Monitoring report form

(Version 04.0)

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
Reference number of the project activity	9036
Version number of the monitoring report	01.0
Completion date of the monitoring report	22/09/2014
Registration date of the project activity	28/12/2012
Monitoring period number and duration of this monitoring period	Monitoring period number: 01 Duration: first and last days included (12/05/2013 – 31/08/2014: 477 days)
Project participant(s)	Viet Nam Power Development Joint Stock Company
Host Party(ies)	Viet Nam
Sectoral scope and selected methodology(ies), and where applicable, applied standardized baseline(s)	Energy Industries (renewable energy) ACM0002, version 13.0.0
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	316,801 tCO_2
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	305,992 tCO_2
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period up to 31 December 2012(if applicable)	Not applicable, since the monitoring period of the project started from 12 May 2013.
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period from 1 January 2013 onwards (if applicable).	305,992 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 10.42 W/m^2. Annual expected gross electricity generation of the Project is 442,800 MWh for a net[1] annual supply to the Grid of 436,158 MWh. The plant load factor of this project is 50.54%.

Prior to the implementation of the proposed project activity, the electricity that will be supplied by the proposed project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources. The baseline scenario is the same as the scenario existing prior to the implementation of the proposed project activity. In the project scenario, the electricity generated from the Khe Bo HPP (Hydropower Plant) will displace more emission-intensive electricity and will therefore result in a reduction of greenhouse gas (GHG) emissions of approximately 242,416 tCO_2e per annum. The total emissions reduction during the ten years fixed crediting period are 2,424,160 tCO_2e.

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

The total emission reductions achieved in this monitoring period are 305,992 tCO_2.

A.2. Location of project activity

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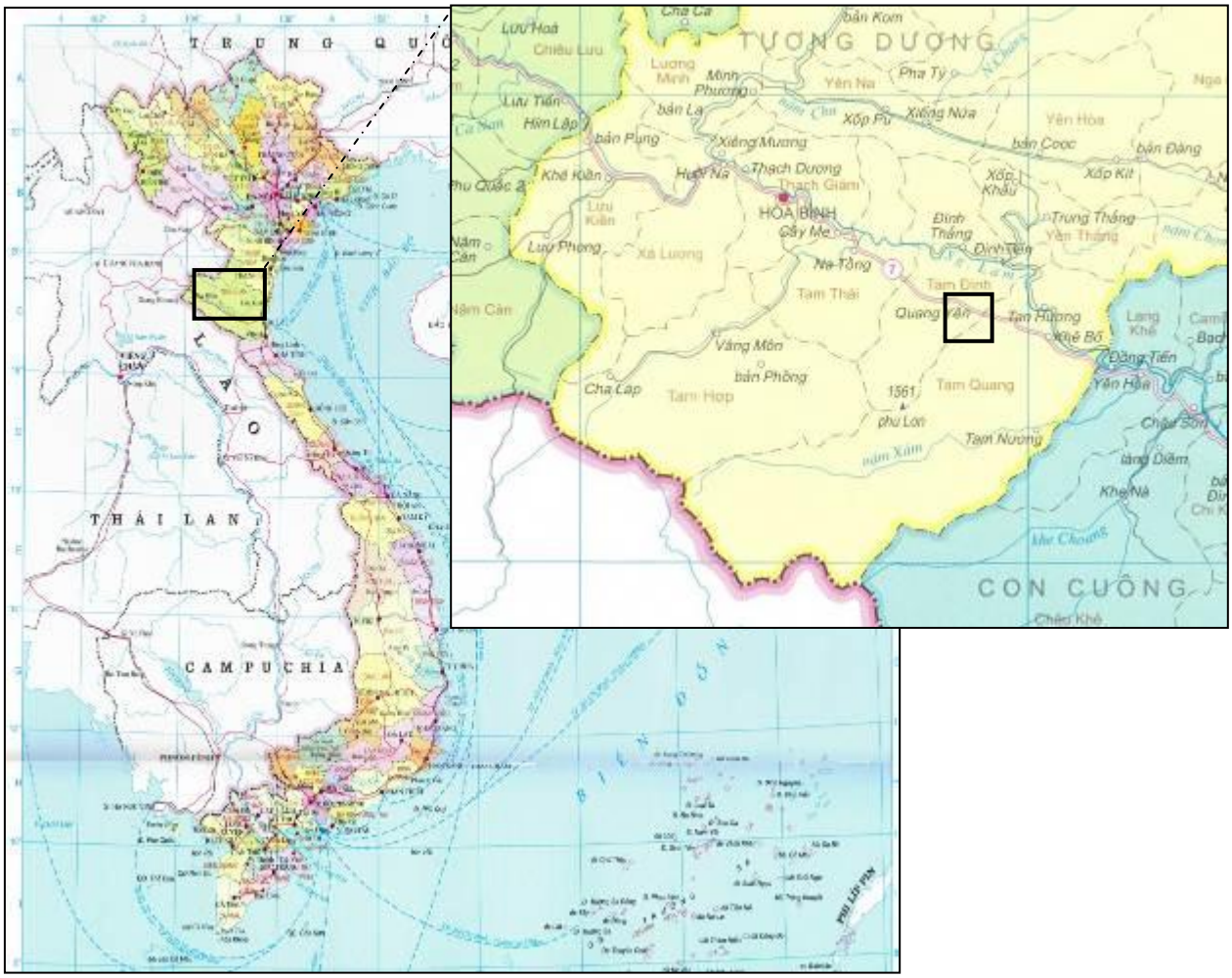
[1] Net annual supply is estimated after deducting 1.5% for transmission losses and self-consumption as per revised FSR in Feb 2007

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

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 104°41'0"E east longitude and 19°8'0"N north latitude.



Legend:

Project Site

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

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 if 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 from 12/05/2013 to 11/05/2023, which has been changed from 01/04/2013 to 30/03/2023.

A.6. Contact information of responsible persons/ entities

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Joost Willem van Acht
Joost.van.acht@blueworldcarbon.com

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

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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 12/05/2013 to 31/08/2014, 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:

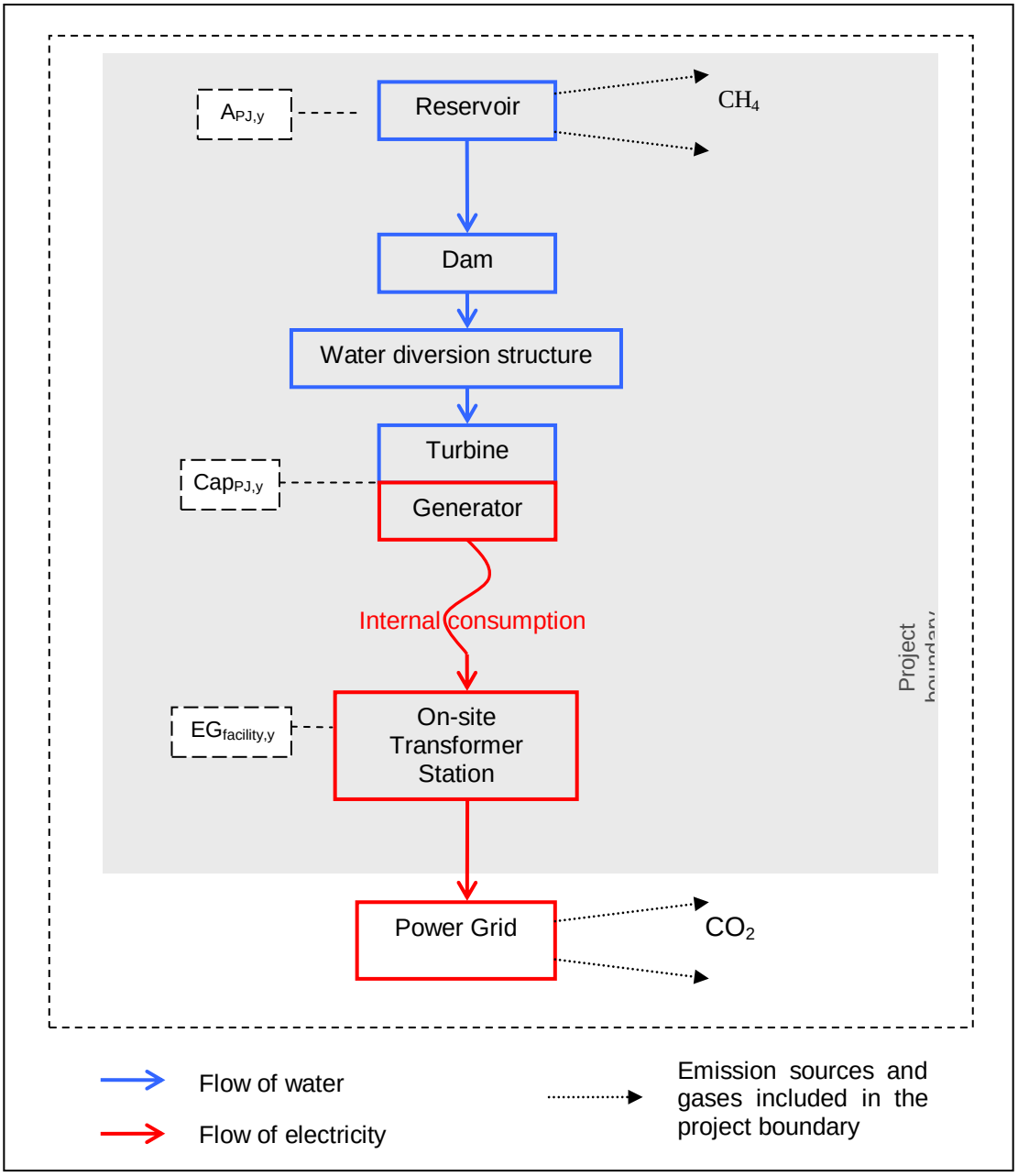

Figure B.1.1- Flow process of Khe Bo Hydropower Project

Table B.1.1: Key technical parameters of the hydro turbine and the generator[2]

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
Weighted average Efficiency	93.06 %	Rated frequency	50 Hz
Manufacturer	Zhejiang Fuchunjiang	Manufacturer	Zhejiang Fuchunjiang

[2] Bidding document for supply, installation of electro-mechanical equipment and technical services dated 08/2008 and the nameplates of turbine-generator.

	Hydropower Equipment Co., Ltd		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 points with identical power meters.

B.2. Post registration changes

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

>>
No deviation is identified in this monitoring period

B.2.2. Corrections

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There are some typographical errors found in the registered PDD that need to be corrected as below:

1. The technical parameters of turbine/generator of the project are incorrect in the registered PDD

Technical parameters of the hydro turbine and the generator

In the registered PDD[3]		**Actual value[4]**	
Hydro Turbine		**Hydro Turbine**	
Turbine Type	Kaplan, vertical axis.	Turbine Type	Kaplan, vertical axis.
Max water head	25.90 m	Max water head	25.90 m
Rated water head	23.00 m	Rated water head	23.00 m
Rated output	51,282 MW	Rated output	51.282 MW
Rated speed	107.1 rpm	Rated speed	125 rpm
Rated flow	254.3 m^3/s	Rated flow	243.9 m^3/s
Efficiency	93,20 %	Weighted average Efficiency	93.06 %
Manufacturer	Zhejiang Fuchunjiang Hydropower Equipment Co., Ltd	Manufacturer	Zhejiang Fuchunjiang Hydropower Equipment Co., Ltd
Expected lifetime	40 years[5]	Expected lifetime	40 years[6]
Generator			**Generator**
Generator Type	Three phases – synchronous-vertical axis	Generator Type	Three phases – synchronous-vertical axis
Rated power	58,824 MVA	Rated power	58.82 MVA
Rated speed	107.1 rpm	Rated speed	125 rpm
Rated power factor cos φ	0.85	Rated power factor cos φ	0.85
Rated voltage	13.8 kV	Rated voltage	13.8 kV

[3] Bidding document for supply, installation of electro-mechanical equipment and technical services dated 03/2008.

[4] Turbine/generator contract signed 18/04/2009 and the nameplate of turbine/generator.

[5] Decision 709/QD-NLDK dated 13th April 2004

[6] Decision 709/QD-NLDK dated 13th April 2004

Rated frequency	50 Hz	Rated frequency	50 Hz
Manufacturer	Zhejiang Fuchunjiang Hydro Power Equipment Co., Ltd	Manufacturer	Zhejiang Fuchunjiang Hydro Power Equipment Co., Ltd
Expected lifetime	40 years[7]	Expected lifetime	40 years[8]

The values indicated in the registered PDD were taken from the bidding document dated 03/2008 which was not the final numbers agreed by two parties. And the actual parameters have been taken from the signed contract dated 18/04/2009 and also from the nameplates of turbines/generators installed at the plant. Hence, there are some differences between the technical parameters in registered PDD and in actual situation. However, the differences do not cause to any changes of turbine capacity as well as the total installed capacity of the project.

B.2.3. Permanent changes from registered monitoring plan, applied methodology or applied standardized baseline

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1. There is a change of the calibration frequency of power meters as in the table below:

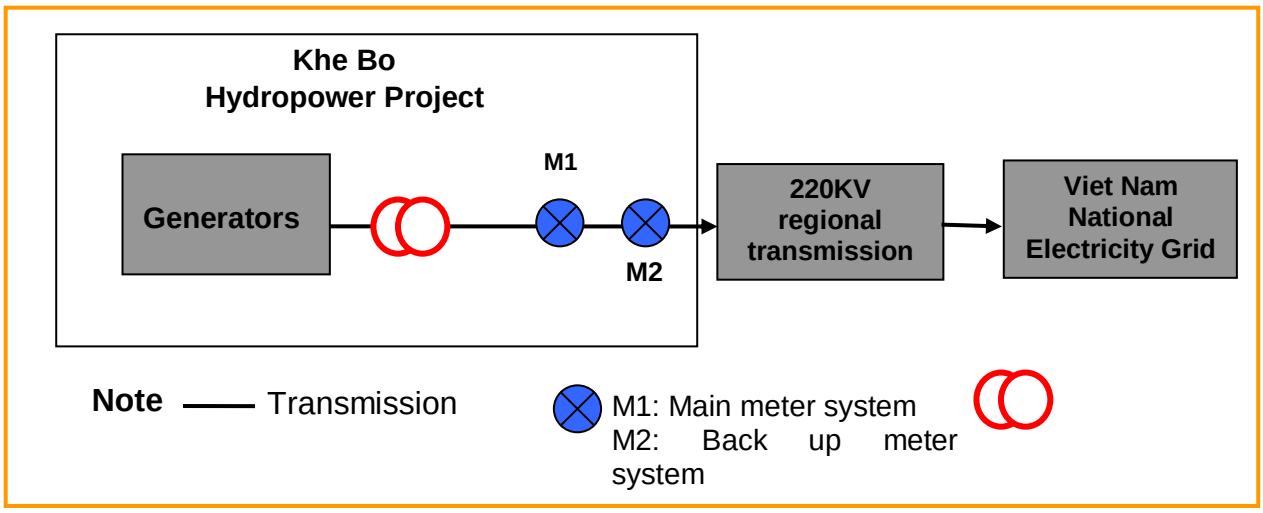
	Calibration frequency	Rationale
Registered PDD	The calibration and verification for the power meters need to be conducted at least every two years by the third party once during project operation.	Pursuant to national standard according to Decision 25/2007/QD-BKHCN issued by Ministry of Technology and Science on application of process and period for inspection of measurement devices
Actual situation	The calibration and verification for the power meters need to be conducted at least every year by the third party once during project operation.	Following the Power Purchase Agreement (PPA) signed between Vietnam Power Development JSC Company (Project Owner or the seller) and EVN (the Buyer) dated 20/06/2013, the EVN required that all power meters which are using for billing purpose have to be calibrated every year by a qualified calibration party during the project operation. Hence, this change is not within the control of the project participant.

2. There is different number of power meters in the actual monitoring system of Khe Bo Hydropower plant compared to the registered PDD.

The registered PDD has described the metering system installed in the plant including a main meter system and a backup meter system, as in figure below.

[7] Decision 709/QD-NLDK dated 13th April 2004

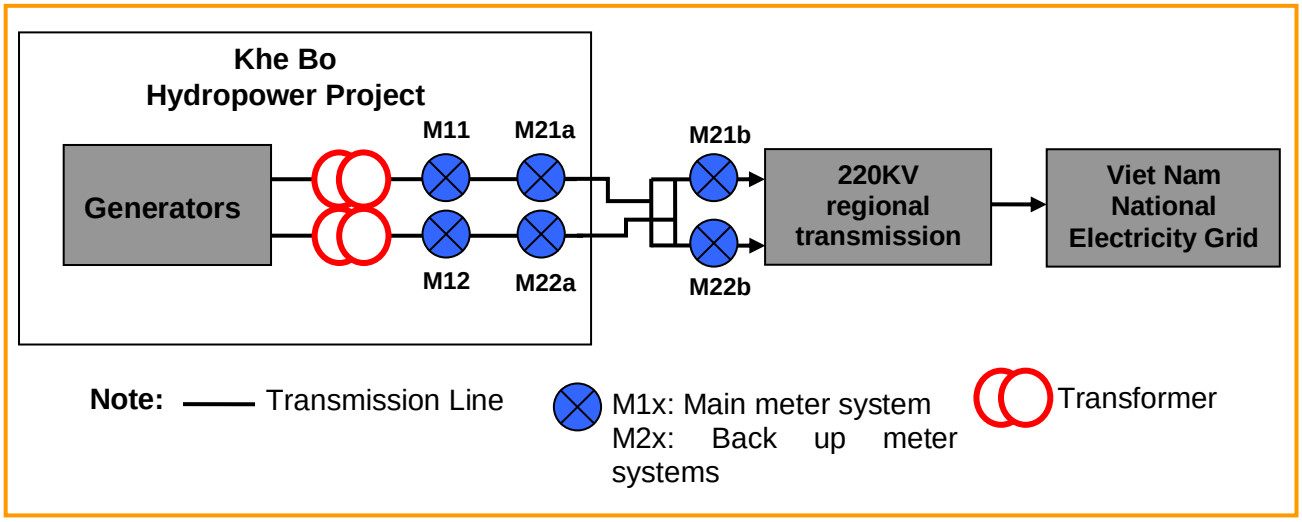
[8] Decision 709/QD-NLDK dated 13th April 2004



Where:
M1: the main meter system.
M2: the backup meter system.

Figure B.2.3.1. The monitoring plan in the registered PDD

However, due to requirements from EVN, who is buying the power generated from Khe Bo Hydropower Plant, following the Power Purchase Agreement (PPA) signed on 20/06/2013, the plant shall install a main meter system and two backup meter systems that are described in the figure below.



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 B.2.3.2. Monitoring layout in actual situation.

Since the additional meters are the backup meters with the accuracy class of 0.5s that are meet the national standard electricity metering instruments as well as the EVN's requirement, hence the monitoring measurements of the project have not been adversely impacted by this change.

B.2.4. Changes to project design of registered project activity

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Not applicable.

B.2.5. Changes to start date of crediting period

>>

The project has been registered as CDM project on 28/12/2012 with UNFCCC registration reference number 9036. The start date of crediting period stated in the PDD section C.2.1.1 was 01/04/2013; however the actual commercial operation date of the project was 12/05/2013 (unit 1). Thus, according to paragraphs 263-266 in PS version 07.0.0, a notification letter for requesting change of crediting period start date to 12/05/2013 was submitted to EB and got approval on 17/09/2014. So the fixed crediting period is from 12/05/2013 to 11/05/2023.

Please refer to: http://cdm.unfccc.int/Projects/DB/BVQI1356082462.11/view

B.2.6. Types of changes specific to afforestation or reforestation project activity

>>

Not applicable. This section is left blank intentionally.

SECTION C. Description of monitoring system

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The monitoring plan will be made in accordance with the methodology; the Project Owner will be responsible for the implementation of the monitoring plan. The data that is required to be monitored is described in section B.7.1.

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.

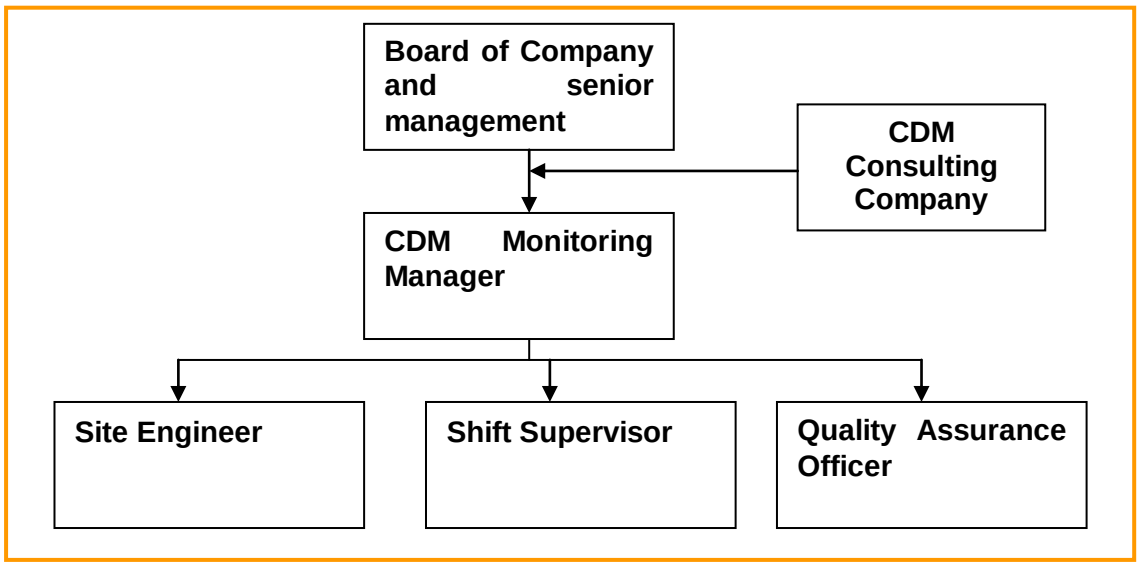


Figure C.1 Operational and Management Structure

Table C.1: Monitoring responsibility

Position	Outline of Responsibilities	Reporting
CDM Monitoring Manager	• 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 storage of data; • Calculates Emission Reductions; • Prepares the CDM Monitoring Report; • Prepares Baseline Emission Factor report at the end of each crediting period.	Reports to senior management and the Board of the Company
Site Engineer	• 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)	• 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	• Undertakes regular internal audits of the project; • Ensures compliance with Company Quality Assurance Procedures.	Reports to senior management

1.2 Training

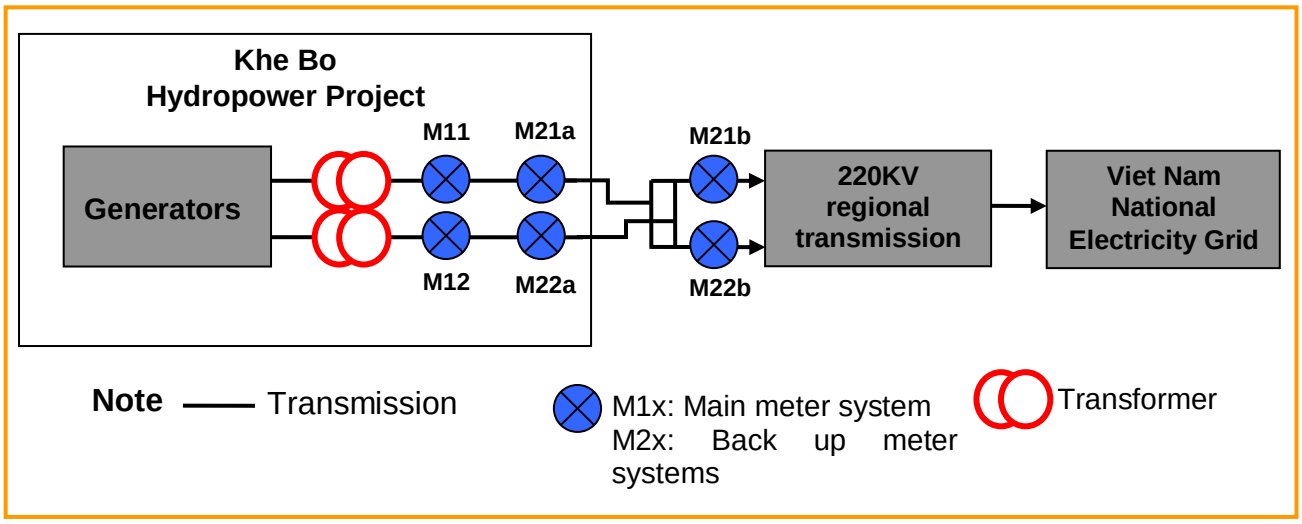
All persons that are involved in the CDM monitoring will receive appropriate training to be conducted by the project owner in association with a CDM consulting company. The training will provide an overview of the CDM and will cover all elements of the monitoring plan in detail. A copy of the project monitoring manual will be distributed to all training participants, and an additional copy will be easily accessible at appropriate locations on site.
The electromechanical equipment supplier will provide technical training with respect to assembly, start-up, operation, maintenance and/or repair of the electrical and mechanical equipment. This forms part of the contract terms for equipment supply.

2. Monitoring data

2.1. Installation of monitoring equipment

The specification of energy meters installed in the project shall comply with Technical Specification of Energy Metering (Decision No. 02/2007/QD-BCN dated 9th Jan. 2007 issued by Ministry of Industry) 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 will be properly configured, and the metering equipment shall

be checked by both the project owner and the grid company before operation.
Below is the layout of the monitoring systems in the project:



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[9]. These meter reading records are the basis of CER calculation. The monthly electricity sale receipt mentioning the export and the import will be 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 [10] have been also installed by the PP at the substation alongside the main meters. Both the main meters and the backup meters will be 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 in line with 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 shall be improved as part of this CDM project activity. This is an on-going process which will be ensured through the CDM

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

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

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 will be inspected internally to ensure the monitoring activities. Especially in the beginning of the crediting period, these internal inspections should take place, to guarantee the implementation of monitoring procedures.

Corrective actions will be 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.

2.5. Calibration of Meters and Metering

The meters have been calibrated and verified pursuant to national standard according to Decision 25/2007/QD-BKHCN on application of process and period for inspection of measurement devices. 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 must be calibrated every year[11]. After every calibration, the meters will be 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 power meters have been calibrated the first time by Northern Electrical Testing Company Limited (under EVN) on 17/04/2013. During the monitoring period (12/05/2013-31/08/2014), the main power metering system has been replaced since there were some errors found during the operation. The main meters for Unit 1 and Unit 2 have been replaced on 27/06/2013 and 24/08/2013 respectively by the same type of meters with the same accuracy class. Details on the power meters are presented in the table below:

Table C.2- Technical details of main power meters

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

Technical details	Main meter M11 (for Unit 1)	Main meter 12 (for Unit 2)
Old Meters	11038222	11038221
Model	Elster A1700	
Type and specification	PB3KAGGHT-5	
Accuracy class	0.2s	
Date of the first calibration	17/04/2013	17/04/2013
Valid to	04/2015	04/2015
Calibration party	Northern Electrical Testing Company Limited	
New Meters (Replaced)	11090580	09092857
Model	Elster A1700	
Type and specification	PB3KAGGHT-5	
Accuracy class	0.2s	
Changing date	27/06/2013	24/08/2013
Date of Calibration	27/06/2013	24/08/2013
Valid to	06/2015	07/2015
Calibration frequency	Every year[12]	
Calibration party	Northern Electrical Testing Company Limited	

Table C.3- Technical details of backup power meters

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 first calibration	17/04/2013	17/04/2013
Valid to	04/2015	
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 Calibration	17/04/2013	17/04/2013
Valid to	04/2015	04/2015
Calibration frequency	Every year[13]	
Calibration party	Northern Electrical Testing Company Limited	

2.6. Data Management System

Data will be archived time to time in an electronic spreadsheet printed out monthly. The electronic files will be stored on a hard disk or/and other media; a data backup system shall be established. The project owner will also collect and keep electricity sales receipts from the grid company for the purpose of double checking. At the end of each vintage 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.

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

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

2.7. Damages to metering equipment:

In case the main meter (M1x) fails, the data from the backup meter (M2x) will be 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 will be used to determine net power supplied to the grid for the days for which no record could be kept. The project entity will furthermore document all efforts taken to restore normal monitoring procedures.
- 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 will be 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 will be immediately repaired / replaced and calibrated for its accuracy before re-installing. In case the backup meter (M2x) fails, then the backup meter will be 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):	0
Purpose of data:	Calculation of project emissions
Additional comment:	-

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
Purpose of data:	Calculation of project emissions
Additional comment:	-

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
Purpose of data:	Calculation of baseline emissions
Additional comment:	-

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)
Purpose of data:	Calculation of baseline emissions
Additional comment:	-

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

Purpose of data:	Calculation of baseline emissions
Additional comment:	-

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
Purpose of data:	Calculation of baseline emissions
Additional comment:	-

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
Purpose of data:	Calculation of baseline emissions
Additional comment:	-

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
Purpose of data:	Calculation of baseline emissions
Additional comment:	-

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
Purpose of data:	Calculation of baseline emissions
Additional comment:	-

D.2. Data and parameters monitored

Data / Parameter:	**$EG_{facility, y}$**
Unit:	MWh/yr
Description:	Net electricity supplied by the proposed hydropower plant to the national grid
Measured/ Calculated / Default:	Measured by M1 and/or M2
Source of data:	Electricity meter(s)
Value(s) of monitored parameter:	550,544
Monitoring equipment:	

Technical details	Main meter M11 (for Unit 1)	Main meter 12 (for Unit 2)
OLD ONE	11038222	11038221
Model	Elster A1700	
Type and specification	PB3KAGGHT-5	
Accuracy class	0.2s	
Date of the first calibration	17/04/2013	17/04/2013
Valid to	04/2015	04/2015
Calibration party	Northern Electrical Testing Company Limited	
NEW ONE	11090580	09092857
Model	Elster A1700	
Type and specification	PB3KAGGHT-5	
Accuracy class	0.2s	
Changing date	27/06/2013	24/08/2013
Date of Calibration	27/06/2013	24/08/2013
Valid to	06/2015	07/2015
Calibration frequency	Every year[14]	
Calibration party	Northern Electrical Testing Company Limited	

Measuring/ Reading/ Recording frequency:	Continuously measured and at least monthly recording
Calculation method (if applicable):	-
QA/QC procedures:	Cross check measurement results with records for sold electricity The net supply of power to the grid by the proposed project activity is measured through national standard electricity metering instruments. The measurement of electricity will be in accordance with the following standard *"Decision 02/2007/ QD-BCN (Ministry of Industry) standard IEC 62053-22"*[15].
Purpose of data:	Calculation of baseline emissions
Additional comment:	For CERs calculation The calibration and accuracy of the power meters has been indicated in Section B.7.2 of the PDD.

[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

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 comment:	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:	9,600,000
Monitoring equipment:	Measured from topographical surveys, maps, satellite pictures, etc
Measuring/ Reading/ Recording frequency:	Yearly
Calculation method (if applicable):	-
QA/QC procedures:	-
Purpose of data:	Calculation of project emissions
Additional comment:	Refer to B.7.2 of the PDD. Description of the monitoring plan

D.3. Implementation of sampling plan

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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

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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[16]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 first monitoring period (12/05/2013-31/08/2014), Khe Bo Hydropower project has supplied to the National Grid the net electricity of 550,544 MWh.

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

$$BE_y = 550{,}544 * 0.5558 = 305{,}992\ tCO_2$$

The details have been shown in the table below[17]:

Comparison	Registered PDD	Actual values
Gross Electricity generation in the Monitoring Period (MWh)	578,672.877	550,950.841
Generation Factor (Generated electricity/Maximum electricity) generation) (%)	50.54%	48.13%
Electricity imported from the Grid in the monitoring period	8,680.093	406.804
Net Electricity generation in the Monitoring Period (MWh)	569,992.784	550,544.037
Baseline emission of the monitoring period (tCO_2e) - BE_y	**316,801.000**	**305,992.000**

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

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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)

[16]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_Idoc_59vnBao%20cao%20EF%202010.pdf

[17] More details in Emission Reduction Spread sheet.

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}) = 9,600,000 m^2 (measured 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

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}} = \frac{100{,}000{,}000 - 0}{9600000 - 0} = 10.42 W / m^2$$

Hence, the power density is 10.42 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 anthropogenic 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)	Emission reductions or net anthropogenic GHG removals by sinks (t CO_2e)
Total	**305,992**	**0**	**0**	**305,992**

E.5. Comparison of actual emission reductions or net anthropogenic 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)	**316,801**	**305,992**

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 305,992 tCO_2e while the estimated emission reductions in registered PDD is 316,801 tCO_2e. The actual emission reductions of the project in this monitoring report is 9.7% less than the ex-ante estimation.

E.7. Actual emission reductions or net anthropogenic GHG removals by sinks during the first commitment period and the period from 1 January 2013 onwards

Item	Actual values achieved up to 31 December 2012	Actual values achieved from 1 January 2013 onwards
Emission reductions or GHG removals by sinks (t CO_2e)	NA	305,992

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

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity 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.
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