Project design document form
(Version 10.1)

Complete this form in accordance with the instructions attached at the end of this form.

BASIC INFORMATION	
Title of the project activity	Nam Ngan Hydropower Project
Scale of the project activity	☐ Large-scale ☒ Small-scale
Version number of the PDD	02.1
Completion date of the PDD	19/03/2018
Project participants	1. Nam Mu Hydropower Joint Stock Company 2. Swiss Carbon Assets Ltd. 3. Energy and Environment Consultancy Joint Stock Company
Host Party	Vietnam
Applied methodologies and standardized baselines	AMS-I.D. ver.18 - Grid connected renewable electricity generation
Sectoral scopes linked to the applied methodologies	1. Energy industries (renewable - / non-renewable sources)
Estimated amount of annual average GHG emission reductions	47,927 (tCO_2e)

SECTION A. Description of project activity

A.1. Purpose and general description of 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 main structures of the project include a reservoir, a dam, intakes, tunnels, a pressurized well, penstocks, a power house and a discharge channel (all of these facilities are located along the Nam Ngan stream).

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 electricity generation 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.

In the absence of the project activity, electricity sources which will be supplied to the national grid would come from fossil fuel power plants. The generation of electricity by burning fossil fuels result in CO_2 emission into the atmosphere. Hence, the baseline scenario of the project 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 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 335,488 tCO_2e over the second 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.

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.

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.

Nam Ngan Hydropower project involves the construction of a new hydropower plant, therefore it is small scale project – type I (installed capacity below 15 MW) under category I.D "Renewable electricity generation for the national power grid".

A.2. Location of project activity

A.2.1. Host Party

Socialist Republic of Viet Nam

A.2.2. Region/State/Province etc.

Ha Giang province

A.2.3. City/Town/Community etc.

Viet Lam and Quang Ngan communes, Vi Xuyen district

A.2.4. Details of physical location

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[1]	Co-ordinates of the powerhouse[2]
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.

[1] Feasibility Study Report

[2] 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

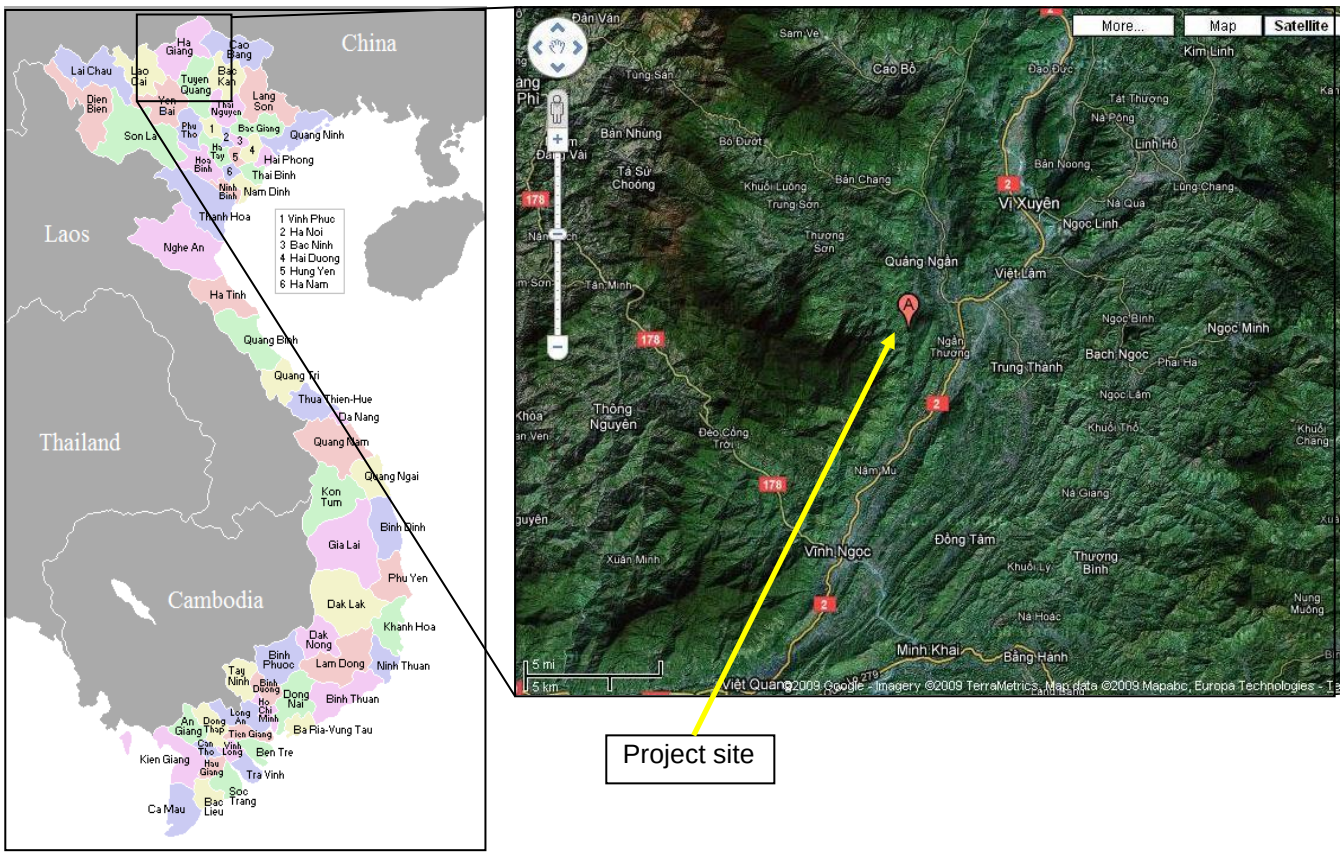

Figure 1. Project site on the map

A.3. Technologies/measures

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.

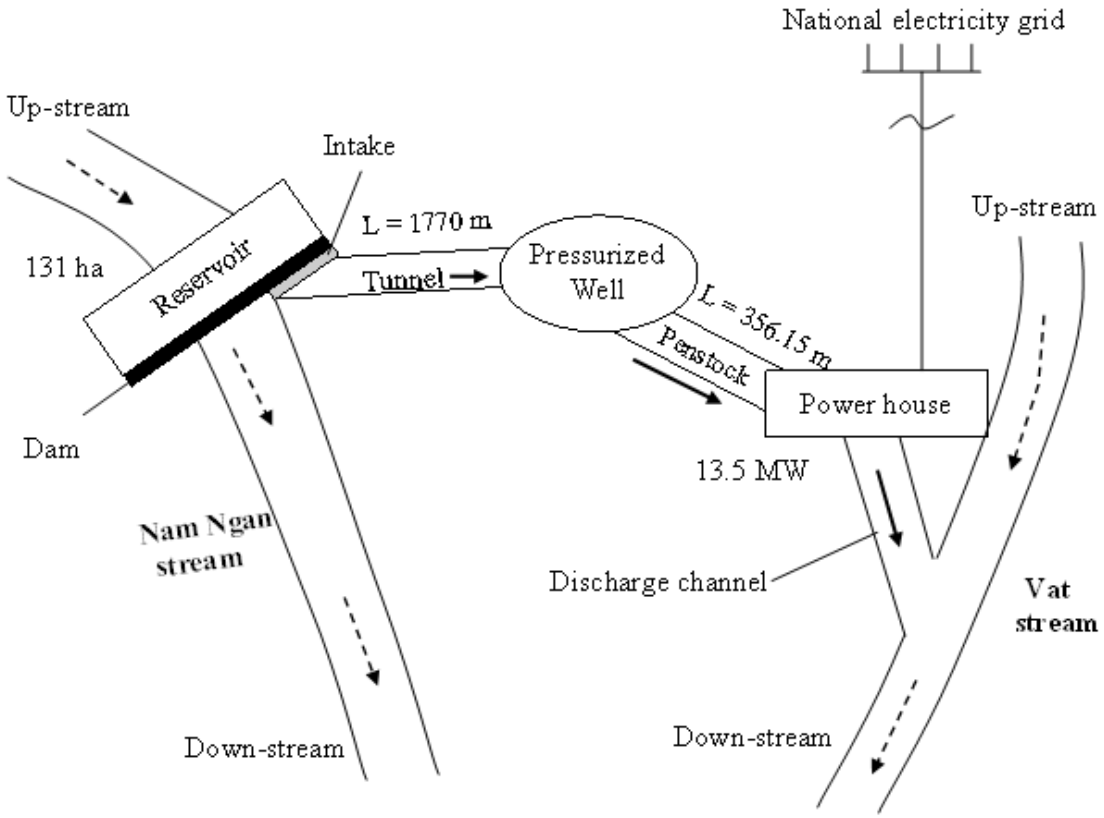

Figure 2: Project lay-out

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[3]	hour	150,000	EB 50, Annex 15
2. Generator			Symbol: SFW 6750 – 6/1780, Manufacturer: Hunan Ling Ling Hengyuan Generating
• Type		synchronous, 3 phases, horizontal axis	
• Number	set	2	

[3] The default lifetime in EB 50, Annex 15

• Rated voltage	kV	6.3	Equipment Co LTD, China
• Rated capacity	kW	6750	
• Efficiency at 100% load, Cosφ = 0.8		97.27%	
• Expected lifetime[4]	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. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Viet Nam (host)	Nam Mu Hydropower Joint Stock Company	No
Viet Nam (host)	Energy and Environment Consultancy Joint Stock Company	No
Switzerland	Swiss Carbon Assets Ltd.	No

A.5. Public funding of project activity

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

A.6. History of project activity

The history of project activity is listed in Table 2.

Table 2. The list of key events of Nam Ngan Hydropower project

Date	Key events
10/12/2006	Starting date of project activity
13/06/2009	Commissioning date
13/12/2010	Registration
13/12/2010 – 12/12/2017 (renewable)	The first crediting period
13/12/2017 – 12/12/2024 (renewable)	The second crediting period

The project owner confirms that:

- Nam Ngan Hydropower project is neither registered as a CDM project activity nor included as a component project activity (CPA) in a registered CDM programme of activities (PoA)
- Nam Ngan Hydropower project is not a project activity that has been deregistered.
- Nam Ngan Hydropower project was not a CPA that has been excluded from a register CDM PoA and the registered CDM project activity whose crediting period has not expired exists in the same geographical location as the proposed CDM project activity.

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

A.7. Debundling

According to version 04.0 of the methodological tool for "Assessment of debundling for small-scale project activities", 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 selected methodologies and standardized baselines

B.1. Reference to methodologies and standardized baselines

The applied methodology:

- Version 18.0 of AMS-I.D: Grid connected renewable electricity generation. UNFCCC CDM website for reference: https://cdm.unfccc.int/methodologies/DB/W3TINZ7KKWCK7L8WTXFQQOFQQH4SBK

The applied tools:

- Version 04.0 of the "Assessment of debundling for small-scale project activities". UNFCCC CDM website for reference: https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-20-v1.pdf

- Version 06.0 of the "Tool to calculate the emission factor for an electricity system". UNFCCC CDM website for reference: https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v6.pdf

- Version 7.0 of the "Tool for the demonstration and assessment of additionality". UNFCCC CDM website for reference: https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v7.0.0.pdf

- Version 05 of the "Guideline on the assessment of investment analysis". UNFCCC CDM website for reference: https://cdm.unfccc.int/Reference/Guidclarif/reg/reg_guid03.pdf

No standardized baseline is applicable

B.2. Applicability of methodologies and standardized baselines

The proposed project activity involves electricity generation from renewable natural resource, thus it belongs type I project activities: renewable energy project activities with a maximum output capacity equivalent to up to 15 MW.

The details on how the proposed project is complied with the applicable requirements of AMS-I.D are presented in the Table below (see version 18 of AMS-I.D.):

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

	Applicability Criteria	Project Activity	Applicability criterion met?
1	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); (d) involve a rehabilitation of (an) existing plant(s)/unit(s); or (e) 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.	Yes
2	Hydropower plant with reservoirs that satisfy at least one of the following conditions are eligible to apply this methodology: • The project activity is implemented in an existing reservoir with no change in the volume of reservoir; • The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the Project Emissions section, is greater than 4 W/m^2; • 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 constructs a new reservoir and the power density of the power plant, as per definitions given in the Project Emissions section, is 10.63 W/m^2 which is much greater than 4 W/m^2.	Yes
3	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.	Not applicable
4	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.	Not applicable
5	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.	Not applicable

6	In case of retrofit, rehabilitation 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).	Not applicable
7	In case of landfill gas, waste gas, wastewater treatment and agro-industries projects, recovered methane emissions are eligible under a relevant Type III category. If the recovered methane is used for electricity generation for supply to a grid then the baseline for the electricity component shall be in accordance with procedure prescribed under this methodology. If the recovered methane is used for heat generation or cogeneration other applicable Type I- methodologies such as "AMS-I.C.: Thermal energy production with or without electricity" shall be explored.	The project activity does not involve the landfill gas, waste gas, wastewater treatment and agro-industries projects	Not applicable
8	In case biomass is sourced from dedicated plantations, the applicability criteria in the tool "Project emissions from cultivation of biomass" shall apply	The project activity involves the construction of a hydropower plant.	Not applicable

B.3. Project boundary, sources and greenhouse gases (GHGs)

According to methodology AMS I.D, Version18, the boundary for this project is delineated by the physical, geographical site of the renewable generation source.

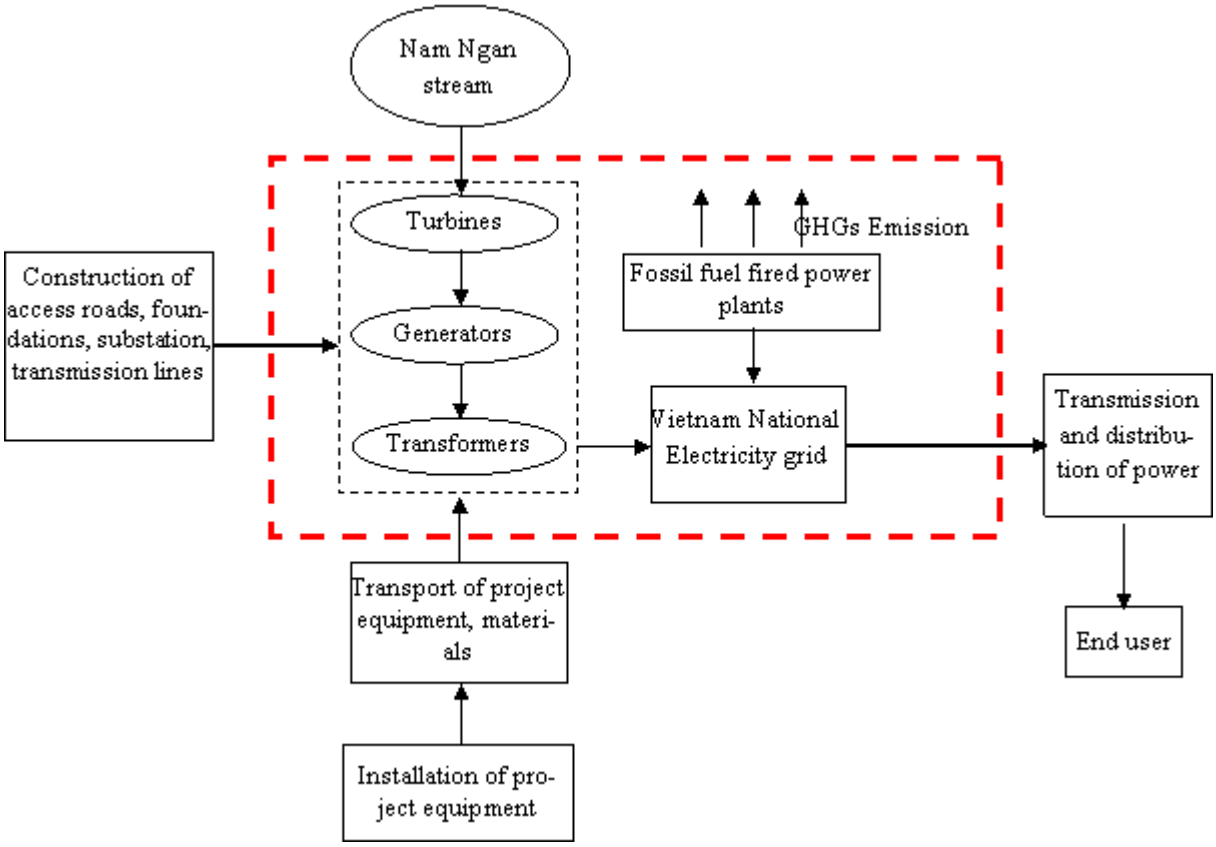

Figure 3. Project boundary

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 10.63 W/m^2
		N_2O	No	Minor emission source

B.4. Establishment and description of baseline scenario

EB 63, Annex 29: "Procedure for renewal of the crediting period of a registered CDM project activity" (Version 06.0) says that:

"3. The demonstration of the validity of the original baseline or its update does not require a reassessment of the baseline scenario, but rather than an assessment of the emission which would have resulted from that scenario".

CDM Project Standard, *Version 01.0, item 10 – "Renewal of crediting period" – para. 287 says that: "To demonstrate the validity of the original baseline or its update, the project participants are not required to re-assess the baseline scenario."*

Nam Ngan Hydropower project is a registered CDM project. Therefore, the reassessment of the baseline scenario is not required.

The baseline scenario of the project is the delivery of an equivalent amount of annual power output from the Vietnam national grid to which the proposed project is also connected.

The following national and sectoral policies and circumstances existing at the time of requesting renewal of the crediting period have not changed comparing to those at the time of project registration. The delivery of power from the national grid complies with all laws and regulations in Vietnam. The Vietnam national electricity grid is operated by EVN (Viet Nam Electricity), which has a monopoly on transmission and distribution. All power plants in Vietnam are physically connected to the national electricity grid. Thus the above circumstances do not affect the baseline GHG emissions.

The latest report of Emission Factor of Vietnam Electricity system, publish by Department of Climate Change (DNA Vietnam), Ministry of Natural Resources and Environment in March, 2017 affects the baseline GHG emission, and the reassessment of the baseline emissions applying the data of the latest report is in the Section B.6 below.

The stepwise procedure to assess the continued validity of the baseline and to update the baseline at the renewal of a crediting period is conducted following methodological tool "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period" (Version 03.0.1, EB 66, Annex 47). The tool consists of two steps. The first step provides an approach to evaluate whether the current baseline is still valid for the next crediting period. The second step provides an approach to update the baseline in case that the current baseline is not valid anymore for the next crediting period.

Step 1: Assess the validity of the current baseline for the next crediting period

The "Procedures for the renewal of the crediting period of a registered CDM project activity" approved by the CDM Executive Board require assessing the impact of new relevant national and/or sectoral policies and circumstances on the baseline.

The validity of the current baseline is assessed using the following sub-steps:

Step 1.1: Assess compliance of the current baseline with relevant mandatory national and/or sectoral policies

According to the registered PDD, in the absence of the project activity, electricity which will be supplied to the national grid would come from fossil fuel power plants. The generation of electricity by burning fossil fuels result in CO_2 emission into the atmosphere. Hence, the baseline scenario of the project is the electricity delivered to the grid by the project activity that otherwise would have been generated by the operation of grid-connected fossil fuel power plants and by the addition of new generation sources.

Electricity Law No. 28/2004/QH11 dated on 03/12/2004 and Law No. 50/2010/QH12 on "Economical and Efficient use of energy" dated on 17/06/2010 are the main laws that govern the electricity sector in Vietnam. Their implementation is regulated under Government Decree No. 14/2014/ND-CP on "Stipulating in detail the implementation of electricity law regarding electricity safety" dated on 26/02/2014. National policy and regulation does not mandate setting up renewable power plants and there is no mandatory to upgrade the geothermal power plant capacity from existing capacity. Thus it can be concluded that the current baseline scenario is in compliance with relevant mandatory national and sectoral policies.

Step 1.2: Assess the impact of circumstances

There is no impact of circumstances existing at the time of requesting renewal of crediting period on the current baseline emissions.

Step 1.3: Assess whether the continuation of use of current baseline equipment(s) or an investment is the most likely scenario for the crediting period for which renewal is requested.

The lifetime of the project activity is 35 years as per registered PDD; hence an investment is not the most likely scenario for the renewal crediting period under consideration.

Step 1.4: Assessment of the validity of the data and parameter

"Where emission factors, values or emission benchmarks are used and determined only once for the crediting period, they should be updated, except if the emission factors, values or emission benchmarks are based on the historical situation at the site of the project activity prior to the implementation of the project and cannot be updated because the historical situation does not exist anymore as a result of the CDM project activity".

In the registered PDD, the grid emission factor was calculated as per the combined margin approach described in the "Tool to calculate the emission factor for an electricity system" version 2. The grid emission factor was calculated as the weighted average of OM & BM; and was fixed ex-ante for the entire crediting period.

The OM and BM was obtained from official data provided by DNA Vietnam on 17/03/2017. This is the most recent data available during the validation of renewal of crediting period.

Considering the guidance provided under this step, calculation of emission factor and baseline emissions are updated for the next crediting period as per step 2.

Step 2: Update the current baseline and the data and parameters

Step 2.1: Update the current baseline

The baseline emissions for the second crediting period have been updated, without reassessing the baseline scenario, based on the latest approved version of the methodology applicable to the project activity. This update was applied in the context of the sectoral policies and circumstances that is applicable at the time of request for renewal of the crediting period.

Step 2.2: Update the data and parameters

As mentioned in step 1.4, all parameters regarding the grid emission factor are updated in the second crediting period.

B.5. Demonstration of additionality

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 5. 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	
Finalizing 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

Finalizing 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 Term sheet 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:

$$WACC = \frac{E}{V} * \mathrm{R}_{\mathrm{e}} + \frac{D}{V} * \mathrm{R}_{d} * (1 - T_{c}) \qquad (1)$$

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[5].

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.

Determine the cost of equity

To derive an appropriate cost of equity for electricity generation project type in Vietnam, the following well-known CAPM[6] 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:

[5] 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.

[6] 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.

$R_{e,}$ 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[7].

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.

According to the source from Bloomberg[8], 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 6. 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

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

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

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:

$$R_e = 27.04\%$$

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[9]. 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 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[10]. Therefore, **the rate of 22.45% applied as the cost of equity for power generation projects in Viet Nam at the date of decision making of the proposed project is the most conservative value.**

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

Table 7. Key assumptions to calculate the benchmark

No	Parameter	Unit	Value
1	Total investment cost[11]	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[12]	billion VND	75.4
3	Expected return on equity rate[13]	%	22.45
4	Debt		
	• Total	billion VND	175.9
	• Interest rate[14]	%	12.6

[9] 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.

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

[11] Page 4, Total investment cost, (07, 2005), prepared by Song Da Ucrin consultant

[12] 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

[13] "International Cost of Capital Perspectives Report" 2005. Ibbotson Associates, Inc.

[14] Page 38, Annual report 2005, State Bank of Vietnam

5	Average enterprise revenue tax during the lifetime[15]	%	22.00
6	**WACC**	**%**	**13.61**

The key assumptions used to calculate the Project IRR of the proposed project are presented in Table 8.

Table 8. Key assumption for investment analysis

No	Parameter	Unit	Value
1.	Gross capacity[16]	MW	13.5
2.	Annual net electricity generation[17]	MWh	57,450
3.	Total investment cost	billion VND	251.3
4.	Total annual O&M cost[18]	billion VND	3.3
5.	Preparation and construction period[19]	year	2.5
6.	Life time (Period of financial assessment) [20]	year	35
7.	Depreciation[21]	year	20
8.	Feed-in tariff[22]	VND/kWh	608
9.	Resources tax[23]	%	2
10.	Enterprise revenue tax[24] • 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

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

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

[17] 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)

[18] 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.

[19] Project feasibility study

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

[21] Prevailing common practice period for industrial investment project

[22] 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.

[23] 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%

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

- Investment costs
- Feed-in tariff set by EVN

Table 9 shows the impact of variations in key factors on the Project IRR.

Table 9. 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%[25] so this option shall be discarded.
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

[25] According to the financial report.

In conclusion, the proposed project activity is additional.

EB 63, Annex 29: "Procedure for renewal of the crediting period of a registered CDM project activity" (Version 06.0) says that:

"2. Project participants shall update those sections of the project design document (CDM-PDD) relating to the baseline, estimated emission reductions and the monitoring plan using an approved baseline and monitoring methodology"

CDM Project Standard, *Version 01.0, item 10 – "Renewal of crediting period" – para. 284 says that: "For renewal of crediting period of a registered CDM project activity, the project participants are not required to reassess the additionality of the project activity nor update the section of the PDD relating to additionality.*

Nam Ngan Hydropower project is a registered CDM project. Therefore, the reassessment of the additionality is not required for renewing crediting period.

B.6. Estimation of emission reductions

B.6.1. Explanation of methodological choices

I. Project emissions *(PE_y)*

For most renewable project activities, PE_y = 0. However, for the following categories of project activities, project emissions have to be considered following the procedure described in the version 17.0 of "ACM0002: Grid-connected electricity generation from renewable sources":

a) Emissions related to the operation of geothermal power plants
b) Emissions from water reservoirs of hydro power plants

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:

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

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 emission factor has been calculated and published on 17 March 2017 by the host country DNA of Vietnam using the latest relevant EF tool and data available at the time of calcucation. The official document that demonstrates the updated EF is given in the link below:

http://www.noccop.org.vn/Data/vbpq/Airvariable_ldoc_73vnCV%20EF%202015.pdf

The applied EF value is calculated from the latest EF value published by DNA Vietnam for the purpose of renewing the crediting period.

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

$EF_{grid,OM,y}$ = 0.7777 tCO_2/MWh $\quad$ w_{OM} = 0.25
$EF_{grid,BM,y}$ = 0.8531 tCO_2/MWh $\quad$ w_{BM} = 0.75

Thus, $EF_{grid,CM,y}$ = 0.83425 tCO_2/MWh

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

III. Leakage emissions (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 18 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/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 fixed ex ante

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

Data/Parameter	**A_{BL}**
Data unit	m^2
Description	Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full. For new reservoirs, this value is zero.
Source of data	This is a green-field project. This value does not exist prior to the implementation of the project activity
Value(s) applied	0
Choice of data or measurement methods and procedures	The project activity builds a new reservoir, so A_{BL} is considered by zero.
Purpose of data	For calculating the power density (PD)
Additional comment	-

Data/Parameter	EF_{res}
Data unit	kg CO_2e/MWh
Description	Default emission factor for emissions from reservoirs
Source of data	Default value as per EB23
Value(s) applied	90 kgCO_2e/MWh.
Choice of data or measurement methods and procedures	
Purpose of data	For calculation of project emission (PE)
Additional comment	-

Data/Parameter	$EF_{grid,y}$
Data unit	tCO2/MWh
Description	CO_2 emission factor of the grid
Source of data	Ministry of Natural resources and Environment Department of Meteorology, Hydrology and Climate change
Value(s) applied	0.83425
Choice of data or measurement methods and procedures	The EF is calculated and published by Ministry of Natural resources and Environment Department of Meteorology, Hydrology and Climate change.
Purpose of data	Calculation of baseline emissions
Additional comment	-

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

$EF_{CO2,grid,y}$ = 0.83425 tCO_2/MWh

Therefore:

BE_y = 47,927 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 10. Installed capacity and respective reservoir area of hydropower plant

Hydropower plant	**Nam Ngan**
Installed capacity (MW)	13.5
Reservoir area (m^2)	1,270,000

The power density project plant is derived as follows:

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}} = \frac{13.5 \times 10^6 - 0}{1{,}270{,}000 - 0} = 10.63 \ {}^{W}/_{m^2}$$

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:

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

= 47,927 tCO_2

B.6.4. Summary of ex ante estimates of emission reductions

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

Table 11. Emission reduction of the project activity

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
2017 (13th Dec. to 31st Dec.)	2,494	0	0	2,494
2018	47,927	0	0	47,927
2019	47,927	0	0	47,927
2020	47,927	0	0	47,927
2021	47,927	0	0	47,927
2022	47,927	0	0	47,927
2023	47,927	0	0	47,927
2024 (1st Jan. to 12th Dec.)	45,432	0	0	45,432
Total	335,488	0	0	335,488
Total number of crediting years	07			

Annual average over the crediting period	47,927	0	0	47,927

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data/Parameter	**$EG_{y, export}$**
Data unit	MWh
Description	Electricity supplied by the proposed hydropower plant to the national grid
Source of data	Direct measurement at the lines after the rising transformer 6.3/110KV in 110kV Nam Ngan distribution station
Value(s) applied	57,450
Measurement methods and procedures	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	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.
Purpose of data	For $EG_{BL,y} = EG_{y, export} - EG_{y, import}$
Additional comment	-

Data/Parameter	$EG_{y, import}$
Data unit	MWh
Description	Electricity supplied by the grid to the proposed hydropower plant
Source of data	Direct measurement at the lines after the rising transformer 6.3/110KV in 110kV Nam Ngan distribution station
Value(s) applied	0
Measurement methods and procedures	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	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.
Purpose of data	For $EG_{BL,y} = EG_{y, export} - EG_{y, import}$
Additional comment	-

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	Calculating from $\mathbf{EG_{y,\ import}}$ and $EG_{y,\ export}$
Value(s) applied	57,450
Measurement methods and procedures	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	Sales record of electricity to the grid is used to ensure the consistency.
Purpose of data	For CERs calculation
Additional comment	-

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	Project site
Value(s) applied	1,270,000
Measurement methods and procedures	Measured from topographical surveys, maps, satellite pictures, etc
Monitoring frequency	Yearly
QA/QC procedures	The uncertainty level of this data is low
Purpose of data	For power density calculation
Additional comment	-

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	Project site
Value(s) applied	13,500,000
Measurement methods and procedures	Manufacture's nameplate
Monitoring frequency	Yearly
QA/QC procedures	
Purpose of data	Use for calculating the power density
Additional comment	-

Data/Parameter	$\boldsymbol{TEG_y}$
Data unit	MWh/yr
Description	Total electricity produced by the project activity, including the electricity supplied to the grid and the electricity supplied internal loads, in year y
Source of data	Direct measurement at the project site
Value(s) applied	58,030
Measurement methods and procedures	Electricity meters
Monitoring frequency	Continuous measurement by the power meter and monthly recording

QA/QC procedures	The uncertainty level of this data is low. The 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.
Purpose of data	Use for calculating the power density
Additional comment	Applicable to hydropower project activities with a power density greater than 4 W/m^2 and less than or equal to 10 W/m^2.

B.7.2. Sampling plan

N/A

B.7.3. Other elements of monitoring plan

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 failing of the main meter.

Data from the operating meters will be recorded electronically hourly. 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.

SECTION C. Start date, crediting period type and duration

C.1. Start date of 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.2. Expected operational lifetime of project activity

35 years

C.3. Crediting period of project activity

C.3.1. Type of crediting period

A 7-year crediting period (the second crediting period)

C.3.2. Start date of crediting period

First crediting period's start date: 13/12/2010
Second crediting period's start date: 13/12/2017

C.3.3. Duration of crediting period

Length of the first crediting period: 7 years 00 months
Length of the second crediting period: 7 years 00 months

SECTION D. Environmental impacts

D.1. Analysis of 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.

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.

<u>Impact on water flow of Nam Ngan stream</u>

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. Environmental impact assessment

N/A

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

The local stakeholder consultant process was conducted during the first crediting period, and had been validated for the purpose of registering the CDM project.

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 Committee'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 vegetation 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 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 vegetation) occupied and/or replaced by the project will be compensated adequately.

E.3. Consideration of 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.

SECTION F. Approval and authorization

Issued date for LoA from DNA of Vietnam: 30 July 2007
Issued date for LoA from DNA of Switzerland: 20 June 2014

Appendix 1. Contact information of project participants

Organization name	**Nam Mu Hydro Power Joint Stock Company**
Country	Viet Nam
Address	Tan Thanh commune, Bac Quang district, Ha Giang province, Vietnam
Telephone	+ 84 – 219 – 3827276
Fax	+ 84 – 219 – 3827276
E-mail	Nguyenvietky18@yahoo.com.vn
Website	
Contact person	Ha Ngoc Phiem

Organization name	**Energy and Environment Consultancy Stock Company**
Country	Viet Nam
Address	8th Floor, Diamond Flower Tower, Nhan Chinh ward, Thanh Xuan district, Hanoi, Vietnam
Telephone	+84 – 4 – 6666 – 9753
Fax	+84 – 4 – 6666 – 9755
E-mail	dhanh@eec.vn
Website	www.eec.vn
Contact person	Dang Thi Hong Hanh

Organization name	Swiss Carbon Assets Ltd.
Country	Switzerland
Address	Technoparkstr.1, Zurich 8005, Switzerland
Telephone	+41 – 43 – 501 – 3550
Fax	+41 – 43 – 501 – 3599
E-mail	registration@southpolecarbon.com
Website	www.southpolecarbon.com
Contact person	Renat Heuberger

Appendix 2. Affirmation regarding public funding

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

Appendix 3. Applicability of methodologies and standardized baselines

N/A

Appendix 4. Further background information on ex ante calculation of emission reductions

N/A

Appendix 5. Further background information on monitoring plan

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:

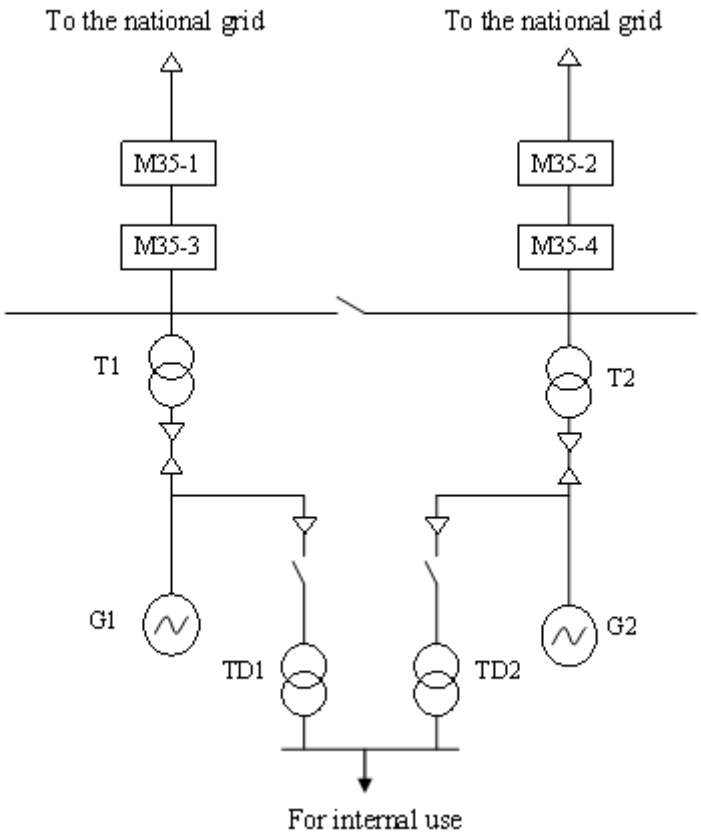

Figure 4. Location of metering equipment

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:

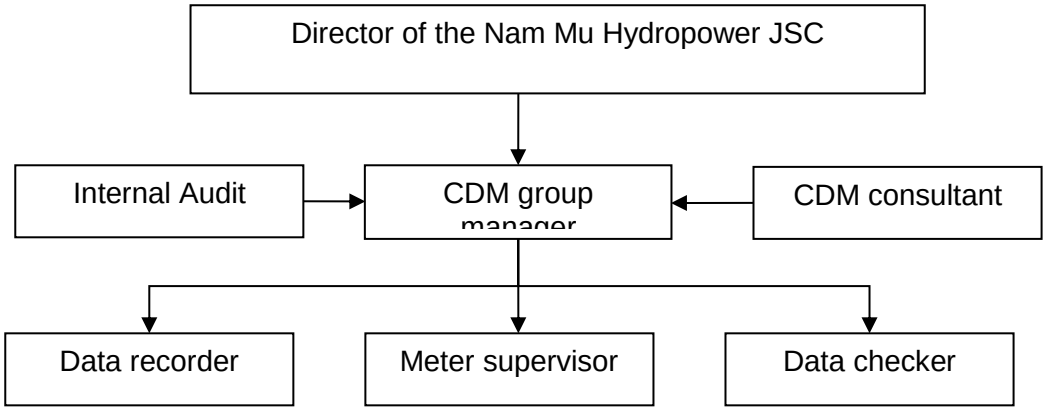

Figure 5. Structure of the monitoring group

The responsibilities of each person involved are elaborated as follows:

Group members and their responsibilities[26]

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:

(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.

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

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

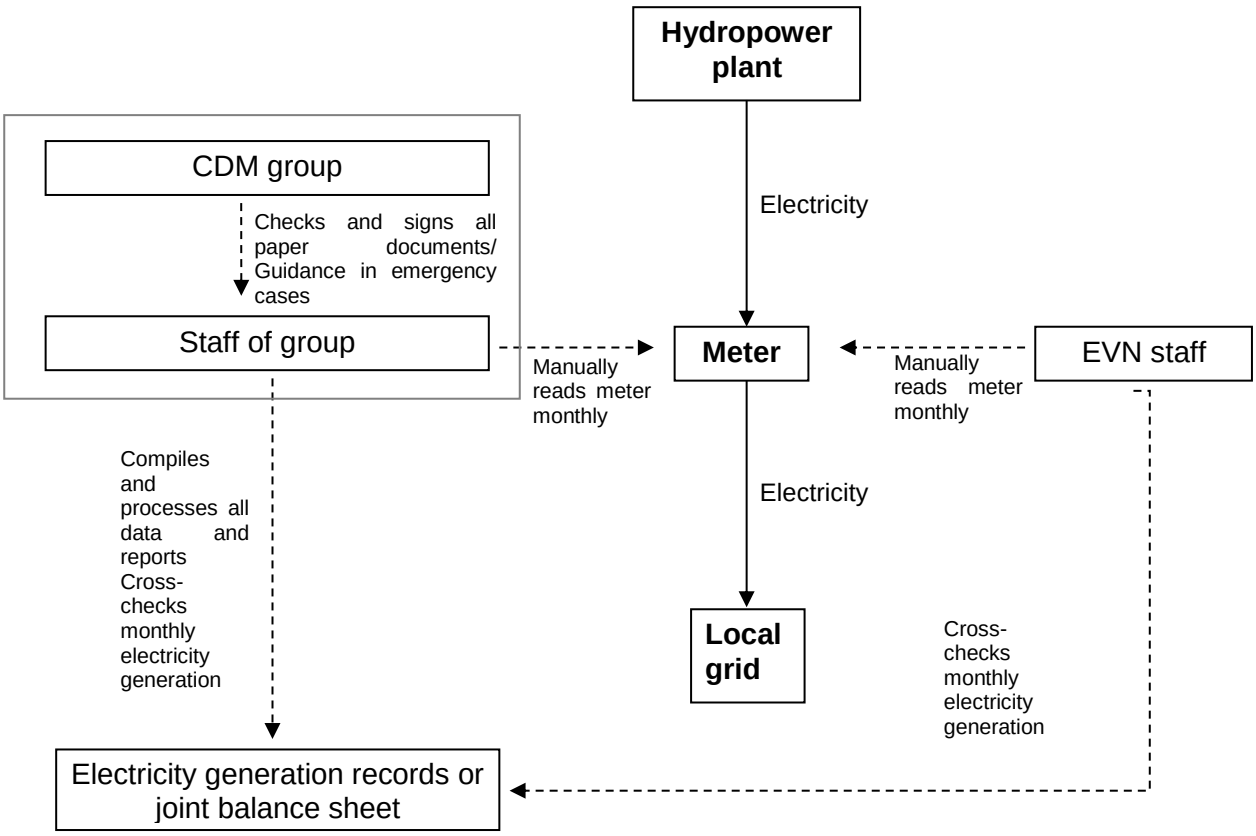

Figure 6. Monitoring process

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[27]. 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.

[27] Decision No 65/2002/QD-BKHCNMT[27] 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".

- 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.

Appendix 6. Summary report of comments received from local stakeholders

N/A

Appendix 7. Summary of post-registration changes

N/A

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Document information

Version	*Date*	*Description*
10.1	28 June 2017	Revision to make editorial improvement.

Version	*Date*	*Description*
10.0	7 June 2017	Revision to: • Improve consistency with the “CDM project standard for project activities” and with the PoA-DD and CPA-DD forms; • Make editorial improvement.
09.0	24 May 2017	Revision to: • Ensure consistency with the “CDM project standard for project activities” (CDM-EB93-A04-STAN) (version 01.0); • Incorporate the “Project design document form for small-scale CDM project activities” (CDM-SSC-PDD-FORM); • Make editorial improvement.
08.0	22 July 2016	EB 90, Annex 1 Revision to include provisions related to automatically additional project activities.
07.0	15 April 2016	Revision to ensure consistency with the “Standard: Applicability of sectoral scopes” (CDM-EB88-A04-STAN) (version 01.0).
06.0	9 March 2015	Revision to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Make editorial improvement.
05.0	25 June 2014	Revision to: • Include the Attachment: Instructions for filling out the project design document form for CDM project activities (these instructions supersede the "Guidelines for completing the project design document form" (Version 01.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Appendix 1; • Change the reference number from F-CDM-PDD to CDM-PDD-FORM; • Make editorial improvement.
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	13 March 2012	Revision required to ensure consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Annex 8).
03.0	26 July 2006	EB 25, Annex 15
02.0	14 June 2004	EB 14, Annex 06b
01.0	03 August 2002	EB 05, Paragraph 12 Initial adoption.

Version	*Date*	*Description*

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