CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

CONTENTS

SECTION A. General description of project activity

A.1. Title of the project activity:

Title: Thac Xang Hydropower Project

Version: 1.1

Date: 15/08/2011

A.2. Description of the project activity:

Thac Xang Hydropower Project is a new hydropower project located on Bac Giang river in Hung Viet commune, Trang Dinh district, Bac La commune, Van Lang district and Hong Phong commune, Binh Gia district, Lang Son province, Viet Nam.The project activity involves the construction of a dam, intakes, penstocks, a powerhouse and discharge channel.

Prior to the implementation of the project activity, electricity in Viet Nam is generated mainly from fossil fuel sources and is solely distributed to consumers via Vietnam national electricity grid (hereafter referred to as the national grid).

The project's purpose is to generate hydroelectricity from a clean and renewable source (hydropower of the Bac Giang river) to supply to the national grid via the Power Purchase Agreement (PPA) signed with the Electricity of Viet Nam (EVN). The project's installed capacity and estimated annual gross power generation is 20 MW[1] and 76,350MWh[2], respectively. The net electricity generated (with an estimated annual volume of 75,205MWh[3]) will be supplied to the national grid via a newly constructed transmission line.

The baseline scenario of the project activity is the same as the scenario existing prior to the start of implementation of the project activity.

The project's contributions to the sustainable development of the local area as well as the host country are as follows:

General contributions towards national sustainable development:

- In recent years, Viet Nam, especially the North of Viet Nam, has suffered a critical electricity shortage as a consequence of rapidly increasing demand and insufficient supply, thereby imposing negative impacts on economic growth as well as on daily lives of people. This project activity will be a contribution towards balancing the supply and demand gap. By exporting electricity directly to the national grid, it will help to reduce electricity losses across the national grid and to lessen the risks of cascading national grid collapse due to overload.
- Modern and highly efficient turbines and generators are being used in the project and the power transmission will be at high voltage to ensure low losses. The project will accelerate the deployment of renewable energy technologies in Viet Nam.

Contributions towards local sustainable development:

a) Economic well-being

[1]Feasibility Study Report (FSR)
[2]FSR
[3]The gross power generation subtracts 1.5% for internal use, parasitic and loss load.

Once commissioning, this proposed project will increase the industrial share in the economic structure of Lang Son province. This project will pay annual enterprise income tax[4] and the naturalresource tax[5] and CER tax[6] to the local budget.

By supplying a stable electricity output, this project will facilitate the industrialisation process of the province and leverage the performance of traditional trade villages as well as tourism industry and services inside the province.

b) Social well-being

The Project will contribute directly to improve the low-quality infrastructure systems of Hung Viet, Bac La and Hong Phong communes. These communesare categorised as mountainous communes with sparse population, less developed and autarky agricultural economy.

The Project will newly construct and upgrade roads that then will be integrated into the traffic system of the commune. The Project will construct new transmission line exporting electricity to the national grid. The Project will contribute indirectly to reduce electricity losses and improving the electricity quality supplied in the region thanks to the stable and new electricity source supplied by the project to the national grid

The communication system and clean water treatment serving for workers of the project during the both construction and operation phases will be shared with local people. Besides, the project activity could result in the employment of the local people for the construction and operation later on. Therefore, this project activity will contribute directly to alleviate poverty in the region.

This demonstrates that the Project activity will contribute positively towards sustainable development and it satisfies the sustainable development criteria for CDM projects set by the DNA of Viet Nam.

A.3. 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)
Viet Nam (host)	Su Pan 1 Hydropower Joint Stock Company[7]	No
Viet Nam (host)	Energy and Environment Consultancy Joint Stock Company[8]	No
Kingdom of Sweden	Nordic Environment Finance Corporation NEFCO in its capacity as Fund Manager to the NEFCO Carbon	No

[4] Government Decision No 124/2008/ND-CP on implementation of enterprise tax law issued on 11 December 2008
[5] Decision No 588/QĐ-BTC issued by Ministry of Finance on 22 March 2010
[6] According to Circular No. 58/2008/TTLT-BTC-BTN&MT issued by Ministry of Finance and Ministry of Natural Resource and Environment on 04 July 2008.
[7] Su Pan 1 Hydropower Joint Stock Company is the project owner of Thac Xang hydropower project
[8] Energy and Environment Consultancy Joint Stock Company (VNEEC) is the CDM Consultant. VNEEC is also a project participant which is confirmed in LoA of the host country

	Fund (NeCF)	
(*) In accordance with the CDM modalities and procedures, at the time of making the PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

The carbon purchaser is the Nordic Environment Finance Corporation NEFCO in its capacity as Fund Manager to the NEFCO Carbon Fund (NeCF).

NEFCO Carbon Fund (NeCF)

NEFCO, the Nordic Environment Finance Corporation, is a multilateral risk capital institution financing environmental projects in Central and Eastern Europe, with an emphasis on the Russian Federation and Ukraine. Its purpose is to facilitate the implementation of environmentally beneficial projects in the neighbouring region, with transboundary effects that also benefit the Nordic region. Today, NEFCO manages funds in an aggregate of approximately €400 million. NEFCO is located in Helsinki, Finland.

The NEFCO Carbon Fund (NeCF) was established as a Public Private Partnership in April 2008, to provide financial assistance to projects by purchasing emission reduction credits from projects under the JI and CDM mechanisms. The NEFCO Carbon Fund (NeCF) has the Danish Energy Agency, DONG Energy, Eesti Energia, the Industrialisation Fund for Developing Countries (Denmark), Ministries of Environment and Foreign Affairs of Finland, Etelä-Pohjanmaan Voima Oy (Finland), Kymppivoima Oy (Finland), GDF Suez, the Norwegian Finance Ministry and NEFCO itself, as participants in the fund. The total available resources are ca. €165 million.

NEFCO is the Fund Manager of the NeCF, and has been authorised by the governments investing in the NeCF to participate on their behalf in actions leading to the generation, transfer and acquisition of CERs under Article 12 of the Kyoto Protocol.

Further contact information of project participants is provided in Annex 1.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Viet Nam

A.4.1.2. Region/State/Province etc.:

Lang Son province

A.4.1.3. City/Town/Community etc.:

Hung Viet commune, Trang Dinh district; Bac La commune, Van Lang district and Hong Phong commune, Binh Gia district

A.4.1.4. Details of physical location, including information allowing the unique identification of this project activity (maximum one page):

The Project is located on Bac Giang River in Lang Son province with geographic coordinates[9] as below:

Geographic co-ordinates	Northern latitude	Eastern longitude
Dam	22°10'21.96"	106°29'49.17"
Powerhouse	22°10'21.96"	106°29'53.20"

The site of the project is showed in Figure 1:

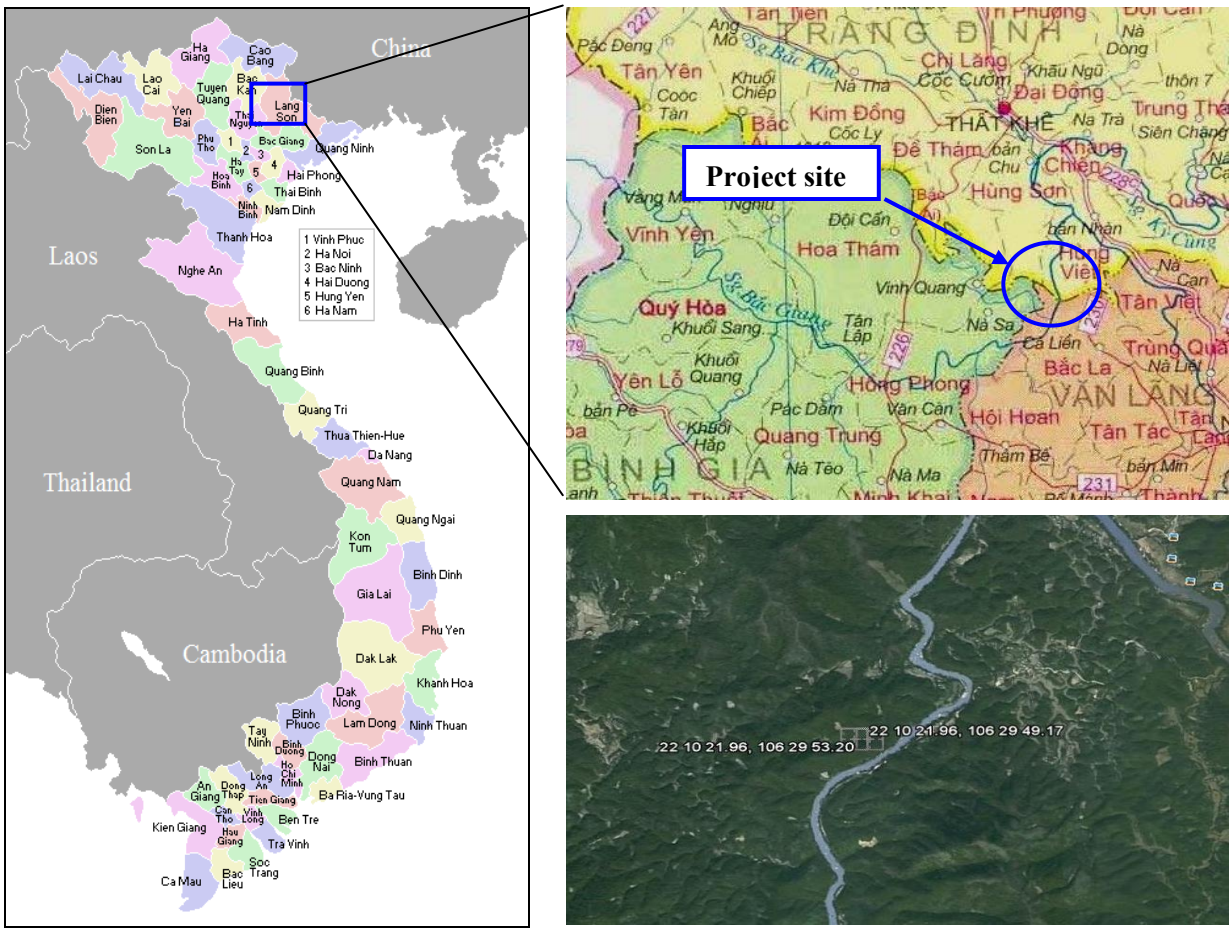

Figure 1: Location of the Project

A.4.2. Category(ies) of project activity:

Sectoral scope/ Category: Energy industries (renewable sources)

Grid-connected electricity generation from renewable sources

[9] FSR

A.4.3. Technology to be employed by the project activity:

The project is a new hydropower project with the installed capacity of 20 MW (2 turbines x 10MW). The purpose of the project is to generate clean electricity by harnessing hydrological resource of Bac Giang river to supply to the national grid.

Prior to the implementation of the project activity, electricity in Viet Nam is generated mainly by firing coal, oil or gas and is solely distributed via the unique national electricity grid. All fuel fired power plants connected to the national grid use boiler rooms, steam heating boilers and steam turbines to generate electricity. In that technology cycle, GHGs are generated. Since hydropower generation technology is a renewable electricity generation technology which displaces fossil fuel fired power generation technology to supply electricity to the nationalgrid, the implementation of this project activity will generate emission reductions.

The project involves the construction of a new hydropower plant and the installation of new hydro turbines and generators in order to convert potential flowing energy of Bac Giang River into electrical energy, which will be supplied to the national grid.

Layout of the projectis shown in Figure 2 below:

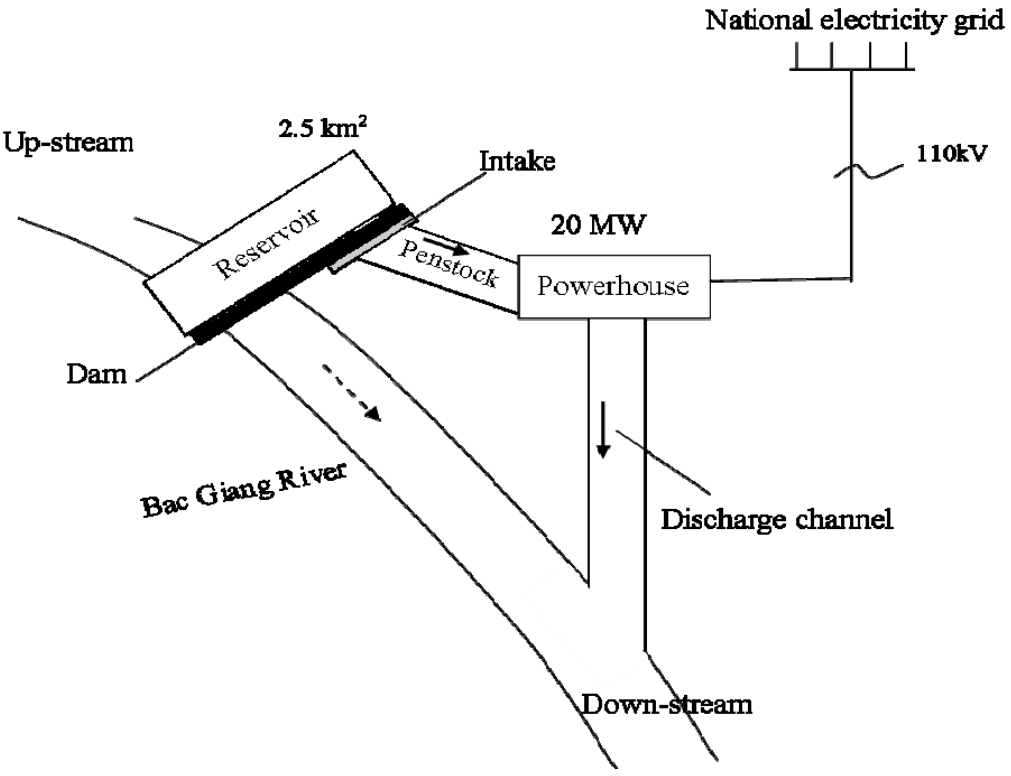

Figure 2: Project layout

The key parameters of the Project and the specification of main equipment is shown in Table 1 below:

Table 1: Main technical parameters of the Project[10]

Main parameters	Units	Value
1. Turbine		
Number	set	2
Type	-	Francis with vertical shaft
Capacity	MW	10.363
2. Generator		
Number	set	2
Type	-	synchronous, 3 phases
Rated capacity	MW	10.0
Rated voltage	kV	6.3
3. Transformer		
Type	-	3 phases, 2 windings
4. Annual river flow	m^3/s	50.1
5. Plant Load Factor (PLF)	%	43.58

The main equipment utilized in the Project will be imported. The project owner will choose suppliers via tender. The tender documents will set criteria for supplier to ensure that all the turbines and generators will be environmentally safe and sound technology.

The professional technicians and engineers will train the hydropower plant staffs on the monitoring procedures, operation regulation, maintenance procedures and other required knowledge regarding the hydropower plant before the start of operation of the project. Furthermore, there will be regular training courses regarding monitoring and operation for plant staffs during operation period so that the hydropower plant staffs can handle and operate equipments safely and efficiently. Therefore, the modern technology and know-how will be transferred to the host country and the technology of the Project is considered environmentally safe technology.

A.4.4. Estimated amount of emission reductions over the chosen crediting period:

The project activity will achieve GHG emission reduction by replacing part of power generated by fossil fuel fired plants connected to the national grid. The project will apply for a 7-year crediting period, renewable twice up to a total of 21 years. The estimated emission reductions for the first crediting period are presented in the table below.

[10] FSR

Table 2: Emission reduction of the Project during the first crediting period

Years	Annual estimation of emission reductions in tonnes of CO_2 e
2013 (01/04 - 31/12)	27,357
2014	36,476
2015	36,476
2016	36,476
2017	36,476
2018	36,476
2019	36,476
2020 (1/1 – 31/03)	9,119
Total estimated reductions (tonnes of CO_2 e)	**255,332**
Total number of crediting years	**7**
Annual average over the crediting period of estimated reductions (tonnes of CO_2 e)	**36,476**

A.4.5. Public funding of the project activity:

No public funds from Annex I countries is involved in the Project.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:

Applied methodology:

- Version 12.1.0 of ACM0002: "Consolidated baseline methodology for grid-connected electricity generation from renewable sources"

This methodology refers to the following tools:

- Version 02.2.0 of the "Tool to calculate the emission factor for an electricity system"
- Version 05.2 of the "Tool for the demonstration and assessment of additionality"

B.2. Justification of the choice of the methodology and why it is applicable to the project activity:

This proposed project is a grid-connected renewable power generation that is then eligible to apply Version 12.1.0 of ACM0002. More details of the comparison of the project's characteristics and the applicability criteria as specified in, Version 12.1.0 of ACM0002 is given in Table below.

Table 3: Comparison of project's characteristics and eligibility criteria of Version 12.1.0 of ACM0002

Applicability conditions in Version 12.1.0 of ACM0002	Characteristics of the project activity	Applicability criterion met?
This methodology is applicable to grid-connected renewable power generation project activities that (a) install a new power plant at a site where no renewable power plant was operated prior to the implementation of the project activity (greenfield plant); (b) involve a capacity addition; (c) involve a retrofit of (an) existing plant(s); or (d) involve a replacement of (an) existing plant(s).	The project activity is the installation of a new grid-connected renewable power plant at a site where no renewable power plant was operated prior to the implementation of the project activity (greenfield plant).	Yes
The project activity is the installation, capacity addition, retrofit or replacement of a power plant/unit of one of the following types: hydro power plant/unit (either with a run-of-river reservoir or an accumulation reservoir), wind power plant/unit, geothermal power plant/unit, solar power plant/unit, wave power plant/unit or tidal power plant/unit;	The project activity is the installation of a power plant of the following type: hydro power plant.	Yes
In the case of capacity additions, retrofits or replacements (except for wind, solar, wave or tidal power capacity addition projects which use Option 2: on page 10 to calculate the parameter $EG_{PJ,y}$): the existing plant started commercial operation prior to the start of a minimum historical reference period of five years, used for the calculation of baseline emissions and defined in the baseline emission section, and no capacity expansion or retrofit of the plant has been undertaken between the start of this minimum historical reference period and the implementation of the project activity;	The project activity is the installation of a new hydropower plant.	Not applicable
In case of hydro power plants, one of the following conditions must apply: * The project activity is implemented in an existing reservoir, with no change in the volume of reservoir; or * The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the Project Emissions section, is greater than 4 W/m^2; or * The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the Project Emissions section, is greater than 4 W/m^2.	The Project is the installation of a hydro power plant with the power density of 8 W/m^2. Therefore, it satisfies with the applicable condition: The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the Project Emissions section, is greater than 4 W/m^2.	Yes

This methodology is not applicable to project activities that involve switching from fossil fuels to renewable energy sources at the site of the project activity, since in this case the baseline may be the continued use of fossil fuels at the site;	The Project activity does not involve switching from fossil fuels to renewable energy sources.	Yes
This methodology is not applicable to the biomass fired power plants;	The Project is not a biomass fired power plant.	Yes
This methodology is not applicable to hydro power plants that result in new reservoirs or in the increase in existing reservoirs where the power density of the power plant is less than 4 W/m^2.	The Project results in a new reservoir where the power density of the power plant is 8 W/m^2 that is greater than 4 W/ m^2.	Yes

This comparison shows clearly that Version 12.1.0 of ACM0002 is applicable to the project activity.

B.3. Description of the sources and gases included in the project boundary:

According to Version 12.1.0 of ACM0002, the spatial extent of the project boundary includes the Project and all power plants connected physically to the national electricity grid to which the proposed project is also connected.

The flow diagram of the project boundary is shown in Figure 3.

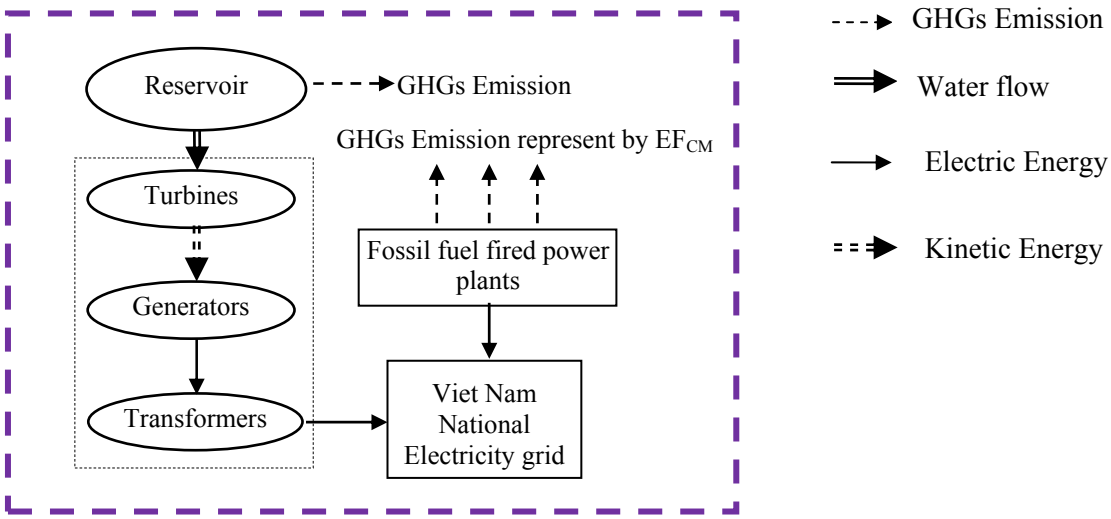

Figure 3: Project boundary

The GHGs and emission sources included in or excludedfrom the project boundary are shown in Table below.

Table 4: Sources and gases included in or excluded from the project boundary

	Source	Gas	Included?	Justification/Explanation
Baseline	CO_2 emission from electricity generation in fossil fuel fired power plants that is displaced due to the project activity	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
Project Activity	Emissions of CH_4 from the reservoirs	CO_2	No	Minor emission source
		CH_4	Yes	Main emission source. Because the power density of the project is 8 W/m^2 less than 10 W/m^2, CH_4 emissions are calculated according to Version 12.1.0 of ACM0002.
		N_2O	No	Minor emission source

B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

According to Version 12.1.0 of ACM0002, if the project activity is the installation of a new grid-connected renewable power plant, the baseline scenario is the following:

"Electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin calculations described in the "Tool to calculate the emission factor for an electricity system".

The Vietnam national electricity grid, which is operated and monopolized by the EVN and is the unique transmission and distribution line, to which all power plants in Vietnam are physically connected is the project electricity system.

Thus the baseline scenario of the proposed project is the delivery of equivalent amount of annual power output from the Vietnam national grid to which the proposed project is also connected. The database for calculating the baseline is provided by the DNA of Vietnam.

The analysis and description in B.6 will support the baseline scenario shown above.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):

CDM consideration of the Project

The major milestones in developing the investment project and CDM application are summarized in the table below.

Table 5: Major milestones in developing the investment project and CDM application

Development of the hydropower project	Activities taken to secure CDM status	Time	Implication on CDM
Finalising Feasibility Study report by the third party		05/2008	
Issuing Investment License		17/06/2009	
	Achieving the Minutes of meeting to consult public opinions of Hung Viet and Bac La communes on the social and environmental impacts of the hydropower project in order to develop it as a CDM activity	04/11/2009	CDM early consideration evidence
	Achieving the Minutes of meeting to consult public opinions of Hong Phong commune on the social and environmental impacts of the hydropower project in order to develop it as a CDM activity	05/11/2009	CDM early consideration evidence
Issuing the Adjustment for the FS by another third party		03/2010	
Issuing the Investment Decision on implementing the investment project with the CDM application by the Board of Management		**19/04/2010**	**Date of making Investment Decision**
Signing EPC contract		16/09/2010	Starting date of the Project
	Notifying the project activity to DNA and EB	29/12/2010	
Expected commissioning date ofthe Project		01/04/2013	Starting date of the credit period

According to Version 12.1.0 of ACM0002, the latest version of the "Tool for the demonstration and assessment of additionality" shall be used to demonstrate the additionality of this project activity. Version 05.2 of the additionality tool includes the following steps:

Step 1: Identification of alternatives to the project activity consistent with current laws and regulations

Sub-step 1a: Define alternatives to the project activity

Paragraph 4 of version 05.2 of the additionality tool states: "Project activities that apply this tool in context of approved consolidated methodology ACM0002, only need to identify that there is at least one credible and feasible alternative thatwould be more attractive than the proposed project activity."

We will therefore consider the two scenarios in the following analysis:

– Alternative 1 : the proposed project undertaken without the CDM

– Alternative 2: continuation of the current situation. In this case, the proposed project will not be constructed and the power will be solely supplied from the Vietnam national grid.

Sub-step 1b: Consistency with mandatory laws and regulations

The alternative 2 "continuation of the current situation" alternative does not face with any barrier from the current law and regulation in Vietnam because it is the "do-nothing" alternative. The project owner of a proposed project has no obligation to build or invest in the power plant to supply electricity for the local area. Hence this alternative is consistent with mandatory laws and regulations.

The alternative 1 is consistent with mandatory laws and regulations of Vietnam[11].

Step 2: Investment analysis

Sub-step 2a: Determine appropriate analysis method

The proposed project activity generates financial and economic benefits other than CER revenues, so the simple cost analysis (Option I) is not applicable. Out of the two remaining options, as there are no other credible and realistic baseline scenario alternatives other than electricity supply from the grid, Option II is also not applicable. Thus, the benchmark analysis (Option III) is chosen to proof additionality.

Sub-step 2b – Option III: Apply benchmark analysis

In the following, Project IRR is used to demonstrate the Additionality of the project.

As indicated in paragraph 12, Annex 5, EB 62: Guidelines on the Assessment of Investment Analysis, Version 04, "*Local commercial lending rates or weighted average costs of capital (WACC) are appropriate benchmarks for a project IRR*", the project participant applies the local commercial lending rates as a benchmark for this project IRR. This benchmark is derived from the average long-term lending rates available from the beginning of calculated year up to the date of decision making. All data is sourced from weekly reports published by the State Bank of Vietnam on its official website (www.sbv.gov.vn/en/).

The benchmark of 13.65% at the date of making the investment decision is a standard value.

Sub-step 2c: Calculation and comparison of financial indicators

The key assumptions used to calculate the Project IRR of the proposed project are presented in table below:

[11] The project's owner received the investment license for this project on 17 June 2009. This proved that this project complies with the law and regulation in Viet Nam.

Table 6: Key assumption for investment analysis

No	Parameter	Unit	Value	Source
1.	Gross capacity	MW	20	FSR
2.	Annual net electricity generation	MWh	75,205	Subtracting 1.5% of loss load and internal consumption from the total electricity generation
3.	Total investment cost	million VND	432,791	FSR
4.	Total annual O&M cost	million VND	6,089	Decision No. 2014/QD – BCN dated 13/06/2007 issued by the Ministry of Industry provides temporary guidelines for conducting the economic, financial and investment analysis and providing the purchasing-selling price frame for power generation projects
5.	Preparation and construction period	year	3	FSR
6.	Period of financial assessment	year	30	FSR
7.	Electricity tariff	VND/kWh	777.64	Calculated according to Decision No. 18/2008/QD-BTC dated 17/08/2008 Promulgating the Regulation on Avoided Cost Tariff and Standardised Power Purchase for small renewable energy power plantand Decision No. 73/QD-DTDL dated 30/12/2009 on avoided cost tariff for the year 2010
8.	Resources tax	%	2	Circular No 45/2009/TT-BTC issued by Ministry of Finance on 11/03/2009
9.	Royalties calculation price	VND/kWh	1,058	Decision No. 588/QD-BTC issued by Ministry of Finance on 22/03/2010
10.	**Project IRR without CDM**	**%**	**10.28**	Calculated

This table shows that the IRR of the project was lower than the benchmark at the time of decision makingwhich is defined as the date of issuing the Decision to pursue the CDM application for the investment project by the Board of Management on 19/04/2010.

Sub-step 2d: Sensitivity analysis

A sensitivity analysis of the project activity has been conducted to test the robustness of the above calculations. According to EB 62, Annex 5, paragraph 20:"Only variables, including the initial investment cost, that constitute more than 20% of either total project costs or total project revenue should be subjected to reasonable variation", the following parameters are used in the sensitivity analysis of the project activity:

- Annual export to the national grid
- Investment cost
- Feed-in tariff set by EVN

Table below show the impact of variations in key factors on the Project IRR considering a ±10% variation in the parameters.

Table 7: Sensitivity analysis for the Project

No	Parameter	Variation[12]	Project IRR	Likelihoods to happen
1	Annual amount of electricity exported to the national grid	10.00%	11.51%	Lower than the benchmark
		-10.00%	9.00%	Lower than the benchmark
2	Investment costs	10.00%	9.25%	Lower than the benchmark
		-10.00%	11.50%	Lower than the benchmark
3	Feed- in tariff set by EVN	10.00%	11.55%	Lower than the benchmark
		-10.00%	8.97%	Lower than the benchmark

The sensitivity analysis shows that the Project IRR of the project was considerably lower than the benchmark in all cases.

In conclusion, the proposed CDM project activity is unlikely to be financially attractive.

Step 3: Barrier analysis

Not applied.

Step 4: Common practice analysis

Sub-step 4a: Analyse other activities similar to the proposed project activity

Government Decree No 45/2001/ND-CP electricity activities and use, which was issued on 2 August 2001 and was entered into force 15 days after the issuance date, created a legal basis to allow other entities to invest in and generate electricity rather than only state-owned entities as previously regulated. Before that time, all power plants have been invested from the state budget sources and operated by state-owned companies. Hence, any hydropower projects that have started the construction activities before August 2001 are not subject to this analysis.

According to Vietnam Construction Code - TCXDVN 285:2002 "Irrigation projects - Major standards on designing"[13] which regulates the criteria for construction contractors, design steps and warranty period for construction works activities, hydropower projects are categorized as follows.

[12] ±10% is selected according to the Decision No. 709/QĐ – NLDK issued by the Ministry of Industry, dated 13/04/2004 to provide temporary guidelines for conducting the economic, financial and investment analysis and providing the purchasing-selling price frame for power generation projects. It is also common-practice for sensitivity analysis for additionality demonstration. Furthermore, ±10% is also a common practice rate for sensitivity analysis of a CDM project

[13] Construction Code regulates the basic technical standards that are mandatory for construction activities in Vietnam

Table 8: Groups of hydropower projects according to Vietnam Construction Code - TCXDVN 285:2002

Group	Installed capacity
I	equal and larger 300 MW
II	equal and larger 50 MW but smaller 300 MW
III	smaller 50 MW but equal and larger 5MW
IV	smaller 5 MW but equal and larger 0.2MW
V	up to 0.2MW

According to the Prime Minister's Decision No.176/2004/QD-TTg which defines the legal entities against the project scales, private entities are not encouraged to invest in hydropower projects with capacity above 100 MW. Furthermore, according to the Decision of Ministry of Industry - No 3454/QĐ-BCN dated 18/10/2005 defining the jurisdictions to approve the Master Plans and management hierarchy for small scale hydropower projects, hydropower projects having installed capacity within the range 1MW to 30 MW are categorised as small scale projects.

To serve the purpose of this analysis and in order to categorise hydropower projects in correspondence with the existing regulations mentioned above, hydropower projects are categorised into groups as follows:

Table 9: Groups of hydropower projects serving for common practice analysis

Group	Installed capacity	Referred regulations
A	equal and larger 300 MW	Vietnam Construction Code - TCXDVN 285:2002
B	larger 100 MW and smaller 300 MW	Vietnam Construction Code - TCXDVN 285:2002 and Prime's Minister Decision No 176/2004/QD-TTg
C	equal and larger 50 MW and equal and smaller 300 MW	Vietnam Construction Code - TCXDVN 285:2002
D	smaller 50 MW and larger 30MW	Vietnam Construction Code - TCXDVN 285:2002 and Decision of Ministry of Industry - No: 3454/QD-BCN.
E	equal and smaller 30 MW and larger 5MW	Vietnam Construction Code - TCXDVN 285:2002 and Decision of Ministry of Industry - No: 3454/QD-BCN.
F	up to 5MW	Vietnam Construction Code - TCXDVN 285:2002 and Decision of Ministry of Industry - No: 3454/QD-BCN.

According to the table above, this proposed project activity falls into Group E.

Hydropower plants which belong to Group E but were developed without CDM are listed in Table 10.

Table 10: Hydropower plants which belong to range (5MW to 30MW) were developed in Viet Nam[14]

No	Name	Capacity MW	Construction starting year	Commissioning year	Developed as CDM project
1	Nam Mu	12	2002	2004	No
2	EaKrong Rou	28	2003	2007	No
3	Suoi Sap	14.4	2004	2007	No
4	Group of Nam Tha	19.5	2006	2007	Yes

[14] List of power plants published by the Vietnam DNA

5	NgoiXan	18.6	2006	2007	Yes
6	Na Loi	9.3	2000	2003	No

Because the Na Loi hydropower project started construction from 2000, it is excluded from this common practise analysis. Exclusion is also applied to Group of Nam Tha and Ngoi Xan as they are developed as CDM projects. Thus, only 3 projects are relevant in this analysis.

The comparison of the three remaining hydropower plants and the proposed project activity is presented in table below.

Table 11: Hydropower plants which belong to group E (5 – ≤ 30 MW) were developed in Viet Nam

No	Name	Capacity MW	Elec. outputs 10^3MWh	Load factor (%)	Construc-tion starting year	Commi-ssioning year	Investor during the investment and construction period
0	**The Project**	**20**	**76.35**	**43.58**	**2010**	**2013**	**Su Pan 1 Hydropower Joint Stock Company** (private owned company)
A. Invested and constructed by state-owned companies or joint stock companies which are either state-owned or whose major shares held by the government							
1	Nam Mu	12	55.7	53.0	Jan. 2002	2004	Song Da Construction Corporation - one of the largest state-owned construction corporation belongs to Ministry of Construction (Nam Mu Hydropower JSC was set up on 29 May 2003 to take over the continuing construction and to operate the Nam Mu plant[15])
2	EaKrong Rou	28	110.7	45.1	Otc. 2003	2007	This project has received ODA loan from India[16]
B. Invested and constructed by private companies							
3	Suoi Sap	14.4	65.7	52.1	Jul. 2004	2007	Truong Thanh Construction Company Limited

Sub-step 4b: Discuss any similar options that are occurring

The existence of these hydropower plants does not contradict the result of the benchmark analysis stating that the proposed project is financially unattractive, because of the following reasons:

[15] Prospectus of Nam Mu Hydropower Joint Stock Company
http://images1.cafef.vn/Images/Uploaded/DuLieuDownload/Ban%20Cao%20Bach/HJS_BCB.doc

[16] http://www.mientrungpid.com.vn/?page=13

- *For projects 1 - 2*: These projects have been invested in by either large state-owned corporations or joint stock companies whose majority shares held by large state-owned corporations. These projects do not face the barriers that the proposed project faces because:

  1. The state-owned corporations mentioned above are among the largest state-owned power and construction corporations in Vietnam. They are financed by the state budget as well as their investment activities. In 1990s, Song Da Construction Corporation have been assigned by the government to construct national hydropower plants like Hoa Binh (1920 MW), Yaly (720 MW), Tri An (400 MW), Ham Thuan (300 MW), Thac Ba (108 MW)…. And from 2000, Song Da Corporation had been studying and investing in a series of hydropower plants like: RyNinh 2, Na Loi, Can Don, Se San 3A…[17] Therefore, they have substantial experiences in designing, investing, constructing, and operating hydropower plants.

  2. The state-owned corporations mentioned above were established according to the Prime Minister's Decisions No 90/TTg and 91/TTg dated 07/03/1994. The formulation of these corporations is to aim at developing power and construction industries in order to meet national socio-economical development goals and strategies and to implement development tasks assigned by their ministries and/or Prime Minister in certain development periods. Therefore, the key target of these corporations is to serve as the governmental tool for macroeconomic interferences rather than profit making[18].

- *Project 3*: The initial main objective of this project by the government was to invest in an irrigation project to provide water for 700 ha commercial plantation and rice fields in order to alleviate poverty and to develop local agriculture and rural communes in Phu Yen District, Son La Province. Therefore, this project has borrowed ODA soft-loan from India at a very favourable interest rate[19] while the proposed project has to take loans from domestic banks without such a favourable condition. The circumstances of this project thus clearly show that this project has not been facing a similar barrier as the proposed project.

*As can b*e seen from the above analysis, no similar projects facing the same barriers as the proposed project have been developed without the aid of CDM.

In conclusion, the proposed project is additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

The reduced emission is calculated in accordance with the approved consolidated baseline methodology Version 12.1.0 of ACM0002.

I. Project emissions *(PE_y)*

According to ACM0002 Version 12.1.0, the project emission

are calculated using the following equation:

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

[17] http://www.songda.vn/info/en/Home/tabid/38/Default.aspx
[18] http://vi.wikipedia.org/wiki/Tổng_công_ty_91
[19] ODA Credit contract of Suoi Sap

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)
$PE_{FF,y}$	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 proposed project is a hydro power plant that neither uses fossil fuel nor operates geothermal power plants (i.e. $PE_{FF,y}= 0$; $PE_{GP,y} = 0$); therefore, the above equation can be shortened as follows:

$$PE_y = PE_{HP,y}$$

Emission from reservoir:

For hydropower project activity that results in new reservoirs and/or the increase of existing reservoirs, the power density (*PD*) of the project activity shall be calculated as follows:

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

Where:

PD	Power density of the project activity, in 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 reservoir 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 reservoir 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.

If the *PD* is greater than 4 W/m^2 and less than or equal to 10 W/m^2:

$$PE_y = \frac{EF_{Res} \cdot TEG_y}{1000}$$

Where:

PE_y	Emission from reservoir expressed as tCO_2e/year
EF_{Res}	is the default emission factor for emissions from reservoirs, and the default value as per EB23 is 90 Kg CO_2e /MWh.
TEG_y	Total electricity produced by the project activity, including the electricity supplied to the grid and the electricity supplied to internal loads, in year *y* (MWh).

If *PD* is greater than 10 W/m^2, then:

$$PE_y = 0$$

II. Baseline emissions *(BE_y)*

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

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

Where:

BE_y	Baseline emissions in year *y* (tCO_2/yr).
$EG_{PJ,y,y}$	Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh/yr).
$EF_{grid,CM,y}$	Combined margin CO_2 emission factor for grid connected power generation in year *y* used the applied value(tCO_2/ MWh).[20]

Calculation of EG_{PJ}

Because the project activity is the installation of a new grid-connected renewable power plant/unit at a site where no renewable power plant was operated prior to the implementation of the project activity, then:

$$EG_{PJ,y} = EG_{facility,y}$$

Where:

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

Therefore, the baseline emissions are calculated as follows:

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

<u>Calculation of the emission factor (EF) of the national electricity grid</u>

Version 02.2.0 of "Tool to calculate the emission factor for an electricity system" determines the CO_2 emission factor for the displacement of electricity generated by power plants in an electricity system, by calculating the "operating margin" and "build margin" as well as the "combined margin", including 6 steps as follows:

STEP 1. Identify the relevant electric power system.

STEP 2. Choose whether to include off-grid power plants in the project electricity system (optional).

STEP 3. Select a method to determine the operating margin (OM)

STEP 4. Calculate the operating margin emission factor according to the selected method.

STEP 5. Calculate the build margin (BM) emission factor.

STEP 6. Calculate the combined margin (CM) emissions factor.

[20] This value is required to be used by the DNA Viet Nam and referred to the link as http://www.noccop.org.vn/Data/vbpq/Airvariable_ldoc_vnHe%20so%20phat%20thai.pdf

Step 1. Identify the relevant electricity systems

This hydropower project will be connected to the national electricity grid of Vietnam, which is operated and monopolized by the EVN. This national electricity grid is the unique transmission and distribution line, to which all power plants in Vietnam are physically connected. Hence the national electricity grid is the project electricity system.

There are electricity imports to the national electricity grid from China - another host country, thus the China Power Grid is the connected electricity system and the emission factor for the imported electricity is zero tons CO_2 per MWh by default.

Step 2: Choose whether to include off-grid power plants in the project electricity system (optional)

There are 2 options in the tools to choose, including:
Option I: Only grid power plants are included in the calculation.
Option II: Both grid power plants and off-grid power plants are included in the calculation.
Because only the data of grid connected power plants is available, so Option I will be chosen for calculating the grid emission factor.

Step 3. Select a method to determine the operating margin (OM)

The calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on one of the following methods:

a) Simple OM;

b) Simple adjusted OM;

c) Dispatch data analysis OM;

d) Average OM.

The method (a) can be used in the project because low-cost/must-run resources in Vietnam is 34.77 % that constitute less than 50% of total grid generation in average of the five most recent years (details see the table below).

Table 12: Rate of low cost/must-run sources based on generation[21]

Year	2004	2005	2006	2007	2008	Average value for 2004-2008
Hydro Power (MWh)	17,858,651	16,365,438	19,508,244	22,385,232	25,933,762	102,051,327
Total Power (MWh)	44,974,169	50,330,468	57,160,493	66,348,589	74,689,636	293,503,355
Low-cost/ Must-run Ratio	39.71%	32.52%	34.13%	33.74%	34.72%	34.77%

The data vintage which is used to calculation the Simple OM emission factor is the Ex-ante option of a 3-year generation-weighted average (2006, 2007 and 2008) that is the most recent data available at the time of submission of the CDM-PDD to the DOE for validation, without requirement to monitor and recalculate the emissions factor during the crediting period.

[21] Data source from DNA Viet Nam

Step 4. Calculate the OM emission factor according to the selected method

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

There are two options proposed, including:

Option A: Based on data on the net electricity generation and a CO2 emission factor of each power unit, or
Option B: Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system.

Because the data for Option A is available, Option A "*Calculation based on average efficiency and electricity generation of each plant"* is used and then the simple OM emission factor is calculated as follows:

$$EF_{grid,OM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

Where:

$EF_{grid,OM,y}$	is the simple operating margin CO_2 emission factor in year *y* (tCO_2/GWh)
$EG_{m,y}$	is the net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (GWh)
$EF_{EL,m,y}$	is the CO_2 emission factor of power unit *m* in year *y* (tCO_2/GWh)
m	All power plants/units serving the grid in year *y* except low-cost/must-run power plants/units
y	Either the three most recent years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option)

Because the data on fuel consumption and electricity generation of power unit *m* is available, so the emission factor ($EF_{EL,m,y}$) should be determined as **Option A1** :

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{EG_{m,y}}$$

Where:

$EF_{EL,m,y}$	is the CO_2 emission factor of power unit *m* in year *y* (tCO_2/GWh)
$FC_{i,m,y}$	Amount of fossil fuel type *i* consumed by power plant/unit *m* in year *y* (mass or volume unit)
$NCV_{i,y}$	Net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ/mass or volume unit)
$EF_{CO2,i,y}$	CO_2 emission factor of fossil fuel type *i* in year *y* (tCO_2/GJ)
$EG_{m,y}$	Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost/must-run power plants/units,in year *y* (MWh)

i All fossil fuel types combusted in power sources in the project electricity system in year *y*

y The relevant year as per the data vintage chosen in Step 3

Table 13: OM emission factor in 2008

Year	Total output (MWh)	Total emission (tCO2e)	OM 2008 (tCO2e/MWh)
	A	**B**	**(ΣB/ΣA)**
2006	37,618,249.00	25,702,898.00	
2007	43,921,357.00	28,544,283.00	
2008	48,719,874.00	29,963,699.00	
Total	**130,259,574.00**	**84,210,900.00**	**0.6465**

So $EF_{grid,OMsimple,y}$ is derived as follows:

$$\boldsymbol{EF_{grid,OMsimple,y} = 0.6465\ tCO_2/MWh}$$

Step 5. Calculate the BM emission factor

In terms of vintage of data, one of the following two options can be chosen:

Option 1: For the first crediting period, calculate the build margin emission factor *ex ante* based on the most recent information available on units already built for sample group *m* at the time of CDM-PDD submission to the DOE for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period, or

Option 2: For the first crediting period, the build margin emission factor shall be updated annually, *ex post*, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin emissions factor shall be calculated *ex ante*, as described in Option 1 above. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used.

The most recent information on units already built for sample group *m* is available, so Option 1 shall be chosen for the proposed project.

The sample group of power units *m* used to determine as per the following procedure, consistent with the data vintage selected above:

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

In 2008, the set of five power units that have been built most recently ($SET_{5\text{-}units}$) is indicated in Annex 3 has annual generation ($AEG_{SET\text{-}5\text{-}units}$) of 7,829,812.02 MWh.

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

The total output of Vietnam electricity grid (AEG_{total}) in 2008 is 74,689,635.97 MWh then 20% of the total output of Vietnam electricity grid in 2008 is 14,937,927.19 MWh.

Most recent-built power plants ($SET_{\geq 20\%}$) addition in the electricity system that comprise 20% of the system generation in 2008 is shown in the annex 3 have annual electricity generation ($AEG_{SET-\geq 20\%}$) of 16,514,761.12 MWh.

(c) From $SET_{5\text{-units}}$ and $SET_{\geq 20\%}$ select the set of power units that comprises the larger annual electricity generation (SET_{sample}).

The comparison carried out by the project participants shows that the set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) that have been built most recently has the larger annual generation (14,937,927.19 MWh) than the set of five power units that have been built most recently in 2008 does (7,829,812.02 MWh), and hence it is employed and SET_{sample}.

There is no plant in SET_{sample} is started to supply electricity to the grid more than 10 years ago, then use SET_{sample} to calculate the build margin.

The BM emissions factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units *m* during the most recent year *y* for which power generation data is available. It is calculated as follows:

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

Where:

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

Then $EF_{grid,BM,y}$ is derived as follows:

$$\boldsymbol{EF_{grid,BM,y} = 0.5064\ tCO_2/MWh}$$

Step 6. Calculate the combined margin emissions factor

The CM emissions factor is calculated as follows:

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

Where:

w_{OM} Weighting of OM emissions factor (%)

w_{BM} Weighting of BM emissions factor (%)

For the proposed project, the following default values are used: w_{OM}= 0.5 and w_{BM} = 0.5 in the first crediting period, and w_{OM}= 0.25 and w_{BM}= 0.75 in the second and third crediting period.

So in the first crediting period, the CM emission factor is derived as follows:

$$EF_{grid,CM,y} = 0.5 \times 0.6465 + 0.5 \times 0.5064 = 0.5764 \text{ tCO}_2\text{/MWh}$$

The baseline emission factor EF shall be fixed for the crediting period.

III. Leakage

According to ACM0002, Version 12.1.0, 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.

IV. Emission reductions *(ER_y)*

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y$$

Where:

ER_y Emission reductions in year y (tCO_2e/yr).

BE_y Baseline emissions in year y (tCO_2e/yr)

PE_y Project emissions in year y (tCO_2e/yr).

B.6.2. Data and parameters that are available at validation:

Data / Parameter:	**Cap_{BL}**
Data unit:	MW
Description:	Installed capacity of hydropower plant before the implementation of the project activity.
Source of data used:	This is a green-field project. This value does not exist prior to the implementation of the project activity
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	The project activity constructs a new hydropower plant, so Cap_{BL} is considered by zero according to Version 12.1.0 of ACM0002.
Any comment:	For calculating the power density (PD)

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:	This is a green-field project. This value does not exist prior to the implementation of the project activity
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	The project activity builds a new reservoir, so A_{BL} is considered by zero according to Version 12.1.0 of ACM0002.
Any comment:	For calculating the power density (PD)

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 applied:	90 kgCO_2e/MWh.
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	For calculation of project emission (PE)

Data / Parameter:	**$EF_{grid,OM,y}$**
Data unit:	tCO_2/MWh
Description:	Operating margin CO_2 emission factor for grid connected power generation in year *y* calculated using the "Tool to calculate the emission factor for an electricity system"
Source of data used:	Data published by DNA Vietnam
Value applied:	0.6465
Justification of the choice of data or description of measurement methods and procedures actually applied:	As per the "Tool to calculate the emission factor for an electricity system"
Any comment:	For calculation of $\boldsymbol{EF}_{grid,CM,y}$

Data / Parameter:	$EF_{grid,BM,y}$
Data unit:	tCO_2/MWh
Description:	Build margin CO_2 emission factor for grid connected power generation in year *y* calculated using the "Tool to calculate the emission factor for an electricity system"
Source of data used:	Data published by DNA Vietnam
Value applied:	0.5064
Justification of the choice of data or description of measurement methods and procedures actually applied:	As per the "Tool to calculate the emission factor for an electricity system"
Any comment:	For calculation of $EF_{grid,CM,y}$

Data / Parameter:	$EF_{grid,CM,y}$
Data unit:	tCO_2/MWh
Description:	Combined margin CO_2 emission factor for grid connected power generation in year *y* calculated using the "Tool to calculate the emission factor for an electricity system"
Source of data used:	Data published by DNA Vietnam
Value applied:	0.5764
Justification of the choice of data or description of measurement methods and procedures actually applied:	As per the "Tool to calculate the emission factor for an electricity system"
Any comment:	Fixed for crediting period.

B.6.3. Ex-ante calculation of emission reductions:

Baseline emissions

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:

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

Where:

$EG_{facility,y}$ = 75,205MWh/yr

$EF_{grid,CM,y}$ = 0.5764 tCO_2/MWh

Therefore:

$$BE_y = 75{,}205 \times 0.5764 = 43{,}348 (tCO_2/yr)$$

Project emissions (PE_y)

Emission from reservoir:

The Project involves the construction of a new hydropower plant with capacity (Cap_{PJ}) of 20 MW and anew reservoir with area (A_{PJ}) of 2,500,000 m^2, thus $A_{BL} = 0$ and $Cap_{BL} = 0$.

The power density of project plant is derived as follows:

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}} = \frac{20.0 \times 10^6 - 0}{2,500,000 - 0} = 8.0 W / m^2$$

As the power density of the project plant is greater than 4 W/m^2 and less than or equal to 10 W/m^2, thus the project emission is calculated as follows:

$$PE_y = \frac{EF_{Res} \cdot TEG_y}{1000} = \frac{90x76,350}{1000} = 6,872(tCO_2 / yr)$$

Therefore, the GHG emission from the project activity is calculated as follows:

$$PE_y = PE_{HP,y}$$

$PE_{HP,y}$= 6,872 tCO_2/yr

Reduction emissions

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y = 36,476 \ (tCO_2/yr)$$

B.6.4. Summary of the ex-ante estimation of emission reductions:

The estimated emission reduction of the project activity is provided in table 14.

Table 14: Emission reduction of the project activity

Year	**Estimation of project activity emissions (tCO_2 e)**	**Estimation of baseline emissions (tCO_2 e)**	**Estimation of leakage (tCO_2 e)**	**Estimation of overall emission reductions (tCO_2 e)**
2013 (01/04 - 31/12)	5,154	32,511	0	27,357
2014	6,872	43,348	0	36,476
2015	6,872	43,348	0	36,476
2016	6,872	43,348	0	36,476
2017	6,872	43,348	0	36,476
2018	6,872	43,348	0	36,476
2019	6,872	43,348	0	36,476
2020 (01/01- 31/03)	1,718	10,837	0	9,119
Total (tonnes of CO_2e)	**48,104**	**303,436**	**0**	**255,332**

B.7. Application of the monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Data / Parameter:	**$EG_{y, export}$**
Data unit:	MWh
Description:	Electricity supplied by the proposed hydropower plant to the national grid
Source of data to be used:	Direct measurement at the project connection point of the plant. It is excluded the electricity used for internal consumption and losses
Value of data applied for the purpose of calculating expected emission reductions in section B.6	75,205
Description of measurement methods and procedures to be applied:	Two-way power meters will be installed at the grid-connected point to measure the amount of electricity supplied to the grid by the proposed project by the positive direction. The readings of electricity meter will be continuously measured by the power meter and monthly recorded. The recorded data will be confirmed by the joint balance sheet which will be signed by the representatives of EVN and the project owner. Electronic data will be archived within the crediting period and 2 years after the end of the crediting period.
Monitoring frequency	Continuously measured by the power meter and monthly recording
QA/QC procedures to be 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.
Any comment:	For $EG_{facility, y} = EG_{y, export} - EG_{y, import}$

Data / Parameter:	**$EG_{y, import}$**
Data unit:	MWh
Description:	Electricity supplied by the local grid to the plant
Source of data to be used:	Direct measurement at the connection point ofthe plant
Value of data applied for the purpose of calculating expected emission reductions in section B.6	0
Description of measurement methods and procedures to be applied:	The power meters will be installed at the grid-connected point to measure the amount of electricity supplied by the grid to the proposed hydropower plant. The readings of electricity meter will be monthly recorded. Double checking by the invoice issued by EVN to ensure the consistency. Hardcopy of invoice from EVN will be archived within the crediting period and 2 years after the end of the crediting period.
Monitoring frequency	Monthly recording
QA/QC procedures to	The uncertainty level of this data is low. The measurement/ monitoring

be applied:	equipment should adopt the colligated automation system complying with national standard and technology. These equipment and systems should be calibrated and checked every 2 year.
Any comment:	For $EG_{facility, y}$= $EG_{y, export}$ - $EG_{y, import}$

Data / Parameter:	**$EG_{facility, y}$**
Data unit:	MWh
Description:	Net electricity supplied by the proposed hydropower plant to the national grid
Source of data to be used:	Measured from $EG_{y, import}$ and $EG_{y, export}$
Value of data	75,205
Description of measurement methods and procedures to be applied:	Measured from $EG_{y, import}$ and $EG_{y,export}$. Data will be archived within the crediting period and 2 years after the end of the crediting period.
Monitoring frequency	Monthly recording
QA/QC procedures to be applied:	The uncertainty level of this data is low
Any comment:	Using for calculating $ER_{y,}$

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
Source of data to be used:	Project site
Value of data applied for the purpose of calculating expected emission reductions in section B.6	2,500,000
Description of measurement methods and procedures to be applied:	Measured from topographical surveys, maps, satellite pictures, etc
Monitoring frequency	Yearly
QA/QC procedures to be applied:	The uncertainty level of this data is low
Any comment:	For power density calculation

Data / Parameter:	Cap_{PJ}
Data unit:	W
Description:	Installed capacity of the hydro power plant after the implementation of the project activity.
Source of data to be used:	Project site
Value of data applied for the purpose of calculating expected emission reductions in section B.6	20,000,000
Description of measurement methods and procedures to be applied:	
Monitoring frequency	Yearly
QA/QC procedures to be applied:	
Any comment:	Use for calculating the power density

Data / Parameter:	TEG_y
Data unit:	MWh
Description:	Total electricity produced by the project activity, including the electricity supplied to the grid and the electricity supplied to internal loads, in year *y*.
Source of data to be used:	Direct measurement at the project site
Value of data applied for the purpose of calculating expected emission reductions in section B.6	76,350
Description of measurement methods and procedures to be applied:	Directly measured power meters will be installed at the grid-connected point to measure the amount of generated electricity. The readings of electricity meter will be continuously measured by the power meter and monthly recorded. Electronic data will be archived within the crediting period and 2 years after the end of the crediting period.
Monitoring frequency	Continuously measurement by the power meter and monthly recording.
QA/QC procedures to be applied:	The uncertainty level of this data is low. The measurement/ monitoring equipment should adopt the colligated automation system complying with national standard and technology. These equipment and systems should be calibrated and checked every 2 year.
Any comment:	Use for calculating $PE_{HP,y}$

B.7.2. Description of the monitoring plan:

Because the baseline emission factor of Vietnam National Grid ($EF_{grid,CM,y}$) is fixed ex-ante (detail in Section B.6), the main data to be monitored is $EG_{facility, y}$. $EG_{facility, y}$ will be calculated according to this formula below:

$$EG_{facility,y} = EG_{y, export} - EG_{y, import}$$

The electricity generated from the project activity will be sold to the EVN for the complete project lifetime under a long-term PPA with EVN.

The electricity generated from the project activity before entering into the grid at the grid interconnection point will be measured by a digital kilowatt hour (kWh) meter. The metering system includes the main system and a back-up system. The back-up system will be used in case of failure of the main meter.

Data from the operating meters will be continuously measured. Additionally, monthly manual readings will be taken from the operating meters.

Monthly, EVN staff and staff of the operation division of the power plant will cross-check manual meter readings with the electronically recorded data and prepare and sign a joint balance sheet which indicates the amount of power fed into the grid within that month.

This joint balance sheet is also the basis of payment by the EVN to the project proponent. Hence, the monitoring plan is well integrated into the standard EVN procedures.

For further details see Annex 4.

B.8. Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies):

Date: 21/07/2011

The responsible entity: **Energy and Environment Consultancy Joint Stock Company (VNEEC)** which is the project participant listed in Annex 1 of this document.

SECTION C. Duration of the project activity / crediting period

C.1. Duration of the project activity:

C.1.1. Starting date of the project activity:

16/09/2010 (defined as the date of the EPC contract)

The choosing of this date is in accordance with the "CDM Glossary of Terms/version 05", which define the starting date of project as "the earliest date at which either the implementation or construction or real action of a project activity begins".

C.1.2. Expected operational lifetime of the project activity:

30 years

C.2. Choice of the crediting period and related information:

C.2.1. Renewable crediting period:

C.2.1.1. Starting date of the first crediting period:

01/04/2013 or date of registration whichever is later

C.2.1.2. Length of the first crediting period:

7 years

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not applicable

C.2.2.2. Length:

Not applicable

SECTION D. Environmental impacts

D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

Pursuant to Environment Protection Law of Vietnam 2005, Decree No. 80/2006/ND-CP dated 09/08/2006 on details of regulations and guidance on implementing of Environment Protection Law of Vietnam 2005 and Circular No.08/2006/TT-BTNMT dated 08/09/2006 of Ministry of Natural Resources and Environment on guiding assessment of strategic environment, environmental impact and environment protection commitment, the project owner submitted the Environmental Impact Assessment (EIA) report for the Project to the Department of Natural Resources and Environment of Lang Son Province (Lang Son DONRE). This EIA report was approved by Lang Son Provincial People's Committee on 19/06/2008 at the Decision No. 1168/QD-UBND.

The surface water license is to be obtained from the Ministry of Natural Resources & Environment before operation as this is mandatory for this type ofproject in Vietnam.

The environmental impacts and mitigation measures mentioned in EIA report are summarized as follows.

1.1. Environment Impacts

1.1.1. Impacts on land

The Project will occupy 2.65 km^2including 2.4681 km^2 of poor forest and uncultivated land (93.3%), 0.1457 km^2 of rice field and cultivated land (6.33 %), 0.01038 km^2 of residential (0.37%) and there is no

land of protective forest is occupied[22]. The occupied land will be compensated adequately in the compliance with current law and regulations.

No historical culture and archaeological places exist in the project site.

1.1.2. Impacts on water environment

The Project creates a reservoir with area of 2.5 km^2. The plants in this area which are flooded in the reservoir-filling period will be decomposed in the water environment.

Water environment is mainly affected by domestic wastewater, solid wastes from the work camps and waste oil from the truck and vehicle during construction and operation phases. Therefore, sanitations will be built to collect and treat with wastewater and solid waste.

1.1.3. Impacts on air environment

The local environment surrounding the construction site will be affected by dusts and noise generated in the construction phase by dust and exhaust from the operation of construction equipments, blast, material exploitation and material transportation. However, these impacts are temporary and will be terminated after commissioning the construction phase.

1.1.4. Impacts on ecological system

The ecological system that is disturbed in construction phase will become stable gradually after finishing this phase and filling the reservoir with water.

1.2. Socio-economic impacts

1.2.1. **Negative impacts**

There is no household has to be resettled due to the project activity. The land will be occupied by the project activity. The project owner has committed to implement the compensation for affected households in compliance with current government law and regulations.

1.2.2. **Positive impacts**

As presented in Section A.2

1.2. Mitigation measures to reduce negative impacts

1.2.1. Construction phase

- *Waste collection and treatment*

– Implement regular collection and treatment of solid and liquid wastes, including the construction of a dumping area

– Conduct awareness on the environmental protection for workers and local people.

- *Local pollution*

– Dust removal measures will be taken such as spraying water along the roads.

– All means/vehicles for transport of construction materials must be covered in order to minimize dust dispersion.

– All transport equipment/vehicles and machines must have operational certifications

- *On socio-economic impacts:*

[22]EIA report

– Implement the compensation plan for the local impacted people according to the government law.

1.2.2. Operational phase

Preventive measures and reaction towards environment problems: Install monitoring equipment to monitor absorption and distortion of water rising and water quality released from the plant and propose suitable preventive measures if required

1.3. Conclusion

The main negative impacts on the environment are due to construction. However, all these impacts will be mitigated by implementing adequate mitigation measures and then will cease after the completion of the construction phase. Preventive and mitigation measures are planned to be conducted during the operation period to prevent and/or reduce any adverse impacts.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

Not applicable

SECTION E. Stakeholders' comments

E.1. Brief description how comments by local stakeholders have been invited and compiled:

The following stakeholders have been consulted during the preparation of the project activity:

- People's Committee of Lang Son Province (highest local authority): the People's Committee of Lang Songave approval for EIA report via the official letter No. 1168/QD-UBND dated 19/06/2008. The People Committee was informed about the CDM development of the project and supported to develop this project as a CDM project activity via the official verification letter No.100/UBND-KTNdated 03/03/2011 which was sent to Vietnam DNA.
- Local people in the project area in Hung Viet commune, Trang Dinh district; Bac La commune, Van Lang district and Hong Phong commune, Binh Gia district, Lang Son province.

On 04/11/2009 and 05/11/2009, meetings between the project owner and the representatives of the local people were held in order to consult local people on the social-economic and environment impacts of the proposed project:

- The first meeting was took place on 04/11/2009 in Hung Viet commune.
- The next meeting was took place on 04/11/2009 in Bac La commune.
- The final meeting was took place on 05/11/2009 in Hong Phong commune.

The representatives of the local people are as follows:

- Commune's People Council: The members of Commune People Council are elected by residents in commune. So the Council opinions officially represent for opinions of the local people.
- Commune's People Committee (CPC): CPC is the lowest administration level in Vietnam administrative hierarchy. Chairman of CPC is elected by the Commune People Council, so he well represents the commune's interest.

- Commune's communist party committee secretary: this is one of the key government bodies in making development strategies at the communal level.
- Village's representative: head of village, secretary of young union, head of farmers' association, head of women's association. Such associations are NGOs and represent the interests of different groups.

E.2. Summary of the comments received:

All stakeholders involved agreed that the project will certainly contribute to sustainable development and environment protection in Viet Nam and especially this project will reduce poverty and contribute to increase the electricity supply. Therefore, they strongly support for the project implementation and promptly made comments.

Comments of the representatives of local people and local authority are summarized as follows:

- The proposed hydropower project is a clean industrial project and will contribute to socio-economic development of the project's area;
- The good impacts are expected from infrastructure improvement such as road, electricity access, and clean water system. Besides, the increase of awareness and market access are also implies the positive impacts on spiritual and material lives of local people and
- The local people expect that the project activity will employ local people for construction as well as operation phases if suitable and will minimise negative impacts during the construction phase.

E.3. Report on how due account was taken of any comments received:

To address the requests from local people, the project's owner committed to:

- Use local human resources for appropriate jobs in the construction and operation phases;
- Construct the project in accordance with the existing regulations and codes and take appropriate mitigation measures to prevent negative impacts on the environment as listed in the EIA report.
- Dust removal measures will be taken such as spraying water along the roads.
- Implementing the compensation budget and plan as agreed with local people. The project owner has been in process to negotiate and reach an agreement with each impacted household. The payment to each household will be made under the supervision of the Compensation Board which has representatives from government offices and local people.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding from the Annex I parties is involved in the project activity

Annex 3

BASELINE INFORMATION

The Baseline Emission Factor is approved under Official document No. 151/KTTBDKH issued on 26/03/2010 by the Department of Meteorology, Hydrology and Climate Change of the Ministry of Natural Resources and Environment on "Vietnam electricity emission factor"

Data sources using to calculation $EF_{CM, grid}$ has been referred to the published data of DNA Vietnam. The link is accessible at:

http://www.noccop.org.vn/Data/vbpq/Airvariable_ldoc_vnHe%20so%20phat%20thai.pdf

Data of power plants in the Vietnam national grid in 2006, 2007 and 2008

Table 1: Data for calculating of $EF_{grid, OM, 2006}$

Power Plant	Total electrictiy generation supply to the grid (MWh)	Main fuel consumed						Fuel included						Volume of emissions
		Type of fuel	Fuel consumption	Net calorific values		Emission factor of fuel		Type of fuel	Fuel consumption	Net calorific values		Emission factor of fuel		
			Coal, DO, FO: kt; Gas: mill.m3	Coal, DO, FO: kCal/kg; Gas: MJ/m3	Coal, DO, FO: GJ/kt; Gas: GJ/mill.m3	kg CO2/TJ	tCO2/GJ		Coal, DO, FO: kt; Gas: mill.m3	Coal, DO, FO: kCal/kg; Gas: MJ/m3	Coal, DO, FO: GJ/kt; Gas: GJ/mill.m3	kg CO2/TJ	tCO2/GJ	t CO2
A	B	C	D	E	Coal, DO, FO: F=E*4.1868 Gas: F=E*1000	G	H= G/10^6	I	J	K	L=K*4.1868	M	N= M/10^6	O=D*F* H+J*L*N
Coal fired														
Phả Lại 1	2,462,209	Coal	1,717	4,953	20,737	98,300	0.0983	FO	7.62	9,800	41,031	77400	0.0774	3,524,257
Phả Lại 2	3,696,205	Coal	1,951	5,039	21,097	98,300	0.0983	FO	3.76	9,800	41,031	77400	0.0774	4,058,045
Uông Bí	766,634	Coal	554	5,258	22,014	98,300	0.0983	FO	1.52	10,097	42,273	77400	0.0774	1,203,127
Uông Bí 2	0	Coal	0	0	0	98,300	0.0983	FO	0.00	0	0	77400	0.0774	0
Ninh Bình	721,277	Coal	440	5,421	22,697	98,300	0.0983	FO	0.09	10,376	43,442	77400	0.0774	982,282
Na Dương	641,510	Coal	514	4,006	16,770	98,300	0.0983	FO	0.35	7,496	31,386	77400	0.0774	848,198
Cao Ngạn	0	Coal	0	0	0	98,300	0.0983	FO	0.00	0	0	77400	0.0774	0
Formosa	701,395	OtherBituminousCoal	470	6,483	27,143	94,600	0.0946	FO	0.23	9,810	41,073	77400	0.0774	1,207,702
Gas Turbine														
Gas-Turbine-Gas														
Bà Rịa	1,308,583	Gas	436.24	34.85	34,850	56,100	0.0561	-		0	0	0	0	852,889
Phú Mỹ	10,073,917	Gas	2,432.92	37.17	37,173	56,100	0.0561	-		0	0	0	0	5,073,624
		Gas	523.22	38.80	38,797	56,100	0.0561	-		0	0	0	0	1,138,792

Phú Mỹ 3	2,531,004	Gas	703.82	38.75	38,750	56,100	0.0561	-		0	0	0	0	1,530,021
Nhơn Trạch	0	Gas	0.00	0.00	0	56,100	0.0561	-		0	0	0	0	0
Cà Mau 1&2	0	Gas	0.00	0.00	0	56,100	0.0561	DO	0	0	0	74100	0.0741	0
Phú Mỹ 2.2	4,838,810	Gas	1,354.87	38.75	38,750	56,100	0.0561	-		0	0	0	0	2,945,311
VÊ ĐAN	47,894	Gas	236.67	42.80	42,800	56,100	0.0561	FO	1.09	9,665	40,465	77400	0.0774	571,687
Đạm Phú Mỹ	38,556	Gas	55.49	42.50	42,500	56,100	0.0561	-						132,307
Gas-Turbine-Oil														
Bà Rịa	13,958	DO	4	10,300	43,124	74,100	0.0741	-			0	0	0	14,188
Phú Mỹ	67,721	DO	18	10,895	45,615	74,100	0.0741	-			0	0	0	61,889
Phú Mỹ 3	12,615	DO	3	10,255	42,936	74,100	0.0741	-			0	0	0	10,583
Phú Mỹ 2.2	0	DO	0	0	0	74,100	0.0741	-			0	0	0	0
CẦN THƠ	106,998	DO	33	10,860	45,469	74,100	0.0741	-			0	0	0	112,583
THỦ ĐỨC	32,290	DO	11	10,800	45,217	74,100	0.0741	-			0	0	0	35,684
Steam tail														
Bà Rịa	660,965	Đuôi hơi			0	0	0	-			0	0	0	0
Phú Mỹ	5,336,388	Đuôi hơi			0	0	0	-			0	0	0	0
Phú Mỹ 3	1,473,329	Đuôi hơi			0	0	0	-			0	0	0	0
Nhơn Trạch	0	Đuôi hơi			0	0	0	-			0	0	0	0
Cà Mau 1&2	0	Đuôi hơi			0	0	0	-			0	0	0	0
Phú Mỹ 2.2	0	Đuôi hơi			0	0	0	-			0	0	0	0
Oil-fired														
HIỆP PHƯỚC	453,303	FO	229	10,220	42,789	77,400	0.0774	DO	0.011	10,150	42,496	74100	0.0741	758,788
CẦN THƠ	118,748	FO	36	10,226	42,814	77,400	0.0774	DO	1.9693	10,860	45,469	74100	0.0741	126,004
THỦ ĐỨC	471,940	FO	133	10,300	43,124	77,400	0.0774	DO	0.132	10,800	45,217	74100	0.0741	442,801
Diesel FO														
CÁI LÂN - VINASHIN	0	FO	0	0	0	77,400	0.0774	-			0	0	0	0
AMATA	80,000	FO	16.60	9,600	40,193	77,400	0.0774	-			0	0	0	51,642

Diesel DO														
NM điện Đồng Khởi (Bến Tre)	3,150	DO	0.81	10,700	44,799	74,100	0.0741	-			0	0	0	2,676
NM điện Diesel Cà Mau	3,123	DO	0.83	10,970	45,929	74,100	0.0741	-			0	0	0	2,834
NM điện Diesel An Giang	1,505	DO	0.39	10,305	43,145	74,100	0.0741	-			0	0	0	1,247
Điện lực Đồng Tháp	119	DO	0.03	10,320	43,208	74,100	0.0741	-			0	0	0	109
Điện lực Bình Thuận	6,372	DO	1.54	10,150	42,496	74,100	0.0741	-			0	0	0	4,843
Diesel khác	10,732	DO	2.79	10,150	42,496	74,100	0.0741	-			0	0	0	8,787
Import	**937,000**	-			0	0	0	-			0	0	0	0
Total generated electricity	MWh	37,618,249												
Total emissions	tCO2	25,702,898												
Emission factor	tCO2/MWh	0.683												

Table 2: Data for calculating of $EF_{grid, OM, 2007}$

Power Plant	Total electrictiy generation supply to the grid (MWh)	Main fuel consumed						Fuel included						Volume of emissions
		Type of fuel	Fuel consumption	Net calorific values		Emission factor of fuel		Type of fuel	Fuel consumption	Net calorific values		Emission factor of fuel		
			Coal, DO, FO: kt; Gas: mill.m3	Coal, DO, FO: kCal/kg; Gas: MJ/m3	Coal, DO, FO: GJ/kt; Gas: GJ/mill.m3	kg CO2/TJ	tCO2/GJ		Coal, DO, FO: kt; Gas: mill.m3	Coal, DO, FO: kCal/kg; Gas: MJ/m3	Coal, DO, FO: GJ/kt; Gas: GJ/mill.m3	kg CO2/TJ	tCO2/GJ	t CO2
A	B	C	D	E	Coal, DO, FO: F=E*4.1868 Gas: F=E*1000	G	H= G/10^6	I	J	K	L=K*4.1868	M	N= M/10^6	O=D*F*H +J*L*N
Coal-fired														
Phả Lại 1	2,501,097	Coal	1,728	4,946	20,708	98,300	0.0983	FO	6.59	9,800	41,031	77400	0.0774	3,538,411
Phả Lại 2	3,804,635	Coal	2,054	5,021	21,022	98,300	0.0983	FO	4.66	9,800	41,031	77400	0.0774	4,259,288
Uông Bí	705,778	Coal	526	5,210	21,813	98,300	0.0983	FO	1.74	11,975	50,137	77400	0.0774	1,133,997
Uông Bí 2	520,000	Coal	281	5,021	21,022	98,300	0.0983	FO	0.64	11,975	50,137	77400	0.0774	582,589
Ninh Bình	652,464	Coal	412	5,286	22,131	98,300	0.0983	FO	0.10	10,376	43,442	77400	0.0774	895,616
Na Dương	660,520	Coal	546	4,076	17,067	98,300	0.0983	FO	0.17	9,973	41,754	77400	0.0774	916,604
Cao Ngạn	352,577	Coal	330	4,980	20,850	98,300	0.0983	FO	1.52	9,800	41,031	77400	0.0774	680,234
Formosa	639,334	OtherBituminousCoal	511	6,259	26,205	94,600	0.0946	FO	0.11	9,802	41,039	77400	0.0774	1,266,157
Gas Turbine														
Gas-Turbine-Gas														
Bà Rịa	1,244,018	Gas	416.89	34.85	34,850	56,100	0.0561	-		0	0	0	0	815,059
Phú Mỹ	10,700,737	Gas	3,040.39	36.99	36,988	56,100	0.0561	-		0	0	0	0	6,308,885
		Gas	99.85	38.49	38,486	56,100	0.0561	-		0	0	0	0	215,576
Phú Mỹ 3	2,393,620	Gas	665.69	38.56	38,560	56,100	0.0561	-		0	0	0	0	1,440,029
Nhơn Trạch	0	Gas	0.00	0.00	0	56,100	0.0561	-		0	0	0	0	0
Cà Mau 1&2	697,572	Gas	15.82	39.00	39,000	56,100	0.0561	DO	20.669	10,909	45,674	74100	0.0741	104,554

Phú Mỹ 2.2	4,942,360	Gas	1,383.86	38.56	38,560	56,100	0.0561	-		0	0	0	0	2,993,590
VÊ ĐAN	26,742	Gas	229.22	42.80	42,800	56,100	0.0561	FO	0.44	9,665	40,465	77400	0.0774	551,758
Đạm Phú Mỹ	18,542	Gas	59.23	42.50	42,500	56,100	0.0561	-			0	0	0	141,217
Gas-Turbine-Oil														
Bà Rịa	80,828	DO	25.33	10,300	43,124	74,100	0.0741	-			0	0	0	80,957
Phú Mỹ	240,652	DO	64.92	10,895	45,615	74,100	0.0741	-			0	0	0	219,435
Phú Mỹ 3	17,278	DO	4.50	10,244	42,890	74,100	0.0741	-			0	0	0	14,317
Phú Mỹ 2.2	0	DO	0.00	0	0	74,100	0.0741	-			0	0	0	0
CẦN THƠ	148,862	DO	45.10	10,880	45,552	74,100	0.0741	-			0	0	0	152,247
THỦ ĐỨC	70,260	DO	23.41	10,800	45,217	74,100	0.0741	-			0	0	0	78,438
Steam tail														
Bà Rịa	618,330	Đuôi hơi			0	0	0	-			0	0	0	0
Phú Mỹ	5,986,285	Đuôi hơi			0	0	0	-			0	0	0	0
Phú Mỹ 3	1,377,820	Đuôi hơi			0	0	0	-			0	0	0	0
Nhơn Trạch	0	Đuôi hơi			0	0	0	-			0	0	0	0
Cà Mau 1&2	911,012	Đuôi hơi			0	0	0	-			0	0	0	0
Phú Mỹ 2.2	0	Đuôi hơi			0	0	0	-			0	0	0	0
Oil-fired														
HIỆP PHƯỚC	1,102,498	FO	410	10,196	42,690	77,400	0.0774	DO	0.018	10,150	42,496	74100	0.0741	1,355,716
CẦN THƠ	128,641	FO	38	10,215	42,768	77,400	0.0774	DO	3.1779	10,880	45,552	74100	0.0741	136,341
THỦ ĐỨC	603,270	FO	166	10,300	43,124	77,400	0.0774	DO	0.24	10,800	45,217	74100	0.0741	554,312
Diesel FO														
CÁI LÂN - VINASHIN	104,626	FO	25.15	9,800	41,031	77,400	0.0774	-			0	0	0	79,867
AMATA	0	FO	0.00	9,600	40,193	77,400	0.0774	-			0	0	0	0
Diesel DO														
NM điện Đồng Khởi (Bến Tre)	4,483.00	DO	1.14	10,700	44,799	74,100	0.0741	-			0	0	0	3,794
NM điện	6,820.60	DO	0.18	10,870	45,511	74,100	0.0741	-			0	0	0	600

Diesel Cà Mau														
NM điện Diesel An Giang	1,628.51	DO	0.42	10,305	43,145	74,100	0.0741	-			0	0	0	1,343
Điện lực Đồng Tháp	272.26	DO	0.08	10,320	43,208	74,100	0.0741	-			0	0	0	248
Điện lực Bình Thuận	7,246.00	DO	1.73	10,150	42,496	74,100	0.0741	-			0	0	0	5,460
Diesel khác	21,549.63	DO	5.60	10,150	42,496	74,100	0.0741	-			0	0	0	17,643
Import	**2,629,000**	-			0	0	0	-			0	0	0	0

Total generated electricity	MWh	43,921,357
Total emissions	tCO2	28,544,283
Emission factor	tCO2/MWh	0.650

Table 3: Data for calculating of $EF_{grid, OM, 2008}$

Power Plant	Total electrictiy generation supply to the grid (MWh)	Main fuel consumed						Fuel included						Volume of emissions
		Type of fuel	Fuel consumption	Net calorific values		Emission factor of fuel		Type of fuel	Fuel consumption	Net calorific values		Emission factor of fuel		
			Coal, DO, FO: kt; Gas: mill.m3	Coal, DO, FO: kCal/kg; Gas: MJ/m3	Coal, DO, FO: GJ/kt; Gas: GJ/mill.m3	kg CO2/TJ	tCO2/GJ		Coal, DO, FO: kt; Gas: mill.m3	Coal, DO, FO: kCal/kg; Gas: MJ/m3	Coal, DO, FO: GJ/kt; Gas: GJ/mill.m3	kg CO2/TJ	tCO2/GJ	t CO2
A	B	C	D	E	Coal, DO, FO: F=E*4.1868 Gas: F=E*1000	G	H= G/10^6	I	J	K	L=K*4.1868	M	N= M/10^6	O=D*F*H +J*L*N
Coal-fired														
Phả Lại 1	2,299,120	Coal	1,621	4,788	20,046	98,300	0.0983	FO	7.66	9,800	41,031	77400	0.0774	3,218,609
Phả Lại 2	3,929,218	Coal	2,081	4,995	20,913	98,300	0.0983	FO	4.05	9,800	41,031	77400	0.0774	4,290,874
Uông Bí	722,766	Coal	515	5,216	21,838	98,300	0.0983	FO	1.13	10,087	42,231	77400	0.0774	1,109,945
Uông Bí 2	532,000	Coal	282	4,995	20,913	98,300	0.0983	FO	0.55	10,087	42,231	77400	0.0774	581,018
Ninh Bình	675,372	Coal	431	5,191	21,734	98,300	0.0983	FO	0.16	10,376	43,442	77400	0.0774	922,073
Na Dương	627,930	Coal	532	4,034	16,889	98,300	0.0983	FO	0.20	9,923	41,545	77400	0.0774	883,846
Cao Ngạn	708,693	Coal	526	4,980	20,850	98,300	0.0983	FO	0.75	9,800	41,031	77400	0.0774	1,081,145
Formosa	560,295	OtherBituminousCoal	495	6,579	27,545	94,600	0.0946	FO	0.28	9,808	41,064	77400	0.0774	1,291,302
Gas Turbine														
Gas-Turbine-Gas														
Bà Rịa	1,331,905	Gas	450.37	34.85	34,850	56,100	0.0561	-		0	0	0	0	880,515
Phú Mỹ	11,085,997	Gas	3,193.95	36.99	36,991	56,100	0.0561	-		0	0	0	0	6,628,061
		Gas	72.54	38.18	38,184	56,100	0.0561	-		0	0	0	0	155,387
Phú Mỹ 3	3,167,237	Gas	883.26	38.59	38,590	56,100	0.0561	-		0	0	0	0	1,912,160
Nhơn Trạch	544,809	Gas	166.38	40.50	40,500	56,100	0.0561	-		0	0	0	0	378,023

Cà Mau 1&2	2,106,807	Gas	647.24	39.00	39,000	56,100	0.0561	DO	4.417	10,909	45,674	74100	0.0741	1,431,048
Phú Mỹ 2.2	4,141,980	Gas	1,159.75	38.59	38,590	56,100	0.0561	-		0	0	0	0	2,510,751
VÊ ĐAN	12,780	Gas	209.48	42.80	42,800	56,100	0.0561	FO	0.79	9,665	40,465	77400	0.0774	505,453
Đạm Phú Mỹ	4,716	Gas	56.15	42.50	42,500	56,100	0.0561	-			0	0	0	133,868
Gas-Turbine-Oil														
Bà Rịa	34,460	DO	10.64	10,300	43,124	74,100	0.0741	-			0	0	0	34,014
Phú Mỹ	69,324	DO	18.69	10,895	45,615	74,100	0.0741	-			0	0	0	63,174
Phú Mỹ 3	0	DO	0.00	10,246	42,898	74,100	0.0741	-			0	0	0	0
Phú Mỹ 2.2	0	DO	0.00	0	0	74,100	0.0741	-			0	0	0	0
CẦN THƠ	62,274	DO	19.39	10,890	45,594	74,100	0.0741	-			0	0	0	65,515
THỦ ĐỨC	17,030	DO	5.62	10,800	45,217	74,100	0.0741	-			0	0	0	18,830
Steam tail														
Bà Rịa	658,459	Steam Tail			0	0	0	-			0	0	0	0
Phú Mỹ	6,037,037	Steam Tail			0	0	0	-			0	0	0	0
Phú Mỹ 3	1,853,448	Steam Tail			0	0	0	-			0	0	0	0
Nhơn Trạch	0	Steam Tail			0	0	0	-			0	0	0	0
Cà Mau 1&2	2,728,872	Steam Tail			0	0	0	-			0	0	0	0
Phú Mỹ 2.2	0	Steam Tail			0	0	0	-			0	0	0	0
Oil-fired														
HIỆP PHƯỚC	877,631	FO	366	10,195	42,685	77,400	0.0774	DO	0.019	10,150	42,496	74100	0.0741	1,209,684
CẦN THƠ	66,709	FO	20	10,220	42,789	77,400	0.0774	DO	3.7286	10,890	45,594	74100	0.0741	78,681
THỦ ĐỨC	537,540	FO	149	10,300	43,124	77,400	0.0774	DO	0.228	10,800	45,217	74100	0.0741	496,461
Diesel FO														
CÁI LÂN - VINASHIN	90,465	FO	22.48	9,800	41,031	77,400	0.0774	-			0	0	0	71,385
AMATA	0	FO	0.00	9,600	40,193	77,400	0.0774	-			0	0	0	0
Diesel DO														

NM điện Đồng Khởi (Bến Tre)	860.00	DO	0.22	10,700	44,799	74,100	0.0741	-			0	0	0	734
NM điện Diesel Cà Mau	1,273.50	DO	0.33	10,940	45,804	74,100	0.0741	-			0	0	0	1,118
NM điện Diesel An Giang	252.86	DO	0.07	10,305	43,145	74,100	0.0741	-			0	0	0	224
Điện lực Đồng Tháp	51.25	DO	0.01	10,320	43,208	74,100	0.0741	-			0	0	0	46
Điện lực Bình Thuận	7,575.00	DO	1.80	10,150	42,496	74,100	0.0741	-			0	0	0	5,675
Diesel khác	4,987.39	DO	1.30	10,150	42,496	74,100	0.0741	-			0	0	0	4,083
Import	**3,220,000**	-			0	0	0	-			0	0	0	0

Total generated electricity	MWh	48,719,874
Total emissions	tCO2	29,963,699
Emission factor	tCO2/MWh	0.615

Table 4: Data for calculating of $EF_{grid, BM, 2008}$

Total domestic electricity generation of Vietnam Grid in 2008	**74,689,635.97**	**MWh**
20% of domestic electricity generation of Vietnam Grid in 2008	**14,937,927.19**	**MWh**

Power Plant	Commission year	Grid-connected out put (MWh)	Main fuel						Included fuel						Volume of emissions	
			Type of Fuel	Fuel consumed	Net calorific value		Emission factor of fuel		Type of Fuel	Fuel consumed	Net calorific value		Emission factor of fuel			
				Coal, DO, FO: kt; Gas: mill.m3	Coal, DO, FO: kCal/kg; Gas: MJ/m3	Coal, DO, FO: GJ/kt; Gas: GJ/mill.m3	kg CO2/TJ	tCO2/GJ		Coal, DO, FO: kt; Gas: mill.m3	Coal, DO, FO: kCal/kg; Gas: MJ/m3	Coal, DO, FO: GJ/kt; Gas: GJ/mill.m3	kg CO2/TJ	tCO2/GJ	t CO2
A	B	C	D	E	F	Coal, DO, FO: G=F*4.1868 Gas: G=F*1000	H	I= H/10^6	J	K	L	M=L*4.1868	N	O= N/10^6	P=E*G*I +K*M*O	
5 most recently power plants																
A Vương	2008	168,103.50	Hydropower													
Tuyên Quang	2008	1,136,112.18	Hydropower													
Đại Ninh	2008	1,145,108.50	Hydropower													
Nhơn Trạch	2008	544,808.60	Gas	166.38	40.50	40,500	56100	0.0561	-		0	0	0	0	378,023	
Cà Mau 1&2	2007	2,106,807.24	Gas	647.24	39.00	39,000	56100	0.0561	DO	4.417	10,909	45,674	74100	0.0741	1,431,048	
		2,728,872.00	Steam tail													
Total		**7,829,812.02**														
Most recently power plant capacity additions in the electricity system that comprise 20%																
A Vương	2008	168,103.50	Hydropower													
SROC Phu Mieng IDICO	2006	241,556.00	Hydropower													
SÊ SAN 3A	2006	394,895.70	Hydropower													
Tuyên Quang	2008	1,136,112.18	Hydropower													

Đại Ninh	2008	1,145,108.50	Hydropower												
SÊ SAN 3	2006	1,131,614.00	Hydropower												
Quảng Trị	2007	250,804.40	Hydropower												
Uông Bí 2	2007	532,000.00	Coal	281.759	4995	20,913	98300	0.0983	FO	*0.548*	*10,087*	42,231	77400	0.0774	581,018
Na Dương	2005	627,930.00	Coal	532	4,034	16,889	98300	0.0983	FO	0.20	9,923	41,545	77400	0.0774	883,846
Cao Ngạn	2007	708,693.00	Coal	526	4,980	20,850	98300	0.0983	FO	0.75	9,800	41,031	77400	0.0774	1,081,145
Formosa	2004	560,295.00	OtherBituminousCoal	495	6,579	27,545	94600	0.0946	FO	0.28	9,808	41,064	77400	0.0774	1,291,302
Nhơn Trạch	2008	544,808.60	Gas	166.38	40.50	40,500	56100	0.0561	-		0	0	0	0	378,023
Cà Mau 1&2	2007	2,106,807.24	Gas	647.24	39.00	39,000	56100	0.0561	DO	4.417	10,909	45,674	74100	0.0741	1,431,048
		2,728,872.00	Steam tail												
Phú Mỹ 2.2	2004	4,141,980.00	Gas	1,159.75	38.59	38,590	56100	0.0561	-		0	0	0	0	2,510,751
Đạm Phú Mỹ	2006	4,716.00	Gas	56.15	42.50	42,500	56100	0.0561	-			0	0	0	133,868
CÁI LÂN - VINASHIN	2007	90,465.01	FO	22.48	9,800	41,031	77400	0.0774	-			0	0	0	71,385
Total		**16,514,761.12**													**8,362,386**

Total generated electricity	MWh	16,514,761.12
Total emissions	tCO2	8,362,386.08
Emission factor	tCO2/MWh	0.5064

Table 5: CO_2 emission factor according to IPCC

Fuel Type	Default Carbon Content (kg/GJ)	Default Carbon Oxidation Factor	Emission factor CO2 (kg/TJ)		
			Default Value	95% Confidence interval	
				Lower	Upper
Gas/Diesel DO	20.2	1	74,100	72,600	74,800
Fuel FO	21.1	1	77,400	75,500	78,800
Anthracite Coal	26.8	1	98,300	94,600	101,000
Bitum Coal types	25.8	1	94,600	89,500	99,700
Natural Gas	15.3	1	56,100	54,300	58,300

Annex 4

MONITORING INFORMATION

A. Description of technical equipment

The metering system will be installed at the transformer station (as the connected point). The metering system includes the main system and a back-up system with allowed accuracy[23] of "±0.5". The meter type used is an electronic 3 phase.

Details on the technical equipment can be found in the hard copy document "Technical explanation for metering system" as developed by the project proponent and approved by EVN. The document will be completed by the technical consultant and it will be available in the first crediting period and before signing PPA.

B. Monitoring organization

The structure of the monitoring group is as follows:

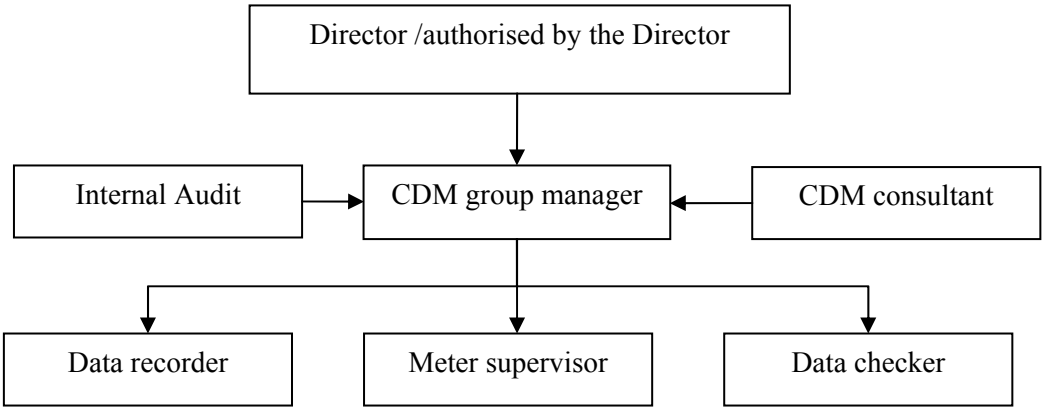

Figure 1: Structure of the monitoring group

The responsibilities of each person involved are elaborated as follows:

Group members and their responsibilities

Person	Responsibility
Director /authorised by the Director	Check and sign the monitoring report annually
CDM group manager	Managing the whole CDM business of the power plant, guiding and supervising data recorder after trained by CDM consultant.
CDM consultant	Providing CDM group manager training and technical support about CDM monitoring plan.
Internal auditor	Check the monitoring procedure at least once in a year

[23] Circular No. 27/2009/TT-BCT dated 25 September 2009 regulating on electricity metering in the competitive power generation market issued by Ministry of Industry and Trade

Data recorder	Collecting and recording data every month.
Meter supervisor	Checking power meter periodically according to relevant regulation.
Data checker	Double checking the collected data measured by power meter.

C. Monitoring procedure

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:

(1) The electricity supplied by the project to the grid will be automatically monitored by the two meter systems (main and backup). The data is measured continuously;

(2) Persons in charge of data record and meter supervisor from the power plant together with staff from EVN shall read and collect data from main power meters and backup power meters at the end of every month, the result or the joint balance sheet will be signed by both parties and kept respectively;

(3) The power plant provides electricity sales invoice to EVN, and keeps the copy of invoice;

(4) The power plant provides the record of main, backup power meters and copy of invoices to the verifier of DOE;

(5) The company shall hire the assigned third party for measuring the surface area of reservoir at the normal water level yearly.

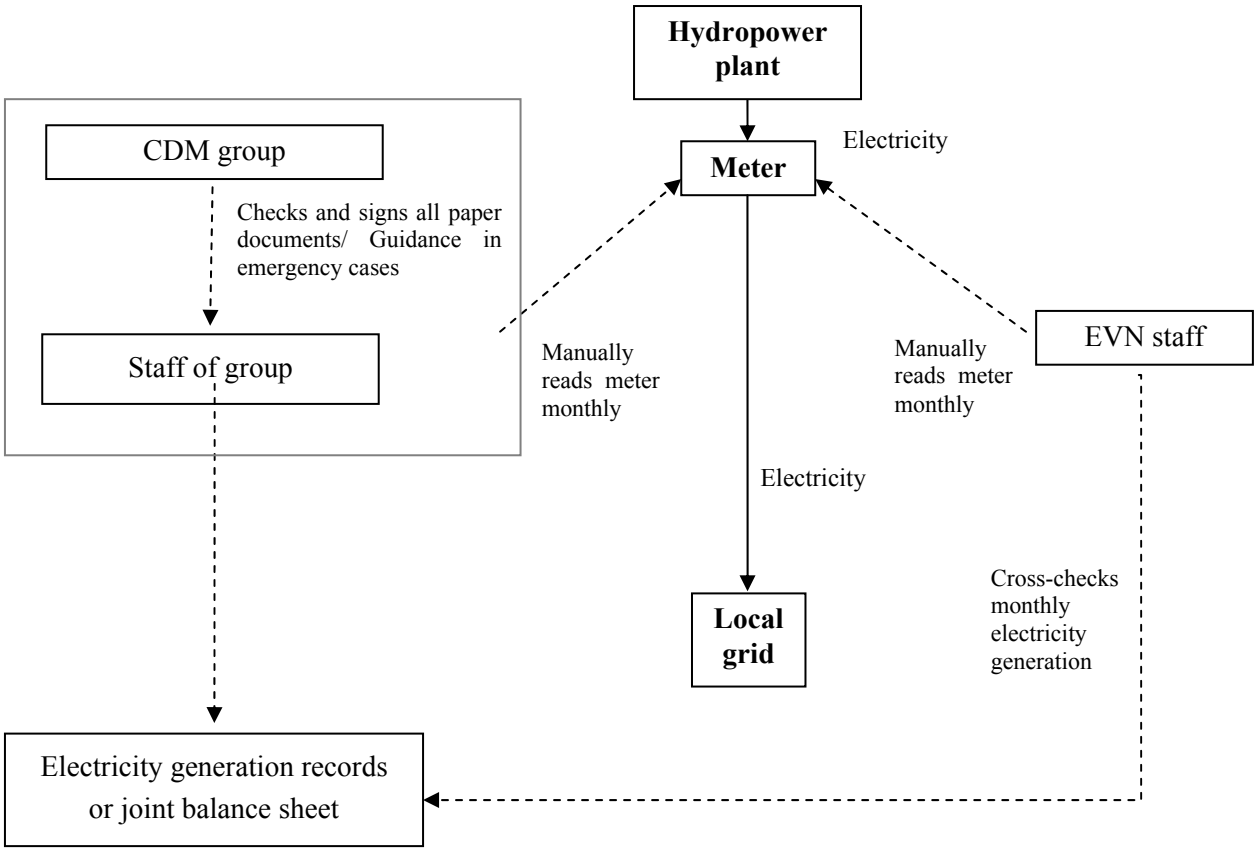

Figure 2: Monitoring process

D. Calibration of metering equipment

The meters will be calibrated and verifiedpursuant to national standard. According to the Decision No 65/2002/QD-BKHCNMT[24], calibration and verification for 3 phase meters need to be conducted every two yearby the third party once during project operation. After every calibration,the meters will be sealed so that no illegal interference is possible

E. Data recording and archiving procedures

- The CDM group appointed by the power plant shall keep monitored data in electronic archives at the end of every month. Paper documents should be stored in electronic format and copied by CD. Electronic documents should be printed out and kept.
- The power plant shall keep the copy of electricity sales/purchase invoices (the original electricity sales/purchase invoices shall be kept by the project owner).
- In order to help verifiers obtain documents and information related to the emission reduction of the proposed project, the project owner shall prepare an index of the data documents and monitoring report.
- All the data and information in the form of paper documents shall be archived by the CDM group, with at least one copy backup for each datum.
- All the data shall be kept for 2 years after the crediting period.

F. Emergency procedures

In case of any unforeseen event that is not covered under this monitoring plan, staff of the CDM group shall inform the manager and the director. The manager and director are then responsible to ensure that the cause for the unforeseen event is detected, the event is remedied and for the period of time in which the unforeseen event has occurred uncertainty in data gathered is limited as much as possible.

In the case the error of main meter exceeds allowed level the backup meter will be used to measure output of electricity exporting to grid.

G. Training

Before the start of the crediting period, VNEEC will in close collaboration with the chief of the operation division of the power plant develop a training manual and training course for the staff of the operation division that will clearly lay out rules and procedures for all activities related to metering, data recording and processing, data archiving and preparation of monitoring reports.

[24] Decision No 65/2002/QD-BKHCNMT[24] issued by the Minister of Scientific, Technology and Environment on 19 August 2002 to promulgate "The list of meter equipment must be calibrated and verified and the verification procedures".