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

CONTENTS

Annexes

SECTION A. General description of project activity

A.1. Title of the project activity:

Title: Nam Hong Hydropower Project

Version: 1.0

Date: 27/10/2010

A.2. Description of the project activity:

The project activity involves the construction of two sub-hydropower plants, i.e. Nam Hong 1 hydropower plant and Nam Hong 2 hydropower plant. Each has installed capacity of 8 MW[1]. The project activity is implemented on Nam Hong stream in Chieng Cong commune, Muong La district, Son La province, Vietnam. The main structure of each sub-hydropower plant includes dams, water intake, tunnel, pressurized well, penstock, power house and discharge channel.

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

The project's purpose is to generate hydroelectricity from a clean and renewable source (hydropower of the Nam Hong stream) by installation of water turbines and generators to supply hydroelectricity to the national grid. The project's total installed capacity and total estimated annual gross power generation is 16 MW and 63,020 MWh, respectively. The net electricity generated (with a total estimated annual volume of 62,389.8 MWh[2]) will be supplied to the national grid via a newly constructed 35kV single-transmission line with the leng of 3km, which will connect Nam Hong 1 hydropower plant with Nam Hong 2 hydropower plant, a newly constructed 110kV single-transmission line with length of 2 km, which will connect between Nam Hong 2 hydropower plant and Chieng Cong 110kV transformer station.

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

The project activity will generate renewable power with negligible GHG emissions, which will displace part of the electricity otherwise supplied by fossil fuel fired power plants. The Nam Hong hydropower project involves the construction of two reservoirs with an area of 1.36 ha and 1 ha[3], respectively, the Nam Hong 1 power density of 588.2 W/m^2 and Nam Hong 2 power density of 800 W/m^2, accordingly. As the power density of each step hydropower plant is all above 10 W/m^2, GHG emissions from the reservoirs need not to be accounted in the project activity. Thus, this project activity generates GHG emission reductions up to a total expected CO_2 emission reduction of 251,726 tCO_2 over the first crediting period of 7 years.

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

[1] FSR, General Description, page 2.
[2] The gross power generation subtracts 1% for parasitic and loss load
[3] FSR, Environmental Impact Assessment Report, page 28

General contributions towards national sustainable development:

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

Contributions towards local sustainable development:

a) Economic well-being

Once commissioning, this proposed project will increase the industrial share in the economic structure of Son La province – poor mountainous province in the Northwest of Vietnam. This proposed project will have a significant contribution to the state budget via annual taxes (i.e. corporate income tax[4], resources tax[5], CER tax[6]).

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 Chieng Cong commune. The commune is categorised as a very poor mountainous commune with scattered population, less developed and autarky agricultural economy. The project will upgrade and improve roads that then will be integrated into the traffic system of the communes. Besides, the project will construct newly 35kV and 110 kV transmission lines together with sub-hydropower plants, which will contribute to reduce electricity losses and improve the quality of electricity supplying in the regions.

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

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

[4] Law on Corporate Income Tax No.14/2008/QH12 dated 03 June 2008

[5] Investment Law and Law on resources tax

[6] Decision No.130/2007/QD-TTg dated 02 August 2007 of the Prime Minister on some mechanisms and financial policies for the projects invested in under the Clean Development Mechanism and Joint Circular No.58/2008/TTLT-BTC-BTN&MT dated 04 July 2008 of the Ministry of Natural Resources and Environment providing for the implementation of Decision No.130/2007/QD-TTg.

In conclusion the project activity will positively contribute towards sustainable development in 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 Hong Hydropower Investment & Construction Joint Stock Company (Private entity)	No
Vietnam (host)	Energy and Environment Consultancy Joint Stock Company (Private entity)	No
Switzerland	Vietnam Carbon Assets Ltd. (Private entity)	No
(*) In accordance with the CDM modalities and procedures, at the time of making the PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Viet Nam

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

Son La province

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

Chieng Cong commune, Muong La district

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

The proposed project activity involves the construction of Nam Hong 1 and Nam Hong 2 sub-hydropower plants which is located on the Nam Hong stream. This project has the following coordinates[7]:

Hydrpower plant		Northern latitude	Eastern longitude
Nam Hong 1	Power house	$21^0$27’12’’	$104^0$13’14’’

[7] Feasibility Study Report

	Dam	$21^0$27'08''	$104^0$14'12''
Nam Hong 2	Power house	$21^0$27'24''	$104^0$11'35''
	Dam	$21^0$27'36''	$104^0$12'30''

The site of the project is showed in Figure 1:

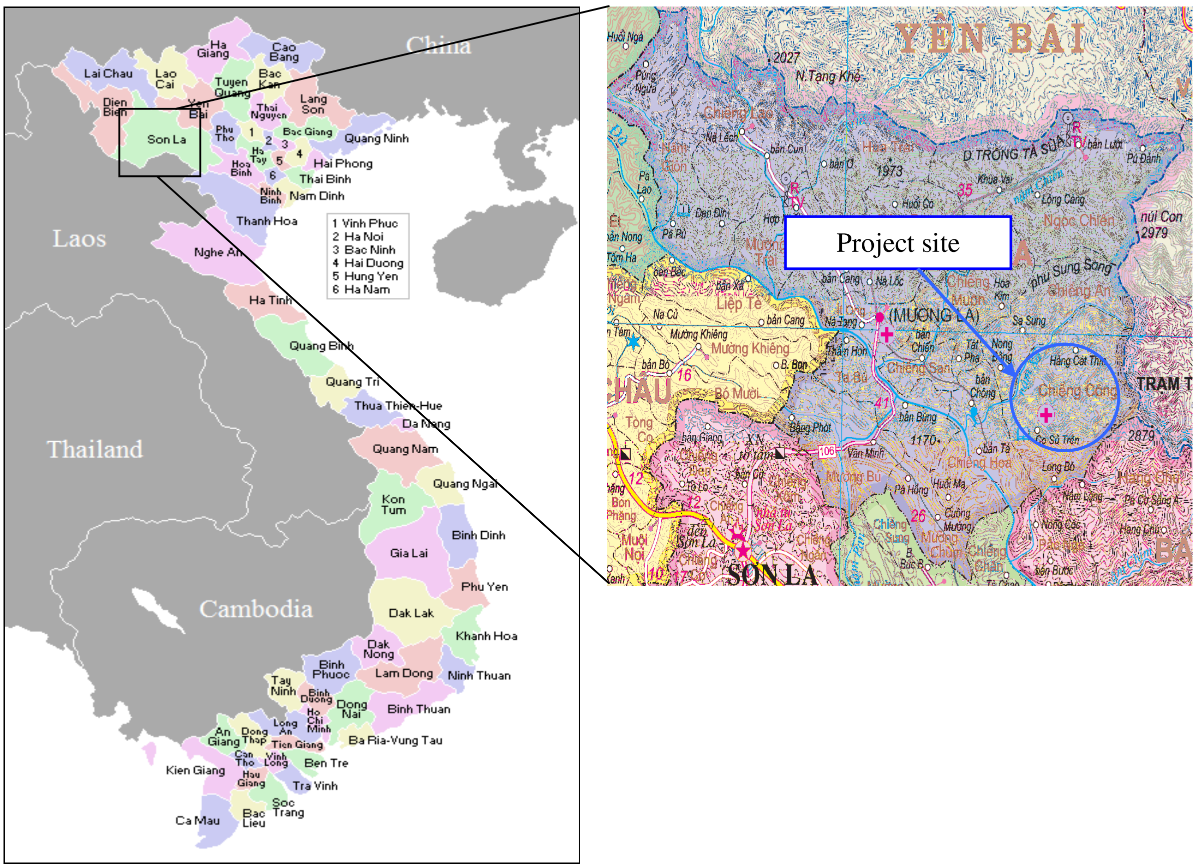

Figure 1: Map of the location of the project activity

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

Sectoral scope: 1: Energy industries (renewable sources)

Category: Grid-connected electricity generation from renewable sources

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

Prior to the implementation of the proposed project, there is no power generation existing at the project location. Electricity supplied to the national grid is generated by the operation of grid-connected power plants. Electricity in Vietnam is generated mainly by firing coal, oil or gas and is solely distributed via the

unique national electricity grid. All fuel fired power plants connected to the national grid use boiler rooms, steam heating boilers and steam turbines to generate electricity. In that technology cycle, GHGs are generated. Since hydro power generation technology is a renewable electricity generation technology which displaces fossil fuel fired power generation technology to supply electricity to the grid, the implementation of this project activity will generate emission reductions.

The project involves the construction of two sub-hydropower plants. Each plant involves the construction of dam, water intake, tunnel, pressurized well, penstock, and power house with 02 units and discharge channel in order to convert potential flowing energy from the Nam Hong stream into clean electrical energy, which will be supplied to the national grid at the connection point through the transmission line (total expected generation of 63,020MW). The project involves the construction of two reservoirs with power density above 10 W/m^2. According to Version 12.1.0 of ACM0002, no GHG emissions from the reservoirs need to be accounted in the project activity.

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

The lay-out of these two sub-hydropower plants can be illustrated as follow:

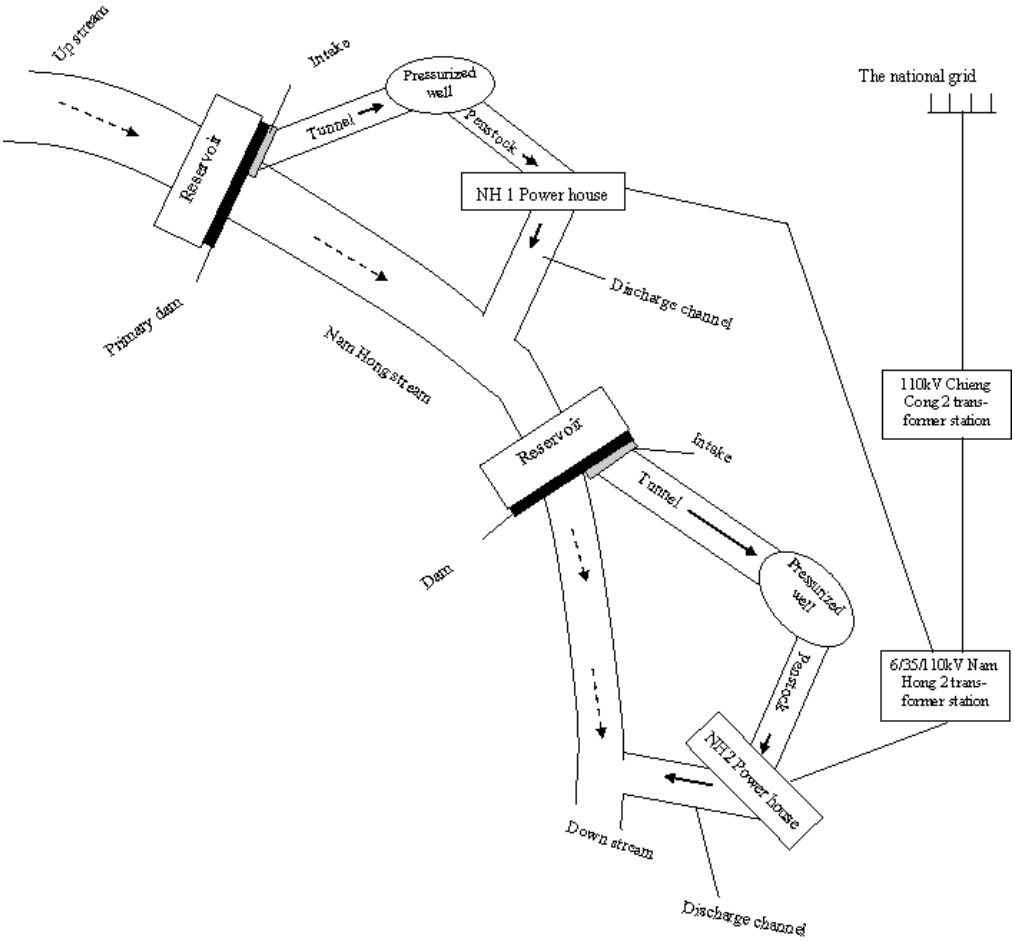

Figure 2: Project lay-out

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

Table 1: Main technical parameters of the proposed project activity[8]

Main parameters	Units	Values	
		Nam Hong 1	Nam Hong 2
1. Turbine			
• Type		Francis with horizontal shaft	Francis with horizontal shaft
• Diameter of runner	m	0.88	0.76
• Rated net head	m	200.85	143.48
• Number of turbine	set	02	02
• Turbine discharge	m^3/s	2.3	3.2
• Efficiency	%	93.7	93.5
• Capacity	MW	4.167	4.167
• Speed	rpm	1000	1000
• Expected lifetime[9]	hour	150,000	150,000
2. Generator			
• Number	set	02	02
• Type		Synchronous, 3 phase, horizontal shaft	Synchronous, 3 phase, horizontal shaft
• Rated voltage	kV	6.3	6.3
• Rated capacity	MW	4.0	4.0
• Efficiency	%	96	96
• Expected lifetime[10]	years	30	30
3. Transformer			
• Number	set	02	02
• Type		3 phases, 3 windings	3 phases, 3 windings
• Rated capacity	MVA	6.0	6.0
• Expected lifetime[11]	year	30	30
4. Annual river flow[12]	m^3/s	1.47	2.92

The main equipment utilized in this project is imported from China. The project owner has chosen suppliers via tender. The tender documents set criteria for supplier to ensure that the turbines and alternators are state-of-the-art technology.

The project owner will cooperate with the equipment supplier to provide technical services such as training courses for the operational staff of the Nam Hong hydropower plant on the monitoring procedures, operation regulations, maintenance procedures and other relevant operational knowledge before operating the power plant. Furthermore, there will be regular training courses on monitoring and operation for the staff during the operation period. Via these exchanges, the foreign technology would be transferred to the host country.

[8] Feasibility Study Report, Volume IV.6 "Technological Equipment Report"
[9] Default value provided at EB 50 report, Annex 15, page 4.
[10] Default value provided at EB 50 report, Annex 15, page 4.
[11] Default value provided at EB 50 report, Annex 15, page 4.
[12] Feasibility Study Report, Volume "Hydro-meteorological Report", page 12

The baseline scenario of this project activity is identical to the existing scenario mentioned above, where electricity is supplied by Vietnamese national grid system, which is mainly composed of GHG intensive fossil fuel based power stations.

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

The project activity will achieve GHG emission reduction by replacing part of power generated by fossil fuel fired plants connected to the national grid. The project will apply three renewable seven-crediting-year periods. The estimated emission reductions of the first crediting period are presented in Table 2.

Table 2: Emission reduction of the Nam Hong 1 hydropower project during the first crediting period

Years	Annual estimation of emission reductions in tonnes of CO_2 e
2012 (from 01/07/2012 to 31/12/2012)	9,164
2013	18,328
2014	18,328
2015	18,328
2016	18,328
2017	18,328
2018	18,328
2019 (from 01/01/2019 to 30/06/2019)	9,164
Total estimated reductions (tonnes of CO_2 e)	**128,296**
Total number of crediting years	**7**
Annual average over the crediting period of estimated reductions (tonnes of CO_2 e)	**18,328**

Table 3: Emission reduction of the Nam Hong 2 hydropower project during the first crediting period

Years	Annual estimation of emission reductions in tonnes of CO_2 e
2012 (from 01/07/2012 to 31/12/2012)	8,816
2013	17,632
2014	17,632
2015	17,632
2016	17,632
2017	17,632
2018	17,632
2019 (from 01/01/2019 to 30/06/2019)	8,816
Total estimated reductions (tonnes of CO_2 e)	**123,424**
Total number of crediting years	**7**
Annual average over the crediting period of estimated reductions (tonnes of CO_2 e)	**17,632**

Table 4: Emission reduction of the proposed project during the first crediting period

Years	Annual estimation of emission reductions in tonnes of CO_2 e
2012 (from 01/07/2012 to 31/12/2012)	17,980
2013	35,961
2014	35,961
2015	35,961
2016	35,961
2017	35,961
2018	35,961
2019 (from 01/01/2019 to 30/06/2019)	17,980
Total estimated reductions (tonnes of CO_2e)	**251,726**
Total number of crediting years	**7**
Annual average over the crediting period of estimated reductions (tonnes of CO_2 e)	**35,961**

A.4.5. Public funding of the project activity:

No public funds from Annex I countries are involved in this project.

SECTION B. Application of a baseline and monitoring methodology

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

Applied methodology:

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

Related tools:

- Version 02 of the "Tool to calculate the emission factor for an electricity system"
- Version 05.2 of the "Tool for the demonstration and assessment of additionality"

The methodology and the related tools are available on the UNFCCC website:
http://cdm.unfccc.int/methodologies/DB/TZFK7NUO5DYE5AI2PDMLG65BFIWMG5/view.html

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

This proposed project is a grid-connected renewable power generation that is then applicable to apply Version 12.1.0 of ACM0002. More details of the comparison of the project's characteristics and the applicability criteria as specified in Version 12.1.0 of ACM0002 is given in Table 5.

Table 5: Comparison of project's characteristics and eligibility criteria of Version 12.1.0 of ACM0002

Applicability conditions in Version 12.1.0 of ACM0002	Characteristics of the project activity	Applicability criterion met?
The project activity is the installation, capacity addition, retrofit or replacement of a power plant/unit of one of the following types: hydro power plant/unit (either with a run-of-river reservoir or an accumulation reservoir), wind power plant/unit, geothermal power plant/unit, solar power plant/unit, wave power plant/unit or tidal power plant/unit.	The project activity is to install a new two - step hydro power plant	Yes
In case of hydro power plants:		
• The project activity is implemented in an existing reservoir, with no change in the volume of reservoir	The project activity constructs two new reservoirs	Not applicable
• The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density (installed power generation capacity divided by the surface area at full reservoir level) of the project activity, is greater than 4 W/m^2	The project activity constructs two new reservoirs	Not applicable
• The project activity results in new reservoirs and the power density of the power plant is greater than 4 W/m^2	The project activity creates two new reservoirs with power density of 588.2 W/m^2 and 800 W/m^2 respectively, which are all greater than 4 W/m^2.	Yes
This methodology is not applicable to project activities that involve switching from fossil fuels to renewable energy at the site of the project activity	It is a renewable energy project with no fuel-switch involved.	Yes
This methodology is not applicable to biomass fired power plants	The project activity involves the construction of hydro power plants	Yes
This methodology is not applicable to hydro power plants that result in new reservoirs or in the increase in existing reservoirs where the power density of the power plant is less than 4 W/m^2	The power densities of the new reservoirs are 588.2W/m^2 and 800W/m^2. Both are above 4 W/m^2.	Yes

This comparison shows clearly that the proposed project activity fulfils all applicability criteria to be eligible under Version 12.1.0 of ACM0002.

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

According to Version 12.1.0 of ACM0002, the spatial extent of the project boundary includes the Nam Hong 1 hydro power plant, the Nam Hong 2 hydro power plant and all power plants connected physically to the national electricity grid to which the proposed project is also connected.

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

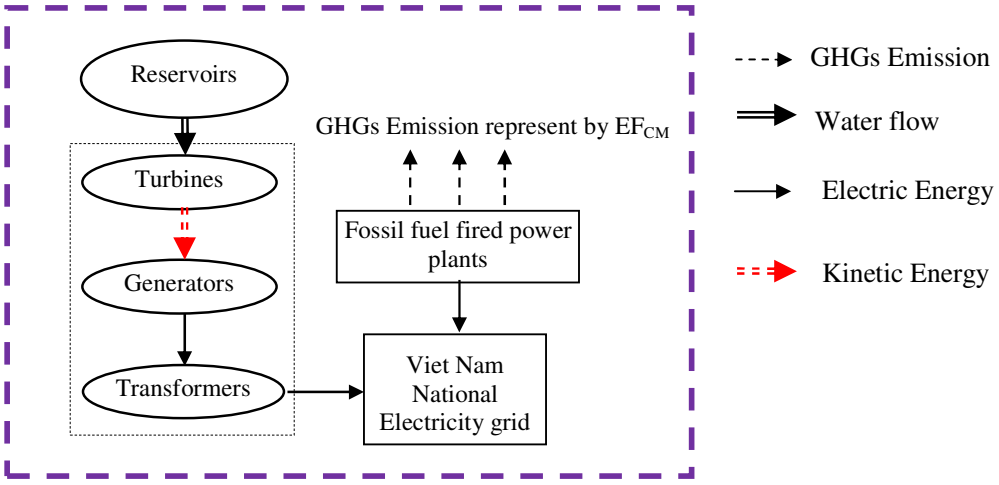

Figure 3: Project boundary

The GHGs and emission sources included in the project boundary are shown in Table 6.

Table 6: Sources and gases included in or excluded from the project boundary

	Source	Gas	Included?	Justification/Explanation
Baseline	CO_2 emission from electricity generation in fossil fuel fired power plants that is displaced due to the project activity	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source

Project Activity	For hydro power plants, emissions of CH_4 from the Reservoir	CO_2	No	Minor emission source
		CH_4	No	Main emission source. However, as the power density of all sub-hydro power plants are greater than 10 W/m^2 CH_4 emissions are neglected according to ACM0002.
		N_2O	No	Minor emission source

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

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

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

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

Thus the baseline scenario of the proposed project is the delivery of equivalent amount of annual power output from the Vietnam national grid to which the proposed project is also connected. In the absence of the project activity, the clean energy generated by this proposed project would have been generated through non-renewable sources from Power Plants connected to the National grid, fostering the emission of greater quantities of green house gases.

The analysis and description in B.5 and B.6 will support the baseline scenario shown above.

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

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

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

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

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

The following two scenarios are therefore considered through the analysis:

- Alternative 1: the proposed project is undertaken without the CDM
- Alternative 2: continuation of the current situation. In this case, the proposed project will not be constructed and the power will be solely supplied from the Vietnam national grid.

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

The alternative 2 "continuation of the current situation" does not face any barrier from the current law and regulation in Vietnam because it is the "do-nothing" alternative. The project owner of a proposed project has no obligation to build or invest in the power plant to supply electricity for the local area. Hence this alternative is consistent with mandatory laws and regulations.
The Nam Hong hydropower project received the Investment License issued by Son La Provincial People's Committee on 29 October 2009, which defines legal right of the project owner to invest in and construct Nam Hong hydropower project. Therefore, the alternative 1 "the proposed project is undertaken without the CDM" is consistent with mandatory laws and regulations of Vietnam.

Step 2: Investment analysis

Sub-step 2a: Determine appropriate analysis method

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

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

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

The WACC benchmark is indicated in paragraph 12, EB 51, Annex 58 "Guidance on Assessment of Investment Analysis", "*Local commercial 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:

$$WACC = E * R_e + D * R_d * (1 - T_c) \quad (1)$$

Where:

R_e : cost of equity

R_d : cost of debt

E : Amount of equity in the project

D : Amount of debt in the project

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[13].

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% to 12.75% of the interest rates for long-term credit published in the Annual Report of the State Bank of Viet Nam 2008. 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%[14] at the date of making the investment decision.

Determine the cost of equity

To derive an appropriate cost of equity for electricity generation project type in Vietnam, the following well-known CAPM[15] standard formula, which describes the relationship between risk and expected return, is employed:

$$R_e = R_f + \beta * (R_m - R_f) \qquad (2)$$

Where:

R_e	cost of equity for electricity generation project type
R_f	Risk free rate return
β	Beta of the security for electricity generation project type
$R_m - R_f$	Market risk premium

Risk free rate:

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

The risk free rate applied is 15% for 15 years term[16].

[13] 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.
[14] Annual Report of State Bank of Vietnam 2008, page 30
[15] 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.

Beta:

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

Due to the difference in capital structure (Dept/Equity) between these companies and Nam Hong Hydropower Investment & Construction Joint Stock Company, the Beta applied for this CDM project has to be adjusted according to the following steps:

- Step 1 – It is obtained the Levered Betas of hydropower companies published in stock market with its own capital structures;
- Step 2 – The Beta is Unlevered according the average capital structure of the companies; The unlevered beta is the beta of a company without any debt. Unlevering a beta removes the financial effects from leverage[17].
- Step 3 – The Unlevered Beta is levered again according to the capital structure of the Nam Hong Hydropower project. This Levered Beta was used for calculation of cost of equity of the Nam Hong Hydropower Project

Table 7: Betas of similar companies in hydro power generation[18]

Company name	Levered Beta of similar projects	D/E	Unlevered Beta	Levered Beta for CDM project
Vinh Son Song Hinh Hydropower Company	0.98	0.12	0.90	2.48
Ry Ninh II Hydropower JSC	0.64	0.79	0.40	1.1
Thac Ba Hydropower Company	1.06	0.06	1.02	2.08
Naloi Hydropower JSC	1.13	0.31	0.92	0.24
Nam Mu Hydropower JSC	0.93	3.89	0.24	0.65
Can Don Hydropower JSC	0.84	1.58	0.39	1.06
Thac Mo Hydropower JSC	0.71	0.93	0.42	1.15
Mien Trung Power Investment and Development JSC	0.74	1.61	0.34	0.93
Average Beta				**1.59**

[16] http://research.acbs.com.vn/BondInfo.aspx?LangId=2
[17] http://www.investopedia.com/terms/u/unleveredbeta.asp
[18] The betas of these companies have been calculated by the project developer based on the published daily data. The link of sources are included in the attached excel sheet.

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 8: Market expected return calculation

Market index (VN Index) as of 28-Jul-2000	100.00
Market index (VN Index) as of 25 Dec 2009	479.10
No. of years	9.41
Compounded annual return	**18.11%**

Substituting

R_f = 15%;

R_m = 18.11%;

β = 1.59

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:

$$R_e = 19.94\%$$

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).

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 Vietnam from an investor's point of view. In the report the costs of capital for Vietnam are displayed[19]. In total the report gives 12 different values for Vietnam (due to different calculation methods and investors background). The lowest value among all 12 values given in the report in 2007 is 21.02 %. However, the return on equity calculated using CAMP model for power generation projects in Viet Nam is lower than that reported by Ibbotson Associates, Inc.; therefore 19.94% 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[20]. Therefore, **the rate of 19.94% is**

[19] The referenced report has been updated annually since 2001. The report that was published in May 2007 includes the data up to March 2007 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.

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

conservatively 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 9: Key assumptions to calculate the benchmark

No	Parameter	Unit	Value	
			Nam Hong 1	Nam Hong 2
1	Total investment cost[21]	billion VND	176.8	167.9
2	Project equity[22]	billion VND	53.04	50.38
3	Required return on equity rate	%	19.94	19.94
4	Debt			
	• Total	billion VND	123.77	117.56
	• Interest rate[23]	%	12	12
5	Average business revenue tax during the life time[24]	%	17.25	17.25
6	**WACC (Benchmark)**	**%**	**12.93**	**12.93**

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

The key assumptions used to calculate the project IRR of the proposed project are presented in Table 10:

Table 10: Key assumption for investment analysis

No	Parameter	Unit	Value	
			Nam Hong 1	Nam Hong 2
1	Gross capacity[25]	MW	8.0	8.0
2	Annual net electricity generation[26]	MWh	32,120	30,900
3	Total investment cost	billion VND	176.8	167.9
4	Total annual O&M cost[27]	%	1	1
5	Preparation and construction period[28]	year	2.5	2.5
6	Financial project lifetime[29]	year	40	40
7	Feed-in tariff[30]	VND/kWh	605	605
8	Resources tax[31]	%	2	2

[21] FSR, Volume "Total Investment Cost"

[22] Decision No.30/2006/QD-BCN issued on 31 August 2006 by Ministry of Industry regulates that the investment capital of project owner (equity) in an IPP project must be accounted for at least 30%

[23] Annual report of State bank of Vietnam 2008, page 30

[24] Decree No.124/2008/ND-CP dated 11 December 2008 of the Government providing detailed regulations and guidance for the implementation of a number of articles of Law on Enterprise Income Tax, Chapter II, Article 10, Item 1; Chapter IV, Article 15, Item 1, Article 16, Item 1(a).

[25] FSR, Volume "General Description", page 2

[26] The gross power generation subtracts 1% for parasitic and loss load

[27] Decision No. 2014/QD – BCN dated 13 June 2007 of the Ministry of Industry. The O&M cost of the power plant with capacity lower than 30MW is 1% to 2%.

[28] Project feasibility study report

[29] EB 50 Report, Annex 15, page 4; Decision No. 2014/QD – BCN dated 13 June 2007 of the Ministry of Industry

[30] This is average tariff among those EVN offered for IPP hydropower plants located in Vietnam

[31] Circular No 42/2007/TT-BTC issued by Ministry of Finance on 27 April 2007 regulating the resource tax that will be calculated as the net electricity outputs supplied to the national electricity grid x 750 VND x 2%

9	Enterprise revenue tax[32] • For the first 4 years • For the next 9 years • For the next 2 years • For the remaining years	%	 0 5 10 25	 0 5 10 25
10	**Project IRR**	**%**	**7.72**	**7.84**

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

All financial data are available to the DOE for Validation.

Sub-step 2d: Sensitivity analysis

A sensitivity analysis of the project activity has been conducted to test the robustness of the above calculations. According to Annex 58 "Guidelines on the Assessment of Investment Analysis", EB 51 Report, page 4, paragraph 17, "Only variables, including the initial investment cost, that constitute more than 20% of either total project costs or total project revenues should be subjected to reasonable variation (all parameters varied need not necessarily be subjected to both negative and positive variations of the same magnitude),..."; therefore, the following parameters are used in the sensitivity analysis of the project activity:

- Annual amount of electricity exported to the national grid
- Investment cost
- Feed-in price set by EVN

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

Table 11: Sensitivity analysis

No	Parameter	Variation[33]	Project IRR	
			Nam Hong 1	Nam Hong 2
1	Annual amount of electricity exported to the national grid	+10%	8.64%	8.76%
		-10%	6.75%	6.87%
2	Investment costs	+10%	6.93%	7.04%
		-10%	8.65%	8.78%
3	Feed-in tariff	+10%	8.66%	8.79%
		-10%	6.73%	6.84%

[32] Decree No.124/2008/ND-CP dated 11 December 2008 of the Government providing detailed regulations and guidance for the implementation of a number of articles of Law on Enterprise Income Tax, Chapter II, Article 10, Item 1; Chapter IV, Article 15, Item 1, Article 16, Item 1(a).

[33] ±10% is selected according to the Decision No. 2014/QD – NLDK dated 13 April 2004 of the Ministry of Industry providing temporary guidance for conducting the economic, financial and investment analysis and providing the purchasing-selling price frame for power generation projects. It is also in line with the Guidelines on the Assessment of Investment Analysis, Annex 5, EB 51 Report, page 4, paragraph 18, i.e. "the sensitivity analysis should at least cover a range of +10% and -10%". Furthermore, ±10% is also a common practice rate for sensitivity analysis of a CDM project.

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

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

Step 3: Barrier analysis

Not applied.

Step 4: Common practice analysis

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

Government Decree No. 45/2001/ND-CP providing for power activities and use, which was issued on 02 August 2001 and was entered into force 15 days after the issuance date, created a legal basis to allow other entities to invest in and generate electricity rather than only state-owned entities as previously regulated. Before that time, all power plants have been invested from the state budget sources and operated by state owned companies. Hence, any hydropower projects that have started the construction activities before August 2001 are not subject to this analysis.

To classify the projects listed against the criteria: *similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate* , the most relevant regulations which regulate the legal entities, the investment management procedures, and the technical designs and construction standards for hydropower projects in different scales (No.3454/QĐ-BCN, Vietnam Construction Code - TCXDVN 285:2002).
According to Vietnam Construction Code - TCXDVN 285:2002 "Irrigation projects - Major standards on designing"[34] which regulates the criteria for construction contractors, design steps and warranty period for construction works activities, hydropower projects are categorized as follows.

Table 12: Groups of hydropower projects according to Vietnam Construction Code - TCXDVN 285:2002

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

Furthermore, according to the Decision of Ministry of Industry – No.3454/QĐ-BCN dated 18 October 2005 defining the jurisdictions to approve the Master Plans and management hierarchy for small scale hydropower projects, hydropower projects having installed capacity within the range 1 MW to 30 MW are categorised as small scale projects.

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

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

Table 13: Groups of hydropower projects serving for common practice analysis

Group	Installed capacity	Referred regulations
A	equal and larger 300 MW	Vietnam Construction Code - TCXDVN 285:2002
B	equal and larger 50 MW and equal and smaller 300 MW	Vietnam Construction Code - TCXDVN 285:2002
C	smaller 50 MW and larger 30MW	Vietnam Construction Code - TCXDVN 285:2002 and Decision of Ministry of Industry - No: 3454/QD-BCN,
D	equal and smaller 30 MW and larger 5MW	Vietnam Construction Code - TCXDVN 285:2002 and Decision of Ministry of Industry - No: 3454/QD-BCN,
E	up to 5MW	Vietnam Construction Code - TCXDVN 285:2002 and Decision of Ministry of Industry - No: 3454/QD-BCN,

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

Table 14: Hydropower plants in group D[35]

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

Because the Na Loi hydropower project started construction from 2000[36], it is excluded from this common practise analysis. Exclusion is also applied to Nam Tha 6[37] and Ngoi Xan 1[38] as they are developed as CDM projects. Thus, only 3 projects are relevant in this analysis.

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

Table 15: Hydropower plants which belong to group D (5 – ≤ 30 MW) were developed in Vietnam

No	Name	Capacity MW	Elec. outputs 10^3 MWh	Load factor %	Construc-tion starting year	Commi-ssioning year	Investor during the investment and construction period
0	**The proposed project**	*16*	*63,02*	*45.0*	**2010**	**2011**	*Nam Hong Hydropower Investment & Construction Joint Stock Company*

[35] List of project supplied by Institute of Energy
[36] http://www.naloi.com.vn/?et=news&page=introduce
[37] http://cdm.unfccc.int/UserManagement/FileStorage/HWAFNGZRTMU51V86XDB2LP40I79KJE
[38] http://cdm.unfccc.int/UserManagement/FileStorage/ZTSNIRG1O4E8YX3H2WFJD0LBA5KM7Q

							(private owned company)
A. Invested and constructed by state-owned companies or joint stock companies which are either state-owned or whose major shares held by the government							
1	Nam Mu	12	55.7	53.0	Jan. 2002	2004	Song Da Construction Corporation - one of the largest state-owned construction corporation belongs to Ministry of Construction (Nam Mu Hydropower JSC was set up on 29 May 2003 to take over the continuing construction and to operate the Nam Mu plant)[39]
2	Ea Krong Rou	28	110.7	45.1	Otc. 2003	2007	MienTrung Power Investment and Development Joint Stock Company (Song Da Construction Corporation and Power Company No.3 hold 85% of shares. Power Company No.3 belongs to EVN)[40]. In addition, this project had received 4 million USD from India's ODA loan[41].
B. Invested and constructed by private companies							
3	Suoi Sap	14.4	65.7	52.1	Jul. 2004	2007	Truong Thanh Construction Company Limited

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

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

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

  1. The state-owned corporations mentioned above are among the largest state-owned power and construction corporations in Vietnam. They are financed by the state budget as well as their investment activities. In 1990s, Song Da Construction Corporation have been constructing many national hydropower plants like Hoa Binh (1920 MW), Yaly (720 MW), Tri An (400 MW), Thac Ba (108 MW)…And from 2000, Song Da Corporation had been studying and investing in a series of hydropower plants like: Ry Ninh 2, Na Loi, Can Don, Se San 3A…[42]Therefore, they have substantial experiences in designing, investing, constructing and operating hydropower plants.

  2. The state-owned corporations mentioned above were established according to the Prime Minister's Decisions No 90/TTg and 91/TTg dated 07 March 1994. The formulation of these

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

[40] http://vincomsc.com.vn/vi/Pages/ReportFileDownload.aspx?id=8338

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

[42] http://songda.com.vn/info/News/tabid/65/ItemID/1/View/Details/Default.aspx

corporations is to aim at developing power and construction industries in order to meet national socio-economical development goals and strategies and to implement development tasks assigned by their ministries and/or Prime Minister in certain development periods. Therefore, the key target of these corporations is to serve as the governmental tool for macroeconomic interferences rather than profit making[43].

- *Project 3*: The initial main objective of this project by the government was to invest in an irrigation project to provide water for 700 ha commercial plantation and rice fields in order to alleviate poverty and to develop local agriculture and rural communes in Phu Yen District, Son La Province. Then the project owner decided to synergise this objective with the construction of a hydropower plant. According to the Government Decree No. 17/2001/NĐ-CP, this project was given priorities to access ODA. Therefore, this project has borrowed ODA soft-loan from India at a very favourable interest rate[44] while the proposed project has to take loans from domestic banks without such a favourable condition. The circumstances of this project thus clearly show that this project has not been facing a similar barrier as the proposed project.

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

Implementation timeline of the proposed project activity

For the purpose of CDM project implementation, the Project owner invited local people and local authorities to discuss the social and environmental impacts potentially caused by the implementation of the project as the CDM project via the meeting with local stakeholders on 20 December 2009 in Chieng Cong commune, Muong La district. The Management Board made a decision on developing the proposed project under CDM via the issuance of Decision No.16/QD-HDQT dated 25 December 2009.

In order to secure the CDM status the project owner sent official letters to the People's Committee of Son La Province (the highest provincial authority) and DNA to notify the CDM project activity and request for their support in developing the proposed project as a CDM project activity on 26 November 2009 and 17 December 2009 respectively.

This was prior to the starting date of the proposed project activity which is defined as the date of signing the earliest contract – the construction contract (October 2010). The proposed project was notified to the EB on 02 November 2010.

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.

The below table indicate the major milestones in developing the investment project and CDM application:

Table 16: Major milestones in developing the investment project and CDM application

Development of the hydropower project	Events and actions taken to achieve CDM registration	Time	Implication on CDM
Finalizing Feasibility Study Report of the project		Jul. 09	
Issuing Investment license		29 Oct. 09	

[43] http://vi.wikipedia.org/wiki/Tổng_công_ty_91

[44] Source: Interview with Truong Thanh Construction Company Limited and confidential documentation provided to DOE

	Submitting official letter to Son La People's Committee by the project owner to obtain the verification and support for CDM project	26 Nov. 09	CDM early consideration
	Signing the CDM consulting contract with a CDM consultant	28 Nov. 09	CDM early consideration
	Submitting the official letter to DNA Vietnam by Son La Provincial People's Committee to obtain the verification and support for CDM project	15 Dec. 09	CDM early consideration
	Submitting the official letter to DNA Vietnam by the project owner to obtain the verification and support for CDM project	17 Dec. 09	CDM early consideration
	Organized stakeholders consultation meetings to inform of CDM project and consult opinions of the local people and authorities on social and environmental impacts of the project. Minutes of meetings was produced.	20 Dec. 09	CDM early consideration
Issued the Decision on implementing the investment project under Clean Development Mechanism by the Management Board		25 Dec. 09	Date of making decision
Signing the first contract for the construction of auxiliary items i.e. access road, worker huts etc.		28 Oct. 10	Starting date of the project activity
	Notification of CDM project to Executive Board	02 Nov. 10	

In conclusion, the proposed project is additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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

I. Project emissions *(PE_y)*

According to ACM0002, Version 12.1.0, the project emissions are calculated using the following equation:

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

Where:

PE_y	Project emissions in year *y* (tCO_2e/yr)
$PE_{FF,y}$	Project emissions from fossil fuel consumption in year *y* (tCO_2/yr)
$PE_{FF,y}$	Project emissions from the operation of geothermal power plants due to the release of non-condensable gases n year *y* (tCO_2e/yr)
$PE_{HP,y}$	Project emissions from water reservoirs of hydro power plants in year *y* (tCO_2e/yr)

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

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

Emissions from water reservoirs of hydro power plant ($PE_{HP,y}$)

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

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

Where:

PD	Power density of the project activity (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.

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

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

Where:

$PE_{HP,y}$	Emission from reservoir expressed as tCO_2e/year
EF_{Res}	Default emission factor for emissions from reservoirs of hydro power plants in year y

($kgCO_2e/MWh$)

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).

(b) 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 in fossil fuel fired power plants that are displaced due to the project activity, calculated as follows:

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

Where:

BE_y Baseline emissions in year *y* (tCO_2/yr).

$EG_{PJ,y}$ Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year *y* (MWh/yr).

$EF_{grid,CM,y}$ Combined margin CO_2 emission factor for grid connected power generation in year *y* (tCO_2/MWh)

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

The emission factor for the Vietnam national grid has been calculated by DNA Vietnam using "Tool to calculate the emission factor for an electricity system", version 02[45].

The Viet Nam DNA published the EF of the national electricity grid in the Official Letter No.151/KTTVBDKH dated 26 March 2010[46]. The DNA then officially required all relevant CDM projects in Vietnam to use this published EF in the CDM projects. According to the published data, the OM, BM and CM emission factors are derived as follows:

Table 17: OM emission factor 2008 (most recent three years: 2005, 2006, 2007)

Year	2005	2006	2007	$EF_{grid, OMsimple,2008}$ (tCO_2/MWh)
Total emission (tCO_2)	25,702,898	28,544,283	29,963,699	0.6465
Total power generation (MWh)	37,618,249	43,921,357	48,719,874	

Table 18: BM emission factor 2008

Total power generation	MWh	16,514,761.12
Total emission	tCO_2e	8,362,386.08

[45] Annex 14 to EB 50 Report "Tool to calculate the emission factor for an electricity system", version 02,

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

$EF_{grid, BM,2008}$	tCO_2e/MWh	0.5064

CM emission factor (EF) 2008:

$$\mathbf{EF_{grid,CM,2008} = 0.5*OM + 0.5*BM = 0.5764\ (tCO_2e/MWh)}$$

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

III. Leakage *(LE_y)*

The main emissions potentially giving rise to leakage in the context of electric sector projects are emissions arising due to activities such as power plant construction and upstream emissions from fossil fuel use (e.g. extraction, processing, transport). But according to ACM0002, Version 12.1.0 these emission sources do not need to be considered as leakage, therefore ***$LE_y = 0$***

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/yr).

BE_y Baseline emissions in year y (tCO_2/yr)

PE_y Project emissions in year y (tCO_2/yr).

LE_y Leakage emissions in year y (tCO_2/yr).

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

Data / Parameter:	**Cap_{BL}**
Data unit:	MW
Description:	Installed capacity of hydropower plant before the implementation of the project activity. For new hydro power plants, this value is zero.
Source of data used:	Project site
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 to be zero according to Version 12.1.0 of ACM0002.
Any comment:	

Data / Parameter:	**A_{BL}**

Data unit:	m^2
Description:	Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full. For new reservoirs, this value is zero.
Source of data used:	Project site
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 to be zero according to Version 12.1.0 of ACM0002.
Any comment:	

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

Data / Parameter:	**$EF_{grid,BM,y}$**
Data unit:	tCO_2/MWh
Description:	Operating margin CO_2 emission factor for grid connected power generation in year *y* calculated using the latest version of "Tool to calculate the emission factor for an electricity system"
Source of data used:	Data published by DNA Viet Nam
Value applied:	0.5064

Justification of the choice of data or description of measurement methods and procedures actually applied:	As per the "Tool to calculate the emission factor for an electricity system"
Any comment:	For calculation of $\boldsymbol{EF}_{grid,CM,y}$

Data / Parameter:	$\mathbf{EF}_{grid,CM,y}$
Data unit:	tCO_2/MWh
Description:	Operating margin CO_2 emission factor for grid connected power generation in year *y* calculated using the latest version of "Tool to calculate the emission factor for an electricity system"
Source of data used:	Data published by DNA Viet Nam
Value applied:	0.5764
Justification of the choice of data or description of measurement methods and procedures actually applied:	As per the "Tool to calculate the emission factor for an electricity system", Version 2
Any comment:	Fixed for crediting period.

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

Project emissions (PE_y)

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

Table 19: Installed capacity and respective reservoir area of sub – hydropower plants

Sub – hydropower plant	**Nam Hong 1**	**Nam Hong 2**
Installed capacity (MW)	8.0	8.0
Reservoir area (ha)	1.36	1.0

The power density of each sub - project plants is derived as follows:

$$PD = \frac{Cap_{pj} - Cap_{BL}}{A_{pj} - A_{BL}} = \frac{8 \times 10^6 - 0}{1.36 \times 10^4 - 0} = 588.2 W / m^2$$

$$PD = \frac{Cap_{pj} - Cap_{BL}}{A_{pj} - A_{BL}} = \frac{8 \times 10^6 - 0}{1 \times 10^4 - 0} = 800 W / m^2$$

As power density of the sub - project plants is both greater than 10 W/m^2, thus the project emission is zero $PE_y = 0$; and thus the monitoring of total electricity generation TEG_y is excluded from the monitoring section.

Baseline emissions (BE_y)

Baseline emissions are calculated as follows:

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

Where:

BE_y Baseline emissions in year y (tCO_2/yr).

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

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

1. For Nam Hong 1 sub-hydropower plant:

$EG_{y, NH1}$ = 31,798 MWh

therefore:

$BE_{y,NH1}$ = 31,798 × 0.5764= 18,328 tCO_2/yr

2. For Nam Hong 2 sub-hydropower plant:

$EG_{y, NH2}$ = 30,591 MWh

therefore:

$BE_{y, NH2}$ = 30,591 × 0.5764 = 17,632 tCO_2/yr

For whole project (Nam Hong hydropower project)

$BE_y = BE_{y,NH1} + BE_{y, NH2}$ = 35,961 tCO_2/yr

Leakage (LE_y)

As it is stated in ACM0002 Version 12.1.0, this emission is considered as zero: $LE_y = 0$

Reduction emissions (ER_y)

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y = 35{,}961 \text{ } tCO_2/\text{year}$$

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

The estimated emission reduction of the project activity is provided in Table 20.

Table 20: Emission reduction of the project activity

Year	Estimation of project activity emissions (tonnes of CO_2)	Estimation of baseline emissions (tonnes of CO_2)	Estimation of leakage (tonnes of CO_2)	Estimation of overall emission reductions (tonnes of CO_2)
2012 (01/07/2012 - 31/12/2012)	0	17,980	0	17,980
2013	0	35,961	0	35,961
2014	0	35,961	0	35,961
2015	0	35,961	0	35,961
2016	0	35,961	0	35,961
2017	0	35,961	0	35,961
2018	0	35,961	0	35,961
2019 (01/01/2019 – 30/06/2019)	0	17,980	0	17,980
Total (tonnes of CO_2e)	**0**	**251,726**	**0**	**251,726**

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

B.7.1 Data and parameters monitored:

Data / Parameter:	**$EG_{y, export}$**
Data unit:	MWh/yr
Description:	Electricity supplied by the proposed hydropower plant to the national grid
Source of data to be used:	Direct measurement at the connection point
Value of data applied for the purpose of calculating expected emission reductions in section B.6	62,389.8
Description of measurement methods and procedures to be applied:	Two-way power meters will be installed at the grid-connected point to measure the amount of electricity supplied to the grid by the proposed project by the positive direction. The readings of electricity meter will be Continuously measured by power meter and monthly recorded. The recorded data will be confirmed by the joint balance sheet which will be signed by the representatives of EVN and the project owner. Electronic data will be archived within the crediting period and 2 years after the end of the crediting period.
Monitoring frequency	Continuously measured by power meter and monthly recording
QA/QC procedures to be applied:	The uncertainty level of this data is low. The measurement/ monitoring equipment should be complied with national standard and technology. These equipment and systems should be calibrated and checked every 2 years.
Any comment:	For the calculation of $EG_{facility,y} = EG_{y, export} - EG_{y, import}$

Data / Parameter:	**$EG_{y, import}$**
Data unit:	MWh/yr
Description:	Electricity supplied by the 110kV grid and 35kV grid to the proposed hydropower plant
Source of data to be used:	Direct measurement at the connection point
Value of data applied for the purpose of calculating expected emission reductions in section B.6	0
Description of measurement methods	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

and procedures to be applied:	by the reverse direction. The readings of electricity meter will be continuously measured by power meter and monthly recorded. The recorded data will be confirmed by the joint balance sheet which will be signed by the representatives of EVN and the project owner. Electronic data will be archived within the crediting period and 2 years after the end of the crediting period.
Monitoring frequency	Continuously measured by power meter and monthly recording
QA/QC procedures to be applied:	The uncertainty level of this data is low. The measurement/ monitoring equipment should be complied with national standard and technology. These equipment and systems should be calibrated and checked every 2 years.
Any comment:	For the calculation of $EG_{faciclity,\ y} = EG_{y,\ export} - EG_{y,\ import}$

Data / Parameter:	$EG_{facility,\ y}$
Data unit:	MWh/yr
Description:	Quantity of net electricity supplied to the national grid by the proposed hydropower plant in year *y*
Source of data to be used:	Calculating from $EG_{y,\ import}$ and $EG_{y,\ export}$
Value of data applied for the purpose of calculating expected emission reductions in section B.6	62,389.8
Description of measurement methods and procedures to be applied:	Calculating by subtracting $EG_{y,\ import}$ from $EG_{y,\ export}$. Double checking by the joint balance sheet issued by EVN and project owner to ensure the consistency. Data will be archived within the crediting period and 2 years after the end of the crediting period.
Monitoring frequency	Continuously measured by power meter and monthly recording
QA/QC procedures to be applied:	The uncertainty level of this data is low. The measurement/ monitoring equipment should be complied with national standard and technology. These equipment and systems should be calibrated and checked every 2 years.
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	Reservoir area of Nam Hong 1 sub-hydropower plant: 13,600 Reservoir area of Nam Hong 2 sub-hydropower plant: 10,000

in section B.6.3.	
Description of measurement methods and procedures to be applied:	Measured by the observation equipment
Monitoring frequency	Yearly
QA/QC procedures to be applied:	The uncertainty level of this data is low.
Any comment:	For calculating the power density

Data / Parameter:	Cap_{PJ}
Data unit:	W
Description:	Installed capacity of the hydro power plant after the implementation of the project activity.
Source of data to be used:	Project site
Value of data applied for the purpose of calculating expected emission reductions in section B.6.3.	Nam Hong 1 sub-hydropower plant: 8,000,000 Nam Hong 2 sub-hydropower plant: 8,000,000
Description of measurement methods and procedures to be applied:	Manufacture's nameplate
Monitoring frequency	Yearly
QA/QC procedures to be applied:	
Any comment:	For calculating the power density

B.7.2. Description of the monitoring plan:

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

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

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

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

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

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

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

For further details see Annex 4.

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

Date: 27/10/2010
The responsible entity: **Energy and Environment Consultancy Joint Stock Company (VNEEC)** which is the project participant listed in Annex 1 of this document.

SECTION C. Duration of the project activity / crediting period

C.1. Duration of the project activity:

C.1.1. Starting date of the project activity:

01/06/2010

This is the date of signing the first contract for the construction of auxiliary items such as access road, worker huts, etc. that is the earliest contract signed by the project owner to commit for the project's expenditures of the Nam Hong hydropower project. This is in accordance with the "CDM Glossary of Terms/version 04", which define the starting date of project as "the earliest date at which either the implementation or construction or real action of a project activity begins".

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

39 years 0 months

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

C.2.1. Renewable crediting period:

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

01/07/2012

C.2.1.2. Length of the first crediting period:

7 years 0 months

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not applicable

C.2.2.2. Length:

Not applicable

SECTION D. Environmental impacts

Pursuant to Law on Environmental Protection of Vietnam 2005 (Article 18) and Decree No.21/2008/ND-CP dated 28 February 2008 of the Government amending and supplementing a number of articles of Decree No. 80/2006/ND-CP dated 09 August 2006 of the Government detailing and providing guidance for the implementation of a number of articles of the Law on Environmental Protection Law of Vietnam 2005, the project owner made the Environmental Standards Registration papers, which was certified by Muong La district People's Committee by issuing the Certificate of Environmental Protection Commitment No.923/XN-UBND on 06 August 2009.

Furthermore, based on the impacts assessed of the proposed project, the Environmental Standards Registration paper proposes that the mitigation measures shall be conducted during the construction and operation phases in order to minimize the negative impacts and ensure the long-term benefits from this project.

D.1. Documentation on the analysis of the environmental impacts, including trans-boundary impacts:

The environmental impacts and mitigation measures are summarized as follows.

1.1. Environment Impacts

1.1.1. Impact on land

The proposed project will permanently occupy about 17.74[47] ha of land for arrangement of project structures, of which Nam Hong 1 sub-hydropower project will occupy about 9.07 ha and Nam Hong 2 about 8.67 ha.

No historical culture and archaeological places exist in the project site. There are 11[48] households who have their land recovered due to the project activity.

1.1.2. Impacts on water flow

The project will create two small reservoirs with a total area of about 2.36 ha. Since the reservoir regulates water level on the daily basis, the water flow of Nam Hong stream will be insignificantly affected in quality and quantity. The content of dissolved oxygen as well as other chemical content as pH, turbidity, etc., will not be changed.

When commissioning, the reservoir will be used for the purpose of generating electricity, creating landscape, ecosystem and micro-climatic environment of sub-area and regulating water served for irrigation purpose in the region[49]. The flow regime in the reservoir area as well as downstream areas behind the powerhouse will be more stable, which in turn can create favourable conditions for fishery[50].

1.1.3. Impacts on air quality

[47] FSR, Volume "Environmental Impact Assessment Report", page 28
[48] EIA report of Nam Hong hydropower project, page 31
[49] Environmental Impact Assessment Report, page 41
[50] Environmental Impact Assessment Report, page 41

Main impacts on air quality during construction are to increase dust level due to construction machinery, tunnel construction, rock blasting, foundation excavation, and cement mixing and road construction. However, these impacts are temporary and will cease upon the commissioning.

1.1.4. Noise impact

During construction, noise will be generated from vehicular movements, sand and aggregate processing, concrete mixing, excavation machinery, construction noise, and blasting. The main potential impact of high noise levels will be on construction workers because of the project area is thinly population. This is the temporary impact only on construction period.

1.1.5. Impacts by waste and hazardous materials

Generation of waste and hazardous material from project activities can cause environmental pollution.

1.1.6. Impacts on flora

Nam Hong Hydropower Project does not cross-out any natural conservation areas, national forests or specialized forest.

1.1.7. Impacts on fauna

The main impacts on fauna are:

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

1.1.8. Impacts on aquatic life

The impacts on quality of water will affect in aquatic species on quantity and quality. The formation of dam on Nam Hong stream will influence the natural migration of aquatic species

1.2. Socio-economic impacts

1.2.1. Negative impacts

There are eleven households who have their land lost due to the project activities. These households may have to take resettlement. The main effect by this project is the occupation 17.74 ha land. The occupied land will be commensurately compensated for under the government law.

There is no historical monument or archaeological area within the project boundary

1.2.2. Positive impacts

As presented in Section A.2

1.3. Mitigation measures to reduce negative impacts

1.3.1. Construction phase

- *Waste collection and treatment*

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

- Conduct reforestation in the temporarily[51] occupied areas and strengthen the slopes to avoid erosions, after accomplishing the construction of main works.
- Raise awareness of 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.

1.3.2. Operational phase

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

1.4. Conclusion

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

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

Not applicable

SECTION E. Stakeholders' comments

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

The following stakeholders have been consulted:

- People Committee of Son La province (highest local authority): certified the Environmental Standards Registration papers by issuing the Certificate of Environmental Standards Registration No.923/XN-UBND on 06 August 2009; and endorsed for the CDM project activity for the Nam Hong hydropower project via submitting the Official letter No. 3023/UBND-KTN dated 15 December 2009 to the DNA.
- Son La Department of Industry and Trade: approved the technical design for Nam Hong hydropower project on 04 September 2009;
- Son La Department of Agriculture and Rural Development: supported the implementation of Nam Hong Hydropower Project via the official letter No.681/SNN-CCTL on 14 August 2009.

[51] Environmental Impact Assessment Report, page 46

- Local people: the project idea and it potential impacts on local people have been introduced to the local and the survey on potential impacts have been conducted at the early stage of the project preparation.

On 20 December 2009, a meeting between the project owner and the representatives of local authorities and local people was held in order to inform the project activity. All participants was served with a prior notice and orally informed of the occurrence of the meeting via radio.

- Commune's People Committee (CPC): CPC is the lowest administration level in Vietnam administrative hierarchy. Chairman of CPC is elected by the Commune People Council, so he well represents the commune's interest.
- Commune's communist party committee secretary: Commune's communist party committee is the key government body in making development strategies at the communal level.
- Village's representatives: head of village, secretary of young union, head of farmers' association, head of women's association. Such associations act as NGOs and represent the interests of different groups.

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

All organizations agreed that the project will certainly contribute to sustainable development and environment protection in Vietnam and especially this project will increase local budget and reduce poverty. Therefore, they fully support the project and promptly made comments.

E.2. Summary of the comments received:

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

- All stakeholders agreed that this clean and renewable project will certainly contribute to sustainable development and environment protection in the region and in Vietnam. Therefore, they fully support the project to develop under the CDM and recommend the project owner to complete necessary procedures to submit the project to the DNA and to the EB for registration.
- 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 owner will employ local people during both construction and operation phases.
- The local people expect that the lands and assesses damaged by the project will be compensated adequately.
- The project owner should implement its committed activities to minimise negative impacts during the construction phase.

The comments of the above mentioned organisations are carefully examined by the project owner. In general, all comments are positive comments without any main concerns or any objections.

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

The project's owner committed to employ suitable local people to work during the construction and operation phases. The comments of the above mentioned organisations are carefully reviewed. All of them are positive comments without any main concerns or any objections.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

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

Annex 3

BASELINE INFORMATION

Data sources using to calculate $EF_{CM, grid}$ have been referred to the published data of DNA Viet Nam according to the link below:

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

Annex 4

MONITORING INFORMATION

A. Description of technical equipment

The metering system will be installed at the connecting point in Nam Hong 2 Transformer Station. They are digital meters bi-directly with the accuracy of at least 0.5 S.

The meter type used is an electronic 3 phase and details on the technical equipment can be found in the hard copy document "Technical explanation for metering system" as developed by the project proponent and approved by EVN.

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

This proposed project will supply the electricity to the national grid at 110 kV voltage level. The metering system includes the main system and back-up system as indicated in Figure 4 below

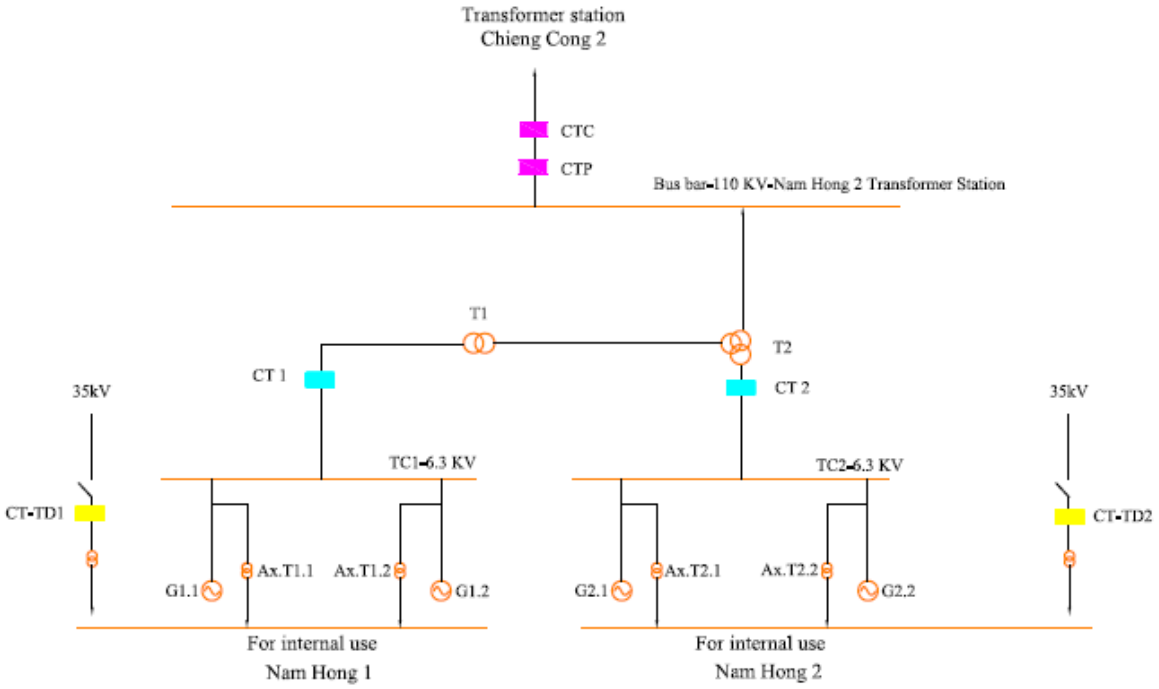

Figure 4: Monitoring meter systems

Note:
G1.1; G1.2; G2.1; G2.2: Generators
T1; T2: Transformer
CTC: Main meter
CTP: Back-up meter

CT 1: Meter to measure electricity exported and imported by Nam Hong 1 hydropower plant at 6.3 kV to and from Nam Hong 2 Transformer station
CT 2: Meter to measure electricity generated by Nam Hong 2 hydropower plant at 6.3kV level

CT-TD1, 2: Meters to measure electricity imported for internal use in emergency case

- Main system: Meter CTC measures electricity exported and imported by Nam Hong 1 and Nam Hong 2 hydropower plants at 110kV level to and from the national grid.

- Back-up system: Meter CTP preceding the main power meter is working in parallel with main meter, and its recorded data will be used if there is a problem with the main system.

CT-TD1, 2: Power meters to measure electricity imported from 35kV grid for internal use in case of emergency.

B. Monitoring organization

The structure of the monitoring group is as follows:

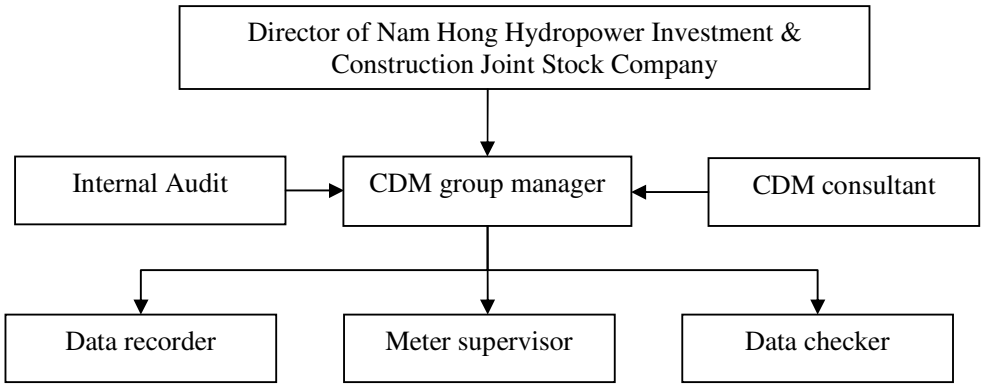

Figure 5: Structure of the monitoring group for each sub-hydropower plant

The responsibilities of each person involved are elaborated as follows:

Group members and their responsibilities

Person	Responsibility
Director of Nam Hong Hydropower Investment & Construction Joint Stock Company / or authorised by the Director	Check and sign the monitoring report annually
CDM group manager	Managing the whole CDM business of Nam Hong hydropower plant, guiding and supervising data recorder after trained by CDM consultant.
CDM consultant (VNEEC)	Providing CDM group manager training and technical support about CDM

	monitoring plan.
Internal auditor	Check the monitoring procedure at least once in a year
Data recorder	Collecting and recording data every month.
Meter supervisor	Checking power meter periodically according to relevant regulation.
Data checker	Double checking the collected data measured by power meter.

C. Monitoring procedure

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

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

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

(3) Nam Hong hydropower plants provide electricity sales invoice to EVN, and keeps the copy of invoice.

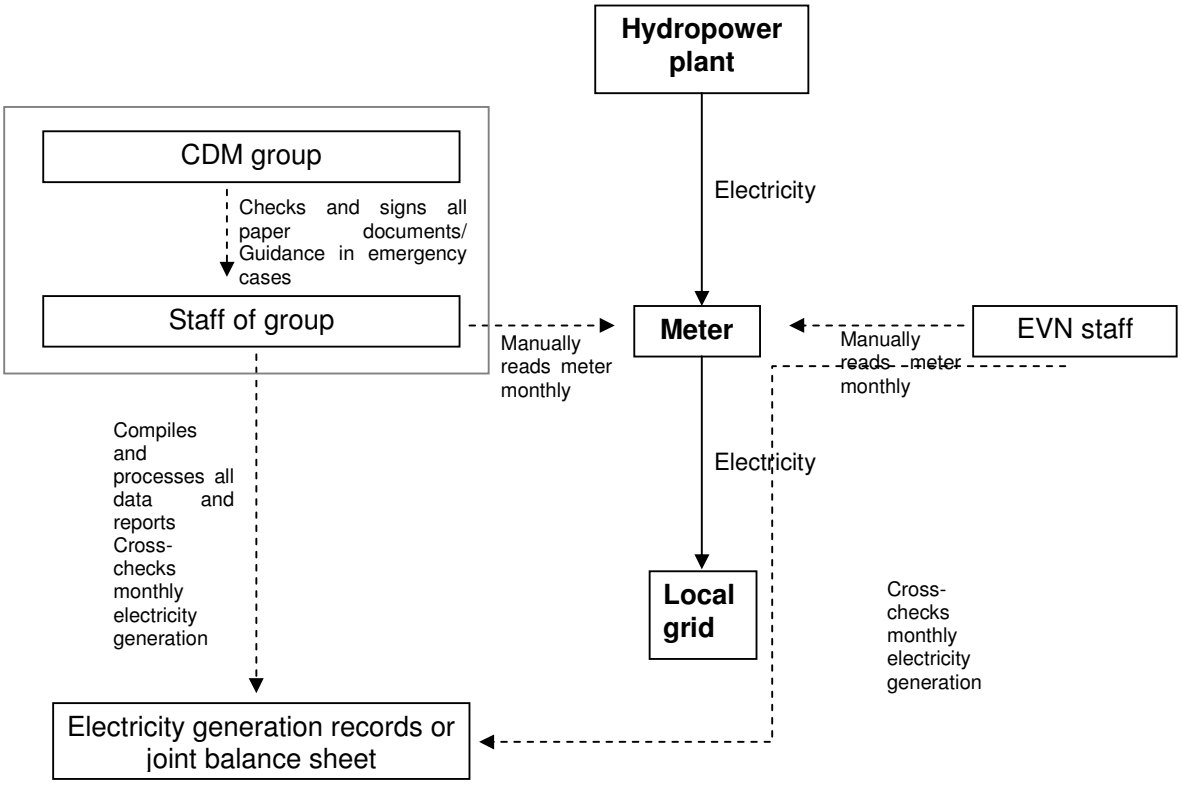

Figure 6: Monitoring process

D. Calibration of metering equipment

Before on-site installation meters will be calibrated and verified by local STAMEQ pursuant to the Decision No 65/2002/QD-BKHCNMT[52]. According to this Decision, calibration and verification for 3 phase meters need to be conducted every two years. This means that calibration will be undertaken by local STAMEQ once in every two-year period during project operation. Local STAMEQ will after every calibration seal the meters so that no interference is possible.

E. Data recording and archiving procedures

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

F. Emergency procedures

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

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

G. Training

VNEEC has been collaborated with the director of the power plant to develop a training manual and training course for the staff of CDM Group that will clearly lay out rules and procedures for all activities related to metering, data recording and processing, data archiving and preparation of monitoring reports.

[52] Decision No 65/2002/QD-BKHCNMT[52] 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".