring period are 464,773 tCO_2.

The project started construction on 05/10/2007 and was put into commissioning on 12/05/2013 for Unit 1 and on 27/08/2013 for Unit 2 respectively. During the first monitoring period, the project continued operation smoothly and stably without any major breakdown and malfunction events regarding operation of turbines/generators.

Relevant dates for the project activity is as follows:

Key Events	Date	Reference
Project starting date	05/10/2007	Construction contract signed
Registration date	28/12/2012	UNFCCC website
Crediting period	fixed 10 years	Selected by PP
Operation of 1st generator	12/05/2013	Acceptance of commissioning equipment for running 72h with on-load of Unit 1- Khe Bo HPP dated 12/05/2013
Operation of 2nd generator	27/08/2013	Acceptance of commissioning equipment for running 72h with on-load of Unit 2- Khe Bo HPP dated 27/08/2013
1st monitoring period	12/05/2013-31/08/2014	Selected by PP
2nd monitoring period	01/09/2014-30/11/2016	Selected by PP

The total emission reductions achieved in this monitoring period are 464,773 tCO_2.

A.2. Location of project activity

>>

(a) Host party (ies)
Viet Nam
(b) Regions/State/Province:

[1] Emission Reduction calculation spreadsheet.

Nghe An Province

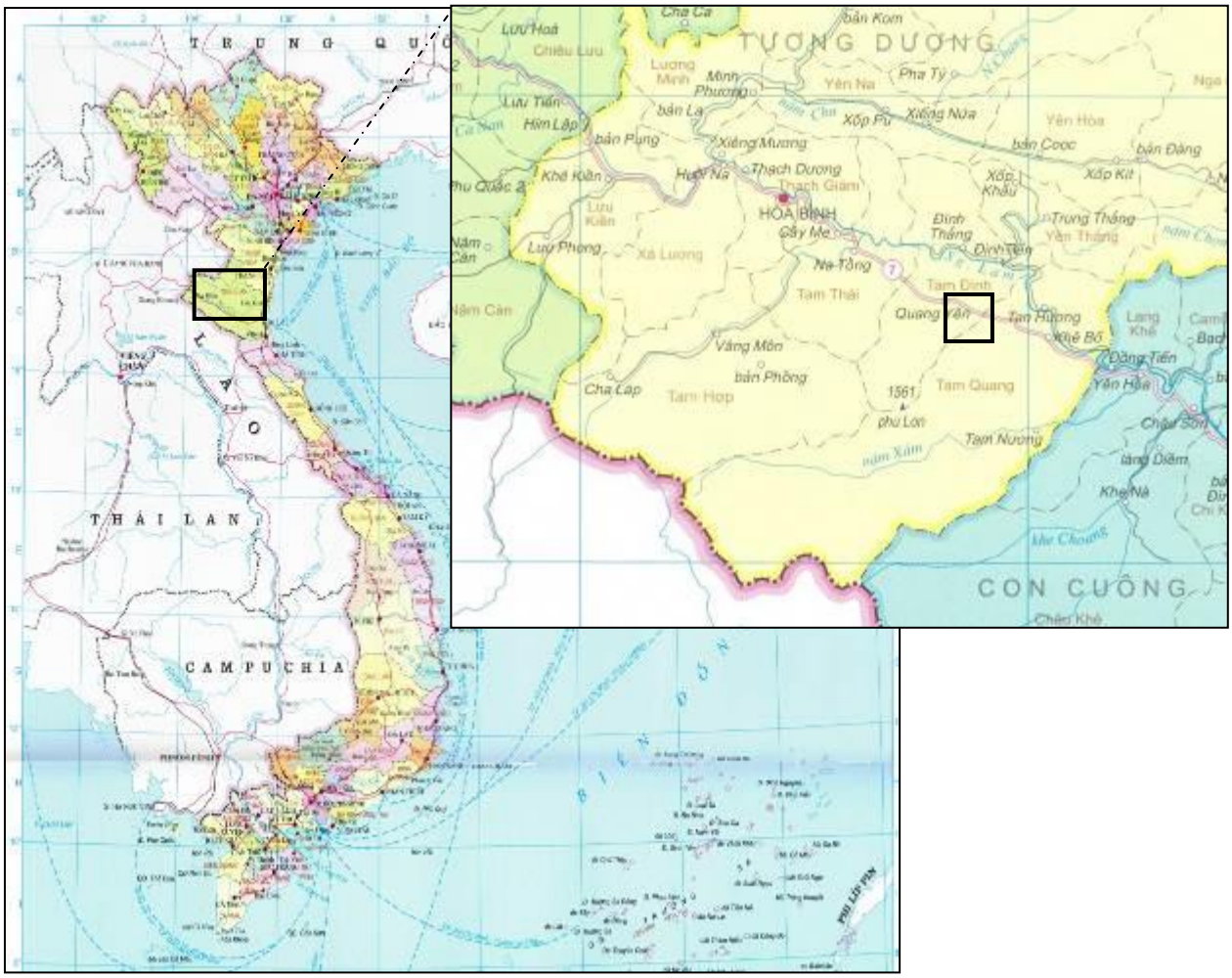
(c) City/Town/Community:

Tam Quang, Yen Thang, Tam Dinh, Tam Thai, Thach Giam, Xa Luong Communes and Hoa Binh town, Tuong Duong District.

(d) Physical/Geographical location:

The main works of the Project as dam and powerhouse are situated in Tam Quang commune, Tuong Duong district, Nghe An Province, Viet Nam. It is approximately 150 km Northwest of Vinh city. Figure below shows the detailed geographical location of the Project site. The project's geographic coordinates are approximately[2]:

- Dam: 104°39'46.74"E or 104.6630 East longitude and 19°10'52.66"N or 19.1813 North latitude
- Power house: 104°39'51"E or 104.6642 East longitude and 19°10'35"N or 19.1764 North latitude.



Legend:

Project Site

Figure A.2.1: Project location in Nghe An province, Viet Nam

[2] The GPS coordinates of Dam and Power house have been taken during the verification site visit and confirmed by PP.

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)
Viet Nam (host)	Viet Nam Power Development Joint Stock Company	No

A.4. Reference of applied methodology and standardized baseline

>>

(a) The applied methodology:

ACM0002 ""Consolidated baseline methodology for grid-connected electricity generation from renewable sources" version 13.0.0.

(b) The related tools:

- Tool for the demonstration and assessment of additionality, version 07.0.0
- Tool to calculate the emission factor for an electricity system, version 02.2.1

The methodology and the related tools are available on the UNFCCC website:

http://cdm.unfccc.int/methodologies/DB/UB3431UT9I5KN2MUL2FGZXZ6CV71LT

A.5. Crediting period of project activity

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- The type of crediting period chosen for the project activity is fixed crediting period.
- Crediting period is 10 year fixed, i.e. from 12/05/2013 to 11/05/2023, which has been changed from 01/04/2013 to 30/03/2023.
- The second monitoring period has been considered from 01/09/2014 to 30/11/2016 (first day and last day included)

A.6. Contact information of responsible persons/entities

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Joost Willem van Acht
Managing Director
Blue World Carbon SEA Pte Ltd
Joost.van.acht@blueworldcarbon.com

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

>>

Khe Bo hydropower plant has started operating commercially on 12/05/2013 (Unit 1) and on 27/08/2013 (Unit 2) and the project has been registered as CDM project by UNFCCC on 28/12/2012.

From 01/09/2014 to 30/11/2016, Khe Bo hydropower plant has been in a stable state, no emergency case occurred. There were no special events such as overhaul or exchange of turbine and/or generator. There were also no events or situations which may impact the applicability of the methodology.

Technology employed by the project activity:

The project consists of a run-of-river type hydropower project with dam, power tunnel, penstock, powerhouse and on-site step-up transformer station. The technology employed in the project is a

conventional water diversion design using the natural water flow of the river. With two sets of 50 MW, the overall capacity of the project is 100 MW.

The flow process of the hydropower station can be identified as below Figure B.1.1:

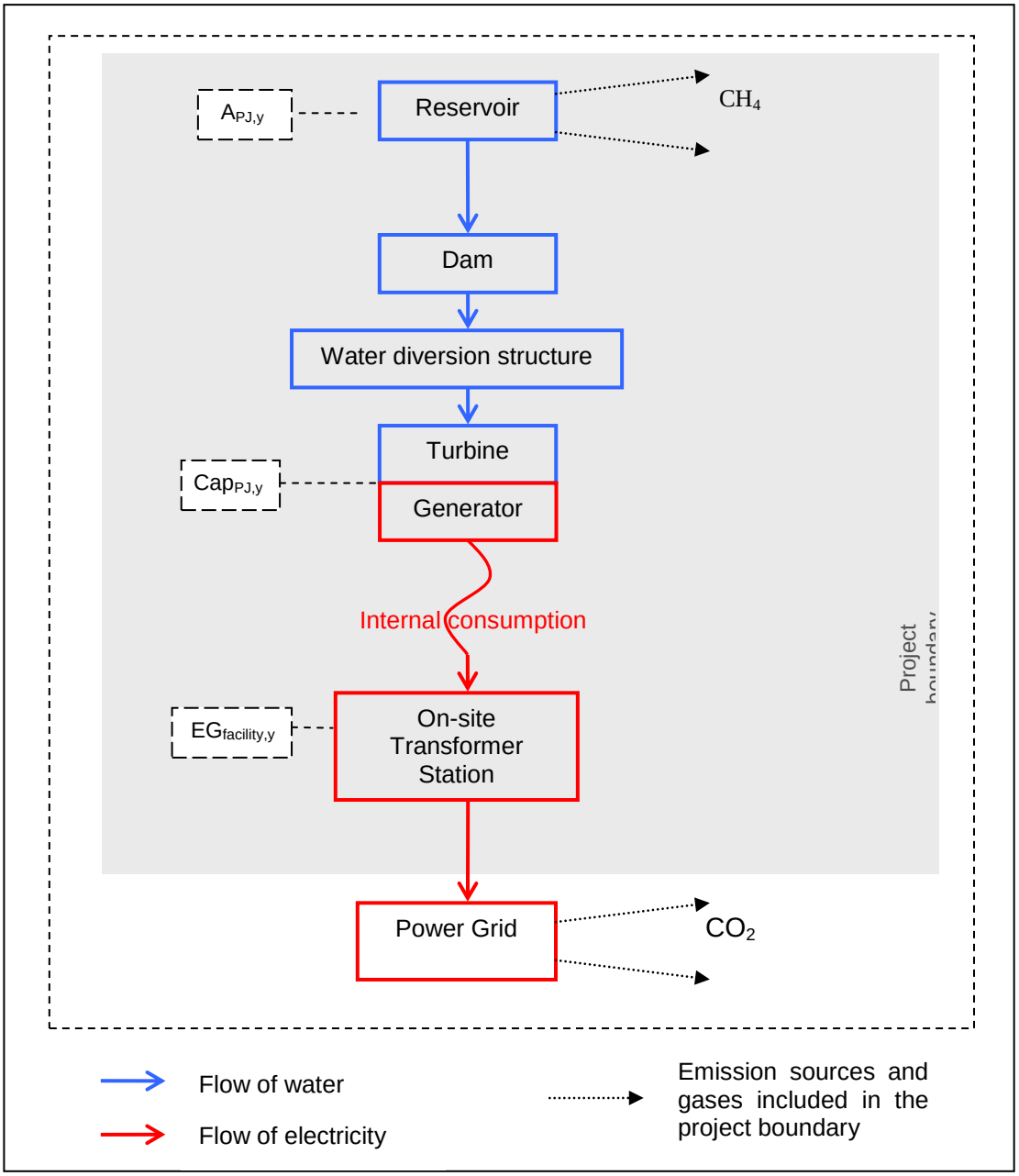

Figure B.1.1- Flow process of Khe Bo Hydropower Project

Table B.1.1: Key technical parameters of the hydro turbine and the generator[3]

Hydro Turbine		Generator	
Turbine Type	Kaplan, vertical axis.	Generator Type	Three phases – synchronous-vertical axis
Max water head	25.90 m		
Rated water head	23.00 m	Rated power	58.82 MVA
Rated output	51.282 MW	Rated speed	125 rpm
Rated speed	125 rpm	Rated power factor cos φ	0.85
Rated flow	243.9 m^3/s	Rated voltage	13.8 kV

[3] Equipment contract signed on 18/04/2009 and the nameplates of turbine-generator.

Weighted average Efficiency	93.06 %	Rated frequency	50 Hz
Manufacturer	Zhejiang Fuchunjiang Hydropower Equipment Co., Ltd	Manufacturer	Zhejiang Fuchunjiang Hydro Power Equipment Co., Ltd

The generators are connected to an onsite transformer, which is connected to the Viet Nam National Electricity Grid via a 220kV local transmission line. The electricity generated by the Project has been measured at two agreed connection points for two generator units separately with identical power meters following the Power Purchase Agreement[4].

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 deviation is identified in this monitoring period.

B.2.2. Corrections

>>

No correction is identified in this monitoring period.

B.2.3. Changes to start date of crediting period

>>

Not applicable. This section is left blank intentionally

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

>>

Not applicable. This section is left blank intentionally

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

>>

Not applicable. This section is left blank intentionally

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

>>

Not applicable. This section is left blank intentionally

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

>>

Not applicable. This section is left blank intentionally

[4] Power Purchase Agreement signed between EVN (the buyer) and the PP (the seller) on 20/06/2013).

SECTION C. Description of monitoring system

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The monitoring plan has been made in accordance with the methodology; the Project Owner is responsible for the implementation of the monitoring plan. The data that is required to be monitored is described in section D.2.

This section details the steps taken to monitor on a regular basis the GHG emission reductions from the Khe Bo Hydropower Project. The Monitoring Plan for this project has been developed to ensure that from the start, the project is well organized in terms of the collection and archiving of complete and reliable data.

1. Monitoring organization

1.1. Operational and Management Structure

The project owner has a dedicated Technical Department, which is responsible for the installation, maintenance and calibration of all meters. In addition, the project owner will allocate specific responsibilities as described below.

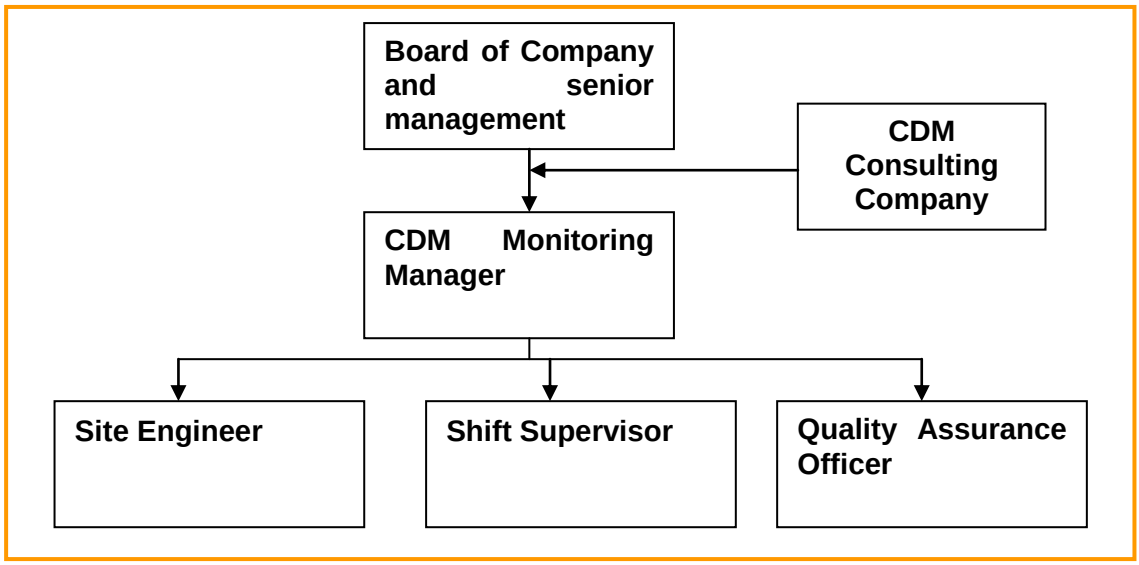


Figure C.1 Operational and Management Structure

Table C.1: Monitoring responsibility

Position	Name[5]	Outline of Responsibilities	Reporting
CDM Monitoring Manager	Mr Do Van Manh (Vice Director of Khe Bo Hydropower Plant)	• Ensures ongoing compliance with the CDM monitoring plan; • Supervises meter calibration requirements and preparation of the meter calibration report; • Reviews and approves quarterly metered net electricity generation reports; • Oversees the collection, recording and	Reports to senior management and the Board of the Company

[5] Group members may be adjusted based on the actual assignment of Khe Bo Hydropower Plant or Viet Nam Power Development Joint Stock Company.

		storage of data; • Calculates Emission Reductions; • Prepares the CDM Monitoring Report; • Prepares Baseline Emission Factor report at the end of each crediting period.	
Site Engineer	Mr Nguyen Thanh Vinh	• Responsible for the completeness and reliability of the data; • Responsible for carrying out meter calibration; • Generates quarterly metered net electricity generation reports.	Reports to the CDM Monitoring Manager (for CDM purposes only)
Shift Supervisor (Shift Based)	Mr Ngo Trung Hai	• The person appointed for each shift must be an experienced officer involved in the operation and maintenance of the hydro power plant; • Responsible for monitoring hourly measurements, generating daily reports, and ensuring that meters are functioning correctly.	Reports to the Site Engineer
Quality Assurance Officer	Mr Le Van Khuong	• Undertakes regular internal audits of the project; • Ensures compliance with Company Quality Assurance Procedures.	Reports to senior management

1.2 Training

All persons that are involved in the CDM monitoring have been received appropriate training to be conducted by the project owner in association with a CDM consulting company (i.e. Blue World Carbon SEA Pte Ltd. or BWC) on 15/04/2013 and the training record has been kept at the plant. The training provided an overview of the CDM and covered all elements of the monitoring plan in detail. A copy of the project monitoring manual has been distributed to all training participants, and an additional copy is easily accessible at appropriate locations on site.
The electromechanical equipment supplier has been also provided technical training with respect to assembly, start-up, operation, maintenance and/or repair of the electrical and mechanical equipment[6]. This forms part of the contract terms for equipment supply.
Furthermore, during the second monitoring period, Khe Bo Hydropower Plant has conducted the annual internal meeting on 07/04/2015 and 05/04/2016 for CDM monitoring. The purpose of internal meetings is to improve the quality of monitoring and operating.

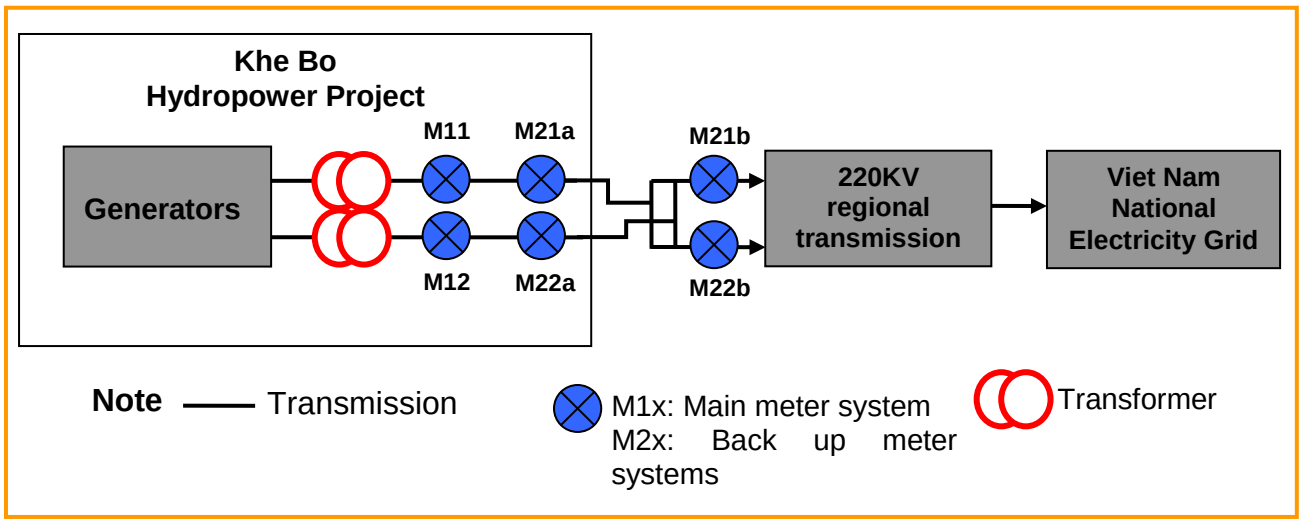
2. Monitoring data

2.1. Installation of monitoring equipment

The specification of energy meters installed in the project are complying with Technical Specification of Energy Metering (Circular 23/2013/TT-BKHCN (Regulation on calibration of measurement equipment), issued by Ministry of Science and Technology, dated 26/09/2013) with accuracy class of 0.2s for main meters complied with international standard IEC 62053-22 and accuracy class of 0.5s for the backup meter complied with international standard IEC 62053-22. The energy metering is properly configured, and the metering equipment has been checked by both the project owner and the grid company before operation.

Below is the layout of the monitoring systems in the project:

[6] Verify Minutes of the Operation and Maintenance Training Services completed on 17/05/2013, as a part of equipment contract package provided by the equipment supplier, i.e. Union Resource& Engineering Co., Ltd (or UREC), who is one of consortium Contractor URECO-ZHEFU-EEMC



Where:
M1x: including M11 and M12 such main meters for Unit 1 and Unit 2 respectively and separately.
M2x: including M21a and M22a such backup meters No.1 for Unit 1 and unit 2 respectively and separately; and M21b and M22b such backup meters No.2 for both Unit 1 and unit 2.

Figure 4: Monitoring layout

2.2. Net electricity supplied to the Grid by the Project

The net electricity, which is the difference between the measured quantities of the grid electricity export ($EG_{ex,y}$) and import ($EG_{im,y}$), delivered to the grid by the project activity have been monitoring by main meters (M1x) installed at the booster station. The main meters are bidirectional meters with the accuracy of no less than 0.2s[7]. These meter reading records are the basis of CER calculation. The monthly electricity sale receipt mentioning the export and the import have been provided by the grid company to the project owner to cross-check the CER calculation. Additionally, the backup meters (M2x) with the accuracy class of no less than 0.5s [8] have been also installed by the PP at the substation alongside the main meters. Both the main meters and the backup meters are capable of measuring the exported electricity from the project activity to the grid and the imported electricity to the project activity from the grid. The data recording for both the main and backup meters have been recording simultaneously. The detailed monitoring procedure of measuring electricity supplied to the grid by the project has been established between the project owner and the grid company as indicated in the Power Purchase Agreement.

2.3. Monitoring of CAP_{PJ} and A_{PJ}

Installed capacity of the hydro power plant after the implementation of the project activity has been monitored by checking the rated capacity on the nameplate of the generator.

Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full, is monitored by calculations based on relevant maps supplied by qualified parties.

2.4. Quality Assurance and Quality Control (QA & QC)

QA & QC procedures for recording, maintaining and archiving data are improved as part of this CDM project activity. This is an on-going process which is ensured through the CDM mechanism in terms of the need for verification of the emission on an annual basis according to the PDD.
Frequently the monitoring plan including all defined procedures, reports, data, and personnel is inspected internally to ensure the monitoring activities. Especially in the beginning of the crediting

[7] Decision No 02/2007/QD-BCN

[8] Decision No 02/2007/QD-BCN

period, these internal inspections should take place, to guarantee the implementation of monitoring procedures.
Corrective actions are taken promptly by the project owner when the erroneous measurements and deviations occur.
Actions to correct deviations from the monitoring plan and the guidelines for the project operation and monitoring will be implemented as these deviations are observed either by the operator or during internal audits.
Except periodic meeting, additional technical meetings among the operator, the management board of the project owner will be held, if necessary, in order to define the corrective actions to be carried out.
Corrective actions are also set down in case of equipment or systems malfunction or breakdown.
During the second monitoring period, Khe Bo Hydropower Plant has conducted the internal meetings on 07/04/2015 and 05/04/2016 for CDM monitoring and purpose of internal meeting is to improve the quality of monitoring and operating.

2.5. Calibration of Meters and Metering

The meters have been calibrated and verified pursuant to national standard according to Circular 23/2013/TT-BKHCN (Regulation on calibration of measurement equipment), issued by Ministry of Science and Technology, dated 26/09/2013. The calibration and verification for the power meters need to be conducted at least every two years by the third party once during project operation. However, following the Power Purchase Agreement (PPA) signed between Vietnam Power Development JSC (as the Seller) and EVN (as the Buyer) on 20/06/2013, the EVN required the power meters to be calibrated every year[9]. After every calibration, the meters has been sealed so that no illegal interference is possible.

Khe Bo Hydropower Plant has started operation since 12/05/2013. The power metering system employed in the plant consists of one main power meter system and two backup power meter systems. The main meters have been calibrated the first time by Northern Electrical Testing Company Limited (under EVN) on 24/06/2013 and 06/07/2013, the second time on 16/12/2014, and the third time on 31/12/2015. Details on the power meters are presented in the table below:

Table C.2- Technical details of main power meters

Technical details	Main meter M11 (for Unit 1)	Main meter 12 (for Unit 2)
	11090580	09092857
Model	Elster A1700	
Type and specification	PB3KAGGHT-5	
Accuracy class	0.2s	
Date of Calibrations[10]	24/06/2013	06/07/2013
	16/12/2014	
	31/12/2015	
Valid to	31/12/2017	
Calibration frequency	Every year[11]	
Calibration party	Northern Electrical Testing Company Limited	

Table C.3- Technical details of backup power meters

[9] The PPA signed on 20/06/2013.

[10] Calibration records of the meters.

[11] This was required by EVN following the PPA signed on 20/06/2013 between EVN and the project participant.

Technical details	Backup meter M21	Backup meter 22
Back up No.1	13076731 (for Unit 1)	11017570 (for Unit 2)
Model	Elster A1700	
Type and specification	PB3KAGGHT-5	
Accuracy class	0.5s	
Date of the calibrations	17/04/2013	
	16/12/2014	
	31/12/2015	
Valid to	31/12/2017	
Calibration party	Northern Electrical Testing Company Limited	
Back up No.2	11017571 (for both unit 1&2)	11017573 (for both unit 1&2)
Model	Elster A1700	
Type and specification	PB3KAGGHT-5	
Accuracy class	0.5s	
Date of Calibrations	17/04/2013	
	16/12/2014	
	31/12/2015	
Valid to	31/12/2017	
Calibration frequency	Every year[12]	
Calibration party	Northern Electrical Testing Company Limited	

The calibrations of the main meters had been delayed from 24/06/2014 to 16/12/2014 and from 16/12/2015 to 31/12/2015. Because the results of the delayed calibration do not show any error in the measuring equipment, as regulated in the CDM VVS, version 09.0 paragraph 395 (a), the following conservative approach is adopted: "applying the maximum permissible error of the instruments to the measured values taken during the period between the scheduled date of calibration and the actual date of calibration". Hence, in this monitoring period, maximum permissible error of 0.2%, which is specified by the manufacturer, is applied for measured data from 01/09/2014 to 31/12/2014 and in December 2015 (i.e. from 01/12/2015 to 31/12/2015) for more conservative. In particular:

Adjusted value = measured value – measured value * 0.2% (exported electricity).
Adjusted value = measured value + measured value * 0.2% (imported electricity).

2.6. Data Management System

Data are archived time to time in an electronic spreadsheet printed out monthly. The electronic files are stored on a hard disk; a data backup system has been established by setting up a big server located in the plant. The project owner also collects and keeps electricity sales receipts from the grid company for the purpose of double checking. At the end of each monitoring year, a monitoring report will be compiled detailing the metering results and evidence.
All data records will be kept for 2 years after the end of the crediting period.

2.7. Damages to metering equipment:

In case the main meter (M1x) fails, the data from the backup meter (M2x) is considered for calculation of net electricity exported to the grid. In details, following the PPA signed on 20/06/2013 with EVN:

- In case the main meters (M1x) fails, the metering data logged by backup meter No.1 and evidence of sales records are used to determine net power supplied to the grid for the days for which no record could be kept. The project entity furthermore documents all efforts taken to restore normal monitoring procedures.

[12] This was required by EVN following the PPA signed on 20/06/2013 between EVN and the project participant.

- In case of both metering equipment (main and backup No.1) operated by the project entity are damaged: The metering data measured by backup No.2 is used to release the billing invoices in the period of both main and backup No1 broken.
- In case of all metering equipment (main and two backup systems) are broken, then the Project Owner and the grid company will jointly calculate a conservative estimate of the amount of power supplied to the grid. A statement will be prepared indicating:

    - The background of the damage to the metering equipment;
    - The assumptions used to estimate net supply to the grid for the days for which no record could be recorded;
    - The estimation of power supplied to the grid;
    - The statement will be signed by both a representative of the Project Owner as well as a representative of the grid company.

The Project Owner will furthermore document all efforts taken to restore normal monitoring procedures. Based on that number, the project participant can calculate the ER and cross check with electricity invoices. *However, the case is hardly to happen since Khe Bo Hydropower Plant has two backup metering systems.*

The main meter is immediately repaired / replaced and calibrated for its accuracy before re-installing. In case the backup meter (M2x) fails, then the backup meter is immediately repaired / replaced and calibrated for its accuracy before re-installing.

2.8. Emergencies:

In case of emergencies, the Project Owner will follow the following procedure for declaring the emergency period to be over:

- The Project Owner will ensure that all requirements for monitoring of emission reductions have been re-established.
- The monitoring manager and the head of operations of the hydropower station will both sign a statement declaring the emergency situation to have ended and normal operations to have resumed.

SECTION D. Data and parameters

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

Data/parameter:	**Cap_{BL}**
Unit	W
Description	Installed capacity of the hydro power plant before the implementation of the project activity. For new hydro power plants, this value is zero.
Source of data	-
Value(s) applied)	
Choice of data or measurement methods and procedures	The project activity constructs a new hydropower plant, so Cap_{BL} is considered to be zero according to Version 13.0.0 of ACM0002.
Purpose of data	Calculation of project emissions
Additional comments	-

Data/parameter:	**A_{BL}**
Unit	m^2
Description	Area of the single or multiple reservoirs measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m^2). For new reservoirs, this value is zero

Source of data	-
Value(s) applied)	0
Choice of data or measurement methods and procedures	The project activity constructs a new hydropower plant, so A_{BL} is considered by zero according to Version 13.0.0 of ACM0002.
Purpose of data	Calculation of project emissions;
Additional comments	-

Data/parameter:	**$FC_{i,m,y}$**
Unit	Mass or volume unit
Description	Amount of fossil fuel type *i* consumed by power plant/unit *m* in year *y*
Source of data	Data is provided by DNA Viet Nam.
Value(s) applied)	The value of fossil fuel consumed to generate electricity by power plants supplied to national grid in year of 2006, 2007 and 2008 used in the project calculation is referred to Annex 3
Choice of data or measurement methods and procedures	Data is provided by DNA Viet Nam.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data/parameter:	**$NCV_{i,y}$**
Unit	GJ / mass or volume unit
Description	Net calorific value (energy content) of fossil fuel type *i* in year *y*
Source of data	Data is provided by DNA Viet Nam.
Value(s) applied)	The NCV value of specific fossil fuel used to generate electricity at power plants supplied to national grid in year of 2006, 2007 and 2008 is referred to the official document No 151/KTTVBDKH on Grid Emission Factor Study Report issued by Viet Nam DNA dated 26th March 2010.(Annex 3)
Choice of data or measurement methods and procedures	Data source: issued by DNA Viet Nam on 26th March 2010 as per the "Tool to calculate the emission factor for an electricity system".
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data/parameter:	**$EF_{CO2,i,y}$**
Unit	tCO_2/GJ
Description	CO_2 emission factor of fossil fuel type *i* in year *y*
Source of data	IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value(s) applied)	Value applied in Annex 3
Choice of data or measurement methods and procedures	IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories

Purpose of data	Calculation of baseline emissions
Additional comments	-

Data/parameter:	**$EG_{m,y}$**
Unit	MWh
Description	Net electricity generated and delivered to the grid by power plant *m* in year *y*
Source of data	Data is provided DNA Viet Nam.
Value(s) applied)	The value of net electricity generated by power plants supplied to national grid in year of 2006, 2007 and 2008 used in the project calculation is referred to Annex 3
Choice of data or measurement methods and procedures	Data source: issued by DNA Viet Nam
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data/parameter:	**$EF_{grid,BM,y}$**
Unit	tCO_2/MWh
Description	Build Margin Emission Factor for the Viet Nam electricity grid
Source of data	Ex-ante calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (see Annex 3)
Value(s) applied)	0.4876
Choice of data or measurement methods and procedures	Data source: issued by DNA Viet Nam
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data/parameter:	**$EF_{grid,OM,y}$**
Unit	tCO_2/MWh
Description	Operating Margin Emission Factor for the Viet Nam electricity grid
Source of data	Ex-ante calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (see Annex 3)
Value(s) applied)	0.6241
Choice of data or measurement methods and procedures	Data source: issued by DNA Viet Nam.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data/parameter:	**$EF_{grid,CM,y}$**
Unit	tCO_2/MWh

Description	Combined Margin Emission Factor for the Viet Nam electricity grid connected power generation in year *y* calculated using the latest version of the "Tool to calculate the emission factor for an electricity system"
Source of data	Calculated ex-ante based on the available data from Grid Emission Factor Study Report issued by Viet Nam DNA dated 26th March 2010 as per "Tool to calculate the emission factor for an electricity system"
Value(s) applied)	0.5558
Choice of data or measurement methods and procedures	Data source: issued by DNA Viet Nam on 26th March 2010 as per the "Tool to calculate the emission factor for an electricity system".
Purpose of data	Calculation of baseline emissions
Additional comments	-

D.2. Data and parameters monitored

(Copy this table for each piece of data and parameter)

<table>
<tr><td>Data/parameter:</td><td>$EG_{facility, y}$</td></tr>
<tr><td>Unit</td><td>MWh/yr</td></tr>
<tr><td>Description</td><td>Net electricity supplied by the proposed hydropower plant to the national grid</td></tr>
<tr><td>Measured/calculated/default</td><td>Calculated based on measurement by M1x and/or M2x</td></tr>
<tr><td>Source of data</td><td>Electricity meter(s)</td></tr>
<tr><td>Value(s) of monitored parameter</td><td>371,316
(the average value for a year that is calculated based on the net electricity supplied to the national grid for overall monitoring period, i.e. 836,224 MWh for 822 days)</td></tr>
<tr><td>Monitoring equipment</td><td>
<table>
<tr><td>Technical details</td><td>Main meter M11 (for Unit 1)</td><td>Main meter 12 (for Unit 2)</td></tr>
<tr><td></td><td>11090580</td><td>09092857</td></tr>
<tr><td>Model</td><td colspan="2">Elster A1700</td></tr>
<tr><td>Type and specification</td><td colspan="2">PB3KAGGHT-5</td></tr>
<tr><td>Accuracy class</td><td colspan="2">0.2s</td></tr>
<tr><td rowspan="3">Date of Calibrations[13]</td><td>24/06/2013</td><td>06/07/2013</td></tr>
<tr><td colspan="2">16/12/2014</td></tr>
<tr><td colspan="2">31/12/2015</td></tr>
<tr><td>Valid to</td><td colspan="2">31/12/2017</td></tr>
<tr><td>Calibration frequency</td><td colspan="2">Every year[14]</td></tr>
<tr><td>Calibration party</td><td colspan="2">Northern Electrical Testing Company Limited</td></tr>
</table>
</td></tr>
<tr><td>Measuring/reading/recording frequency:</td><td>Continuously measured and at least monthly recording</td></tr>
<tr><td>Calculation method (if applicable):</td><td>-</td></tr>
<tr><td>QA/QC procedures:</td><td>The net supply of power to the grid by the proposed project activity is measured through national standard electricity metering instruments and cross checked measurement results with records for sold electricity invoices. The electricity metering instruments are calibrated every year as per EVN's requirement and following standard "Decision 02/2007/ QD-BCN (Ministry of Industry) standard IEC 62053-22"[15].
All the relevant data would be kept at least two (02) years after the fixed crediting period is finished.</td></tr>
</table>

[13] Calibration records of the meters.

[14] This was required by EVN following the PPA signed on 20/06/2013 between EVN and the project participant.

[15] Decision No. 02/2007/QD-BCN dated 9th Jan. 2007 issued by Ministry of Industry

Purpose of data:	Calculation of baseline emissions
Additional comments:	For CERs calculation The calibration and accuracy of the power meters has been indicated in Section B.7.2 of the PDD.

Data/parameter:	**Cap_{PJ}**
Unit	W
Description	Installed capacity of the hydro power plant after the implementation of the project activity.
Measured/calculated/default	
Source of data	Project site
Value(s) of monitored parameter	100,000,000
Monitoring equipment	Determine the installed capacity based on the recognized standards yearly.
Measuring/reading/recording frequency:	Yearly
Calculation method (if applicable):	-
QA/QC procedures:	The capacity of the turbines is to be checked with reference to the specification from the equipment supplier
Purpose of data:	Calculation of project emissions
Additional comments:	Refer to B.7.2. Description of the monitoring plan

Data/parameter:	**A_{PJ}**
Unit	m^2
Description	Area of the single or multiple reservoirs measured in the surface of the water, after the implementation of the project activity, when the reservoir is full
Measured/calculated/default	Calculated
Source of data	Project site
Value(s) of monitored parameter	9,046,000 (the highest monthly record value during this monitoring period selected[16])
Monitoring equipment	Measured from topographical surveys, maps, satellite pictures, etc
Measuring/reading/recording frequency:	Yearly
Calculation method (if applicable):	The area of reservoir has been calculated based on the approved diagram which is showing the relation between water level and area of reservoir. This diagram was designed in Reservoir Operation Procedure by the engineering consultant during topographical surveys and had been approved by Ministry of Industry and Trade on 24/07/2009. For more conservative, the highest value of reservoir area among monthly average values over the first monitoring period has been selected to calculate the power density of the project.
QA/QC procedures:	-
Purpose of data:	Calculation of project emissions
Additional comments:	Refer to B.7.2 of the PDD. Description of the monitoring plan

[16] The value selected is the average reservoir area of the project in Jul 2015 and July 2016. The data is available for verification.

D.3. Implementation of sampling plan

>>

Not applicable. This section is intentionally left blank.

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)

Baseline emissions are calculated as follows:

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

Where:

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

$EF_{grid,CM,y}$ = The combined margin CO_2 emission factor for grid connected power generation in year y. This factor[17]is calculated as follows:

$EF_{grid,CM,y}$= *0.5558* tCO_2/MWh (Emission factor of National Grid Electricity Emission Factor published in 2012).

In the second monitoring period (01/09/2014 - 30/11/2016), Khe Bo Hydropower project has supplied to the National Grid the net electricity of **836,224** MWh.

Therefore, the baseline emission (BE_y) has been calculated as below:

$$BE_y = 836,224 * 0.5558 = 464,773\ tCO_2$$

The details have been shown in the table below[18]:

Comparison	Registered PDD	Actual values
Gross Electricity generation in the Monitoring Period (MWh)	997,209.863	837,454.000
Generation Factor (Generated electricity/Maximum electricity) generation) (%)	50.54%	42.45%
Electricity imported from the Grid in the monitoring period	14,958.148	1,230.000
Net Electricity generation in the Monitoring Period (MWh)	982,251.715	836,224.000
Baseline emission of the monitoring period (tCO_2e) - BE_y (rounded number)	545,935.000	464,773.000

As justified in section C above, the CER during the period in which the power meters have not been calibrated as schedule would be adjusted following para. 395 (a) of VVS (ver. 9.0), as below:

*Adjusted value = measured value – measured value * 0.2% (exported electricity).*

*Adjusted value = measured value + measured value * 0.2% (imported electricity).*

Please refer to Emission Reduction calculation spreadsheet for more details.

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

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[17]This calculation of the factor is required to be used by the DNA Viet Nam and referred to the link

http://www.noccop.org.vn/Data/vbpq/Airvariable_ldoc_59vnBao%20cao%20EF%202010.pdf

[18] More details in Emission Reduction Spread sheet.

According to the methodology ACM002, for most renewable power generation project activities, PE_y= 0. However, some project activities may involve project emissions that can be significant. These emissions shall be accounted for as project emissions by using the following equation:

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y}$$

Where:

PE_y	=	Project emissions in year *y* (tCO_2e/yr)
$PE_{FF,y}$	=	Project emissions from fossil fuel consumption in year *y* (tCO_2/yr)
$PE_{GP,y}$	=	Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in year *y* (tCO_2e/yr)
$PE_{HP,y}$	=	Project emissions from water reservoirs of hydro power plants in year *y* (tCO_2e/yr)

The methodology provides procedures to calculate the project emissions from the following sources:

- fossil fuel combustion in geothermal and solar thermal projects;
- emissions of non-condensable gases from the operation of geothermal power plants, and;
- emissions from water reservoirs of hydropower plants.

The first source, fossil fuel combustion, applies to geothermal and solar thermal projects. The proposed project activity does not involve either geothermal or solar thermal aspects. Moreover, the backup diesel generators installed for project activity only used in the emergency case when both power plant and national grid are in malfunctioning concurrently. As per ACM0002, version 13.0.0, the use of fossil fuels for the back up or emergency purposes (e.g. diesel generators) can be neglected. So this source does not apply to the proposed project.

The second source involves geothermal power plants. The proposed project activity does not utilize geothermal power. Therefore, the second source also does not apply.

The third source, emissions from water reservoirs of hydropower plants, is applied to the proposed project activity since it is a hydropower plant.

Emissions from water reservoirs of hydropower plants ($PE_{HP,y}$)

According to the methodology, new single or multiple reservoirs and hydro power project activities that result in the increase of single or multiple existing reservoirs, project proponents shall account for CH_4 and CO_2 emissions from the reservoirs when the power density of the project activity (*PD)* is greater than 4 W/m^2 and less than or equal to 10 W/m^2. In the event that the power density of the project activity is greater than 10 W/m^2 (as calculated below), the project emissions are equal to zero.

The power density is calculated as follows:

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}}$$

Where:

PD	=	Power density of the project activity (W/m^2)
Cap_{PJ}	=	Installed capacity of the hydro power plant after the implementation of the project activity (W)
Cap_{BL}	=	Installed capacity of the hydro power plant before the implementation of the project activity (W). For new hydro power plants, this value is zero

A_{PJ} = Area of the single or multiple reservoirs measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m^2)

A_{BL} = Area of the single or multiple reservoirs measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m^2). For new reservoirs, this value is zero

In the case of the proposed project activity:

- Installed power generation capacity (Cap_{PJ}) = 100,000,000 W
- Installed capacity before the implementation of the project activity (Cap_{BL}) = 0 (since the proposed project activity is a new plant)
- Surface area of the reservoir after the implementation of the project activity (A_{PJ}) = 9,046,000 m^2 (measured and calculated value)
- Surface area of the reservoir before the implementation of the project activity (A_{BL}) = 0 (since the reservoir for the proposed project activity is new).

Based on the above project activity's parameters, the power density of the project is

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}} = \frac{100{,}000{,}000 - 0}{9046000 - 0} = 11.05 W / m^2$$

Hence, the power density is 11.05 W/m^2 larger than 10 W/m^2, implying that CH_4 and CO_2 emissions from the reservoirs not need to be accounted as project emissions.

Hence $PE_y = 0$.

E.3. Calculation of leakage

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As per ACM0002, no leakage emissions are considered. The main emissions potentially giving rise to leakage in the context of electric sector projects are emissions arising due to activities such as power plant construction and upstream emissions from fossil fuel use (e.g. extraction, processing, and transport). These emissions sources 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	464,773	0	0	0	464,773	464,773

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)	545,935	464,773

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

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As shown in the table above, the actual emission reductions in this monitoring period is 464,773 tCO_2e while the estimated emission reductions in registered PDD is 545,935 tCO_2e. The actual emission reductions of the project in this monitoring report is 14.87% less than the ex-ante estimation.

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	Viet Nam Power Development Joint Stock Company
Street/P.O. Box	3rd Floor-CT1-Nang Huong Housing and Commercial Service Area, 583 Km9 Nguyen Trai Road, Van Quan Award, Ha Dong District, Hanoi Capital, Viet Nam.
Building	-
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State/region	North of Viet Nam
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Country	Viet Nam
Telephone	+84 4 2131580
Fax	+84 4 7724355
E-mail	vnpd@evn.com.vn
Website	
Contact person	Nguyen Thanh Tung
Title	Director
Salutation	Mr.
Last name	Nguyen
Middle name	
First name	Thanh Tung
Department	-
Mobile	-
Direct fax	+84 4 7724355
Direct tel.	+84 4 2131580
Personal e-mail	-

Project participant and/or responsible person/ entity	☐ Project participant ☒ Responsible person/ entity for completing the CDM-MR-FORM
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E-mail	
Website	www.blueworldcarbon.com
Contact person	Joost Willem van Acht
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Salutation	Mr.
Last name	van Acht
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