MONITORING REPORT FORM (CDM-MR)
Version 01 - in effect as of: 28/09/2010

CONTENTS

MONITORING REPORT
Version 1.0 – 20/09/2011

NAM NGAN HYDROPOWER PROJECT
CDM Registration Reference Number: 3858
The first monitoring period: 13/12/2010-31/08/2011

SECTION A. General description of project activity

A.1. Brief description of the project activity:

The Nam Ngan Hydropower Project is located on the Nam Ngan stream Viet Lam and Quang Ngan communes, Vi Xuyen district in Ha Giang province of Viet Nam. The installed capacity and estimated annual gross power generation of Nam Ngan hydropower project is 13.5 MW and 58,030 MWh, respectively.

The project activity involves the construction of a dam, a canal intake, a penstock, a pressurized well, a power house with 02 units and a discharge channel in order to convert potential flowing energy from the stream into clean electrical energy.

The first verification period of the project is dated from 13 December 2010 to 31 August 2011.

The electricity in Vietnam is generated mainly from fossil fuel sources and is solely distributed to consumers via the unique national electricity grid. The project's purpose is to generate and supply renewable electricity to the national grid via the Power Purchase Agreement (PPA) signed with the Electricity Corporation of Vietnam (EVN). The net electricity generated from this project (annual estimated volume is 57,450 MWh) is supplied to the national grid.

The construction of Nam Ngan hydropower plant started in December of 2006 and it was completed in June of 2009. On 13 June 2009, the plant started commissioning and supplying electricity to the national grid. Nam Ngan hydropower plant was registered as CDM project on 13 December 2010 with the PDD version 2.3 dated 26 April 2010, so the start date of the first monitoring period is 13 December 2010.

The implementation of the project is listed in Table 1.

Table 1: The list of key events of Nam Ngan hydropower plant

Date	Key events
December 2006	Start of construction
13/6/2009	Commissioning date
13/12/2010	Registration and crediting start date

13/12/2010 – 31/08/2011	First monitoring period

The project activity generates renewable power with negligible Greenhouse Gas (GHG) emissions, which displaces part of the electricity otherwise supplied by fossil fuel fired power plants. Thus, this project activity generates GHG emission reductions up to a total expected CO_2 emission reduction of 205,254 tCO_2 over the first crediting period of 7 years. In the first monitoring period, Nam Ngan project has achieved emission reduction of 19,606 tCO_2e.

A.2. Project participants:

Name of Party involved (*)((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Vietnam (host)	Nam Mu Hydropower Joint Stock Company	No
Vietnam (host)	Energy and Environment Consultant Joint Stock Company	No
Germany	swb Erzeugung GmbH & Co. KG	No

A.3. Location of the project activity:

The Nam Ngan Hydropower project is located on the Nam Ngan stream in Viet Lam and Quang Ngan communes, Vi Xuyen district in Ha Giang province of Viet Nam.

The geographic coordination of the dam and the power house of the project is as below:

Project	Nam Ngan	
	Northern latitude	Eastern longitudes
Dam	$22^0$36’17’’	$104^0$54’10’’
Power house	$22^0$36’25’’	$104^0$54’45’’

A.4. Technical description of the project activity:

Technology employed by the project activity

The project involves the construction of a hydro plant and installation of new hydro turbines and alternators in order to convert potential energy available in the river flow into electrical energy.

Figure 1 shows the layout of the project.

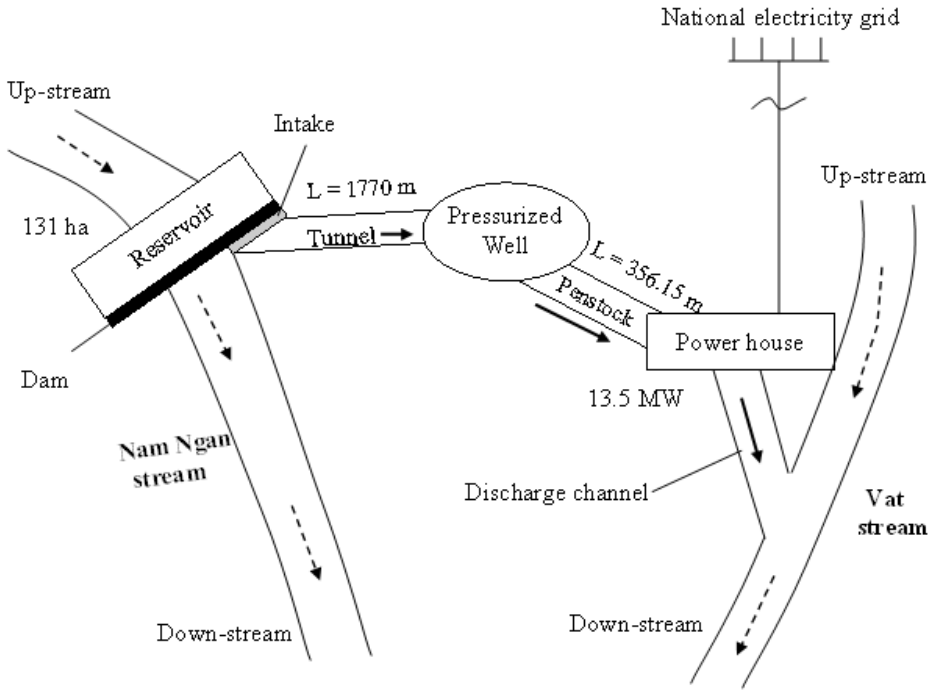

Figure 1: Project lay-out

The main technical parameters of the Nam Ngan Hydropower project are shown in Table 1.

Table 2: Main technical parameters of the proposed project activity

Main parameters	Units	Values	Manufacturer
1. Turbine			Symbol: HLA 743 – WJ – 81, Manufacturer: Hunan Ling Ling Hengyuan Generating Equipment Co LTD, China
• Type		Francis with horizontal shaft	
• Diameter of runner	m	1	
• Rated net head	m	116.7	
• Number of turbine	set	02	
• Turbine discharge	m^3/s	6.64	
• Capacity	kW	6,995	
• Speed	rpm	1,000	
• Annual utilisation hours	hour	4298	
• Expected lifetime	hour	150,000	EB 50, Annex 15
2. Generator			Symbol: SFW 6750 – 6/1780, Manufacturer:
• Type		synchronous, 3 phases,	

		horizontal axis	Hunan Ling Ling Hengyuan Generating Equipment Co LTD, China
• Number	set	2	
• Rated voltage	kV	6.3	
• Rated capacity	kW	6750	
• Efficiency at 100% load, Cosφ = 0.8		97.5%	
• Expected lifetime	year	30	EB 50, Annex 15
3. *Annual river flow*	m^3/s	8.5	

A.5. Title, reference and version of the baseline and monitoring methodology applied to the project activity:

The monitoring methodology I.D. Grid connected renewable electricity generation - Version 16 was applied for this proposed project.

A.6. Registration date of the project activity

Nam Ngan Hydropower project was registered as CDM project by UNFCCC on 13th December 2010 under reference number 3858.

Further background on this project can be found in the PDD and associated documents, which are available on the UNFCCC website: http://cdm.unfccc.int/Projects/DB/RWTUV1279520903.5/view

A.7. Crediting period of the project and related information (start date and choice of crediting period):

Start date of crediting period: 13/12/2010 (Registration date of Nam Ngan Project)

The first renewable crediting period covers 13/12/2010 to 12/12/2017.

A.8. Name of responsible person(s)/entity(ies):

Energy and Environment Consultancy Joint Stock Company

Address: Floor 6, Lac Hong Building, Alley 85, Le Van Luong Street, Hanoi, Vietnam.

Telephone: + 84 – 4 - 22148810

Fax: + 84 – 4 – 35579755

Email: registration@eec.vn

SECTION B. Implementation of the project activity

B.1. Implementation status of the project activity

1. The starting date of operation of the project activity:

Nam Ngan Hydropower plant has started operating on 13th June 2009 and the project has been registered as CDM project by UNFCCC on 13th December 2010.

2. The information regarding the actual operation of the project activity during this monitoring period:

The monitoring period started on 13th December 2010. During this monitoring period, Nam Ngan hydropower plant has been in good state, no emergency case occurred. For more details, please refer to section C and D of this report.

3. A brief description of:

(i) events or situations that occurred during the monitoring period, which may impact the applicability of the methodology:

Nam Ngan Hydropower plant has operated normally. No failure occurrences are reported during the first verification period.

(ii) how the issues resulting from these events or situations are being addressed.

Not applicable

B.2. Revision of the monitoring plan

Not applicable

B.3. Request for deviation applied to this monitoring period

Not applicable

B.4. Notification or request of approval of changes

Not applicable

SECTION C. Description of the monitoring system

Monitoring equipment

The following diagram indicates the power meter location:

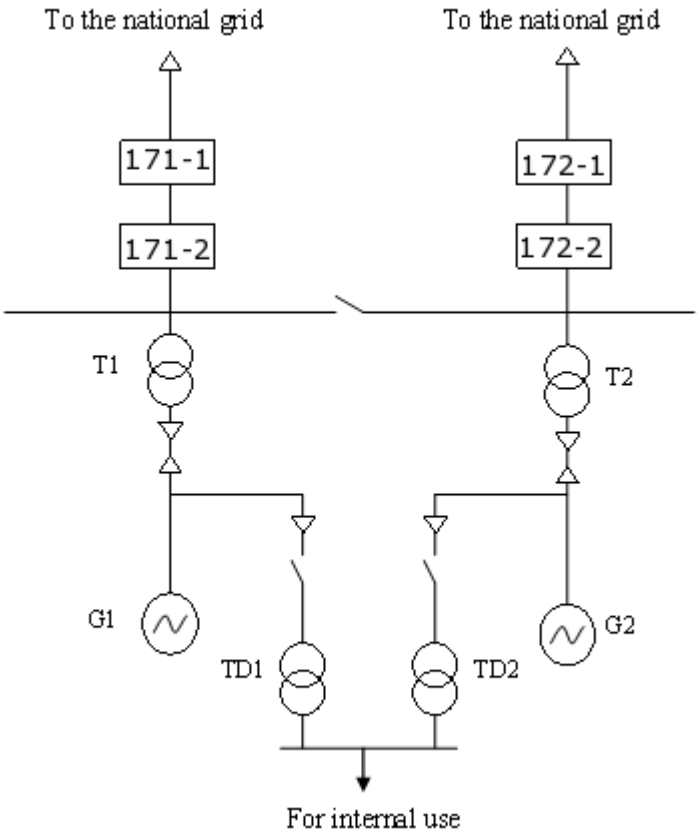

Figure 2: Meter diagram of Nam Ngan Project

The details of power meters are as follow:

Table 3: Parameters of power meters

Power meter	Type	Position	Function	Record frequency	Calibration party and frequency
The main power meter. Serial number 96009794 (171-1)	Landis &Gyr	In Nam Ngan hydropower plant	Amount of electricity exported to the national grid and consumed by Nam Ngan Hydropower Plant	The end of every month	Third Party, At least once every 2 years
The main power meter. Serial number 96009795	Landis &Gyr	In Nam Ngan hydropower plant	Amount of electricity exported to the national grid and	The end of every month	Third Party, At least once every 2 years

(172-1)			consumed by Nam Ngan Hydropower Plant		

All the power meters of Nam Ngan Hydropower plant belongs to EVN system, and they have been sealed up to prevent any interference.

1. Data collection procedures

The steps of monitoring the electricity supplied to the grid and the electricity imported from grid and consumed by the proposed project are as follows:

- The electricity supplied by the project to the grid will be automatically monitored by the meter systems (main and backup). The data is measured continuously.
- Data recorder, meter supervisor from Nam Ngan HPP with staff from EVN should read and collect data from main power meter on the first day of every month, the result will be signed by both parties and kept in records;
- Project Owner provides electricity sales invoice to EVN, and keeps the copy of invoices;
- Project Owner provides the record of main, backup power meter and copy of invoices to DOE for verification.

2. Organizational structure, roles and responsibilities of personnel

Project Owner had setup a special CDM group to take charge of data collection, supervision, recording and verification. CDM group director will be trained by CDM consultation organizations and get technical support from CDM consulting organizations. The structure of monitoring group is as follows:

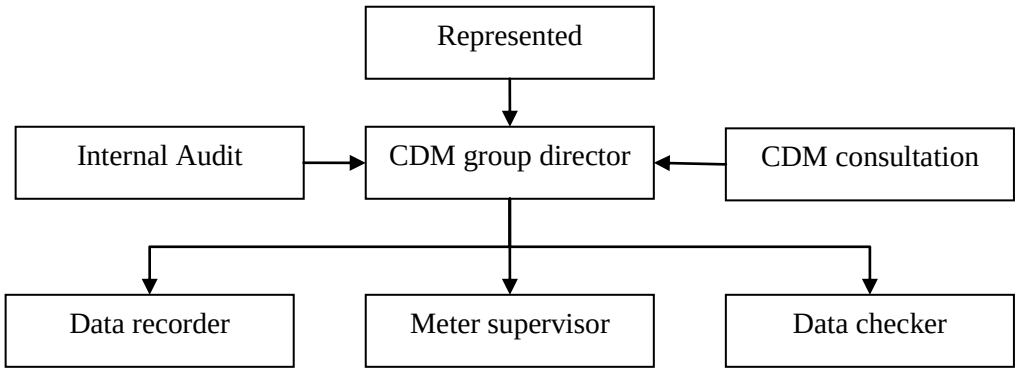

Figure 3: Structure of monitoring group.

The details of members in CDM group are as follow:

Table 4: Group members and their responsibilities:

Function[1]	Name	Job Title	Responsibility
Representative	Nguyen Viet Ky	Deputy Director of Nam Mu Hydropower JSC	Legal representative of Nam Mu Company
CDM group Manager	Bui Trong Can	Manager of Nam Ngan Power plant	Managing the whole monitoring business of Nam Ngan HPP, guiding and supervising data recording after training by Monitoring consultation.
Internal Auditor	Vuong Hai Nguyen	Deputy Manager of Nam Ngan Power plant	Check the monitoring procedure.
Monitoring consultant	Bui Thu Hieu	Energy and Environment Consultancy JSC	Providing monitoring group director training and technical support about monitoring plan.
Data recorder	Pham Duc Hanh	Staff member	Collecting and recording data every month.
Data recorder	Dinh Trong Cuong	Staff member	Collecting and recording data every month.
Data recorder	Dinh Van Bang	Staff member	Collecting and recording data every month.
Data recorder	Dam Van Son	Staff member	Collecting and recording data every month.
Meter supervisor	Nguyen Manh Ha	Shift leader	Checking power meter periodically according to relevant regulation.
Meter supervisor	Vu Quoc Huy	Shift leader	Checking power meter periodically according to relevant regulation.
Data checker	Vuong Hai Nguyen	Shift leader	Double check the collected data measured by power meter.
Data checker	Nguyen Danh Thoi	Shift leader	Double check the collected data

[1] Group members will be adjusted based on the actual adjustment of Nam Mu Joint Stock Company

			measured by power meter.
Representative	Nguyen Viet Ky	Deputy Director of Nam Mu Hydropower JSC	Legal representative of Nam Mu Company
CDM group Manager	Bui Trong Can	Manager of Nam Ngan Power plant	Managing the whole monitoring business of Nam Ngan HPP, guiding and supervising data recorder after trained by Monitoring consultation.
Internal Auditor	Vuong Hai Nguyen	Deputy Manager of Nam Ngan Power plant	Check the monitoring procedure.
Monitoring consultant	Bui Thu Hieu	Energy and Environment Consultancy JSC	Providing monitoring group director training and technical support about monitoring plan.

3. Emergency procedures for the monitoring system

The main and backup power meters will be used in order to record the electricity exported to the grid. These power meters will be calibrated at least once every 2 years. Monthly, the representatives of EVN and the Project Owner with check the result in both main and backup power meters.

The discrepancy between the main power meter and the backup one will be determined. If the discrepancy is larger than the specific error value allowed, then the EVN and Project Owner will follow the steps for dealing with inaccuracy of the meters as described below in order to determine the amount of the electricity supplied to the grid:

- ✓ Conduct calibration of power meters by qualified party to find the erroneous meter.
- ✓ Under normal circumstance, the amount of electricity delivered to the grid measured by main power meter will be adopted, but in case of error with the main power meter, the amount of electricity will be adjusted as follows:
  - ❖ Use the value recorded by the backup power meter.
  - ❖ If the backup power meters are also found to be erroneous:
    - ➢ If the main power meter could record the amount of electricity, the amount of electricity generated by Nam Ngan Hydropower Plants; shall be based on the value recorded by the main power meter after the justification is agreed by both Project Owner and EVN.
    - ➢ If the main power meter could not record the amount of electricity, the Project Owner and EVN will jointly calculate a conservative estimation of power amount supplied to the grid. The assumptions applied to estimate the net electricity supplied to the grid shall be signed by both representatives of the Project Owner and the power company (EVN).

- In any other cases; if Project Owner and EVN cannot reach an agreement on the conservative method to estimate reading, arbitration should be conducted according to Power Purchase Agreement.

Emergency case

Since the starting of Nam Ngan hydropower plant, no emergency case has been reported and the difference between the power meters is in the acceptable range because director of plant has applied the preventive maintenance to ensure the smooth operation of systems.

4. Quality Assurance and Quality Control

4.1. Training

- ✓ All persons working for CDM group should be trained and the training record should be kept. Through the training, persons will know the necessary knowledge on the installation, examination and maintenance of electricity and machine shall be provided. It is also ensured that staff is familiar with the equipment operating principle and basic structure; master the cause and solution of commonly reported problem and the basic knowledge on CDM and monitoring requirement.
- ✓ During the operating period, Project Owner will hold some training to improve staff's professional level.
- ✓ The new personnel are not allowed to operate or maintain the equipment until they master the knowledge and skills required.
- ✓ CDM monitoring training contents:
  - Monitoring organization
  - File system
  - Connection point knowledge
  - Monitoring parameters
  - Monitoring method
  - Guidelines against dispute resolution
  - Data management
  - Calibration and maintenance
  - Monitoring report
  - Internal audit
  - Management review
- ✓ Personnel training VNEEC has cooperated with Nam Ngan HPP to establish CDM group which has full responsibility for CDM monitoring as well as data management. The short training course has started in June 2009, and it has provided Nam Ngan staffs all necessary information to monitor plant. Furthermore, Nam Ngan HPP has an internal meeting for exchanging experience and improving quality of CDM monitoring.
- ✓ History of CDM internal training in Nam Ngan hydropower project during the first monitoring period:

- On 20 September 2010, CDM group leader (Nam Ngan Deputy director) has conducted the internal meeting for CDM monitoring, and the purpose of internal meeting is to improve the quality of monitoring and operating. There were 35 participants who including group leader, internal audit, shift leader, monitoring and operating staffs.

4.2. Data Management

- ❖ The CDM group appointed by Nam Ngan HPP should keep monitored data in electronic archives at the end of every month. Paper documents should be stored in electronic format and copied by CD.
- ❖ Nam Ngan HPP should keep the copy of electricity sales/purchase invoice (the original electricity sales/purchase invoice will be kept by Project Owner).
- ❖ In order to help verifiers obtain documents and information related to the emission reduction of the proposed project, Project Owner should offer index of the project documents and monitoring report.
- ❖ All the data and information in the form of paper documents will be kept in archives by CDM group, with at least one copy backup for each datum.
- ❖ Hard copy documentation will be stored in cabinet for safety. Every month, CDM group leader and internal auditor will check it to ensure that all data is good status.
- ❖ Data in electronic spreadsheet will be stored on main hard disk and other type such as CD ROM, memory stick. In addition, the Nam Ngan power plant will send a copy to VNEEC for secondary backup.
- ❖ All of the data should be kept for 2 years after the crediting period.

4.3. Calibration and Maintenance

- ❖ Project Owner had signed an agreement with EVN that stipulates quality control process of measurement and calibration in order to ensure measurement precision. Periodical power meter inspection and on-site check should be implemented according to standards and regulations of the state electric power industry. After inspection and on-site check, power meters must be sealed after examination and identification by both; the Project Owner and EVN. Nam Ngan HPP and EVN should inspect and seal together, either party cannot remove the seal or modify the power meter when the other party (or its authorized representative) is absent.
- ❖ All installed power meters should be tested by measurement inspection institution entrusted by both Project Owner and EVN in the shortest time after the followings happen: Power meter has to calibrate due to component malfunction.

➢ ***History of power meters of Nam Ngan hydropower***

Power meters of operating period (13/12/2010 – 31/08/2011)

- ✓ Nam Ngan hydropower plant has started operating since 13th of June 2009, from that time power meters of system are Landis&Gyr with accuracy level 0.2s. These power meters are calibrated by Northern Electrical Testing Company (a division of EVN which has authority for calibration of all electrical measurement equipment). During the monitoring

period (13/12/2010 – 31/08/2011), the power meters system is in good state and no failure occurrences reported.

✓ Detailed information of each power meters can be found in below table:

Table 5: Technical details of main power meter (171-1)

Period (13/12/2010 – 31/08/2011)

Technical Details	**1st meter (171-1)**	**2nd meter (172-1)**
Serial No.	96009794	96009795
Certificate number	A6-11-100	A6-11-102
Model	Landis&Gyr	
Type	3x57.7/100 ÷ 240/415V & 3 x 1(2) A	
Accuracy	0.2s	
Operating period	13/12/2010 – 31/08/2011	
Status during the operating period	Good	
Manufacturer	Landis&Gyr (Switzerland)	
Date of calibration before installation	26/03/2009	26/03/2009
Date of current calibration	28/05/2011	28/05/2011
Date of last calibration	28/05/2010	28/05/2010
Expected date for the next calibration	28/05/2013	28/05/2013
Calibration entity	Northern Electrical Testing Company of North Power Corporation	
Calibration frequency	At least once every 2 years	

Table 6: Technical details of backup power meter (171-2)

Period (13/12/2010 – 31/08/2011)

Technical Details	**1st meter (172-1)**	**2nd meter (172-2)**
Serial No.	96009793	96009796
Certificate number	A6-11-101	A6-11-103
Model	Landis&Gyr	
Type	3x57.7/100 ÷ 240/415V & 3 x 1(2) A	
Accuracy	0.2s	
Operating period	13/12/2010 – 31/08/2011	
Status during the operating period	Good	

Manufacturer	Landis&Gyr (Switzerland)	
Date of calibration before installation	26/03/2009	26/03/2009
Date of current calibration	28/05/2011	28/05/2011
Date of last calibration	28/05/2010	28/05/2010
Expected date for the next calibration	28/05/2013	28/05/2013
Calibration entity	Northern Electrical Testing Company of North Power Corporation	
Calibration frequency	At least once every 2 years	

4.4. Internal Audit

This is an internal process to confirm that the scheduled or requested Nam Ngan HPP's monitoring process is operated in proper manner to confirm to CDM monitoring. .

Regular Audit

Deputy Director shall be responsible for ensuring that internal audits are conducted at least once a year to ensure observance of the standards set forth.

According to the internal audit reports, deputy director has conducted internal audit every month, and the result of each month reflect that the quality of operation and monitoring of staffs is improving and they follow the operation guidance of hydropower plant and CDM monitoring manual.

Occasional Audit

Occasional audit will be conducted when the Director feels a necessity for same..

4.5. Management Review

Management review of the project shall be made at least once a year for reviewing of monitoring and internal audit.

The chairman of Nam Mu Hydropower Jsc. will conduct management review on December of each year. So in the first verification period, the chairman of Nam Mu conducted management review on 31st December 2009 and 12th Novemver 2010. This management review's purpose is to improve their efficient of quality management.

SECTION D. Data and parameters

D.1. Data and parameters determined at registration and not monitored during the monitoring period, including default values and factors

Data / Parameter:	**$FC_{i,m,y}$**
Data unit:	mass or volume unit

Description:	Amount of fossil fuel type *i* consumed by power plant / unit *m* in year *y*
Source of data used:	Institute of Energy – EVN, 2007 via a data providing contract
Value (s):	Value applied presented in Annex 3 of registered PDD
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	The data are used for project emission calculation
Additional comment:	For calculation of EF_{OM} or EF_{BM}

Data / Parameter:	**$NCV_{i,y}$**
Data unit:	GJ / mass or volume unit
Description:	Net calorific value (energy content) of fossil fuel type *i* in year *y*
Source of data used:	Institute of Energy – EVN, 2007 via a data providing contract
Value (s):	Value applied presented in Annex 3 of registered PDD
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	The data are used for project emission calculation
Additional comment:	For calculation of EF_{OM} or EF_{BM}

Data / Parameter:	**$EF_{CO2,i,y}$**
Data unit:	tCO_2/GJ
Description:	CO_2 emission factor of fossil fuel type *i* in year *y*
Source of data used:	Default value of the IPCC 2006 Guidelines
Value (s):	Value applied presented in Annex 3 of registered PDD
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	The data are used for project emission calculation
Additional comment:	For calculation of EF_{OM} or EF_{BM}

Data / Parameter:	**$EG_{m,y}$**
Data unit:	MWh
Description:	Net electricity generated and delivered to the grid by power plant/unit m in year *y*
Source of data used:	Institute of Energy – EVN, 2007 via a data providing contract
Value (s):	Value applied presented in Annex 3 of registered PDD
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	The data are used for baseline emission calculation
Additional comment:	For calculation of EF_{OM} or EF_{BM}

Data / Parameter:	**Cap_{BL}**
Data unit:	MW

Description:	Installed capacity of hydropower plant before the implementation of the project activity.
Source of data used:	According to EIA report, this is a green-field project. This value does not exist prior to the implementation of the project activity
Value (s):	0
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	The data are used for Project emission calculations
Additional comment:	

Data / Parameter:	**A_{BL}**
Data unit:	m^2
Description:	Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full. For new reservoirs, this value is zero.
Source of data used:	According to EIA report, this is a green-field project. This value does not exist prior to the implementation of the project activity
Value (s):	0
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	The data are used for project emission calculation
Additional comment:	

Data / Parameter:	**EF_{res}**
Data unit:	kg CO_2e/MWh
Description:	Default emission factor for emissions from reservoirs
Source of data used:	Default value as per EB23
Value (s):	90 kgCO_2e/MWh.
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	The data are used for project emission calculation
Additional comment:	For calculation of project emission (PE)

D.2. Data and parameters monitored

Data / Parameter:	**$EG_{y, export}$**
Data unit:	MWh/yr
Description:	Electricity supplied by the proposed hydropower plant to the national grid
Measured /Calculated /Default:	Measured

Source of data:	Direct measurement at the project connection point so $EG_{y,\ export}$ does not include the electricity generated by the proposed project used for internal consumption and losses.
Value(s) of monitored parameter:	38,472.519
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	The data are used for Baseline Emission calculation
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	04 power meters: • Manufacturer: Landis&Gyr • Model: ZMD 402 CT • Type: 3x57.7/100 ÷ 240/415V & 3 x 1(2) A • Accuracy (active energy): 0.2s • Serial number: 96009793, 96009794, 96009795, 96009796 • Calibration frequency: At least once every two year • Date of current calibration: 28 May 2011 • Validity: May 2013
Measuring/ Reading/ Recording frequency:	Continuously measured and monthly recorded
Calculation method (if applicable):	$EG_{y,} = EG_{y,\ export} - EG_{y,\ import}$
QA/QC procedures applied:	The uncertainty level of this data is low. The measurement/ monitoring equipment should be complied with national standard and technology. These equipment and systems should be calibrated and checked at least once every 2 year.

Data / Parameter:	**$EG_{y,\ import}$**
Data unit:	MWh/yr
Description:	Electricity supplied by the grid to the proposed hydropower plant
Measured /Calculated /Default:	Measured
Source of data:	Direct measurement at the project connection point
Value(s) of monitored parameter:	59.281
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	The data is used for project emission calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	04 power meters: • Manufacturer: Landis&Gyr • Model: ZMD 402 CT • Type: 3x57.7/100 ÷ 240/415V & 3 x 1(2) A • Accuracy (active energy): 0.2s • Serial number: 96009793, 96009794, 96009795, 96009796

	• Calibration frequency: At least once every two year • Date of current calibration: 28 May 2011 • Validity: May 2013
Measuring/ Reading/ Recording frequency:	Continuously measurement and monthly recording
Calculation method (if applicable):	$EG_{y,} = EG_{y, export} - EG_{y, import}$
QA/QC procedures applied:	The uncertainty level of this data is low. The measurement/ monitoring equipment should be complied with national standard and technology. These equipment and systems should be calibrated and checked every 2 year.

Data / Parameter:	**$EG_{BL, y}$**
Data unit:	MWh/yr
Description:	Net electricity supplied to the national grid by the proposed hydropower plant
Measured /Calculated /Default	Calculated
Source of data:	Calculating from $EG_{y,import}$ and $EG_{y,export}$. It indicates the net electricity exported to the grid by the project activity.
Value(s) of monitored parameter:	38,413.238
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	NA
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	
Measuring/ Reading/ recording frequency:	Continuously measured and recorded on monthly basis
Calculation method (if applicable):	$EG_{BL,y} = EG_{y, exp} - EG_{y, imp}$
QA/QC procedure applied	Sales record of electricity to the grid is used to ensure the consistency.

Data / Parameter:	**A_{PJ}**
Data unit:	m^2
Description:	Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full.
Measured /Calculated /Default:	Measured
Source of data:	Project site.
Value(s) of monitored parameter:	131,000
Indicate what the data	Not applicable

are used for (Baseline/ Project/ Leakage emission calculations)	
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Not application.
Measuring/ Reading/ Recording frequency:	Yearly
Calculation method (if applicable):	Measured from topographical surveys and maps
QA/QC procedures applied:	The uncertainty level of this data is low.

Data / Parameter:	**Cap_{PJ}**
Data unit:	W
Description:	Installed capacity of the hydro power plant after the implementation of the project activity.
Measured /Calculated /Default:	Default
Source of data:	Project site
Value(s) of monitored parameter:	13,500,000
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	The data is used for Project emission calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Not applicable
Measuring/ Reading/ Recording frequency:	Yearly
Calculation method (if applicable):	Not applicable
QA/QC procedures applied:	Not applicable

SECTION E. Emission reductions calculation

E.1. Baseline emissions calculation

Baseline emissions include only CO_2 emissions from electricity generation by fossil fuel fired power plants that are displaced due to the project activity. It is calculated as follows:

$$BE_y = EG_y \cdot EF_{grid,CM,y}$$

Where:

EG_y Net electricity supplied by the Nam Ngan hydropower plant to the grid during the monitoring period (MWh);

$EF_{grid,CM,y}$ Emission factor of the grid (tCO_2/MWh) (0.5104 tCO_2/MWh, as calculated ex-ante in the registered PDD and will be fixed during the first crediting period).

Table 8: Baseline emission calculation in monitoring period

Period		Electricity exported (MWh) - $EG_{y,export}$	Electricity imported (MWh) - $EG_{y,import}$	Net electricity (MWh) - EG_y	Emission Factor (tCO_2e/MWh)	Baseline Emission BEy (tCO_2e)
From	To	A	B	C=A-B	D	E=C*D
13/12/2010	31/12/2010	2,995.750	2.719	2,993.031	0.5104	1,528
01/01/2011	31/01/2011	2,380.395	6.169	2,374.226	0.5104	1,212
01/02/2011	28/02/2011	1,761.905	6.377	1,755.528	0.5104	896
01/03/2011	31/03/2011	3,523.495	7.110	3,516.385	0.5104	1,795
01/04/2011	30/04/2011	2,723.409	11.082	2,712.327	0.5104	1,384
01/05/2011	31/05/2011	4,151.186	8.573	4,142.613	0.5104	2,115
01/06/2011	30/06/2011	5,263.550	10.037	5,253.513	0.5104	2,681
01/07/2011	31/07/2011	8,253.969	2.091	8,251.878	0.5104	4,212
01/08/2011	31/08/2011	7,418.859	5.123	7,413.736	0.5104	3,784
Total		**38,472.519**	**59.281**	**38,413.238**		**19,606**

E.2. Project emissions calculation

Because this proposed project did not use fossil fuel for electricity generation so the project emission is zero.

$$(PE_y = 0)$$

E.3. Leakage calculation

Because the energy generating equipment are newly manufactured and not transferred from another activity so leakage is no need to be considered.

($L_y = 0$)

E.4. Emission reduction calculation/ table

This section includes the formula of calculating the emission reductions in monitoring period:

Nam Ngan Hydropower project has been commissioned on 13th June 2009. However, project was registered as CDM project by UNFCCC on 13th December 2010; therefore the net electricity from 13th December 2010 will be calculated in the verification period.

The total net electricity in the first monitoring period is **38,413.238 MWh.**

Total baseline emissions:

The baseline emission (BE_y) can be calculated by the formula below:

$$BE_y = EG_y \times EF_{grid,CM,y} = 38,413.238 \times 0.5104 = 19,606 \text{ tCO}_2\text{e}$$

The detail BE_y calculation for each month can be seen in the table 18 below.

Total project emissions:

$PE_y = 0$

Total leakage:

$L_y = 0$

Total emission reductions:

As the project emission and leakage from the project activity are zero, emission reduction during the monitoring period (13/12/2010 – 31/08/2011) is:

$$ER_y = BE_y - PE_y - L_y = 19,606 \text{ tCO}_2\text{e}$$

Net electricity supplied by the project to the grid and corresponding baseline emission, project emission, leakage and emission reductions are listed monthly as below:

Table 9: Emission reductions calculation in monitoring period

Emission Reductions (Period: 13/12/2010 - 31/08/2011)									
Period		**Electricity exported (MWh)**	**Electricity imported (MWh)**	**Net electricity (MWh)**	**Emission Factor (tCO_2e/ MWh)**	**Baseline Emission BEy (tCO_2e)**	**Project Emission PEy (tCO_2e)**	**Leakage Ly (tCO_2e)**	**Emission Reduction ER (tCO_2e)**
From	**To**	**A**	**B**	**C=A-B**	**D**	**E=C*D**	**F**	**G**	**H=E-F-G**
13/12/2010	31/12/2010	2,995.750	2.719	2,993.031	0.5104	1,528	0.000	0.000	1,528
01/01/2011	31/01/2011	2,380.395	6.169	2,374.226	0.5104	1,212	0.000	0.000	1,212
01/02/2011	28/02/2011	1,761.905	6.377	1,755.528	0.5104	896	0.000	0.000	896
01/03/2011	31/03/2011	3,523.495	7.110	3,516.385	0.5104	1,795	0.000	0.000	1,795
01/04/2011	30/04/2011	2,723.409	11.082	2,712.327	0.5104	1,384	0.000	0.000	1,384
01/05/2011	31/05/2011	4,151.186	8.573	4,142.613	0.5104	2,115	0.000	0.000	2,115
01/06/2011	30/06/2011	5,263.550	10.037	5,253.513	0.5104	2,681	0.000	0.000	2,681
01/07/2011	31/07/2011	8,253.969	2.091	8,251.878	0.5104	4,212	0.000	0.000	4,212
01/08/2011	31/08/2011	7,418.859	5.123	7,413.736	0.5104	3,784	0.000	0.000	3,784
Total		**38,472.519**	**59.281**	**38,413.238**		**19,606**			**19,606**

E.5. Comparison of actual emission reductions with estimates in the CDM-PDD

During this verification period, plant load factor was 45.25% and calculated as follows:

Total power generation in this verification: EG_y = **38,413.238 MWh** (gross power)

The maximum possible power generation in that period is:

$EG_{y,maximum}$ = Capacity * hours of day * days

= 13.5 * 24 * 262

= 84,888 MWh

Because the monitoring period is from December to August or beginning half of dry season and ending half of rainy season (Rainy season is from July to October and dry season is from November to June). So the estimation power generation in the 9 months is:

$$EG_{y,\ estimated} = \frac{57,450 * 262}{365} = 41,238 \text{ MWh}$$

Estimation load factor: $PLF_{estimation} = \frac{41,238}{84,888} = 48.58\%$

Actual load factor: $PLF_{actual} = \frac{38,414.390}{84,888} = 45.25\%$

In the registered PDD, the estimated emission reduction is 29,322 tCO_2e annually, which is equals to 2,444 CO_2e per month. Based on the calculation above, the emission reduction during monitoring period (13/12/2010 – 31/08/2011) is 19,606 tCO_2e, which is equals to 2,178 tCO_2e per month, and less than emission reduction estimated in the registered PDD.

Table 10: Comparison of actual emission reductions with estimates

Item	Values applied in ex-ante calculation of the registered CDM-PDD	Actual values reached during the monitoring period
Emission reductions (tCO2e) per month	2,444	2,178
Emission reductions (tCO2e) of the monitoring period.	21,048	19,606

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

Not applicable because according to the Table 10, the actual emission reductions were lower. This difference was because of the monitoring period is from December to August or beginning half of dry season and ending half of rainy season which caused the water flow in the monitoring period lower than the average annual flow.