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: Ban Coc Hydropower Project

Version: 01

Date: 11/01/2010

A.2. Description of the project activity:

The project activity involves the construction of a dam, intakes, tunnels, pressurized wells, penstocks, power house with 3 units (each unit has a turbine and a power generator) and discharge channels located in Chau Kim commune, Que Phong district, Nghe An province, Vietnam.

Prior to the implementation of the project activity, there is no power generation existing at the project location. Electricity supplied in Vietnam is generated mainly from fossil fuel sources and is solely distributed to consumers via the unique national electricity grid.

The project's purpose is to generate hydroelectricity from a clean and renewable source (hydropower of the Nam Giai stream) to supply to the national grid via a Power Purchase Agreement (PPA) signed with the Electricity Corporation of Vietnam (EVN). The project's installed capacity and estimated annual gross power generation is 18 MW and 75,470 MWh[1], respectively. The net electricity generated (with an estimated annual volume of 74,715 MWh[2]) will be supplied to the national grid via a newly constructed 35kV transmission line which connects between Ban Coc hydropower plant and 35/110kV Truong Banh transformer station.

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 activity will generate renewable power with negligible GHG emissions, which will displace part of the electricity otherwise supplied by fossil fuel fired power plants. The project involves construction of a reservoir with an area of 21 ha[3] and power density of 85.7 W/m^2, accordingly. As the power density of this project is above 10 W/m^2, no GHG emissions from the reservoir need to be accounted in the project activity. Thus, GHG emission reductions can be achieved via this proposed project activity. Total expected CO_2 emission reduction is 280,070 tCO_2 over the first crediting period of 7 years.

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, Vietnam, especially the North Central of Vietnam, has suffered a critical electricity shortage as a consequence from 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 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.

[1] Feasibility Study Report of Ban Coc Hydropower plant
[2] The gross power generation subtracts 1% for parasitic and loss load
[3] Feasibility Study Report of Ban Coc Hydropower plant

- Reducing reliance on exhaustible fossil fuel based power sources and also reducing the import of fuels for the purpose of power generation.
- 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 Vietnam.

Contributions towards local sustainable development:

a) Economic well-being

Once commissioning, this proposed project will increase the industrial share in the economic structure of Nghe An province – a poor mountainous province in the North Central of Vietnam. This proposed project will pay annual enterprise's revenue tax and CER tax to the state budget.

By supplying a stable electricity output, this project will facilitate the industrialisation process of the province and support economic development of local villages through fostering tourism, trade and services inside the province.

b) Social well-being

This project will contribute directly to improve the low-quality infrastructure systems of the Chau Kim commune, where almost only minority ethnics settle. The communes are categorised as mountainous communes with thin population, less developed and autarky agricultural economy. The project will upgrade roads access to the project site and construct a new 35 kV transmission line together with a hydropower plant, which will contribute to reduce electricity losses and improve the electricity quality supplied in the region.

The majority of local residents living in the project area are from the ethnic minorities like Thai and Kho Mu. They usually live in less favourable living conditions than those of Kinh ethnic – the majority of population in Vietnam. Thus, the project will contribute to improve their living standard that will fill the gap in development between different ethnic groups in Vietnam.

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 that it is consistent with the energy policies set by the Government[4] of Vietnam. Therefore, it satisfies the sustainable development criteria for CDM projects set by the DNA of Vietnam.

[4] To encourage the investment in exploitation of renewable energy resources in Vietnam, the project "Strategies and master plans for renewable energy in Vietnam for the period up to 2015 with the perspectives up to 2025" is being implemented by the Ministry of Trade and Industry since 2007

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)
Vietnam (host)	Que Phong Hydropower Joint Stock Company	No
Vietnam (host)	Energy and Environment Consultancy Company Limited	No
Kingdom of Sweden	Nordic Environment Finance Corporation NEFCO in its capacity as Fund Manager to the NEFCO Carbon Fund (NeCF)	No
(*) 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, in conjunction with the Nordic Investment Bank (NIB).

The NEFCO Carbon Fund (NeCF) was established as a Public Private Partnership in April 2008, to provide financial assistance to concrete 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, the Industrialisation Fund for Developing Countries (Denmark), Ministries of Environment and Foreign Affairs of Finland, Etelä-Pohjanmaan Voima Oy (Finland), Kymppivoima Oy (Finland), the Norwegian Finance Ministry and NEFCO itself.

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.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Socialist Republic of Viet Nam

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

Nghe An province

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

Chau Kim commune, Que Phong district

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

The proposed project activity involves the construction of Ban Coc hydropower plant which is located on the Nam Giai stream, which is the first branch of the Hieu river. This project has co-ordinates as follows:

Northern latitude: $19^0$37'00''

Eastern longitude: $104^0$52'00''

The site of the project is showed in Figure 1.

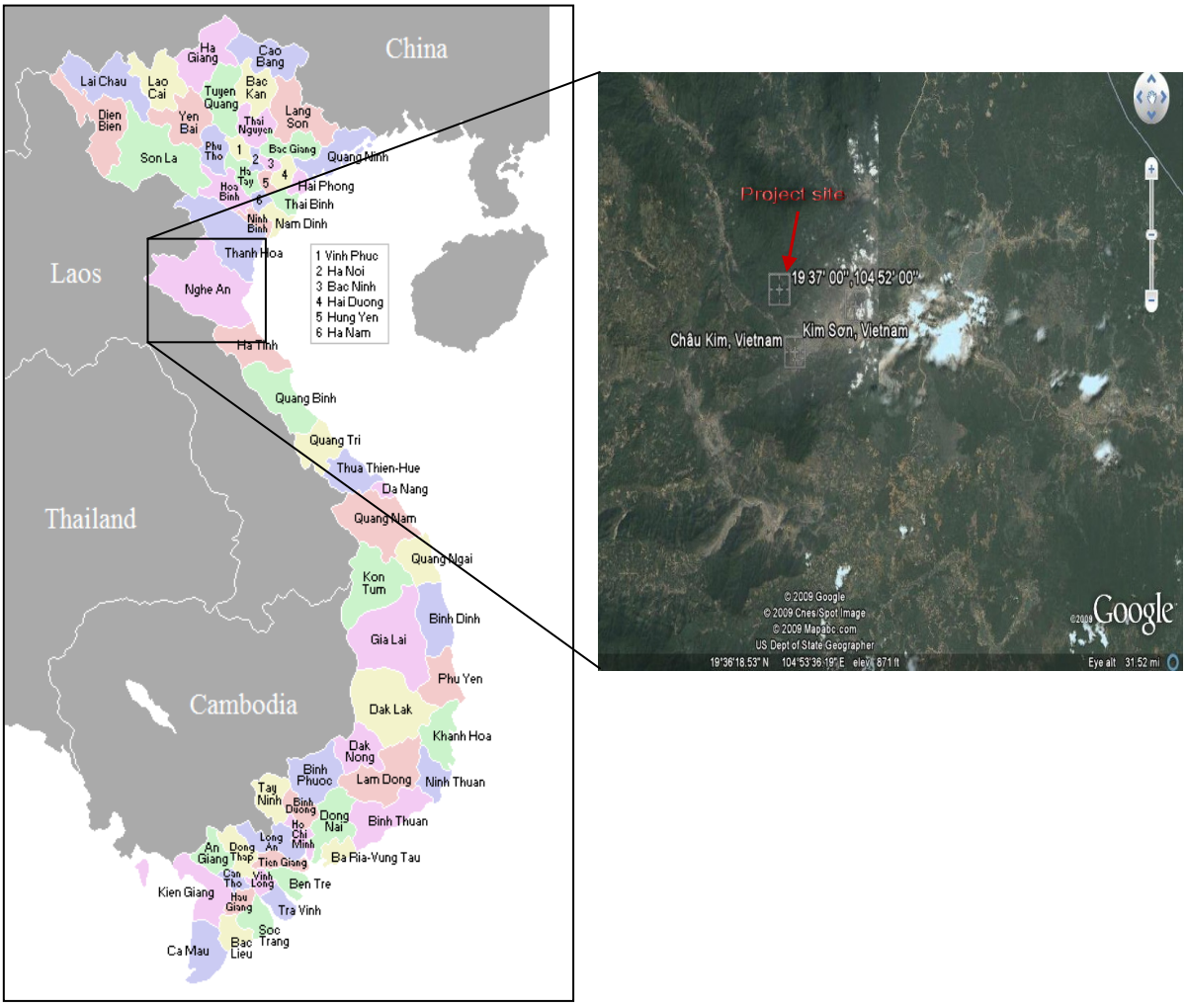

Figure 1: Map of the location of the project activity

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

Sectoral scope/ Category: 1: Energy industries (renewable sources)

Grid-connected electricity generation from renewable sources

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

Prior to the implementation of the proposed project, electricity supplied to the national grid is generated by the operation of grid-connected power plants. Electricity in Vietnam is generated mainly by firing coal, oil or gas (for more information see Annex 3) and is solely distributed via the unique national electricity grid. All fuel fired power plants connected to the national grid using boiler rooms, steam heating boilers and steam turbines to generate electricity. In that technology cycle, GHGs are generated. Since hydro power generation technology is a renewable electricity generation technology which displaces fossil fuel fired power generation technology to supply electricity to the grid, the implementation of this project activity will generate emission reductions.

The project activity involves the construction of a dam, canal intakes, tunnels, pressurized wells, penstocks, power house with 3 units and discharge channels in order to convert potential flowing energy from the Nam Giai stream into clean electrical energy, which will be supplied to the national grid at the connection point through a 35kV transmission line. At the connection point, the power meter systems will be installed. They are digital and bi-directional type to measure the export from and import electricity to Ban Coc Hydropower plant. It also involves the construction of a reservoir with a power density about 85.7 W/m^2 that is above the 10.00 W/m^2 threshold established in Version 10 of ACM0002. Accordingly, GHG emissions from the reservoir need not to be accounted under this the project activity.

At the connection point, the power meter systems will be installed. They are digital and bi-directional type to measure the export and import electricity of Ban Coc hydropower plant

Figure 2 shows the layout of the project.

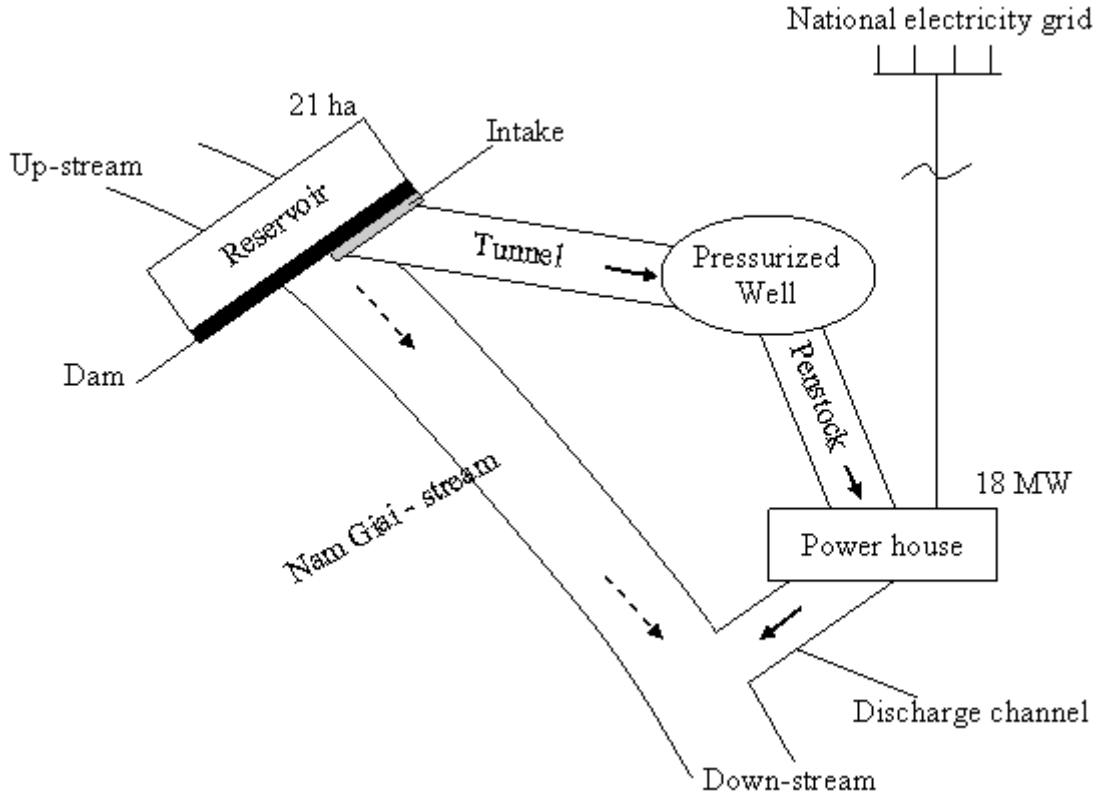

Figure 2: Ban Coc hydropower plant's lay-out

The main technical parameters of the Ban Coc Hydropower Project are shown in Table below

Table 1: Main technical parameters of the proposed project activity[5]

Main parameters	Units	Values
1. Turbine		
• Type		HL100A-LJ-120 Francis with vertical shaft
• Diameter of runner	m	1.235
• Rated net head	m	187
• Number of turbine	set	3
• Assured runoff	m^3/s	3.71
• Capacity	MW	6.289
• Speed	r/min	750
• Expected lifetime[6]	hour	150,000
2. Generator		
• Number	set	3
• Type		Synchronous, 3 phases, vertical axis
• Rated voltage	kV	6.3

[5] The Supplied Equipment Contract signed on 22 Feb 2006

[6] The default lifetime in the EB 50, Annex 15

• Efficiency	%	95.4
• Expected lifetime[7]	year	30
3. Transformer		
• Number	set	1
• Type		3 phases, 2 windings
• Rated capacity	MVA	25
• Primary voltage	kV	6.3
• Secondary voltage	kV	38.5
• Expected lifetime[8]	year	30
4. *Annual river flow*	m^3/s	9.08

The main equipment utilized in Ban Coc Hydropower plant is imported. The contract for "supply of materials, equipment and technical services" dated 22 February 2006 to supply mechanical equipment and technical service package for Ban Coc Hydropower plant was signed with Equipment and Machine Import-Export Company, China. The supplier was chosen via tender.

The project owner will incorporate with equipment supplier – China Equipment and Machine Import-Export Company to provide technical service such as training courses for the operation of Ban Coc hydropower plant

The baseline scenario of this project activity is identical to the existing scenario mentioned above.

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. A seven-year crediting period, renewable twice up to a total of 21 years will be applied for the proposed project. The estimated emission reductions for the first crediting period are presented in Table below.

Table 2: Emission reduction of the proposed project during the first crediting period

Years	Annual estimation of emission reductions in tonnes of CO_2 e
2010 (Jul to Dec)	20,005
2011	40,010
2012	40,010
2013	40,010
2014	40,010
2015	40,010
2016	40,010
2017 (Jan to Jun)	20,005
Total estimated reductions (tonnes of CO_2 e)	**280,070**
Total number of crediting years	**7**
Annual average over the crediting period of estimated reductions (tonnes of CO_2 e)	**40,010**

[7] The default lifetime in the EB 50, Annex 15
[8] The default lifetime in the EB 50, Annex 15

A.4.5. Public funding of the project activity:

No public funds from Annex I countries is involved in this 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 10 of ACM0002: "Consolidated baseline methodology for grid-connected electricity generation from renewable sources"

Related tools:

- Version 02 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 applicable to apply Version 10 of ACM0002. More details of the comparison of the project's characteristics and the applicability criteria as specified in, Version 10 of ACM0002 is given in Table below.

Table 3: Comparison of project's characteristics and eligibility criteria of Version 10 of ACM0002

Applicability conditions in version 10 of ACM0002	Characteristics of the project activity	Applicability criterion met?
The project activity is the installation, capacity addition/ retrofit or replacement of a power plant/unit	The project activity is to install a new hydro power plant	Yes
The project activity results in new reservoirs and the power density of the power plant is greater than 4 W/m^2	The power density of the Ban Coc is 85.7 W/m^2	Yes
This methodology is not applicable to project activities that involve switching from fossil fuels to renewable energy at the site of the project activity	The project activities do not involve switching from fossil fuel to renewable energy sources since no fuel-fired power plant presents on the project site.	Yes
This methodology is not applicable to biomass fired power plants	The project activity is to install a new hydro 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 power density of the new reservoirs is 85.7 W/m^2	Yes

This comparison shows clearly that Version 10 of ACM0002 is applicable to the proposed project activity.

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

According to Version 10 of ACM0002, the spatial extent of the project boundary includes the Ban Coc hydro power plant 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.

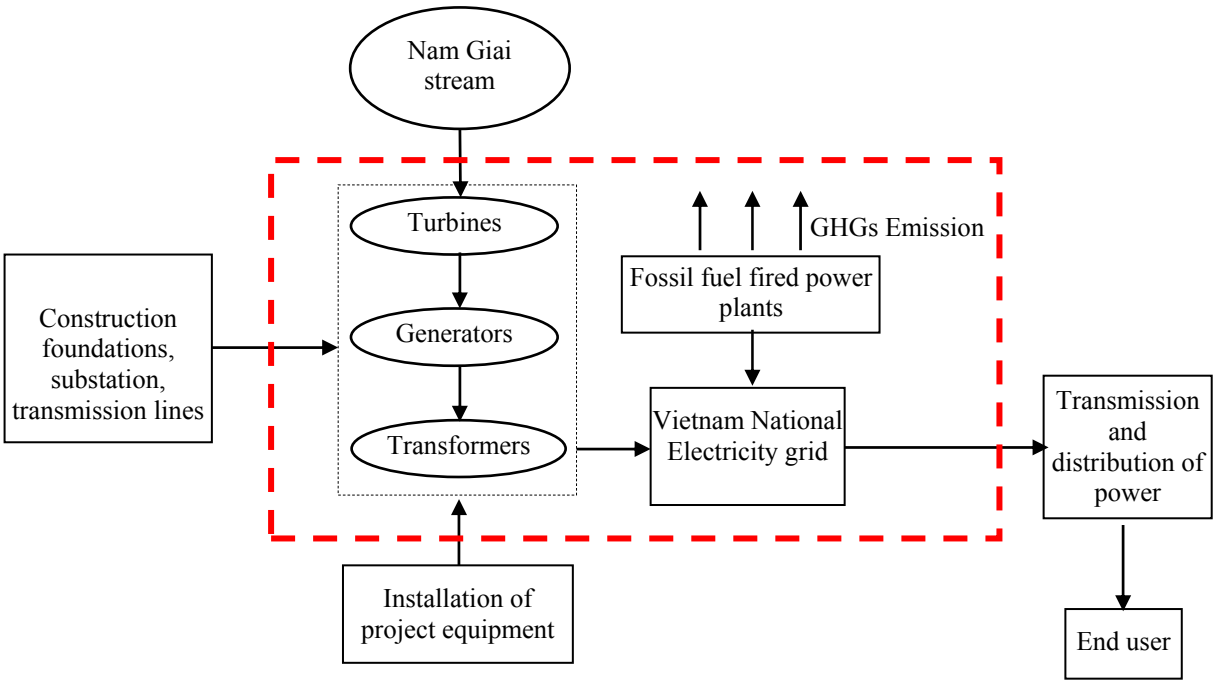

Figure 3: Project boundary

The GHGs and emission sources included in 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	For hydro power plants, emissions of CH_4 from the Reservoir	CO_2	No	Minor emission source
		CH_4	No	Main emission source. However, as the power density of the project is greater than 10 W/m^2 CH_4 emissions are neglected according to 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 10 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 Institute of Energy, EVN.

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):

According to Version 10 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* that would 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

Alternative 1 is theoretically technically feasible and complies with Vietnamese current laws and regulations because there is no law which prohibits it[9]. The project owner complies with all relevant laws and regulations when implementing this project by applying and obtaining all the licenses required for the implementation of the project like investment license, the approval of EIA report and an approval for

[9] It is proved by the issuance of the investment license for this proposed project because it can only be issued if the proposed project activity is allowed by the government.

compensation plan etc. This alternative is not enforced by the government or regulations because the Ban Coc Hydropower Project is an IPP (Independent Power Project) investment project which is not funded by the state budget.

Alternative 2 does not face with any barrier from the current law and regulation because it is the "do-nothing" alternative. The project owner has no obligation to build or invest in the power plant to supply electricity for the local area.

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, Option II is also not applicable as there are no other credible and realistic baseline scenario alternatives other than electricity supply from the grid. Thus, the benchmark analysis (Option III) is chosen to prove additionality.

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

In the following, Project IRR is used to demonstrate the Additionality of the project. Provided that the proposed project is financed by **both equity and loan** sources, the appropriate benchmark is WACC which represents the weighted average of the costs of various sources of financing in the financing structure. This benchmark represents the minimal required Project IRR of the project to be economically attractive.

The WACC benchmark is indicated in para 11, Annex: Guidance on Assessment of Investment Analysis, Annex 58, EB 51, "*Local lending rates or weighted average costs of capital (WACC) are appropriate benchmarks for a project IRR*". Thus the project participant applies the following WACC equation to estimate the *required return on capital* as a benchmark for this project IRR:

$$WACC = \frac{E}{V} * \mathrm{R_e} + \frac{D}{V} * \mathrm{R}_d * (1 - T_c) \quad (1)$$

Where:

R_e : cost of equity

R_d : cost of debt

E : Amount of equity in the project

D : Amount of debt in the project

V : Total investment cost (=E + D)

T_c : average enterprise tax rate

This WACC is the "*the cost of financing and required return on capital*" which is "*based on private equity investors/fund"* required return on comparable projects" as presented in Option III, Item (6)(b) of "*Tool for the demonstration and assessment of additionality*" version 5.2.

Determine the cost of debt

The cost of debt is the interest rate for a long-term loan prevailed at the time of making the investment decision. The project participant chooses the lowest value of the interest rates for long-term credit

published in the Annual Report of the State Bank of Viet Nam in 2004. This report is published at the website of the State Bank annually (*www.sbv.gov.vn/)*. So the cost of debt used for benchmark derivation is conservative and standard value.

The applied cost of debt is 14.4% at the date of making the investment decision.

Determine the cost of equity

To derive an appropriate cost of equity for electricity generation project type in Vietnam, the following well-known CAPM[10] standard formula, which describes the relationship between risk and expected return, is employed:

$$R_e = R_f + \beta * (R_{m,} - R_f) \qquad (2)$$

Where:

$R_{e,}$	cost of equity for electricity generation project type
R_f	Risk free rate return
β	Beta of the security for electricity generation project type
$R_{m,} - R_{f,}$	Market risk premium

Risk free rate:

The risk free rate is understood as the rate of return on an asset that is theoretically free of any risks, therefore the rate of interest on government bonds are considered as risk free rates. Accordingly the risk free rate has been taken from long term Vietnamese government bond rates available at the date of making the investment decision. The data on government bond rates is published on Asia Commercial Bank securities company website.

The risk free rate applied is 9.25% for 15 years term[11].

Beta:

Beta (β) indicates the sensitivity of the company to market risk factors. Beta represents the market risk for an asset and is calculated as the statistical measure of volatility of a specific asset/investment relative to the movement of a market group. The conventional approach for estimating beta of an investment is a regression of returns on investment against returns on a market index. For companies that are not publicly listed like Que Phong Hydropower Joint Stock Company, the beta is determined by referring to beta values of publicly listed companies that are engaged in similar types of business. The project activity type is power generation; therefore the applied beta for this project should be based on the beta values of listed power generation companies in Vietnam.

[10] In finance, the **Capital Asset Pricing Model (CAPM)** is used to determine a theoretically appropriate required rate of return of an asset, if that asset is to be added to an already well-diversified portfolio, given that asset's non-diversifiable risk. The model takes into account the asset's sensitivity to non-diversifiable risk (also known as systemic risk or market risk), often represented by the quantity beta (β) in the financial industry, as well as the expected return of the market and the expected return of a theoretical risk-free asset.

[11] http://www.acbs.com.vn/chungkhoan/?fn=bond/listbond20_.jsp

However, at the time of making the investment decision of Ban Coc hydropower plant, there was only one company in power sector of Vietnam which was listed in the stock market for few months. Because Vietnam is an emerging country so the beta for power generation sector could be determined from other companies in emerging countries [12].

According to the source from Bloomberg[13], the beta of electricity generation companies in emerging countries for Ban Coc hydropower plant is in the table below:

Table 5: Betas of similar companies in hydro power generation

No.	Name	Bloomberg symbol	Primary Exchange	Beta
1.	AES TIETE SA	GETI3 BZ Equity	Sao Paulo	0.33
2.	ANHUI WENERGY CO LTD	000543 CH Equity	Shenzhen	1.02
3.	BEIJING JINGNENG THERMAL-A	600578 CH Equity	Shanghai	1.17
4.	CENTRAL COSTANERA S.A.-B 1VT	CECO2 AR Equity	Buenos Floor	0.67
5.	CEZ AS	CEZ CP Equity	Prague-SPAD	1.06
6.	CHONGQING JIULONG ELECTRIC-A	600292 CH Equity	Shanghai	1.04
7.	CIA ENERGETICA DE SAO PAULO	CESP3 BZ Equity	Sao Paulo	0.91
8.	DALIAN THERMAL POWER CO -A	600719 CH Equity	Shanghai	0.99
9.	DATANG INTL POWER GEN CO-H	991 HK Equity	Hong Kong	1.29
10.	EDEGEL SA-COMUN	EDE PE Equity	Lima	0.37
11.	ELECTRICITY GEN PUB CO-FOR R	EGCOMP/FTB Equity	Bangkok	0.94
12.	ELECTRICITY GENERATING PCL	EGCOMP TB Equity	Bangkok	0.83
13.	EMPRESA ELECTRICA PEHUENCHE	PEHUEN CI Equity	Sant. Comerc	0.63
14.	ENERCHINA HOLDINGS LTD	622 HK Equity	Hong Kong	1.39
15.	FUJIAN MINDONG ELECTRIC PWR	000993 CH Equity	Shenzhen	1
16.	GUANGDONG ELEC POWER DEV-A	000539 CH Equity	Shenzhen	0.88
17.	GUANGDONG ELECTRIC POWER-B	200539 CH Equity	Shenzhen	0.97
18.	GUANGDONG SHAONENG GROUP-A	000601 CH Equity	Shenzhen	0.85
19.	GUANGXI GUIGUAN ELECTRIC-A	600236 CH Equity	Shanghai	0.96
20.	GUANGZHOU HENGYUN ENTERPR-A	000531 CH Equity	Shenzhen	0.86
21.	GUODIAN CHANGYUAN ELECTRIC	000966 CH Equity	Shenzhen	1.02
22.	HARBIN SHIRBLE ELECTRIC-A	600864 CH Equity	Shanghai	0.87
23.	HENAN YUNENG HOLDINGS CO-A	001896 CH Equity	Shenzhen	1.05

[12] http://www.stern.nyu.edu/~adamodar/pc/archives/ctryprem04.xls

[13] http://www.stern.nyu.edu/~adamodar/pc/archives/emergcompfirm04.xls

24.	HUADIAN ENERGY CO LTD -A	600726 CH Equity	Shanghai	1.04
25.	HUADIAN ENERGY CO LTD -B	900937 CH Equity	Shanghai	0.99
26.	HUADIAN POWER INTL CORP-H	1071 HK Equity	Hong Kong	1.12
27.	HUANENG POWER INTL INC-H	902 HK Equity	Hong Kong	1.21
28.	HUANENG POWER INTR INC-A	600011 CH Equity	Shanghai	1.05
29.	HUNAN HUAYIN ELECTRIC PWR-A	600744 CH Equity	Shanghai	1
30.	INNER MONGOLIA MENGDIAN HUA	600863 CH Equity	Shanghai	1.04
31.	JIANGXI GANNENG CO-A	000899 CH Equity	Shenzhen	1.12
32.	JILIN POWER SHARE CO-A	000875 CH Equity	Shenzhen	0.95
33.	KOGENERACJA	KGN PW Equity	Warsaw	0.82
34.	LA ELECTRICIDAD DE CARACAS	EDC VC Equity	Caracas	1.35
35.	MALAKOFF BHD	MAL MK Equity	Kuala Lumpur	0.79
36.	PARK ELEKTRIK MADENCILIK	PRKTE TI Equity	Istanbul	0.66
37.	QIANJIANG WATER RESOURCES	600283 CH Equity	Shanghai	0.99
38.	RATCHABURI ELEC GEN HODG PUB	RATCH TB Equity	Bangkok	0.86
39.	SARAWAK ENTERPRISE CORP	SRWE MK Equity	Kuala Lumpur	1.17
40.	SDIC HUAJING POWER HOLDING-A	600886 CH Equity	Shanghai	1
41.	SHANDONG LUNENG TAISHAN-A	000720 CH Equity	Shenzhen	1.11
42.	SHANTOU ELECTRIC POWER DEVEL	000534 CH Equity	Shenzhen	1.1
43.	SHANXI ZHANGZE ELEC POWER-A	000767 CH Equity	Shenzhen	0.96
44.	SHENZHEN NANSHAN POWER ST-A	000037 CH Equity	Shenzhen	0.91
45.	SHENZHEN NANSHAN POWER ST-B	200037 CH Equity	Shenzhen	0.97
46.	TOP ENERGY CO LTD-A	600780 CH Equity	Shanghai	1.18
47.	TRACTEBEL ENERGIA SA	TBLE3 BZ Equity	Sao Paulo	0.92
48.	ZHEJIANG SOUTHEAST ELEC-B	900949 CH Equity	Shanghai	0.92
Average beta				**0.97**

Risk Premium:

The most common approach for estimating the risk premium is to base it on historical data. In the CAPM model, the premium is estimated by looking at the difference between average return on stocks and the risk free rate return. The average return on stocks is defined as the compounded annual return.

Table 6: Market expected return calculation

Market index (VN Index) on 28-Jul-2000	100.00

(starting date of the stock market)	
Market index (VN Index) on 26-Dec-2005 (starting date of making the investment decision)	309.6
No. of years	5.42
Expected Return	**23.20%**

Substituting

R_f = 9.25%;

R_m = 23.20%;

β = 0.97

in (2), we get the **cost of equity for power generation projects in Viet Nam at the date of decision making of the proposed project** as follows:

$$\boldsymbol{R_e = 22.78\%}$$

This rate of the cost of equity for power generation sector meets the EB rules because it reflects a sector specific approach. It is calculated based on similar companies operating in power generation sector in Viet Nam therefore it reflects "*standard in the market, considering the specific characteristics of the project type (...)*" as stipulated in the guidance given in the latest additionality tool under sub-step 2b (5).

However, Ibbotson Associates, Inc. - a leading provider of independent investment research in major international markets who has been published an annual "International Cost of Capital Perspectives Report" since 2001 also provides a source for the expected rate on return on equity in Viet Nam from an investor's point of view. In the report the costs of capital for Viet Nam are displayed[14]. In total the report gives 12 different values for Vietnam (due to different calculation methods and investors background). The lowest value among all 12 values given in the report in 2005 is 22.45 %. Since this value is lower than the return on equity 22.78% calculated by CAPM for power generation projects in Viet Nam, 22.45% is applied as the expected rate on return on equity for the benchmark calculation.

Another survey by a securities company in Viet Nam recommends the range of 25% to 30% for cost of equity for power generation companies in Vietnam market[15]. Therefore, **the rate of 22.45% applied as the cost of equity for power generation projects in Viet Nam at the date of decision making of the proposed project is the most conservative value.**

The table below presents key assumption to calculate the benchmark - WACC according to formula (1)

Table 7: Key assumptions to calculate the benchmark

No	Parameter	Unit	Value
1	Total investment cost[16]	billion VND	310,1
2	Project equity[17]	billion VND	93.0

[14] The referenced report has been updated annually since 2001. The report that was published in May 2005 includes the data up to March 2005 and was available and valid at the date of the decision to implement the project activity.

[15] The report by Alpha Securities Company has been submitted to the DOE.

[16] "General Explanation" of Ban Coc Hydropower project

[17] Decision No 709/QD-NLDK issued on 03 April 2004 by Ministry of Industry regulates that the investment capital of project owner (equity) in the project must be accounted for at least 30% of the total investment cost

3	Required return on equity rate[18]	%	22.45
4	Debt		
	• Total	billion VND	217.1
	• Interest rate[19]	%	14.4
5	Average enterprise revenue tax[20]	%	18.14
6	**Benchmark (WACC)**	**%**	**14.99**

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:

Table 8: Key assumption for investment analysis

No	Parameter	Unit	Value
1	Gross capacity[21]	MW	18
2	Annual net electricity generation[22]	MWh	74.72
3	Total investment cost[23]	billion VND	310.1
4	Total annual O&M cost[24]	billion VND	4.7
5	Preparation period pre-construction[25]	month	6
6	Construction period[26]	year	3.5
7	Period of financial assessment[27]	year	35
8	Fair value[28]	Billion VND	0
9	Feed-in price[29]	VND/kWh	590
10	Resources tax[30]	%	2
11	Enterprise revenue tax [31] • For the first 4 years • For the next 7 years • For the next 4 years • For the remaining years	%	 0 5 10 28
12	**Project IRR**	**%**	**9.38**

[18] "International Cost of Capital Perspectives Report" 2006. Ibbotson Associates, Inc.
[19] Annual Report 2004, p. 48, State Bank of Vietnam
[20] Government Decision No 164/2003/ND-CP on implementation of enterprise tax law issued on 22 December 2003, Chapter V: Article 35 Item 1.d and 2.a and Article 36 - Item 9
[21] "General Explanation" of Ban Coc hydropower project
[22] The gross power generation subtracts 1% for parasitic and loss load
[23] FSR of Ban Coc Hydropower project
[24] Decision No. 709/QĐ – NLDK issued by the Ministry of Industry
[25] FSR of Ban Coc hydropower project
[26] FSR of Ban Coc hydropower project
[27] Lifetime for financial analysis was based on the lifetime of equipment according to EB 50, Annex 15.
[28] The project IRR calculations has reflected "the period of expected operation of the underlying project activity (technical lifetime)", so after 35 years, the fair value is no need to be considered according to *"Guidance on Assessment of Investment Analysis" (version 03)*, Annex 58, EB 51: **"or - if a shorter period is chosen - include the fair value of the project activity assets at the end of the assessment period"**
[29] The minute of negotiation on a electric price of Ban Coc Hydropower project
[30] The Circular No 153/1998/ND-CP issued by Ministry of Finance on 26 November 1998 regulates that the resource tax will be calculated as the net electricity outputs supplied to the national electricity grid x electric prise x 2%
[31] Government Decision No 164/2003/ND-CP on implementation of enterprise tax law issued on 22 December 2003, Chapter V: Article 35 Item 1.d and 2.a and Article 36 - Item 9

This table shows that the Project IRR of the project was lower than the benchmark at the time of decision making which is defined as the date of issuing the Investment Decision on implementing the investment project by the Management Board on 26 December 2005.

All financial data are available to the DOE for Validation.

Sub-step 2d: Sensitivity analysis

A sensitivity analysis of the project activity has been conducted to test the robustness of the above calculations. For the analysis the following parameters have been changed as they mainly influence the feasibility of the project activity:

- Annual export to the national grid
- O&M cost
- Investment cost
- Feed-in price set by EVN

Table below shows the impact of variations in key factors on the project IRR.

Table 9: Sensitivity analysis

No	Parameter	Variation[32]	Project IRR	Likelihoods to happen
1	Annual amount of electricity exported to the national grid	+10.00%	10.41%	Lower than the benchmark
		+ 59.49%	14.99%	The probability of a 59.49% increase in annual export to the national grid is very unlikely. This is because the potential hydrology has been surveyed in long term basis. It is concluded that the hydrological condition is not possible to sustain a 59.49% annual increase compared with the current estimation for the entire crediting period. This option shall be discarded.
		-10.00%	8.29%	Lower than the benchmark
2	O&M costs	+10.00%	9.26%	Lower than the benchmark
		- 100%	10.49%	In the case of zero total O&M cost (or 100% decrease of O&M Cost), the project IRR is 10.49% that is still lower than the benchmark. This option shall be discarded.
		-10.00%	9.59%	Lower than the benchmark
3	Investment costs	+10.00%	8.50%	Lower than the benchmark

[32] ±10% is also a common practice rate for sensitivity analysis of a CDM project

		- 39.82%	14.99%	The probability of a 39.82% decrease in the total investment cost is not likely to happen because the inflation, average consumer prices in 2006, 2007 and 2008[33] show an annual increase of 7.5%, 8.3% and 24% respectively. This option shall be discarded.
		-10.00%	10.41%	Lower than the benchmark
4	Feed-in price set by EVN	+10.00%	10.41%	Lower than the benchmark
		+ 59.49%	14.99%	The probability of a 59.49% increase in feed in tariff annually is very unlikely because the newest negotiation of electric prise was signed with EVN with a fixed feed in tariff for long term. And in fact, the price agreed is 668 VND/kWh (or 13% increasing). This option shall be discarded.
		-10.00%	8.29%	Lower than the benchmark

The sensitivity analysis shows that there is unlikely to be happened the case in which the variation of a parameter can improve the Project IRR without CDM above the benchmark.

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 02 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.

To classify the projects listed against the criteria: *similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate* , the most relevant regulations which regulate the legal entities, the investment management procedures, and the technical designs and construction standards for hydropower projects in different scales (Prime's Minister Decision No 176/2004/QD-TTg, Decision of Ministry of Industry - No 3454/QĐ-BCN, Vietnam Construction Code - TCXDVN 285:2002).

33 http://www.imf.org/external/pubs/ft/weo/2008/02/weodata/weoreptc.aspx?sy=1980&ey=2013&scsm=1&ssd=1&sort=country&ds=.&br=1&c=582&s=PCPIPCH&grp=0&a=&pr1.x=77&pr1.y=10

According to Vietnam Construction Code - TCXDVN 285:2002 "Irrigation projects - Major standards on designing"[34] which regulates the criteria for construction contractors, design steps and warranty period for construction works activities, hydropower projects are categorized as follows.

Table 10: 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's Minister 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 October 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 1 MW 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 11: 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 100 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, Prime's Minister Decision No 176/2004/QD-TTg
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, Prime's Minister Decision No 176/2004/QD-TTg
F	up to 5MW	Vietnam Construction Code - TCXDVN 285:2002 and Decision of Ministry of Industry - No: 3454/QD-BCN, Prime's Minister Decision No 176/2004/QD-TTg

According to Table above, this proposed project activity falls into Group E. Table below provides the projects belong to Group E which are *similar scale and take place in a comparable environment* to the proposed project activity.

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

Table 12: Hydropower plants in group E[35]

No	Name	Capacity MW	Construction starting year	Commissioning year	Developed as CDM project
1	Nam Mu	12	2002	2004	No
2	Ea Krong Rou	28	2003	2007	No
3	Suoi Sap	14.4	2004	2007	No
4	Nam Tha 6	6.0	2006	2007	Yes
5	Ngoi Xan 1	8.1	2006	2007	Yes
6	Na Loi	9.3	2000	2003	No

Because the Na Loi hydropower project started construction from 2000[36], it is excluded from this common practise analysis. Exclusion is also applied to Nam Tha 6[37] and Ngoi Xan 1[38] 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 13: Hydropower plants which belong to group E (5 – ≤ 30 MW) were developed in Vietnam

No	Name	Capacity MW	Elec. outputs 10^3 MWh	Load factor	Construc-tion starting year	Commi-ssioning year	Investor during the investment and construction period
0	**The proposed project**	***18***	***75.47***	***47.9 %***	**2006**	**2009**	***Que Phong 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)[39]
2	Ea Krong Rou	28	110.7	45.1	Otc. 2003	2007	MienTrung Power Investment and Development Joint Stock

[35] List of project supplied by Institute of Energy

[36] http://www.naloi.com.vn/?et=news&page=introduce

[37] http://cdm.unfccc.int/UserManagement/FileStorage/HWAFNGZRTMU51V86XDB2LP40I79KJE

[38] http://cdm.unfccc.int/UserManagement/FileStorage/ZTSNIRG1O4E8YX3H2WFJD0LBA5KM7Q

[39] Prospectus of Nam Mu Hydropower Joint Stock Company http://cafef.vn/hastc/bao-cao-tai-chinh/HJS-cong-ty-co-phan-thuy-dien-nam-mu.chn#taichinh

							Company (Song Da Construction Corporation and Power Company No.3 hold 85% of shares. Power Company No.3 belongs to EVN)[40]
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:

- *For projects 1 - 2*: As can be seen in the Table above, 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 constructing many national hydropower plants like Hoa Binh (1920 MW), Yaly (720 MW), Tri An (400 MW), Thac Ba (108 MW)…. And from 2000, Song Da Corporation had been studying and investing in a series of hydropower plants like: Ry Ninh 2, Na Loi, Can Don, Se San 3A…[41]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 on 07 March 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[42].

- *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 targeted communes in Phu Yen District, Son La Province. Then the project owner decided to synergise this objective with the construction of a hydropower plant. According to the Government Decree No. 17/2001/NĐ-CP, and the Governmental Report at the CG 2001, this project is given priorities to access ODA. Therefore, this project has borrowed ODA soft-loan from India at a very favourable interest rate[43] 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 be seen from the above analysis, no similar projects facing the same barriers as the proposed project have been developed without the aid of CDM.

[40] http://vincomsc.com.vn/vi/Pages/ReportFileDownload.aspx?id=8338
[41] http://songda.com.vn/info/News/tabid/65/ItemID/1/View/Details/Default.aspx
[42] http://vi.wikipedia.org/wiki/Tổng_công_ty_91
[43] Source: Interview with Truong Thanh Construction Company Limited and confidential documentation provided to DOE

Implementation timeline of the proposed project activity

The incentive from the CDM was seriously considered by the Ha Noi Construction Corporation (the project owner) by conducting a serious activity to submit the CDM Project to the Government of Flanders CDM/JI Programme for sale of carbon credit on 16 November 2004, then this proposed project was listed on the CDM guidebook published in December 2004 by TÜV Rheinland Hong Kong Ltd. and Deutsche Investitions- und Entwicklungsgesellschaft GmbH in conjunction with Research Centre for Energy and Environment. The Ban Coc Hydropower project was transferred from Ha Noi Construction Corporation to Que Phong Hydropower Joint Stock Company which was established on 26 July 2005. After that the new project owner officially decided to pursue CDM implementation project on 26 December 2005.

This was period to the starting date of the proposed project activity which is defined as the date of signing the supplied equipment and technical service contract on 22 February 2006. Since then, the project owner has been spending continuous efforts in pushing and pursuing CDM.

CDM Consideration

CDM early consideration and the serious actions to secure the CDM status for the project are reflected in the key milestones in the development of the project listed below:

Table 14: Major milestones in developing the investment project and CDM application

Development of the hydropower project	Activities taken to achieve CDM registration	Time	Implication on CDM
I. Legal & administrative formality to be considered as the project owner			
Finalising the Technical Design report by the technical consultant		Sep 2004	
	Submitting the project by Research Centre for Energy & Environment and Asia Carbon International B.V to the Government of Flanders CDM/JI Programme for sale of carbon credit	16 Nov 2004	*CDM early consideration evidence*
	Listing the project in the CDM guidebook published in December 2004 by TÜV Rheinland Hong Kong Ltd. and Deutsche Investitions- und Entwicklungsgesellschaft GmbH in conjunction with Research Centre for Energy and Environment	Dec 2004	*CDM early consideration*
Establishing the Que Phong Hydropower Joint Stock Company		26 Jul 2005	
	Internal decision to pursue CDM registration	20 Aug 2005	

	Achieving the Minutes of a meeting to consult public opinions (local people and local authorities) on the social and environmental impacts of the hydropower project in order to develop it as a CDM activity	20 Nov 2005	*CDM early consideration evidence*
Issuing the Investment Decision on implementing the investment project and CDM project by the Management Board		26 Dec 2005	*Date of making Investment Decision*
	Signing a CDM development and registration contract with a CDM consultant.	08 Jan 2006	
Signing the Contract for supply of plant technological equipment and technical services		22 Feb 2006	*Starting date of the project activity*
Signing the credit contract		14 Nov 2006	
Issuing Certificate of Investment by Provincial People's		30 Nov 2006	
	Sending the official letter by the project owner to complain the delay in implementing and requesting the CDM consultant to demonstrate the progress and implement the CDM proposed project	15 Dec 2006	
	Sending the official letter by the project owner to complain the delay in implementing and requesting the CDM consultant to demonstrate the progress and implement the CDM proposed project	23 Sep 2007	
	Contacting with buyers	15 Jan 2008	
	Sending the official letter by the project owner to complain the delay in implementing and warning the termination of the CDM contract due to the delay	26 Nov 2008	
Starting the operation of the project (commissioning)		30 Jul 2009	
	Officially terminating the CDM development and registration contract with the first CDM consultant	04 Sep 2009	

	Signing a new CDM development and registration contract with new CDM consultant (CDM consultancy contract) - The new Project Design Document (PDD) started to develop	09 Sep 2009	
	Contacting new buyer	Oct 2009	
	Signing the ERPA	03 Dec 2009	
	Contacting DOEs for validation	Dec 2009	

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 10 of ACM0002.

I. Project emissions *(PE_y)*

According to the ACM0002 Version 10, the project emission for the Hydropwer project is:

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

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:

$$PE_y = \frac{\mathrm{EF}_{\mathrm{Res}} \cdot TEG_y}{1000}$$

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:

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

Where:

BE_y	Baseline emissions in year *y* (tCO_2/yr).
$EG_{PJ,y}$	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)
$EF_{grid,CM,y}$	Combined margin CO_2 emission factor for grid connected power generation in year *y* calculated using the latest version of the "Tool to calculate the emission factor for an electricity system".

Calculation of $EG_{PJ,y}$

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)

Calculation of the emission factor (EF) of the national electricity grid

The Version 02 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 7 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. Identify the group of power units to be included in the build margin (BM).

STEP 6. Calculate the build margin emission factor.

STEP 7. Calculate the combined margin emissions factor.

Step 1. Identify the relevant electric power system

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

Option I: Only gird 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 operation 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 36.08 % that constitute less than 50% of total grid generation in average of the five most recent years (details see the table below).

Table 15: Rate of low cost/must-run sources based on generation[44]

Year	2003	2004	2005	2006	2007	Average
Rate of low cost/must-run sources generation (%)	46.04	38.40	30.90	32.41	32.66	**36.08**

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 (2005, 2006 and 2007) 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.

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 2 Options:

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 necessary data for Option A is available so 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)

Option A2. If for a power unit *m* only data on electricity generation and the fuel types used is available, the emission factor should be determined based on the CO_2 emission factor of the fuel type used and the efficiency of the power unit, as follows:

[44] Source: Appendix 7 of Summation of Operation of National Power System in 2007, EVN, January 2008

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} * 3.6}{\eta_{m,y}}$$

Where,
$EF_{CO2,m,i,y}$ is average CO2 emission factor of fuel type *i* used in power unit *m* in year *y* (tCO2/GJ)
$\eta_{m,y}$ is average net energy conversion efficiency of power unit *m* in year *y* (%)

Where several fuel types are used in the power unit, the fuel type with the lowest CO2 emission factor for $EF_{CO2,m,i,y}$ are used.

Table 16: Operating Margin emission factor of the most recent 3 years (2005, 2006 and 2007)[45]

Year	2005	2006	2007	$EF_{grid,OM}$ (tCO_2/MWh)
Total emission of the Viet Nam national grid (tCO_2e)	**22,635,750**	**24,417,140**	**27,053,720**	0.6202
Total electricity delivered to the grid by fossil power sources (MWh)	**36,417,100**	**39,523,850**	**43,546,790**	

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

$$\boldsymbol{EF_{grid,OM,y} = 0.6202\ tCO_2/MWh}$$

Step 5. Identify the group of power units to be included in the BM

The sample group of power units *m* used to calculate the build margin consists of either:

a) The set of five power units that have been built most recently, or

b) The set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

In terms of vintage of data, Option 1 shall be chosen for the proposed project. Details are as follows: 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 shall 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 shall be used. This option does not require monitoring the emission factor during the crediting period.

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 (13,960,040MWh) than the set of five power units that have been built most recently in 2007 does (1,181,040MWh), and hence it is employed.

[45] Source: EVN, 2009. The data and source are submitted to the DOE for validation. The EVN provides the most actually updated data relevant to the power generation in Viet Nam that could be accessed by public.

Step 6. Calculate the BM emission factor

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:

$$\boldsymbol{EF_{grid,BM,y} = 0.4508\ tCO_2/MWh}$$

Step 7. Calculate the CM emissions factor

The CM emissions factor is calculated as follows:

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

Where:

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

For the proposed project, according to Version 02 of "Tool to calculate the emission factor for an electricity system" 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:

$$\boldsymbol{EF_{grid,CM,y} = 0.5 \times 0.6202 + 0.5 \times 0.4508 = 0.5355\ tCO_2/MWh}$$

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

III. Leakage *(L_y)*

According to ACM0002, Version 10, 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, transport). These emissions sources are neglected., therefore $L_y = 0$

IV. Emission reductions (ER_y)

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - L_y$$

Where:

ER_y	Emission reductions in year y (tCO_2e/y).
BE_y	Baseline emissions in year y (tCO_2e/y)
PE_y	Project emissions in year y (tCO_2/y).
LE_y	Leakage emissions in year y (tCO_2/y).

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

Data / Parameter:	**Heat rate**
Data unit:	kcal/kWh
Description:	Heat rate of each power plant
Source of data used:	Data supplied by EVN
Value applied:	Value applied in Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied:	Dispatch data is not disclosed by the Government of Vietnam. EVN provides the most actually updated data relevant to the power generation in Vietnam that could be accessed by public. And this data source is recommended and endorsed by DNA Vietnam
Any comment:	For calculation of $EF_{grid,OM,y}$ or $EF_{grid,BM,y}$

Data / Parameter:	**$EG_{m,y}$**
Data unit:	MWh
Description:	Net electricity generated and delivered to the grid by power plant/unit m in year y
Source of data used:	Data supplied by EVN
Value applied:	Value applied in Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied:	Dispatch data is not disclosed by the Government of Vietnam. EVN provides the most actually updated data relevant to the power generation in Vietnam that could be accessed by public. And this data source is recommended and endorsed by DNA Vietnam
Any comment:	For calculation of $EF_{grid,OM,y}$ or $EF_{grid,BM,y}$

Data / Parameter:	$EG_{m,y}$
Data unit:	MWh
Description:	Net electricity generated and delivered to the grid by power plant/unit m in year *y*
Source of data used:	Data supplied by EVN
Value applied:	Value applied in Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied:	Dispatch data is not disclosed by the Government of Vietnam. EVN provides the most actually updated data relevant to the power generation in Vietnam that could be accessed by public. And this data source is recommended and endorsed by DNA Vietnam
Any comment:	For calculation of $EF_{grid,OM,y}$ or $EF_{grid,BM,y}$

Data / Parameter:	$EF_{CO2,i,y}$
Data unit:	tCO_2/GJ
Description:	CO_2 emission factor of fossil fuel type *i* in year *y*
Source of data used:	Default value of the IPCC 2006 Guidelines
Value applied:	Value applied in Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied:	With reference to Version 02 of "Tool to calculate the emission factor for an electricity system"
Any comment:	For calculation of $EF_{grid,OM,y}$ or $EF_{grid,BM,y}$

Data / Parameter:	$EF_{grid,OM,y}$
Data unit:	tCO_2/MWh
Description:	Operating margin CO2 emission factor for grid connected power generation in year *y* calculated using the latest version of the "Tool to calculate the emission factor for an electricity system"
Source of data used:	Data supplied by EVN
Value applied:	0.6202
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:	$EF_{grid,BM,y}$

Data unit:	tCO_2/MWh
Description:	Build margin CO2 emission factor for grid connected power generation in year *y* calculated using the latest version of the "Tool to calculate the emission factor for an electricity system"
Source of data used:	Data supplied by EVN
Value applied:	0.4508
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},CM,y**
Data unit:	tCO_2/MWh
Description:	Combined margin CO2 emission factor for grid connected power generation in year *y* calculated using the latest version of the "Tool to calculate the emission factor for an electricity system"
Source of data used:	Data supplied by EVN
Value applied:	0.5355
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:

Project emissions (PE_y)

The proposed project activity involves the construction of a new hydropower plant with capacity (Cap_{PJ}) of 18 MW and a new reservoir with surface (A_{PJ}) of 21,000 m^2, thus $A_{BL} = 0$ and $Cap_{BL} = 0$.

The power density of the project activity is derived as follows:

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}} = \frac{18 \times 10^6 - 0}{21,000 - 0} = 85.7 W / m^2$$

It is greater than 10 W/m^2, thus the project emission is zero: $PE_y = 0$

Baseline emissions (BE_y)

Baseline emissions are calculated as follows:

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

Where: $EG_{PJ,y}$= 74,715MWh, $EF_{grid,CM,y}$ = 0.5355 tCO2/MWh

therefore:

$$BE_y = 40{,}010\ tCO_2$$

Leakage (L_y)

As it is stated in ACM0002 Version 10, this emission is considered as zero: $L_y = 0$

Reduction emissions (ER_y)

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - L_y = 40{,}010\ tCO_2/year$$

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

The estimated emission reduction of the project activity is provided in Table below.

Table 17: Emission reduction of the project activity

Year	Estimation of project activity emissions (tonnes of CO_2e)	Estimation of baseline emissions (tonnes of CO_2e)	Estimation of leakage (tonnes of CO_2 e)	Estimation of overall emission reductions (tonnes of CO_2e)
2010 (Jul to Dec)	0	20,005	0	20,005
2011	0	40,010	0	40,010
2012	0	40,010	0	40,010
2013	0	40,010	0	40,010
2014	0	40,010	0	40,010
2015	0	40,010	0	40,010
2016	0	40,010	0	40,010
2017 (Jan to Jun)	0	20,005	0	20,005
Total (tonnes of CO_2 e)	**0**	**280,070**	**0**	**280,070**

The summary of the ex-ante estimation of emission reductions is shown in Table below.

Table 18. Summary of the ex-ante estimation of emission reductions

Parameters	Unit	Value
1. Total installed capacity	MW	18
2. Baseline CO_2 emissions • The OM • The BM • The CM emission factor	 tCO_2/MWh tCO_2/MWh tCO_2/MWh	 0.6202 0.4508 0.5355
3. Total baseline CO_2 emissions over the chosen crediting period	tCO_2	**280,070**
4. Total project CO_2 emissions over the chosen crediting period	tCO_2	**0**
5. Total leakage CO_2 emissions over the chosen crediting period	tCO_2	**0**
6. Total CO_2 emission reductions over the chosen crediting period	tCO_2	**280,070**

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
Value of data applied for the purpose of calculating expected emission reductions in section B.6	74,715
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 by the proposed hydropower plant to the grid by the positive direction. The readings of electricity meter will be hourly measured and monthly recorded. Double checking by the invoice issued by project owner to ensure the consistency. Electronic data will be archived within the crediting period and 2 years after the end of the crediting period.
Monitoring frequency	Hourly measurement 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:	For $EG_{facility,y,} = EG_{y, export} - EG_{y, import,}$

Data / Parameter:	**$EG_{y, import}$**
Data unit:	MWh
Description:	Electricity supplied by the grid to the proposed hydropower plant
Source of data to be used:	Direct measurement at the project connection point
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:	Two-way 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 by the reverse direction. The readings of electricity meter will be hourly measured and monthly recorded. Automatic measurement and automatic recording will be made by computers. 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	Hourly measurement 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:	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:	Calculating from $\mathbf{EG_{y, import}}$ and $EG_{y, export}$
Value of data applied for the purpose of calculating expected emission reductions in section B.6	74,715
Description of measurement methods and procedures to be applied:	Calculating by subtracting $\mathbf{EG_{y, import}}$ from $EG_{y,export}$. Double checking by the joint balance sheet issued by EVN and project owner to ensure the consistency. Data will be archived within the crediting period and 2 years after the end of the crediting period.
Monitoring frequency	Hourly measurement 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 CERs calculation

Data / Parameter:	$\mathbf{TEG_y}$
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 and separately for each power generation unit. The value applied is the sum of all units
Value of data applied for the purpose of calculating expected emission reductions in section B.6	75,470
Description of measurement methods and procedures to be applied:	Directly measured by power meters which will be installed at the generators to measure the amount of generated electricity. The readings of electricity meter will be hourly measured and monthly recorded. Electronic data will be archived within the crediting period and 2 years after the end of the crediting period.
Monitoring frequency	Hourly measurement and monthly recording
QA/QC procedures to be applied:	The uncertainty level of this data is low.
Any comment:	For PE_y

Data / Parameter:	$\mathbf{A_{PJ}}$
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	Project site.

used:	
Value of data applied for the purpose of calculating expected emission reductions in section B.6	21,000
Description of measurement methods and procedures to be applied:	Measured from topographical surveys and maps yearly
Monitoring frequency	Yearly
QA/QC procedures to be applied:	The uncertainty level of this data is low.
Any comment:	For the calculation of PD

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:	Manufacture's nameplate
Value of data applied for the purpose of calculating expected emission reductions in section B.6	18,000,000
Description of measurement methods and procedures to be applied:	Determine the installed capacity by taking photographs of the nameplates. And the value in nameplate will be included in the monitoring report.
Monitoring frequency	Yearly
QA/QC procedures to be applied:	The capacity of this project will not be changed. The monitoring of Cap_{PJ} will be taken yearly can will be confirmed by the Verifier
Any comment:	For the calculation of PD

B.7.2. Description of the monitoring plan:

According to version 10 of ACM0002, there is no need to project emissions and monitor leakage under this project activity.

Although the power density of the project is higher than 10 W/m^2, the surface area of the reservoirs will be monitored annually. It will be taken by collecting photographic evidence of the surface level when the project becomes operational. This photographic evidence will be compared with the design reservoir dimensions to confirm whether or not the actual surface area substantially deviates from the design surface area.

The baseline emission factor of Viet Nam 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 digital kilowatt hour (kWh) meters. The metering system includes the main system and a back-up system. The back-up system will be used in case of a failure of the main meter.

Data from the operating meters will be recorded monthly. 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 with thin 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: 20/09/2009

The responsible entity: **Energy and Environment Consultancy Company Limited** 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:

22/02/2006

This is the date when the contract for supply of complete Electro-mechanical equipment and technical services signed by the project owner to commit for the project's expenditures of the proposed project.

This is in accordance with the "CDM Glossary of Terms/version 04", 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:

35 years 0 months

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:

01/06/2010 or date of registration whichever is later

C.2.1.2.	Length of the first crediting period:

7 years 0 months

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

Pursuant to Environment Protection Law of Vietnam 2005 (Article 20), the Environmental Impact Assessment (EIA) for this project has been carried out. The EIA reports have already been approved by the Nghe An People Committee on 05 March 2003.

Furthermore, based on the impact assessments of the proposed project, the EIA report proposes that the mitigation measures shall be conducted during the construction and operation phases in order to minimize the negative impacts and ensure the long-term benefits from this project.

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

The environmental impacts and mitigation measures are summarized as follows.

1.1. Environment Impacts

1.1.1. Impact on land

The proposed project will occupy 29.6[46] ha of land for arrangement of project structures, in which, the area of long-term occupied land for reservoir and plant and the balance is temporary occupied land for construction period. Most of land is forest land about 23.7 ha, the agricultural land only account for 1.24 ha of area.
No historical culture and archaeological places exist in the project site.

1.1.2. Impacts on water flow

The project will create a small reservoir with an area of 21 ha. So in the reservoir filling period, the river flow will be reduced. When commissioning, the reservoir will be used for the purpose of generating electricity but is also helpful to regulate water for irrigation purpose in the region. The flow regime in the reservoir area as well as downstream areas behind the powerhouse will be more stable which in turn can create favourable conditions for fishery.

So the main impact on water quality is the disposal of septic wastewater discharging from the work camps and waste oil from the truck and vehicle during the construction phase.

[46] The Statement of recovery land by People Committee of Que Phong district on dated 01 June 2007

1.1.3. Impacts on ecological system

After commissioning, the forest area which is temporarily occupied will be reforested. The reservoir will adjust local climate to be more moderate. This fine weather not only has positive impacts on local people health but also has favourable impacts on surrounding flora system.

1.1.3.1. Impacts on flora

The Ban Coc Hydropower Project does not cross-out any natural conservation areas, national forests or specialized forest. The main impacts on flora are:

- Vegetation will be removed at the construction sites
- Construction activities will require removal of fruit-trees.
- The temporary increase in workers to the construction site will increase the potential for illegal fuel-wood and non timber forest product collection.

1.1.3.2. Impacts on fauna

The main impacts on fauna are:

- There is an increased potential for illegal wildlife hunting in association with the temporary increase in workers.
- Construction activities will disturb the habitat of terrestrial animals immediately adjacent to the project site. This may result in movement of wildlife from the project vicinity to other forested areas.

However,, no valuable and/or endangered animal live within this project's site. So this is a minor impact.

1.1.3.3. Impacts on aquatic life

The impacts on quality of water will affect in aquatic species on quantity and quality. Besides, the aquatic life will change from river regime to reservoir regime, which can make good condition for developing the fishery.

1.1.4. Impacts on local environment surrounding the construction site

During the construction period, the project's activities such as material exploitation, material transportation, mine explosion as well as the concentration of workers will have certain negative impacts on local environments, namely local air and noise pollutions.

However, these impacts are temporary and will be terminated after commissioning the construction phase.

1.2. Socio-economic impacts

1.2.1. Negative impacts

Negative impacts is mainly occupied land, the proposed project will occupy about 29.6 ha. Most occupied land is most forest land and least agricultural. The occupied land will be compensated adequately under the government law.

1.2.2. Positive impacts

As presented in Section A.2

1.3. Mitigation measures to reduce negative impacts

1.3.1 Construction phase

- *Waste collection and treatment*

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

– Conduct reforestation in the temporarily occupied areas and strengthen the slopes to avoid erosions, after accomplishing the construction of main works.

– 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 issued by the Directorate for Standards and Quality.

- *On socio-economic impacts:*

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

1.3.2 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.

1.4. Conclusion

The main negative impacts on environment happen due to the construction activities. However, all these impacts will be mitigated by implementing mitigation measures and then will be terminated after accomplishing the construction phase. Preventive and mitigation measures are planned to conduct during the operation period to reduce and prevent any negative 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 involved in the stakeholder consultation:

- People Committee of Nghe An province (highest local authority):
    - granting the project activity by issuing the investment license No. 27111000003 for Ban Coc Hydropower project issued on 30 June 2006

- approving the Registration of Environmental Conformation report via Certificate of Registration of Environmental Standard Conformation No. 32/KH-MTg dated 05 March 2003

- People Committe of Que Phong District: the statement of recovery land for construction of Ban Coc Hydropower plan at the Statement No. 98/TTr.UBND on dated 01 June 2007
- Local people in the project area in Chau Kim commune, Que Phong district Nghe An province involved directly and actively in commenting on the project and the negotiations on impacted lands and assesses due to the project activity. The inventories on the damages and negotiations on compensation have been organised with each household until a mutual agreement has been reached with each affected household. Then the aggregated plan and budget for compensation has been validated and verified by the People's Committee of Que Phong District.

Besides, the local people of Chau Kim commune were involved in the CDM consultation process. At first, the stakeholders were informed about the project by public speaker and notices at the Communal People Committee's office. And then, they were invited to the official meetings with the project owner to present their comments/concerns. In 2005, meetings between the project owner and the following representatives of the local people were held in order to consult local people on the social-economic and environment impacts of the proposed project in order to develop this project as a CDM activity.

- 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.

Then the internal meetings of local commune were organised subsequently to announce the proposed project activity in non-technical and local language to local residents.

E.2. Summary of the comments received:

All organizations agreed that the project will certainly contribute to sustainable development and environment protection in Vietnam and especially this project will increase local budget and reduce poverty. Therefore, they fully support the project to develop under the CDM and recommend the project owner to complete necessary procedures to submit the project to the DNA and to the EB for registration.

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;
- The project will contribute to conservation of forest and environmental protection; 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.
- The local people support the project to develop under the CDM and recommend the project owner to complete necessary procedures to submit the project to the national and international approval bodies

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;
- Seriously apply and implement mitigation activities as stated in the Registration of Environmental Standard Conformation report in order to minimise negative impacts on local environment.
- Comply with existing regulation on compensations and agreements with households to implement a fair and reasonable plan. The project owner has negotiated and reached an agreement with each impacted households. Then a compensation budget and plan has been approved by the People's Committee of Que Phong District. The payment to each household is 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

Organization:	**Que Phong Hydropower Joint Stock Company**
Street/P.O.Box:	Que Phong's People Committee office, Block 8, Kim Son town, Que Phong district
Building:	
City:	Nghe An province
State/Region:	
Postfix/ZIP:	
Country:	Vietnam
Telephone:	+84 38 3885 709
FAX:	+84 38 3885 215
E-Mail:	
URL:	
Represented by:	Doan Kim Dong
Title:	Director
Salutation:	Mr.
Last name:	Doan
Middle name:	Kim
First name:	Dong
Department:	
Mobile:	
Direct FAX:	+84 38 3885 215
Direct tel:	+84 38 3885 709
Personal e-mail:	

Organization:	**Energy and Environment Consultancy Company Limited**
Street/P.O.Box:	Room 1210, building 18T2 Trung Hoa – Nhan Chinh, Le Van Luong Street
Building:	-
City:	Hanoi
State/Region:	Hanoi
Postfix/ZIP:	-
Country:	Vietnam
Telephone:	+ 84 – 4 – 22148810
FAX:	+ 84 – 4 – 62812733
E-Mail:	eec@eec.vn
URL:	www.eec.vn
Represented by:	Dang Thi Hong Hanh
Title:	Deputy Director
Salutation:	Mrs
Last name:	Dang
Middle name:	Thi Hong
First name:	Hanh
Department:	-
Mobile:	+ 84 – 917.291.417

Direct FAX:	+ 84 – 4 – 62812733
Direct tel:	+ 84 – 4 – 22148810
Personal e-mail:	dhanh@eec.vn

Organization:	**Nordic Environment Finance Corporation, NEFCO in its capacity as Fund Manager to the NEFCO Carbon Fund (NeCF)**
Street/P.O.Box:	Fabianinkatu 34, P.O. Box 249
Building:	34
City:	Helsinki
State/Region:	
Postfix/ZIP:	FI -00171
Country:	Finland
Telephone:	+ 358 10 618 001
FAX:	+ 358 9 630 976
E-Mail:	
URL:	
Represented by:	Ash Sharma
Title:	Senior Investment Manager, Head, Carbon Finance and Funds
Salutation:	Mr.
Last name:	Sharma
Middle name:	
First name:	Ash
Department:	
Mobile:	+ 358 40 08 11 327
Direct FAX:	+ 358 9 630 976
Direct tel:	+ 358 40 08 11 327
Personal e-mail:	

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

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

Annex 3

BASELINE INFORMATION

Data of power plants in the Viet Nam national grid in 2005, 2006 and 2007[47]
Data for calculating of $EF_{grid, OM}$

Sr. No.	Power Station	Fuel/ Technology	Heat Rate Kcal/KWh	Annual Generation GWh		
	EVN Plants			**2005**	**2006**	**2007**
1	**Pha Lai 1**	Coal/ST	3,037.00	2,462.40	2,766.70	2,830.00
2	**Pha Lai 2**	Coal/ST	2,402.00	4,299.00	4,315.00	4,198.00
3	**Uong Bi**	Coal/ST	3,877.00	668.90	759.10	693.90
4	**Uong Bi 2**	Coal/ST	1,880.00			520.00
5	**Ninh Binh**	Coal/ST	3,824.00	689.53	794.70	728.90
6	**Thu Duc**					
	ST	FO/ST	2,694.00	549.99	471.94	603.30
	GT	DO/GT	3,431.00	34.35	32.29	70.26
7	**Can Tho**					
	ST (S4)	FO/ST	2,709.00	127.76	127.87	137.30
	(GT1,2,3,4)	DO/GT	3,056.00	141.63	108.74	150.70
8	**Ba Ria**					
	CCGT	Gas/CCGT	2,210.00	2,150.50	2,024.30	1,982.70
9	**Phu My 1**					
	CCGT	Gas/CCGT	1,746.00	7,179.14	6,421.71	8,076.73
10	**Phu My 2.1**					
	CCGT	Gas/CCGT	1,857.00	3,640.97	6,110.50	5,975.20

[47] Source: EVN, 2009. The data and source are submitted to the DOE for validation. EVN provides the most actually updated data relevant to the power generation in Viet Nam that could be accessed by public

11	**Phu My 4**					
	CCGT	Gas/CCGT	1,829.00	3,125.93	3,209.00	3,276.80
	IPPs					
1	Na Duong	Coal	2,748.00	389.00	709.00	744.00
2	Hiep Phuoc	DO	3,232.00	1,424.00	955.00	1,726.00
3	Formosa	Coal	2,270.00	800.00	1,086.00	1,113.00
4	Amatar	DO	3,300.00	67.00	26.00	13.00
5	Bourbon	Co-gen	2,700.00	43.00	57.00	69.00
6	Ve Dan	Gas	2,900.00	463.00	514.00	534.00
7	Cai Lan	DO	3,300.00			81.00
8	Phu My 2.2	Gas	1,573.00	3,719.00	4,855.00	5,004.00
9	Phu My 3	CCGT	1,739.00	4,442.00	4,110.00	3,883.00
10	Cao Ngan	Coal	2,748.00		70.00	445.00
11	Ca Mau	Gas	2,583.20			691.00

Data for calculating of EF $_{grid, BM, 2007}$

Sr. No.	Name of plant	Unit	Date of commissioning	Capacity	Technology	Generation GWh
				[MW]		2007
1	M1 Dai Ninh	M1	11-Dec-07	150	Hydro	0.04
2	Quang Tri					64
	M2 Quang Tri	M2	27-Nov-07	32	Hydro	
	MI Quang Tri	M1	12-Sep-07	32	Hydro	
3	Se San 3A					345
	M2 Se San 3A	M2	22-May-07	54	Hydro	
	M1 Se San 3A	M1	12-Dec-06	54	Hydro	
4	Ca Mau					691
	GT2 Ca Mau	GT2	24-Apr-07	250	Thermal	
	GT3 Ca Mau	GT3	04-Apr-07	250	Thermal	
5	Cai Lan		08-Mar-07	6x6.5	Thermal	81
6	Srok phu mieng					252
	Srok phu mieng	M2	03-Jan-07	26	Hydro	

	Srok phu mieng	M1	12-Oct-06	25	Hydro	
7	Uong Bi 2	M7	18-Dec-06	300	Thermal	520
8	Se San 3					1130
	M2 Se San 3	M2	28-Jul-06	130	Hydro	
	Ml Se San 3	M1	23-Apr-06	130	Hydro	
9	Cao Ngan					445
	M1 Cao Ngan	M1	03-Feb-06	57.5	Thermal	
	M2 Cao Ngan	M2	10-May-06	57.5	Thermal	
10	Na Duong					744
	Na Duong S2	S2	28-Otc-05	50	Thermal	
	Na Duong S1	S1	25-Apr-04	50	Thermal	
11	Phu My 2.2					5004
	GT1 Phu My 2.2	GT1	03-Oct-04	250	Thermal	
	GT2 Phu My 2.2	GT2	04-Sep-04	250	Thermal	
	ST3 Phu My 2.2	ST3	05-Sep-04	263	Steam Turbine	
12	Phu My 4					3210
	GT42 Phu My 4	GT42	03-Sep-04	237	Thermal	
	ST43 Phu My 4	GT41	03-Apr-04	178	Thermal	
	ST43 Phu My 4	ST43	14-May-04	150	Steam Turbine	
13	S1 Formosa	S1	31-Mar-04	150	Thermal	1113
14	Can Don					361
	M2 Can Don	M2	02-Feb-04	38.8	Hydro	
	Ml Can Don	M1	21-Nov-03	38.8	Hydro	
15	Na Loi		03-Dec-03	3x3.1	Hydro	47
16	Phu My 3					3882
	GT1 Phu My 3	GT1	03-Aug-03	237	Thermal	1247
	GT2 Phu My 3	GT2	03-Aug-03	237	Thermal	1247
	ST3 Phu My 3		03-Aug-03	263.7	Thermal	1388
17	M6 Pha lai 2		30-May-02	300	Thermal	4198

IPCC default values

Fuel fossil	CO2 emission factor [kg CO2/TJ]	Source
Diesel	72,600	*IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories*
Residual Fuel Oil	75,500	
Anthracite	94,600	
Gas	54,300	

Annex 4

MONITORING INFORMATION

Details of the monitoring information can be seen as follows:

A. Description of technical equipment

According to the Basic Technical Design of the Ban Coc project, the installation of equipment of powerhouse and meters is illustrated as follow:

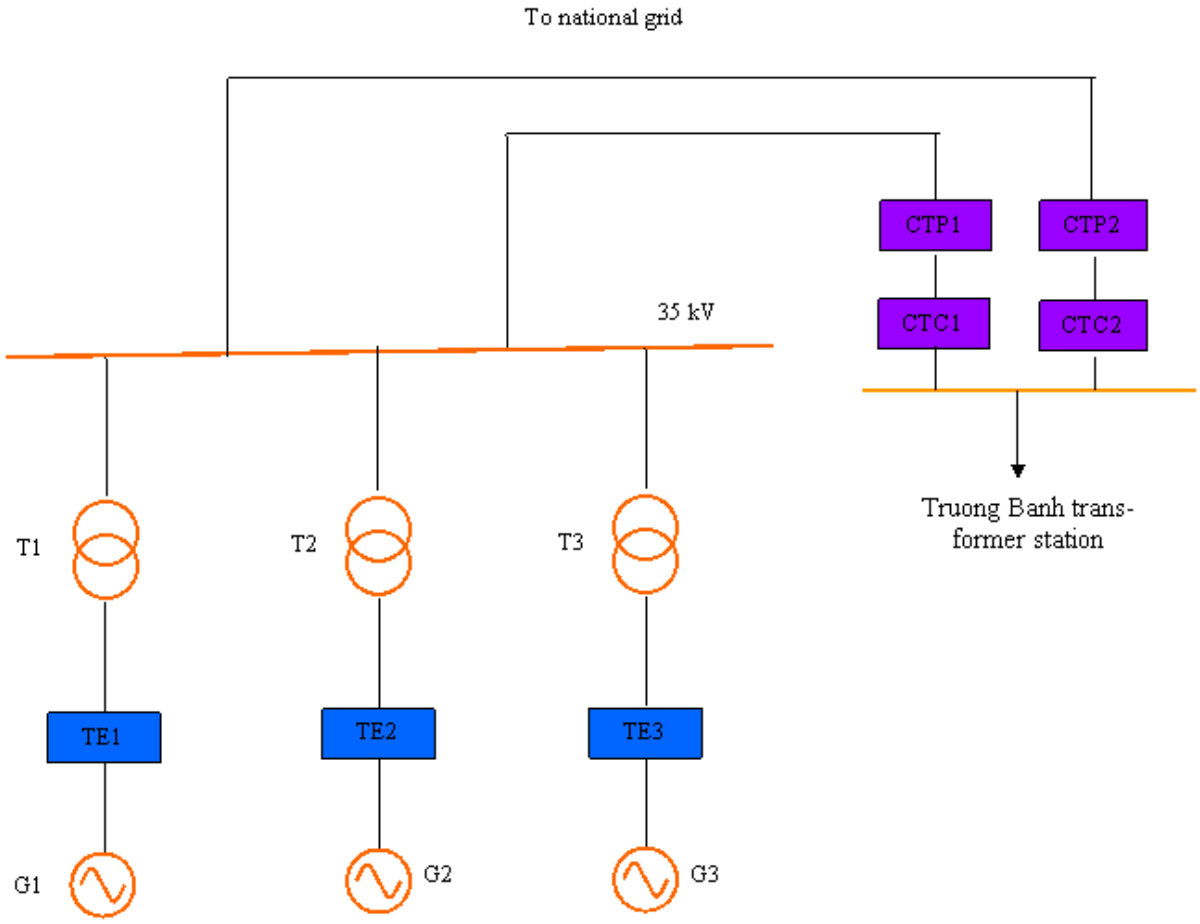

Figure 4: Metering System

The metering system will be installed at the connecting point of the transformer station. They are digital meters bi-directly with the accuracy at least 0.5 S.

The meter type used is an electronic 3 phase and 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.

Power metering equipment should be collocated and installed according to "Technical Design for Electric Metering System" for Ban Coc Hydropower Plant (HPP). Before the power metering equipment puts into operation, Que Phong Hydropower Joint Stock Company (project owner) and EVN should check and accept it. Each terminal block of these equipments are sealed with lead to prevent all the unallowable interferences.

This proposed project will supply the electricity to the national grid at the 35 kV voltage level. The metering system includes the main system and back-up systems:

- Main system: CTC1 and CTC2 power meters are located at Truong Banh Transformer Station for measuring the total electricity export and import at 35 kV level
- Backup system: CTP 1 and CTP 2 power meters are located at Truong Banh Transformer Station (besides the main system) for measuring the total electricity export and import at 35 kV level.

For measuring the Total electricity generation, there are three separately power meter located at the output of each generation output (TE1, TE2, TE3) . The total electricity generation can be calculated by summing up the values of these 3 meters.

B. Monitoring organization

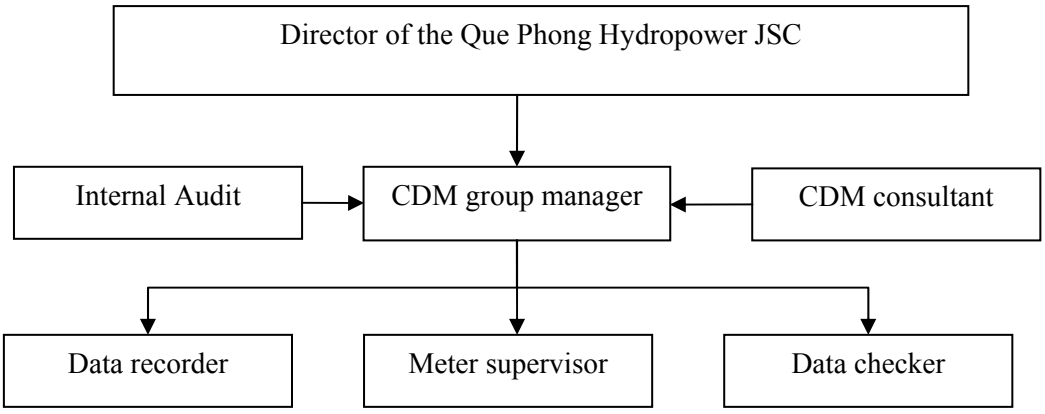

Figure 5: Structure of the monitoring group

The responsibilities of each person involved are elaborated as follows:

Group members and their responsibilities

Person	Responsibility
Director of the Que Phong Hydropower JSC/ or authorised by the Director	Check and sign the monitoring report annually
CDM group manager	Managing the whole CDM business guiding and supervising data recorder after trained by CDM consultant.
CDM consultant (VNEEC)	Providing CDM group manager training and technical support about CDM monitoring plan.
Internal auditor	Check the monitoring procedure at least once in a year
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) Persons in charge of data record and meter supervisor from Ban Coc power plant together with staff from EVN shall read and collect data from main power meters and first 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;

(2) The data from the backup power meter will be monthly recorded by the person in charge of data record of Ban Coc power plant. This recorded data will be cross checked with the data from main power meter. Data will be filled in the form provided by VNEEC.

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

(4) The Total electricity generation for each generation unit will be monthly recorded by the person in charge of data record of Ban Coc power plant. Data will be filled in the form provided by VNEEC.

(5) The Project Owner shall hire the assigned department of Department of Natural Resources and Environment or other third party for measuring the surface area of reservoir at the normal water level yearly.

(6) Ban Coc power plant provides the record of main, backup power meters and copy of invoices to the verifier of DOE.

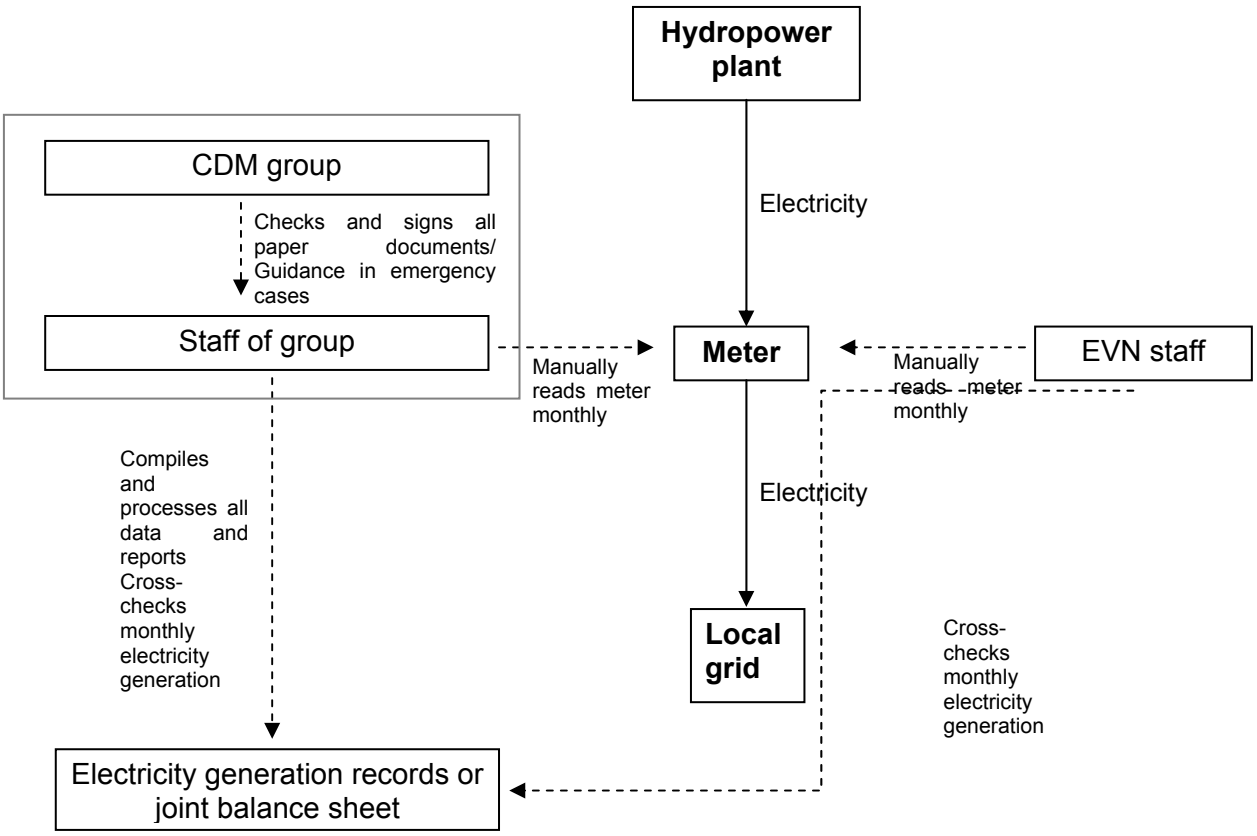

Figure 6: Monitoring process

D. Calibration of metering equipment

Before on-site installation meters will be calibrated and verified by local STAMEQ pursuant to the Decision No 65/2002/QD-BKHCNMT[48]. According to this Decision, calibration and verification for 3 phase meters need to be conducted every two years. This means that calibration will be undertaken by local STAMEQ once in every two-year period during project operation. Local STAMEQ will after every calibration seal the meters so that no interference is possible.

E. Data recording and archiving procedures

- The CDM group appointed by Ban Coc 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.
- Ban Coc power plant shall keep the copy of electricity sales/purchase invoices (the original electricity sales/purchase invoices shall be kept by Finance Department of Que Phong Hydropower

[48] Decision No 65/2002/QD-BKHCNMT[48] 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".

JSC).

- In order to help verifiers obtain documents and information related to the emission reduction of the proposed project, Que Phong Hydropower JSC 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.

In case of both main and back-up metering systems are in failure, the project owner and the power company (EVN) will jointly calculate a conservative estimate of power supplied to the grid. The assumptions used to estimate net electricity supply to the grid will be signed by both a representative of the project owner as well as a representative of the power company (EVN).

G. Training

Before the start of the project activity VNEEC will in close collaboration with the director of the power plant to develop a training manual and training course for the staff of CDM Group 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.