CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
Version 03 - in effect as of: 22 December 2006

CONTENTS

Annexes

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03	22 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

SECTION A. General description of small-scale project activity

A.1 Title of the small-scale project activity:

Title: Nam Ngan Hydropower Project
Version: 2.3
Date: 26/04/2010

A.2. Description of the small-scale project activity:

The Nam Ngan Hydropower Project involves the construction of a two-unit hydropower plant, which is located on the Nam Ngan stream between Viet Lam and Quang Ngan communes, Vi Xuyen district in Ha Giang province of Vietnam. The project's installed capacity and estimated annual gross power generation is 13.5 MW and 58,030 MWh, respectively.

The project's purpose is to generate and to supply renewable electricity to the national grid via the Power Purchase Agreement (PPA) signed with the Electricity Corporation of Vietnam (EVN). The net electricity generated from this project (annual estimated volume is 57,450 MWh) will be supplied to the national grid via a 110 kV double line which connects this plant to Pylon 84 of the 110 kV line Ha Giang – Bac Quang.

The project contributes to the sustainable development on the local, regional and national scale as follows:

General contributions towards national sustainable development:

- In recent years, Vietnam, especially the North 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 the 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.
- 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. Thus, GHG emission reductions can be achieved. Total expected CO_2 emission reduction from the proposed project is estimated to the amount of 205,254 tCO_2e over the first seven year crediting period.
- 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 Ha Giang province – one of the poorest mountainous province in the North of Vietnam. This proposed

project will pay annual tax at an average of 6.05 billion VND to the local budget, accounting for about 0.14% of GDP in 2007 of Ha Giang province[1].

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 Viet Lam and Quang Ngan communes. 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. The new 110 kV double line will reduce electricity losses and improve the electricity quality supplied in the region.

Besides, new jobs (about 37) will be created during construction and operation phases. The project activity could result in the employment of the local people for the construction and operation later on.

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 of Vietnam. Therefore, it satisfies the sustainable development criteria for CDM projects set by the DNA of Vietnam.

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)	Nam Mu Hydropower Joint Stock Company	No
Vietnam (host)	Energy and Environment Consultancy Joint Stock Company	No
Germany	swb Erzeugung GmbH & Co. KG	No
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-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		

A.4. Technical description of the small-scale project activity:

A.4.1. Location of the small-scale project activity:

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A.4.1.1. Host Party(ies):

Socialist Republic of Viet Nam

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

[1] Total GDP in 2007 of Ha Giang province quoted from Statistical Annual Book of Vietnam published by Statistical Publishing House 2008

Ha Giang province.

A.4.1.3. City/Town/Community etc:

Viet Lam and Quang Ngan communes, Vi Xuyen district

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity :

The Nam Ngan Hydropower Project is located on the Nam Ngan stream, Viet Lam and Quang Ngan communes, Vi Xuyen district, Ha Giang province. The Nam Ngan stream is the first branch of the Lo river.

This project has co-ordinates as follows:

	Co-ordinates of the dam[2]	Co-ordinates of the powerhouse[3]
Northern latitude:	$22^0$36'17"	$22^0$36'25"
Eastern longitude:	$104^0$54'10"	$104^0$54'45"

The site of the project is showed in Figure 1.

[2] Feasibility Study Report

[3] The coordinate was measure onsite and could be confirmed by the internet map: http://maps.google.com/maps?f=q&source=s_q&hl=en&q=22.606944,+104.912500&vps=3&jsv=198a&sll=22.551245,104.878922&sspn=0.368435,0.529404&ie=UTF8&geocode=FWD0WAEddNZABg&split=0

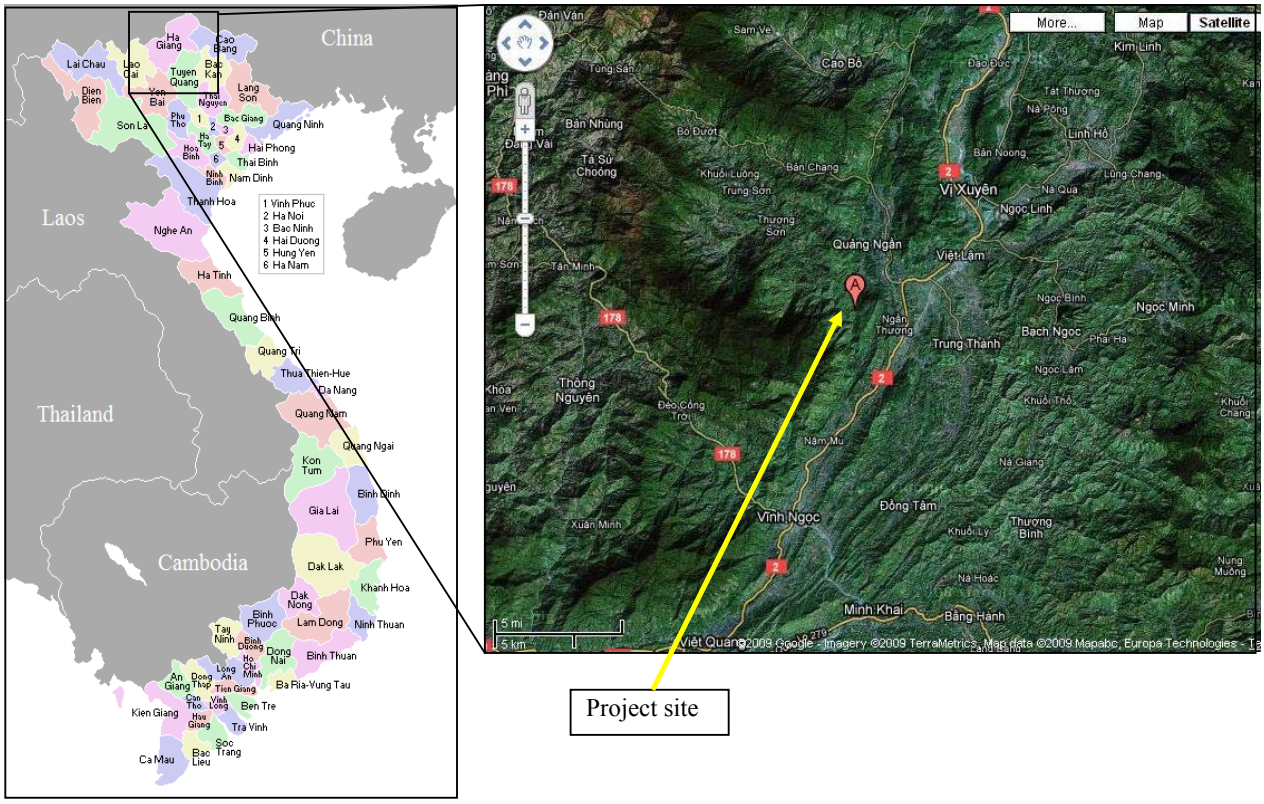

Figure 1. Project site on the map

A.4.2. Type and category(ies) and technology/measure of the small-scale project activity:

A.4.2.1. Type and category

Scale: Small scale project

Type I: Renewable energy projects

Category I.D: Renewable electricity generation for the national power grid.

A.4.2.2. Technology

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

Figure 2 shows the layout of the project.

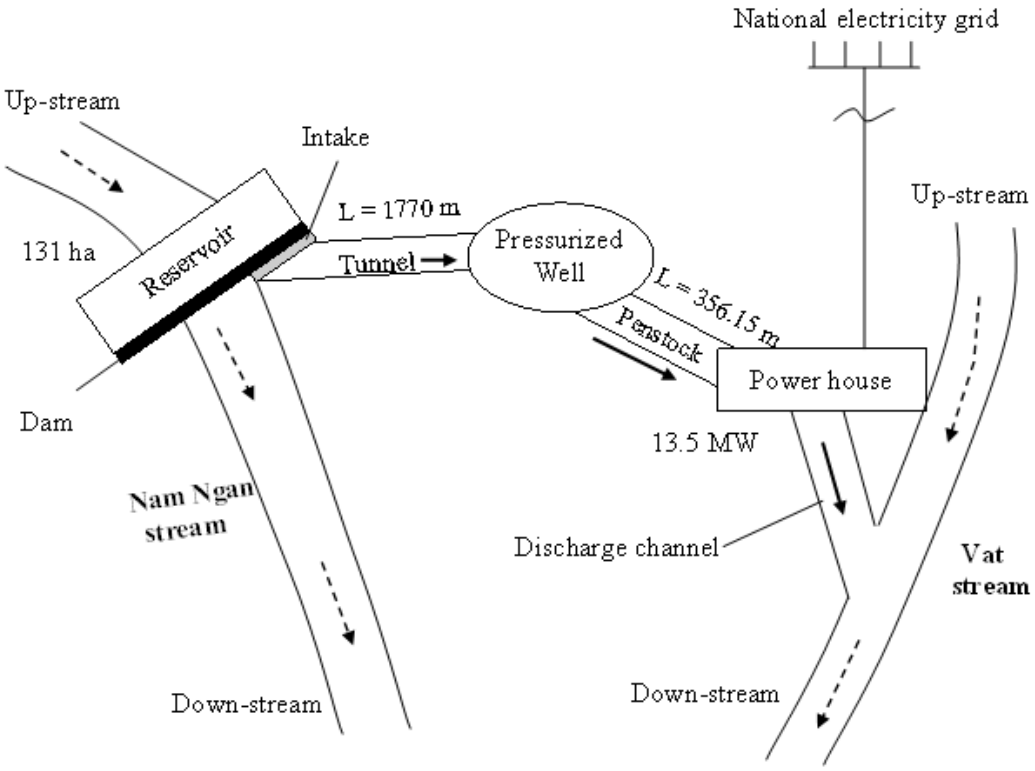

Figure 2: Project lay-out

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

Table 1. Main technical parameters of the proposed project activity

Main parameters	Units	Values	Manufacturer
1. Turbine			Symbol: HLA 743 – WJ – 81, Manufacturer: Hunan Ling Ling Hengyuan Generating Equipment Co LTD, China
• Type		Francis with horizontal shaft	
• Diameter of runner	m	1	
• Rated net head	m	116.7	
• Number of turbine	set	02	
• Turbine discharge	m^3/s	6.64	
• Capacity	kW	6,995	
• Speed	rpm	1,000	

• Annual utilisation hours	hour	4298	
• Expected lifetime[4]	hour	150,000	EB 50, Annex 15
2. Generator			Symbol: SFW 6750 – 6/1780, Manufacturer: Hunan Ling Ling Hengyuan Generating Equipment Co LTD, China
• Type		synchronous, 3 phases, horizontal axis	
• Number	set	2	
• Rated voltage	kV	6.3	
• Rated capacity	kW	6750	
• Efficiency at 100% load, Cosφ = 0.8		97.27%	
• Expected lifetime[5]	year	30	EB 50, Annex 15
3. *Annual river flow*	m^3/s	8.5	

The main equipment utilized in this project was imported after the project owner had chosen suppliers via tender which set criteria for supplier to ensure that the turbines and alternators all was state-of-the-art technology. The technicians and engineers from the equipment supplier will train the operational staff of the Nam Ngan Hydropower plant on the monitoring procedures, operation regulations, maintenance procedures, and other relevant operational knowledge before operating the power plant. Furthermore, there will be regularly internal training courses on monitoring and operation for the staff during the operation period.

A.4.3 Estimated amount of emission reductions over the chosen crediting period:

Estimated emission reductions of the proposed project over the chosen crediting period are given in Table 2.

Table 2. Emission reduction of the proposed project over the chosen crediting period

Years	Estimation of annual emission reductions in tonnes of CO_2 e
2010 (Aug. to Dec.)	12,217
2011	29,322
2012	29,322
2013	29,322
2014	29,322
2015	29,322
2016	29,322
2017 (Jan. to Jul)	17,105
Total estimated reductions (tonnes of CO_2 e)	**205,254**
Total number of crediting years	**7**

[4] The default lifetime in EB 50, Annex 15
[5] The default lifetime in EB 50, Annex 15

Annual average of the estimated reductions over the crediting period (tCO_2e)	**29,322**

A.4.4. Public funding of the small-scale project activity:

There are no public and/or ODA funds involved in this project.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

According to paragraph 2 of Appendix C to the Simplified Modalities and Procedures for Small-Scale CDM project activities (FCCC/CP/2002/7/Add.3), a small-scale project is considered a debundled component of a large project activity if there is a registered small-scale activity or an application to register another small-scale activity:

- With the same project participants;
- In the same project category and technology/measure; and
- Registered within the previous 2 years; and
- Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.

The Nam Ngan Hydropower Project is a unique hydropower plant constructed on the Nam Ngan stream between Viet Lam and Quang Ngan communes, Vi Xuyen district, Ha Giang province. Therefore, this project is not a component of any large project. The project is a stand-alone project, which is privately owned by the Nam Mu Hydropower Joint Stock Company. The Company has not registered another project in the region surrounding the project boundary.

SECTION B. Application of a baseline and monitoring methodology

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

Project Type: I. Renewable energy project
Project Category: I.D. Grid connected renewable electricity generation - Version 16 (I.D./Version 16, Sectoral Scope: 01, EB 54)
Reference: Appendix B of the Simplified Modalities & Procedures for small scale CDM project activities (FCCC/KP/CMP/2005/8/Add.1)

B.2 Justification of the choice of the project category:

The details on how the proposed project is complied with the applicable requirements of AMS-I.D are presented in the Table below:

Table 3. Applicability of small scale methodology AMS-I.D.

	Applicability Criteria	Project Activity
1	This category comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal and renewable biomass that supply electricity to a national or a regional grid. Project activities that displace electricity from an electricity distribution system that is or would have been supplied by at least one fossil fuel fired generated unit shall apply AMS I.F.	The proposed project is based on hydropower, a renewable energy generation source to generate electricity that is supplied to the national grid.
2	This methodology is applicable to project activities that (a) install a new power plant at a site where there was no renewable energy power plant operating prior to the implementation of the project activity (Greenfield plant); (b) involve a capacity addition; (c) involve a retrofit of (an) existing plant(s); or (d) involve a replacement of (an) existing plant(s).	The proposed project involves the installation of a new hydropower plant at a site where there was no renewable energy power plant operating prior to the implementation of the project activity.
3	The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the Project Emissions section, is greater than 4 W/m^2	The project activity results in new reservoir and the power density of the power plant, as per definitions given in the Project Emissions section, is 10.3 W/m^2 which is greater than 4 W/m^2.
4	In the case of biomass power plants, no other biomass types than renewable biomass are to be used in the project plant	The project activity involves the construction of a hydropower plant. This criterion is thus not applicable.
5	If the new unit has both renewable and non-renewable components (e.g.,. a wind/diesel unit), the eligibility limit of 15 MW for a small-scale CDM project activity applies only to the renewable component. If the new unit co-fires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15 MW.	The project does not incorporate a mix of renewable and non-renewable components. This criterion is therefore not applicable. The total installation capacity of the proposed project is 13.5 MW, which is within the limit of 15 MW stipulated for the chosen (small-scale) methodology.
6	Combined heat and power (co-generation) systems are not eligible under this category.	There is no combined heat and power component in the project activity. This criterion is therefore not applicable.
7	In the case of project activities that involve the addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be physically distinct from the existing units.	The project activity does not involve the addition of renewable energy generation units at an existing facility. This criterion is therefore not applicable.

8	In case of retrofit or replacement, to qualify as a small-scale project, the total output of the retrofitted or replacement unit shall not exceed the limit of 15MW.	The project activity does not involve the retrofit or replacement of (an) existing unit(s). This criterion is therefore not applicable.

B.3. Description of the project boundary:

According to methodology AMS I.D, Version 16, the boundary for this project is delineated by the physical, geographical site of the renewable generation source.

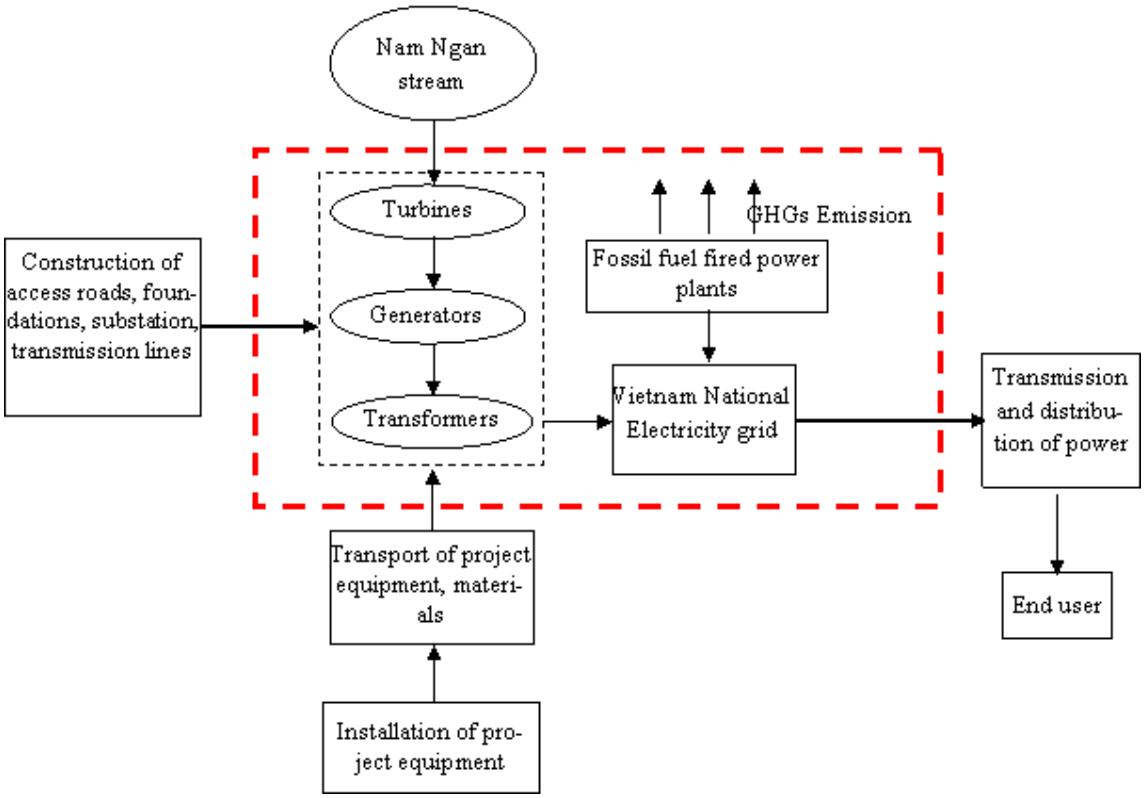

Figure 3: Project boundary

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	Yes	Main emission source. The power density of the project is 10.3 W/m^2
		N_2O	No	Minor emission source

B.4. Description of baseline and its development:

Because the project activity is the installation of a new grid-connected renewable power plant/unit, the baseline scenario is the electricity delivered to the grid by the project activity that otherwise would have been generated by the operation of grid-connected power plants and by the addition of new generation sources. The baseline emissions are the product of electrical energy baseline $EG_{BL, y}$ expressed in MWh of electricity produced by the renewable generating unit multiplied by the grid emission factor.

$$BE_y = EG_{BL, y} \times EF_{CO2,grid,y}$$

Where:

BE_y : *Baseline Emissions in year y (tCO_2)*

$EG_{BL, y}$: *Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year y (MWh)*

$EF_{CO2,grid,y}$: *CO_2 Emission Factor of the grid in year y ($t CO_2/MWh$)*

The Emission Factor can be calculated in a transparent and conservative manner as follows:

(a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the 'Tool to calculate the emission factor for an electricity system'.

OR

(b) The weighted average emissions (in tCO_2e/kWh) of the current generation mix. The data of the year in which project generation occurs must be used

Method (a) is used for calculation of the emission factor.

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 development of the baseline is described in section B.6.

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 small-scale CDM project activity:

The incentive from the CDM was seriously considered in the decision to proceed with the project activity. It was reflected via the Company's action to secure the CDM status by organizing an official meeting to consult public opinions (local residents and local authorities) on the social and environmental impacts of the proposed hydropower project in order to develop it as a CDM activity on 15 August 2005. Later on the project owner submitted official letters to Ha Giang People's Committee – PPC (the highest provincial authority) and to the DNA on 28 October 2006 to notify the CDM project and to request for their support in developing the proposed project as a CDM project activity. Subsequently, an official letter was submitted by Ha Giang People's Committee to the DNA on 31 October 2006 verifying the request from the Company. This was prior to the start date of the proposed project activity which is defined as the date of signing the construction contract for the proposed project on 10 December 2006.

Since then the project owner has been spending continuously efforts in pursuing the CDM, i.e. submitting the project to the DNA for their official approval and looking and negotiating with buyers for CERs generated in parallel with the implementation of the investment project.

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 3: Major milestones in developing the investment project and CDM application

Development of the investment project	Activities taken to secure CDM status	Time	CDM implication
	Learnt about CDM via the publications and materials published by Ministry of Natural Resources and Environment (MONRE)	early 2005	
Finalising Project Idea report (Pre-feasibility Study)		Jun 05	
	The minutes of meeting to consult local people and authorities on the social and environmental impacts of the hydropower project in order to develop the project as a CDM activity	15 Aug 2005	Evidence for CDM early consideration
	Issuing the Decision on CDM and investment project by the Director	25 Feb 2006	Date of making the investment decision
Finalising Project investment report (Feasibility Study)		Jul 2006	

	Submitting an official letter by the project sponsor to the DNA and the PPC on requesting for verifying and support the CDM project	28 Oct 2006	
	Submitting an official letter by the PPC to the DNA on requesting for verifying and support the CDM project	31 Oct 2006	
	Signing CDM development and registration contract with the CDM consultant (CDM consultancy contract)	22 Nov 2006	
Issuing the Decision of the Board of Management on approval of the Technical Design and Investment Cost of the project -		4 Dec 2006	
	Approaching and negotiating with the CER buyer	Dec 2006	
Signing the General Contract for the construction of the proposed project		10 Dec 2006	Starting date of the project activity
Signing the Contract for the purchase of mechanical and hydraulic equipment and technical services		7 Feb 2007	
Issuing the Certificate of Investment by Provincial People's Committee		27 Feb 2007	
	Signing Termsheet for the Sale of CERs	11 Jul 2007	
	Issuing the LOA by the DNA	30 Jul 2007	
Signing the Negotiation report on the purchase of the power generated by the hydropower project signed with EVN		18 Sep 2007	
	Signing ERPA	15 Jan 2008	

According to Attachment A to Appendix B to the simplified Modalities & Procedures for small-scale CDM project activities, which has listed various barriers, at least one barrier listed shall be identified due to which the project would not have occurred any way.

The main barrier identified by the project owner at the date of decision making was the financial barrier and the project owner hence made the decision to implement the project as a CDM project activity. The existence of the barrier is demonstrated in the following by benchmark analysis.

As the project generates financial benefits other than CDM related income, investment comparison analysis or benchmark analysis needs to be used to demonstrate additionality. As there are no other credible and realistic baseline scenario alternatives other than electricity supply from the grid, benchmark analysis is chosen to prove additionality.

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 12, 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:

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

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.

And it also reflects a common-practice approach in investment decision-making in Viet Nam as this approach was also introduced by the Ministry of Industry to conduct the financial analysis of IPP projects in Viet Nam[6].

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 range from 12.6% to 16.2% of the interest rates for long-term credit published in the Annual Report of the State Bank of Viet Nam. 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 12.6% at the date of making the investment decision.

[6] Decision No. 2014/QĐ – BCN issued by the Ministry of Industry provides temporary guidelines for conducting the economic, financial and investment analysis and providing the purchasing-selling price frame for power generation projects.

Determine the cost of equity

To derive an appropriate cost of equity for electricity generation project type in Vietnam, the following well-known CAPM[7] 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 Ha Noi Stock Exchange's website.

The risk free rate applied is 9.25% for 15 years term[8].

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, the beta is determined by referring to beta values of publicly listed companies that are engaged in similar types of business.

However, at the time of making the investment decision, there was only one company in power sector of Vietnam which was listed in the stock market for only several months. Apparently, the data available from the Vietnamese Stock Market is not sufficient to estimate the beta for power generation sector. To solve it, the beta for power generation sector determined from other companies in emerging countries (mainly China) which are in the process of rapid growth and industrialization having similar economic conditions to Viet Nam have been chosen.

[7] 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.

[8] http://hnx.vn/Thongtin_Giaodich.asp?actType=1&menuup=402000&TypeGrp=1&MenuId=114000&StockType=1&IssuerID=697

According to the source from Bloomberg[9], the average beta of electricity generation companies in emerging countries in the recent years is 1.02.

So the applied beta is 1.02

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 4: Market expected return calculation.

Market index (VN Index) on 28-Jul-2000	100.00
Market index (VN Index) on 25-Feb-2006	373.50
No. of years	5.58
Expected Return	26.62%

Substituting

R_f = 9.25%;

R_m = 26.62%;

β = 1.02

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:

$$\boldsymbol{R_e = 27.04\%}$$

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 has been published an annual "International Cost of Capital Perspectives Report" since 2001 that 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[10]. In total the report gives 12 different values for Viet Nam (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

[9] http://www.stern.nyu.edu/~adamodar/

[10] 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. As the report includes proprietary information of the publisher, all relevant details of the report as well as the exact source have been submitted directly to the DOE for validation.

than the return on equity 27.04% 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[11]. 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 5: Key assumptions to calculate the benchmark

No	Parameter	Unit	Value
1	Total investment cost[12]	billion VND	251.345
	Construction cost	billion VND	130.576
	Equipment cost	billion VND	58.795
	Compensation costs	billion VND	4.0
	Other costs	billion VND	36.746
	Contingency cost	billion VND	21.227
2	Project equity[13]	billion VND	75.4
3	Expected return on equity rate[14]	%	22.45
4	Debt		
	• Total	billion VND	175.9
	• Interest rate[15]	%	12.6
5	Average enterprise revenue tax during the lifetime[16]	%	22.00
6	**WACC**	**%**	**13.61**

The key assumptions used to calculate the Project IRR of the proposed project are presented in Table 6.

[11] The report by Alpha Securities Company has been submitted to the DOE.
[12] Page 4, Total investment cost, (07, 2005), prepared by Song Da Ucrin consultant
[13] Decision No. 709/QĐ – NLDK dated 13 April 2004 issued by the Ministry of Industry providing temporary guidelines for conducting the economic, financial and investment analysis and providing the purchasing-selling price frame for power generation projects
[14] "International Cost of Capital Perspectives Report" 2005. Ibbotson Associates, Inc.
[15] Page 38, Annual report 2005, State Bank of Vietnam
[16] Government Decision No 164/2003/ND-CP on implementation of enterprise tax law issued on 22 December 2003, Chapter V: Article 38 – Item 4

Table 6: Key assumption for investment analysis

No	Parameter	Unit	Value
1.	Gross capacity[17]	MW	13.5
2.	Annual net electricity generation[18]	MWh	57,450
3.	Total investment cost	billion VND	251.3
4.	Total annual O&M cost[19]	billion VND	3.3
5.	Preparation and construction period[20]	year	2.5
6.	Life time (Period of financial assessment) [21]	year	35
7.	Depreciation[22]	year	20
8.	Feed-in tariff[23]	VND/kWh	608
9.	Resources tax[24]	%	2
10.	Enterprise revenue tax[25] • For the first 4 years • For the next 7 years • For the next 4 years • For the remaining years	%	 0 14 28 28
11.	**Project IRR without CDM**	**%**	**9.58**

This table shows that the project IRR was lower than the benchmark at the time of decision making on the proposed project which was defined as the date of issuing the investment decision on CDM on 25 February 2006.

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 amount of electricity exported to the national grid
- O&M costs
- Investment costs

[17] Summary report (06, 2005) prepared by Song Da Ucrin consultant

[18] Summary report (06, 2005) prepared by Song Da Ucrin consultant, annual net electricity generation is the different between the total quantity of electricity generated by the power plant and the auxiliary electricity consumption of the power plant (1% of total)

[19] Decision No. 709/QĐ – NLDK dated 13 April 2004 issued by the Ministry of Industry providing temporary guidelines for conducting the economic, financial and investment analysis and providing the purchasing-selling price frame for power generation projects.

[20] Project feasibility study

[21] Lifetime refer to the default lifetime of turbine in the EB 50, Annex 15

[22] Prevailing common practice period for industrial investment project

[23] Referring to an aaverage feed-in tariff agreed for some other IPP hydropower projects by the EVN that is available at the time of making investment decision. The source and details have been provided to the DOE.

[24] According to the Circular No 05/2006/TT-BTC issued by Ministry of Finance on 19 Jan 2006, the resource tax will be calculated as the net electricity outputs supplied to the national electricity grid x 700 VND x 2%

[25] Government Decision No 164/2003/ND-CP on implementation of enterprise tax law issued on 22 December 2003, Chapter V: Article 38 – Item 4

- Feed-in tariff set by EVN

Table 8 shows the impact of variations in key factors on the Project IRR.

Table 7: Sensitivity analysis

No	Parameter	Variation	Project IRR	Likelihoods to happen
1	Annual amount of electricity exported to the national grid	+40%	13.61%	The probability of a 40% 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 40% annual increase compared with the current estimation for the entire crediting period. This option shall be discarded.
		+10%	10.64%	Lower than the benchmark
		-10%	8.47 %	Lower than the benchmark
2	O&M costs	+10%	9.47%	Lower than the benchmark
		-10%	9.68%	Lower than the benchmark
		-100%	10.60%	In the case of zero total O&M cost (or 100% decrease of O&M Cost), the Project IRR is 10.60% that is still lower than the benchmark. This option shall be discarded.
3	Investment costs	+10%	8.67%	Lower than the benchmark
		-10%	10.64%	Lower than the benchmark
		-30%	13.61%	The probability of a 30% decrease in the total investment cost is not likely to happen because the statistic CPI of housing and materials construction in 2005, 2006 and 2007 show an annual increase of 55.1%, 50.4% and 103.6% respectively compared with December of the previous year. The general CPI in 9 first months of 2008 has already increased 21.87%. And in fact, the total Investment cost estimated at time of March 2009 was increased 12%.[26] so this option shall be discarded.

[26] According to the financial report.

4	Feed in tariff set by EVN	39%	13.61%	The probability of a 39% increase in feed in tariff annually is very unlikely because the PPA contract will be signed with EVN with a fixed feed in tariff for long term. And the price has been negotiated and agreed with EVN for this project is 602 VND/kWh (or 1% decreasing). So this option shall be discarded.
		10%	10.66%	Lower than the benchmark
		-10%	8.45%	Lower than the benchmark

In conclusion, the proposed project activity is additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

I. Project emissions *(PE_y)*

The project emission for Nam Ngan hydropower project is:

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

In which:

$PE_{HP,y}$ *:* Emission from reservoir

The emissions from the reservoir ($PE_{PD,y}$)

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:

$$PE_{HP,y} = \frac{EF_{Res} \times TEG_y}{1000}$$

Where:

$PE_{HP,y}$	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:

$$PE_{HP,y} = 0$$

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:

$$BE_y = EG_{BL,y}. EF_{CO2,grid,y}$$

Where

BE_y	Baseline emissions in year *y* (tCO_2/yr).
$EG_{BL, y}$	Quantity of net electricity generation supplied by the hydropower plant to the grid as a result of the implementation of the CDM project activity in year *y* (MWh)
$EF_{CO2,grid, y}$	CO_2 emission factor of the grid in year *y*

The baseline scenario is that electricity delivered to the national grid by the project would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation based mainly on coal and oil resources.

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. (optional)	Choose whether to include off-grid power plants in the project electricity system
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.
STEP 6.	Calculate the build margin emission factor.

STEP 7. Calculate the combined margin emissions factor.

Step 1. Identify the relevant electricity 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 grid power plants are include in the calculation

Option II: Both grid power plants and off-grid power plants are included in the calculation

Because only the data of grid connected power plants is available. So Option I will be chosen for calculating the grid emission factor

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

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

a) Simple OM;

b) Simple adjusted OM;

c) Dispatch data analysis OM;

d) Average OM.

The method (a) can be used in the project because low-cost/must-run resources in Vietnam is 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 8: Rate of low cost/must-run sources based on generation[27]

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

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

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 operating margin 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)

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

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

Where:

$EF_{EL,m,y}$	is the CO_2 emission factor of power unit *m* in year *y* (tCO_2/GWh)
$FC_{i,m,y}$	Amount of fossil fuel type *i* consumed by power plant/unit *m* in year *y* (mass or volume unit)
$NCV_{i,y}$	Net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ/mass or volume unit)

$EF_{CO2,i,y}$	CO_2 emission factor of fossil fuel type *i* in year *y* (tCO_2/GJ)
$EG_{m,y}$	Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost/must-run power plants/units, in year *y* (MWh)
i	All fossil fuel types combusted in power sources in the project electricity system in year *y*
y	The relevant year as per the data vintage chosen in Step 3

Table 9: Operating Margin emission factor of the most recent 3 years (2005, 2006 and 2007)[28]

Year	2005	2006	2007	$EF_{grid,OM}$ (tCO_2/MWh)
Total emission of the Vietnam national grid (tCO_2e)	22,752,237	24,753,523	26,895,639	0.6017
Total electricity delivered to the grid by fossil power sources (MWh)	36,701,670	40,764,000	46,191,700	

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

$$\boldsymbol{EF_{grid,OMsimple,y} = 0.6017\ tCO_2/MWh}$$

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

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

[28] Source: Institute of Energy – EVN, 2007 via a data providing contract. The data and source are submitted to the DOE for validation. The Institute of Energy which belongs to the EVN provides the most actually updated data relevant to the power generation in Vietnam that could be accessed by public.

recently has the larger annual generation (15,476,442MWh) than the set of five power units that have been built most recently in 2007 does (1,175,442MWh)[17], and hence it is employed.

Step 6. Calculate the build margin 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:

$$\boldsymbol{EF_{grid,BM,y} = 0.4191\ tCO_2/MWh}$$

Step 7. Calculate the combined margin emissions factor

The CM emissions factor is calculated as follows:

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

Where:

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

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

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

$$\boldsymbol{EF_{grid,CM,y} = 0.5 \times 0.6017 + 0.5 \times 0.4191 = 0.5104\ tCO_2/MWh}$$

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

III. Leakage *(LE_y)*

The potentially main leakage in the context of the proposed project activity is emissions arising due to activities such as power plant construction and land inundation. But according to AMS.I.D, Version 16 these emission sources do not need to be considered as leakage, therefore $\boldsymbol{LE_y = 0}$

IV. Emission reductions *(ER_y)*

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y$$

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:	**$FC_{i,m,y}$**
Data unit:	mass or volume unit
Description:	Amount of fossil fuel type *i* consumed by power plant / unit *m* in year *y*
Source of data used:	Institute of Energy – EVN, 2007 via a data providing contract
Value applied:	Value applied presented 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. The Institute of Energy which belongs to the EVN provides the most actually updated data relevant to the power generation in Vietnam that could be accessed by public.
Any comment:	For calculation of EF_{OM} or EF_{BM}

Data / Parameter:	**$NCV_{i,y}$**
Data unit:	GJ / mass or volume unit
Description:	Net calorific value (energy content) of fossil fuel type *i* in year *y*
Source of data used:	Institute of Energy – EVN, 2007 via a data providing contract
Value applied:	Value applied presented 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. The Institute of Energy which belongs to the EVN provides the most actually updated data relevant to the power generation in Vietnam that could be accessed by public.
Any comment:	For calculation of EF_{OM} or EF_{BM}

Data / Parameter:	**$EF_{CO2,i,y}$**
Data unit:	tCO_2/GJ
Description:	CO_2 emission factor of fossil fuel type *i* in year *y*
Source of data used:	Default value of the IPCC 2006 Guidelines
Value applied:	Value applied presented 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_{OM} or EF_{BM}

Data / Parameter:	**$EG_{m,y}$**
Data unit:	MWh
Description:	Net electricity generated and delivered to the grid by power plant/unit m in year *y*
Source of data used:	Institute of Energy – EVN, 2007 via a data providing contract
Value applied:	Value applied presented 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. The Institute of Energy which belongs to the EVN provides the most actually updated data relevant to the power generation in Vietnam that could be accessed by public.
Any comment:	For calculation of EF_{OM} or EF_{BM}

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

Data / Parameter:	**A_{BL}**
Data unit:	m^2
Description:	Area of the reservoir measured in the surface of the water, before the

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

Data / Parameter:	**EF_{res}**
Data unit:	kg CO_2e/MWh
Description:	Default emission factor for emissions from reservoirs
Source of data used:	Default value as per EB23
Value applied:	90 kgCO_2e/MWh.
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	For calculation of project emission (PE)

B.6.3 Ex-ante calculation of emission reductions:

Baseline emissions

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

$$BE_y = EG_{BL,y} \cdot EF_{CO_2,grid,y}$$

Where: EG_{BLy} = 57,450 MWh and $EF_{CO2,grid,y}$ = 0.5104 tCO_2/MWh

therefore:

$$BE_y = 29{,}322 tCO_2$$

Project emissions

The project emission includes the emission from a new reservoir. The following formula is applied:

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

$PE_{HP,y}$ is the emissions from the reservoir

The emissions from the reservoir

The proposed project activity involves the construction of a new hydropower plant and new reservoir thus $A_{BL} = 0$ and $Cap_{BL} = 0$. The power plant have installed capacity and reservoir area are listed as detailed in table below

Table 11: Installed capacity and respective reservoir area of hydropower plant

Hydropower plant	**Nam Ngan**
Installed capacity (MW)	13.5
Reservoir area (ha)	131

The power density project plant is derived as follows:

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}} = \frac{13.5 \times 10^6 - 0}{131.0 \times 10^4 - 0} = 10.3 W / m^2$$

As the power density of the project plant is above 10 W/m^{2,} thus the project emission is zero: $PE_{HP,y} = 0$

Leakage

Because the technology used in this project is neither transferred to nor transferred from another activity leakage is considered to be zero ($LE_y = 0$)

Reduction emissions

Emission reduction in year y ER_y is calculated as follows:

$$ER_y = BE_y - PE_y - LE_y = BE_y - PE_y$$

$$= 29{,}322 tCO_2$$

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

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

Table 10: Emission reduction of the project activity

Year	**Estimation of project activity emissions (tCO_2 e)**	**Estimation of baseline emissions (tCO_2 e)**	**Estimation of leakage (tCO_2 e)**	**Estimation of overall emission reductions (tCO_2 e)**
2010 (Aug. to Dec.)	0	12,217	0	12,217
2011	0	29,322	0	29,322
2012	0	29,322	0	29,322
2013	0	29,322	0	29,322
2014	0	29,322	0	29,322
2015	0	29,322	0	29,322

2016	0	29,322	0	29,322
2017 (Jan. To Jul)	0	17,105	0	17,105
Total (tonnes of CO_2e)	**0**	**205,254**	**0**	**205,254**

B.7 Application of a 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 lines after the rising transformer 6.3/110KV in 110kV Nam Ngan distribution station
Value of data applied for the purpose of calculating expected emission reductions in section B.6	57,450
Description of measurement methods and procedures to be applied:	Two-way power meters will be installed at the grid-connected point to measure the amount of electricity supplied to the grid by the proposed hydropower plant by the positive direction. The readings of electricity meter will be continuously measured by the power meter and monthly recorded. The recorded data will be confirmed by the joint balance sheet which will be signed by the representatives of EVN and the project owner. Electronic data will be archived within the crediting period and 2 years after the end of the crediting period.
Monitoring frequency	Continuously 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 $EG_{BL,y} = EG_{y, export} - EG_{y, import}$

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 lines after the rising transformer 6.3/110KV in 110kV Nam Ngan distribution station
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 continuously measured and monthly recorded. The recorded data will be confirmed by the joint balance sheet which will be signed by the representatives of EVN and the

	project owner. Electronic data will be archived within the crediting period and 2 years after the end of the crediting period.
Monitoring frequency	Continuously 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 $EG_{BL,y} = EG_{y,\ export} - EG_{y,\ import}$

Data / Parameter:	$EG_{BL,\ y}$
Data unit:	MWh
Description:	Electricity output produced by the Nam Ngan Hydropower plant and supplied to the national electricity grid
Source of data to be used:	Calculating from $\mathbf{EG_{y,\ import}}$ and $EG_{y,\ export}$
Value of data	57,450
Description of measurement methods and procedures to be applied:	Calculating by subtracting $\mathbf{EG_{y,\ import}}$ from $EG_{y,export}$. Data will be archived within the crediting period and 2 years after the end of the crediting period.
Monitoring frequency	Continuously measurement and monthly recording
QA/QC procedures to be applied:	Sales record of electricity to the grid is used to ensure the consistency.
Any comment:	For CERs calculation

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 used:	Project site
Value of data applied for the purpose of calculating expected emission reductions in section B.6	131,000
Description of measurement methods and procedures to be applied:	Measured from topographical surveys, maps, satellite pictures, etc
Monitoring frequency	Yearly
QA/QC procedures to be applied:	The uncertainty level of this data is low
Any comment:	For power density calculation

Data / Parameter:	$\boldsymbol{Cap_{PJ}}$
Data unit:	W

Description:	Installed capacity of the hydro power plant after the implementation of the project activity.
Source of data to be used:	Project site
Value of data applied for the purpose of calculating expected emission reductions in section B.6	13,500,000
Description of measurement methods and procedures to be applied:	Manufacture's nameplate
Monitoring frequency	Yearly
QA/QC procedures to be applied:	
Any comment:	Use for calculating the power density

Data / Parameter:	TEG_y
Data unit:	MWh
Description:	Total electricity produced by the project activity, including the electricity supplied to the grid and the electricity supplied to internal loads, in year *y*.
Source of data to be used:	Direct measurement at the project site
Value of data applied for the purpose of calculating expected emission reductions in section B.6	58,030
Description of measurement methods and procedures to be applied:	Directly measured power meters will be installed at the grid-connected point to measure the amount of generated electricity. The readings of electricity meter will be continuously measured by the power meter and monthly recorded. Electronic data will be archived within the crediting period and 2 years after the end of the crediting period.
Monitoring frequency	Continuously measurement by the power meter and monthly recording
QA/QC procedures to be applied:	The uncertainty level of this data is low. The measurement/ monitoring equipment should adopt the colligated automation system complying with national standard and technology. These equipment and systems should be calibrated and checked every 2 year.
Any comment:	Use for calculating $PE_{HP,y}$

B.7.2 Description of the monitoring plan:

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

$$EG_{BL,y,} = EG_{y,\,export} - EG_{y,\,import}$$

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

The electricity generated from the project activity before entering into the grid at the grid interconnection point will be measured by a digital kilowatt hour (kWh) meter. The power meters located at the lines after the rising transformer 6.3/110KV in 110kV Nam Ngan distribution station, are bi-directional nature. The metering system includes the main system and a back-up system. The back-up system will be used in case of failing of the main meter.

Data from the operating meters will be recorded electronically continuously. 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 protocol of the amount of power fed into the grid since the last protocol/start of operation of the power plant.

This protocol is the basis of payment by the EVN to the project proponent. Hence the monitoring plan is well integrated into the standard EVN procedures.

In construction phase, the project owner implemented an auxiliary electricity line. However, when the hydropower project starts operating, it will be definitely cut off and not be used in future.

For further details see Annex 4.

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

Date: 1/10/2008

The responsible entity: **Energy and Environment Consultancy Joint Stock Company** 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:

10/12/2006

This is the date of signing the first construction contract that is the earliest contract signed by the project owner to commit for the project's expenditures. This is in accordance with the "CDM Glossary of Terms/version 05", which define the starting date of project as "the earliest date at which either the implementation or construction or real action of a project activity begins".

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

35 years

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

C.2.1. Renewable crediting period

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

01/08/2010 or registered date whenever is the latter

C.2.1.2. Length of the first crediting period:

7 years

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not applicable

C.2.2.2. Length:

Not applicable

SECTION D. Environmental impacts

Pursuant to Circular No. 490/TT-BKHCNMT on guiding the verification of technology and environment of investment projects issued on 29 April 1998 by Ministry of Science, Technology and Environment, the report on and registration for environmental criteria of this project had been carried out. This report was approved by the Department of Natural Resources and Environment of Ha Giang (Ha Giang DONRE) on 04 October 2005.

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.

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

D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

The summary of the environmental impacts of the project activity is given below:

1.1. Environment Impacts

1. Impact on land

The proposed project will occupy about 1,234,105.8 m^2 of land, of which about 9,823.7 m^2 is agricultural land (approximate 0.8%) and 750,587.7 m^2 is forest land (approx. 60.8%). The rest of land occupied is wild land along the banks of the Nam Ngan stream.

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

2. Impact on water flow

The project will create a small reservoir with an area of 1.31 km^2 with total volume about 18,070,000 m^3. It regulates water level on a seasonal basis.

When commissioning, the reservoir will be used for the purpose of generating electricity but also be helpful to prevent floods and to regulate water serving 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 favorable conditions for fishery.

Impact on water flow of Nam Ngan stream

The Nam Ngan stream, the first branch of the Lo river, originates in the right side of Am mountain chain at height 1971 m and the left side of Nam An mountain at height 725.6 m. A valley created by the Nam Ngan stream is located between two high mountain chains, while there are eroding mountain-side terrains with high level separation. The stream after the dam does not have any households and the area is mainly covered by thin and poor forests.In the stream section behind the dam and power plants, there are several small streams still join the Nam Ngan stream that will continue providing extra water for this section. So, the reduction of water level in this area does not impact on agriculture nor living activities.

Impact on water flow of Vat stream

From the discharge channel of Nam Ngan hydropower plant, water runs to the Vat stream and the to the Lo river. The flow regime in the Vat stream will change slightly. Moreover, the sand volume will be reduced and erosion speed to stream banks will be changed accordingly. However, in the stream banks, gravelly soil is stable, so this impact is insignificant.

3. Impacts on ecological system

Impacts on fauna and flora

The Nam Ngan hydropower project does not cross-out any natural conservation areas, national forests or specialized forest. At the project location, there are only poor forest and small cultivated lands along the stream with low productivity will be occupied. So this impact is low.

After commissioning, the forest area which is temporarily occupied will be reforested, combining with perennial and fruit-tree plantation. 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 favorable impacts on surrounding flora system.

The main impact on fauna is the disturbance on the habitat of animals around the project site during the construction period. This may result in movement of wildlife from the project vicinity to other forested areas. However, in this project's site, there is not any endangered animal and the impacts will be terminated after the construction. So this is a minor impact.

Impacts on aquatic life

After the dam is constructed, it will have certain impacts on the mitigation of fish from the up-stream area and down-stream area. According to studies on fish resource in Nam Ngan region, surveys and information provided by local people, the fish resource in this stream is very poor. On the other hand, local people can use this reservoir for aquaculture cultivation. Therefore, the negative impacts are not severe.

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, and road construction 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. Negative impacts

There are 05 households have to be resettled under the project. These households will be compensated for lands, houses, farm produces and to support for stabilising their livings as required by the Vietnamese government and approved by Ha Giang People Committee.

2. Positive impacts

As presented in Section A.2

1.3. Mitigation measures to reduce negative impacts

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.

2. Operational phase

Preventive measures and reaction towards environment problems: Installing 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 during the construction phase. However, all these impacts will be mitigated by implementing mitigation measures and then will be terminated after accomplishing the construction. 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 stakeholders' consultation has been made pursuant to the existing regulations on development of CDM projects and investment in power generation in Vietnam. The following stakeholders have been involved:

- People Committee of Ha Giang province (the highest local authority): has granted the proposed investment project and supported to develop this project as a CDM project activity in the official letter No. 2941/UBND-NVKT dated 31 October 2006.
- Department of Natural Resources and Environment of the Ha Giang province: validated the application for the registration of environmental criteria submitted by the Nam Mu Hydropower Joint Stock Company, then approved it at the Confirmation No. 222/XN - TNMT dated 04 October 2005.
- Local people and local authority (People's Committee of Vi Xuyen district) were informed about the project activity since the formulating stage of the project and have presented their feedbacks on the project proposal. The stakeholders were informed about the project by public speaker and notices at the Communal People Committess's office. And then, they were invited to the official meetings with the project owner to present their comments/concerns.

  The local people also involved actively in negotiation procedures for compensating of lands occupied by the project with the compensation board which was established on 26 November 2006. The negotiation process was organised in the following steps:

  - Firstly, the meeting to announce the proposed project activity and to collect opinions/feedbacks on the project was held with local people. Each household from 65 households who live in Viet Lam, Quang Ngan and Thuong Son communes having either lands and/or vegetations occupied/replaced by the project was invited and filled in a survey to provide statistic data on impacted lands and any assesses during 2006.
  - The negotiations on the reimbursement for local people who are impacted by the project were conducted with each household until reaching an agreement for compensation.
  - After completing the compensation plan, the compensation board submitted this plan to the higher authority – People's Committee of Ha Giang. Finally, the compensated plan was

approved by the People's Committee of Ha Giang province via the Decision No. 194/QD-UBND dated 19 January 2007.

Following the national CDM modalities, the local people of Quang Ngan commune were involved in the consultation process on the impacts and contribution on achieving the local sustainable development target and poverty alleviation of the proposed CDM project via a meeting between the project owner and the representatives of the local people on 15 August 2005.

E.2. Summary of the comments received:

All organizations and stakeholders agreed that the project will certainly contribute to sustainable development and environment protection in Viet Nam, and especially this project will increase local budget and reduce poverty in the project's region. Therefore, they show strong supports to the implementation of the proposed project.

The main comments from the local people and local authority are summarized as follows:

- The proposed hydropower project is highly welcomed since it is a clean industrial project and will facilitate socio-economic development in the project's area.
- The local people can benefit from infrastructure improvement such as electricity access and clean water system at the early phase of the construction that will maintain during the operation phase.
- The local people expect that the project activity will offer new jobs to local people during both construction and operation phases and project owner will minimise negative impacts during the construction phase as committed.
- The local people expect that the lands and assesses (mainly vegetations) occupied and/or replaced by the project will be compensated adequately.

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

The comments of the above mentioned organisations are carefully examined by the project's owner. In general, comments are positive comments with no major concerns or severe objections.

Nevertheless, the project's owner committed to employ and train appropriate local people to work during the construction and operation phases; and to comply and implement mitigation activities during the construction phase as planned in the EIA report in order to minimise negative impacts on local environment.

The negotiations on the compensation for local people impacted by the project were conducted with each household until reaching a satisfied compensation agreement. The project owner commits that 70% of the total compensation budget will be disbursed to local people as soon as the details of compensation plan is finalised. The 30% remaining will be paid soon after the compensation plan approved by the local authority.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There are no public and ODA funds involved in this project.

Annex 3

BASELINE INFORMATION

Data of power plants in the Vietnam national grid in 2005, 2006 and 2007[1]

Data for calculating of $EF_{grid, OM, 2005}$

Table 19: Data for calculating of $EF_{grid, OM, 2005}$

General information			FUEL 1: Main fuel						FUEL 2: Sub fuel						Emission factor
ID(j)	NAME (m)	COM (m)	FUEL (1,m)	FC (1,m,2005)	NCV (1,2005)		EF (CO2,1,2005)		FUEL (2,m)	FC (2,m,2005)	NCV (2,2005)		EF (CO2,2,2005)		EG(m,2005)
ID number of the power plant 'm'	Name of the power plant 'm' serving the grid in year '2005' except low-cost/must-run power plant	Commission date of the whole power plant	Fuel type '1' combusted in power plant 'm' in year '2005'	Amount of fossil fuel type '1' consumed by power plant 'm' in year '2005'	Net Calorific Value (energy content) of fossil fuel type '1' in year '2005'		CO2 emission factor of fossil fuel type '1' in year '2005'		Fuel type '1' combusted in power plant 'm' in year '2005'	Amount of fossil fuel type '2' consumed by power plant 'm' in year '2005'	Net Calorific Value (energy content) of fossil fuel type '2' in year '2005'		CO2 emission factor of fossil fuel type '2' in year '2005'		Net electricity generated and delivered to the grid by the power plant 'm' in year '2005'
-	-	-	-	(Coal, DO, FO: kt; Gas: million m3)	(Coal, DO, FO: kCal/kg Gas: kCal/m3	(Coal, DO, FO: GJ/kt, Gas:GJ/million m3	kg CO2/TJ	tCO2/GJ	-	(Coal, DO, FO: kt; Gas: million m3)	(Coal, DO, FO: kCal/kg Gas: kCal/m3	(Coal, DO, FO: GJ/kt Gas: GJ/million m3	kg CO2/TJ	tCO2/GJ	MWh
1	Phu My 2.1	December 2005	Gas	724	9072	37,983	54,300	0.0543	DO	30.64	10150	42,496	72,600	0.0726	3,640,000
2	Na Duong	November 2005	coal	249	3950	16,538	94,600	0.0946	DO	0.30	10150	42,496	72,600	0.0726	389,000
3	Phu My 2.2	February 2005	Gas	665	9072	37,983	54,300	0.0543	DO	32.74	10150	42,496	72,600	0.0726	3,719,000
4	Phu My 4	July 2004	Gas	537	9072	37,983	54,300	0.0543	DO	28.05	10150	42,496	72,600	0.0726	3,013,000
5	Formosa	April 2004	coal	280	6500	27,214	94,600	0.0946	DO	0.62	10150	42,496	72,600	0.0726	800,000

[1] Source: Institute of Energy – EVN, 2008 via a data providing contract. The data and source are submitted to the DOE for validation. The Institute of Energy which belongs to the EVN provides the most actually updated data relevant to the power generation in Vietnam that could be accessed by public.

6	Phu My 3	March 2004	Gas	772	9072	37,983	54,300	0.0543	DO	58.32	10150	42,496	72,600	0.0726	4,442,000
7	Phu My 1	June 1905	Gas	1308	9072	37,983	54,300	0.0543	DO	1.63	10150	42,496	72,600	0.0726	7,171,300
8	Pha Lai 2	December 2002	coal	2077	4950	20,725	94,600	0.0946	DO	3.32	10150	42,496	72,600	0.0726	4,299,000
9	Ba Ria	early 2002	Gas	456	9072	37,983	54,300	0.0543	DO	12.58	10150	42,496	72,600	0.0726	2,204,495
10	VeDan	2000	FO	121	9910	41,491	75,500	0.0755	0	0.00	0	0	0	0.0000	463,000
11	Small Diesel fired power plants	before 2000	DO	4	10150	42,496	72,600	0.0726	0	0.00	0	0	0	0.0000	16,000
12	Can Tho FO	1999	FO	35	9910	41,491	75,500	0.0755	0	0.00	0	0	0	0.0000	128,000
13	Can Tho DO		DO	41	10150	42,496	72,600	0.0726	0	0.00	0	0	0	0.0000	142,000
14	Hiep Phuoc	1998	FO	373	9910	41,491	75,500	0.0755	0	0.00	0	0	0	0.0000	1,424,000
15	Amata	1998	FO	18	9910	41,491	75,500	0.0755	0	0.00	0	0	0	0.0000	67,000
16	Thu Duc FO	1992	FO	155	9910	41,491	75,500	0.0755	0	0.00	0	0	0	0.0000	549,000
17	Thu Duc DO		DO	11	10150	42,496	72,600	0.0726	0	0.00	0	0	0	0.0000	35,000
18	Pha Lai 1	1986	coal	1582	5035	21,081	94,600	0.0946	DO	4.84	10150	42,496	72,600	0.0726	2,459,000
19	Uong Bi	1975	coal	475	6020	25,205	94,600	0.0946	DO	0.66	10150	42,496	72,600	0.0726	668,875
20	Ninh Binh	1974	coal	537	5500	23,027	94,600	0.0946	DO	0.08	10150	42,496	72,600	0.0726	689,000
21	**Imports from China**														383,000

Table 20: Data for calculating of $EF_{grid, OM, 2006}$

General information			FUEL 1: Main fuel						FUEL 2: Sub fuel						Emission factor
ID(j)	NAME (m)	COM (m)	FUEL (1,m)	FC (1,m,2006)	NCV (1,2006)		EF (CO2,1,2006)		FUEL (2,m)	FC (2,m,2006)	NCV (2,2006)		EF (CO2,2,2006)		EG(m,2006)
ID number of the power plant 'm'	Name of the power plant 'm' serving the grid in year '2006' except low-cost/must-run power plant	Commission date of the whole power plant	Fuel type '1' combusted in power plant 'm' in year '2006'	Amount of fossil fuel type '1' consumed by power plant 'm' in year '2006'	Net Calorific Value (energy content) of fossil fuel type '1' in year '2006'		CO2 emission factor of fossil fuel type '1' in year '2006'		Fuel type '1' combusted in power plant 'm' in year '2006'	Amount of fossil fuel type '2' consumed by power plant 'm' in year '2006'	Net Calorific Value (energy content) of fossil fuel type '2' in year '2006'		CO2 emission factor of fossil fuel type '2' in year '2006'		Net electricity generated and delivered to the grid by the power plant 'm' in year '2006'
-	-	-	-	(Coal, DO, FO: kt; Gas:	(Coal, DO, FO:	(Coal, DO, FO: GJ/kt, Gas:GJ/mil	kg CO2/TJ	tCO2/GJ	-	(Coal, DO, FO: kt; Gas:	(Coal, DO, FO:	(Coal, DO, FO: GJ/kt Gas:	kg CO2/TJ	tCO2/GJ	MWh

				million m3)	kCal/ kg Gas: kCal/ m3	lion m3				million m3)	kCal/ kg Gas: kCal/ m3	GJ/million m3			
1	Cao Ngan	May 2006	coal	39	4500	18,841	94,600	0.0946	DO	0.06	10150	42,496	72,600	0.0726	70,000
2	Phu My Fertilizer Plant	January 2006	Gas	27	9072	37,983	54,300	0.0543	0	0.77	10150	42,496	0	0.0000	141,000
3	Phu My 2.1	December 2005	Gas	1147	9072	37,983	54,300	0.0543	DO	13.45	10150	42,496	72,600	0.0726	6,110,000
4	Na Duong	November 2005	coal	453	3950	16,538	94,600	0.0946	DO	0.62	10150	42,496	72,600	0.0726	709,000
5	Phu My 2.2	February 2005	Gas	871	9072	37,983	54,300	0.0543	DO	56.42	10150	42,496	72,600	0.0726	4,856,000
6	Phu My 4	July 2004	Gas	615	9072	37,983	54,300	0.0543	DO	3.19	10150	42,496	72,600	0.0726	3,211,000
7	Formosa	April 2004	coal	381	6500	27,214	94,600	0.0946	DO	0.96	10150	42,496	72,600	0.0726	1,086,000
8	Phu My 3	March 2004	Gas	691	9072	37,983	54,300	0.0543	DO	89.57	10150	42,496	72,600	0.0726	4,110,000
9	Phu My 1	June 1905	Gas	1196	9072	37,983	54,300	0.0543	DO	1.37	10150	42,496	72,600	0.0726	6,417,000
10	Pha Lai 2	December 2002	coal	2085	4950	20,725	94,600	0.0946	DO	3.80	10150	42,496	72,600	0.0726	4,315,000
11	Ba Ria	early 2002	Gas	434	9072	37,983	54,300	0.0543	DO	4.14	10150	42,496	72,600	0.0726	2,024,000
12	VeDan	2000	FO	135	9910	41,491	75,500	0.0755	0	0.00	0	0	0	0.0000	514,000
13	Small Diesel fired power plants	before 2000	DO	7	10150	42,496	72,600	0.0726	0	0.00	0	0	0	0.0000	25,000
14	Can Tho FO	1999	FO	36	9910	41,491	75,500	0.0755	0	0.00	0	0	0	0.0000	128,000
15	Can Tho DO		DO	33	10150	42,496	72,600	0.0726	0	0.00	0	0	0	0.0000	109,000
16	Hiep Phuoc	1998	FO	250	9910	41,491	75,500	0.0755	0	0.00	0	0	0	0.0000	955,000
17	Amata	1998	FO	7	9910	41,491	75,500	0.0755	0	0.00	0	0	0	0.0000	26,000
18	Thu Duc FO	1992	FO	133	9910	41,491	75,500	0.0755	0	0.00	0	0	0	0.0000	472,000
19	Thu Duc DO		DO	11	10150	42,496	72,600	0.0726	0	0.00	0	0	0	0.0000	32,000
20	Pha Lai 1	1986	coal	1821	5035	21,081	94,600	0.0946	DO	6.29	10150	42,496	72,600	0.0726	2,937,000
21	Uong Bi	1975	coal	547	6020	25,205	94,600	0.0946	DO	0.92	10150	42,496	72,600	0.0726	757,000
22	Ninh Binh	1974	coal	567	5500	23,027	94,600	0.0946	DO	0.09	10150	42,496	72,600	0.0726	794,000
23	**Imports from China**														966,000

Table 21: Data for calculating of $EF_{grid, OM, 2007}$

General information			FUEL 1: Main fuel						FUEL 2: Sub fuel						Emission factor
ID(j)	NAME (m)	COM (m)	FUEL (1,m)	FC (1,m,2007)	NCV (1,2007)		EF (CO2,1,2007)		FUEL (2,m)	FC (2,m,2007)	NCV (2,2007)		EF (CO2,2,2007)		EG(m,2007)
ID number of the power plant 'm'	Name of the power plant 'm' serving the grid in year '2007' except low-cost/must-run power plant	Commission date of the whole power plant	Fuel type '1' combusted in power plant 'm' in year '2007'	Amount of fossil fuel type '1' consumed by power plant 'm' in year '2007'	Net Calorific Value (energy content) of fossil fuel type '1' in year '2007'		CO2 emission factor of fossil fuel type '1' in year '2007'		Fuel type '1' combusted in power plant 'm' in year '2007'	Amount of fossil fuel type '2' consumed by power plant 'm' in year '2007'	Net Calorific Value (energy content) of fossil fuel type '2' in year '2007'		CO2 emission factor of fossil fuel type '2' in year '2007'		Net electricity generated and delivered to the grid by the power plant 'm' in year '2007'
-	-	-	-	(Coal, DO, FO: kt; Gas: million m3)	(Coal, DO, FO: kCal/kg Gas: kCal/m3	(Coal, DO, FO: GJ/kt, Gas:GJ/million m3	kg CO2/TJ	tCO2/GJ	-	(Coal, DO, FO: kt; Gas: million m3)	(Coal, DO, FO: kCal/kg Gas: kCal/m3	(Coal, DO, FO: GJ/kt Gas: GJ/million m3	kg CO2/TJ	tCO2/GJ	MWh
1	Ca Mau	April 2007	Gas	132	9072	37,983	54,300	0.0543	0	3.86	10150	42,496	0	0.0000	691,000
2	Cai Lan	January 2007	DO	21	10150	42,496	72,600	0.0726	0	0.00	0	0	0	0.0000	81,000
3	Expansion Uong Bi	October 2006	coal	244	5094	21,328	94,600	0.0946	DO	0.50	10150	42,496	72,600	0.0726	520,000
4	Cao Ngan	May 2006	coal	246	4500	18,841	94,600	0.0946	DO	0.43	10150	42,496	72,600	0.0726	445,000
5	Phu My Fertilizer Plant	January 2006	Gas	28	9072	37,983	54,300	0.0543	0	1.78	10150	42,496	0	0.0000	150,000
6	Phu My 2.1	December 2005	Gas	1111	9072	37,983	54,300	0.0543	DO	35.97	10150	42,496	72,600	0.0726	5,975,000
7	Na Duong	November 2005	coal	475	3950	16,538	94,600	0.0946	DO	0.72	10150	42,496	72,600	0.0726	744,000
8	Phu My 2.2	February 2005	Gas	885	9072	37,983	54,300	0.0543	DO	60.14	10150	42,496	72,600	0.0726	5,004,000
9	Phu My 4	July 2004	Gas	591	9072	37,983	54,300	0.0543	DO	18.06	10150	42,496	72,600	0.0726	3,210,000
10	Formosa	April 2004	coal	390	6500	27,214	94,600	0.0946	DO	1.08	10150	42,496	72,600	0.0726	1,113,000
11	Phu My 3	March 2004	Gas	656	9072	37,983	54,300	0.0543	DO	75.07	10150	42,496	72,600	0.0726	3,883,000
12	Phu My 1	June 1905	Gas	1437	9072	37,983	54,300	0.0543	DO	10.86	10150	42,496	72,600	0.0726	8,033,700
13	Pha Lai 2	December 2002	coal	2028	4950	20,725	94,600	0.0946	DO	4.06	10150	42,496	72,600	0.0726	4,198,000
14	Ba Ria	early 2002	Gas	417	9072	37,983	54,300	0.0543	DO	25.40	10150	42,496	72,600	0.0726	1,983,000

15	VeDan	2000	FO	140	9910	41,491	75,500	0.0755	0	0.00	0	0	0	0.0000	534,000
16	Small Diesel fired power plants	before 2000	DO	11	10150	42,496	72,600	0.0726	0	0.00	0	0	0	0.0000	42,000
17	Can Tho FO	1999	FO	38	9910	41,491	75,500	0.0755	0	0.00	0	0	0	0.0000	137,000
18	Can Tho DO		DO	45	10150	42,496	72,600	0.0726	0	0.00	0	0	0	0.0000	151,000
19	Hiep Phuoc	1998	FO	452	9910	41,491	75,500	0.0755	0	0.00	0	0	0	0.0000	1,726,000
20	Amata	1998	FO	3	9910	41,491	75,500	0.0755	0	0.00	0	0	0	0.0000	13,000
21	Thu Duc FO	1992	FO	166	9910	41,491	75,500	0.0755	0	0.00	0	0	0	0.0000	603,000
22	Thu Duc DO		DO	23	10150	42,496	72,600	0.0726	0	0.00	0	0	0	0.0000	70,000
23	Pha Lai 1	1986	coal	1737	5035	21,081	94,600	0.0946	DO	6.03	10150	42,496	72,600	0.0726	2,832,000
24	Uong Bi	1975	coal	516	6020	25,205	94,600	0.0946	DO	0.76	10150	42,496	72,600	0.0726	694,000
25	Ninh Binh	1974	coal	530	5500	23,027	94,600	0.0946	DO	0.11	10150	42,496	72,600	0.0726	729,000
26	**Imports from China**														2,630,000

Table 22: Data for calculating of $EF_{grid, BM, 2007}$

ID(j)	NAME (m)	COM (m)	CAPn(m,y)	Registered as CDM project activities?	GEN(m,y)
ID number of the power plant 'j'	Name of the power plant 'm'	Commission date of the whole power plant and/or started to supply electricity to the grid	Net generation capacity of the power plant 'm' in year 'y'		Net electricity generation delivered to the grid by the power plant 'm' in year 'y'
-		-	MW	Yes/No	GWh
1	Suoi Sap	December 2007	14.4	No	0.7
2	Quang Tri	November 2007	64.0	No	64
3	Ngoi Xan 1	August 2007	8.1	Yes	15
4	Nậm Tha 6	July 2007	6.0	Yes	10
5	Se San 3A	May 2007	108.0	No	345
6	Ea Krong Rou	May 2007	28.0	No	75
7	Ca Mau	April 2007	500.0	No	691
8	Cai Lan	January 2007	39.0	No	81
9	Srokphu Mieng	December 2006	51.0	No	252
10	Expansion Uong Bi	October 2006	300.0	No	520
11	Se San 3	July 2006	260.0	No	1130
12	Cao Ngan	May 2006	115.0	No	445
13	Phu My Fertilizer Plant	January 2006	18.0	No	150
14	Phu My 2.1	December 2005	966.0	No	5975
15	Na Duong	November 2005	110.0	No	744
16	Phu My 2.2	February 2005	733.0	No	5004
17	Phu My 4	July 2004	468.0	No	3210
18	Formosa	April 2004	150.0	No	1113
19	Phu My 3	March 2004	733.0	No	3883
20	Nam Mu	February 2004	12.0	No	62
21	Can Don	January 2004	77.6	No	361
22	Na Loi	May 2003	9.3	No	42
23	Phu My 1	2003	1114.0	No	8034
24	Pha Lai 2	December 2002	600.0	No	4198
25	Ba Ria	early 2002	388.8	No	1983

26	Small hydropower plants	before 2002	42.0	No	648
27	Da Mi	2001	175.0	No	630
28	Ham Thuan	2001	300.0	No	1186
29	VeDan	2000	72.0	No	534
30	Ialy	2000	720.0	No	3413
31	Song Hinh	2000	70.0	No	398
32	Nomura - Hai Phong	2000	56.0	No	0
33	Bourbon	2000	24.0	No	69
34	Small Diesel fired power plants	before 2000		No	42.0
35	Can Tho FO	1999	188.0	No	137
36	Can Tho DO			No	151
37	Hiep Phuoc	1998	375.0	No	1726
38	Amata	1998	13.0	No	13
39	Thac Mo	1995	150.0	No	899
40	Hoa Binh	1994	1920.0	No	9100
41	Vinh Son	1994	66.0	No	260
42	Thu Duc FO	1992	291.9	No	603
43	Thu Duc DO			No	70
44	Tri An	1989	400.0	No	2038
45	Pha Lai 1	1986	440.0	No	2832
46	Uong Bi	1975	105.0	No	694
47	Ninh Binh	1974	100.0	No	729
48	Thac Ba	1972	108.0	No	324
49	Da Nhim	1964	167.5	No	1187
50	**Imports from China**		550.0	No	2630

Table 23: 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

Based on a monitoring and management manual: "Technical Design for Electric Metering System", the details of monitoring information are summarized as follows:

A. Description of technical equipment

The installation of equipment of powerhouse and meters is illustrated as below:

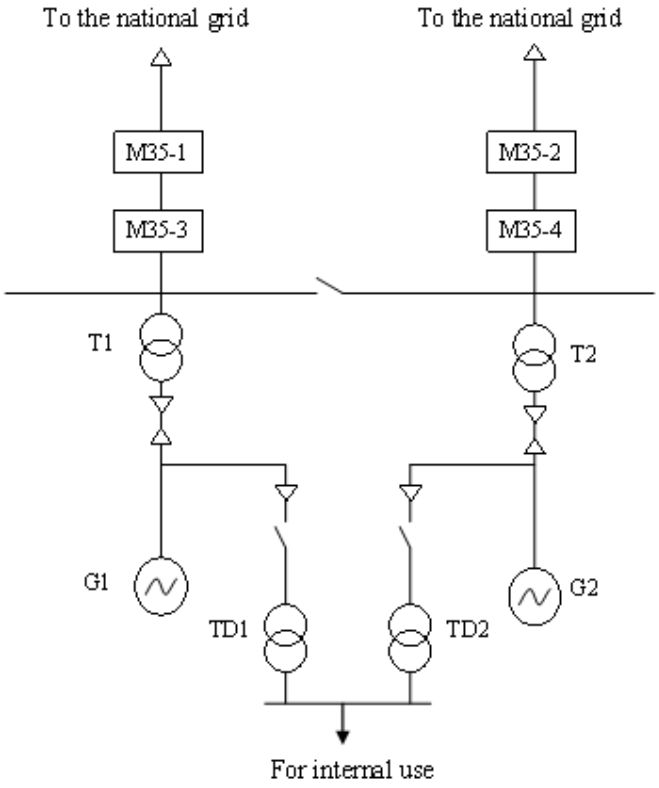

Figure 4: Location of metering equipment

The project has 2 generators with output voltage at 6.3 kV. With the purpose of reducing loss on transmission, after supplying electricity to the grid the voltage will be raised up from 6.3 kV to 110 kV. The main (M35-3 and M35-4) and the first backup metering system (M35-1 and M35-2) will be located in the lines after the rising transformer 6.3/110KV in 110kV Nam Ngan distribution station. These bidirectional meters will measure the electricity supplied by the proposed hydropower plant to the national grid ($EG_{y,export}$) and by the grid to the proposed hydropower plant ($EG_{y,import}$).

The meter type used is an electronic 3 phase meter produced by ELSTER. The accuracy of all power meter will be at least 0.5 S according to the IEC 687 or equivalent standard.

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.

B. Monitoring organization

The structure of the monitoring group is as follows:

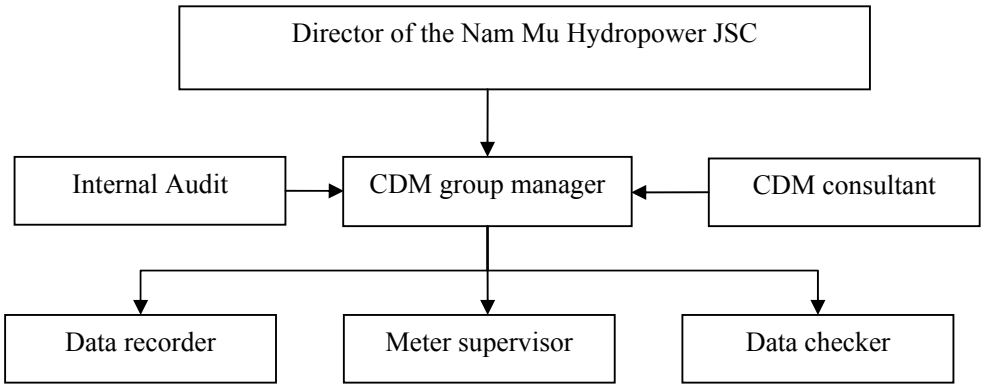

Figure 5: Structure of the monitoring group

The responsibilities of each person involved are elaborated as follows:

Group members and their responsibilities[30]

Person	Responsibility
Director of the Nam Mu 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:

[30] Group members will be adjusted based on the actual adjustment of Nam Mu hydropower JSC

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

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

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

(4) The Project Owner provides the record of main, backup power meters and copy of invoices to the verifier of DOE.

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

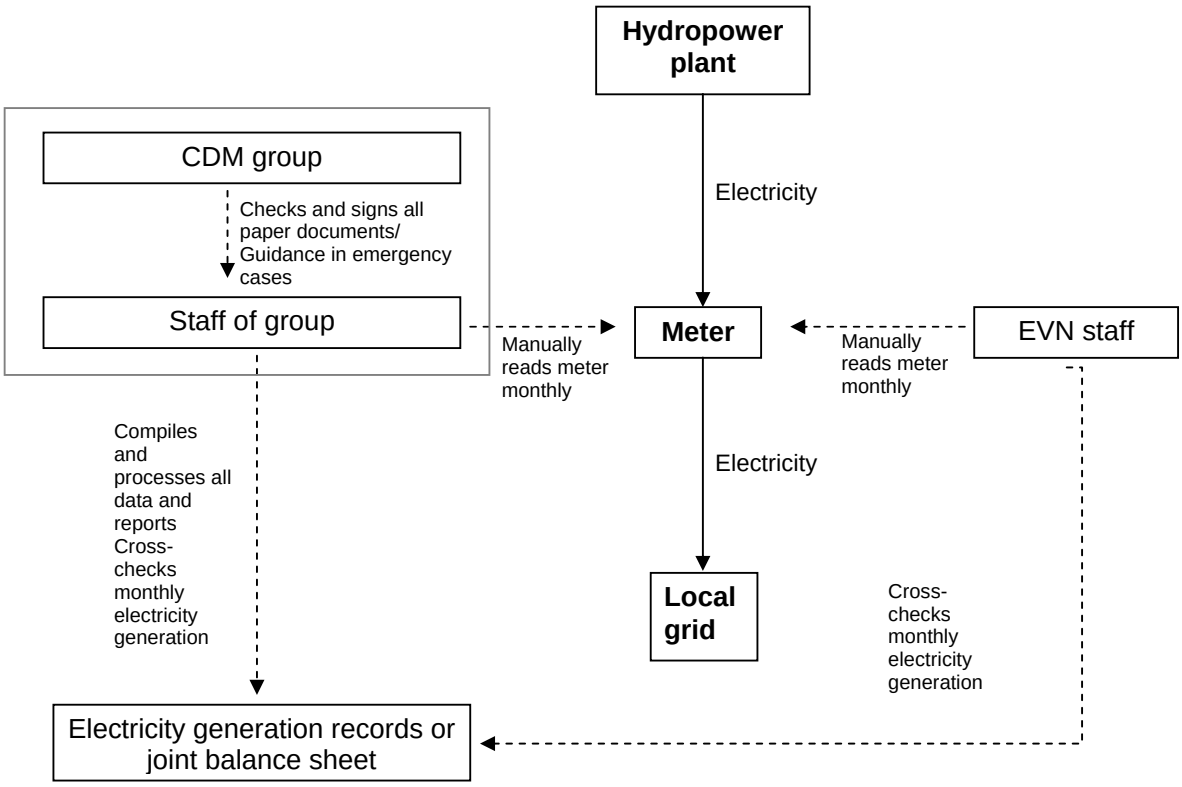

Figure 6: Monitoring process

D. Calibration of metering equipment

Before on-site installation meters will be calibrated and verified by an accredited third party pursuant to the Decision No 65/2002/QD-BKHCNMT[31]. 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 the accredited third party once in every two-year period during project operation. The accredited third party will after every calibration seal the meters so that no interference is possible.

E. Data recording and archiving procedures

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

F. Emergency procedures

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

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

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

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

[31] Decision No 65/2002/QD-BKHCNMT[31] 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".