CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28/07/2006

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SECTION A. General description of project activity

A.1. Title of the project activity:

Title: Nam Pong Hydropower Project
Version: 1.5
Date: 29/11/2011

A.2. Description of the project activity:

The Nam Pong hydropower project activity involves the construction of a two generating unit hydropower plant having installed capacity of 30 MW. The main structures of the project include a dam, intake, tunnel, pressurized well, penstock, a power house, and a discharge canal. The project is located on Nam Pong stream in Chau Hanh and Chau Phong communes, Quy Chau district, Nghe An province, Viet Nam.

Prior to the implementation of the project activity, electricity in Viet Nam is generated mainly from fossil fuel sources and is solely distributed to consumers via the unique national electricity grid.

The project's purpose is to generate hydroelectricity from Nam Pong stream, a clean and renewable source, to supply the national grid. The project's installed capacity and estimated annual gross power generation is 30 MW and 123.29 GWh[1], respectively. The net electricity generated (with an estimated annual volume of 122.057 GWh[2]) will be supplied to the national grid via a newly constructed transmission line from the plant to a 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 Greenhouse Gas (GHG) emissions, which will displace part of the electricity otherwise supplied by fossil fuel fired power plants. The project involves construction of a reservoir with an area of 0.32[3] km^2 and a power density of 93.75[4] W/m^2, accordingly. As the power density of this project is greater than 10 W/m^2, the GHG emission from reservoir is not included in the project emission. Thus, GHG emission reductions can be achieved via this proposed project activity. Total expected CO_2 emission reduction is 492,471 tCO_2 over the first crediting period of 7 years.

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

General contributions towards national sustainable development:

- In recent years, Viet Nam has suffered a critical electricity shortage as a consequence of rapidly increasing demand and insufficient supply, thereby imposing negative impacts on economic growth as well as on 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 national grid, it will help improve the quality of service and lessen the risks of power failure.
- Reducing reliance on exhaustible fossil fuel based power sources and also reducing the import of fuels for the purpose of power generation.

[1] Technical Design Report of Nam Pong HPP
[2] The gross power generation subtracts 1% for parasitic and loss load. Technical Design Report of Nam Pong HPP
[3] Technical Design Report of Nam Pong HPP
[4] Calculation of power density is described in Section B.6

- Modern and highly efficient turbines and generators are being used in the project and the power transmission will be at high voltage to ensure low losses. The project will accelerate the deployment of renewable energy technologies in Viet Nam.

Contributions towards local sustainable

a) Economic well-being

Once commissioning, this proposed project will increase the industrial share in the economic structure of Nghe An province. This proposed project will significantly contribute to the state budget via taxes i.e. annual enterprise revenue tax, natural resource tax[5] and CER tax[6].

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

After commissioning, this project will supply electricity to speed up the commissioning of other large infrastructure projects in the region.

b) Social well-being

The project improves existing roads, which will facilitate the transportation and travel. Thus, the project creates convenience for the transfer and trade in the area, thereby improves minorities' living standard and contribute to fill the gap in development between different ethnic groups in Viet Nam.

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. This project will contribute directly to improve the low-quality infrastructure systems of the mountainous commune.

The project will construct a new transmission line together with the hydropower plant, which will reduce electricity losses and improve the quality of electricity supply in the region.

Besides, the project activity could result in the employment of the local people for the construction and operation later. Therefore, this project activity will contribute directly to alleviate poverty in the region.

In conclusion the project activity will contribute positively towards sustainable development of Viet Nam.

A.3. Project participants:

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants(*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Viet Nam (host)	ZaHung Joint Stock Company	No
	Energy and Environment Consultancy	No

[5] According to the Investment law and Natural resource law

[6] According to Circular No. 58/2008/TTLT-BTC-BTN&MT issued by Ministry of Finance and Ministry of Natural Resource and Environment on 04 July 2008

Viet Nam (host)	Joint Stock Company	
Switzerland	Vietnam Carbon Assets Limited	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.:

Nghe An province

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

Chau Hanh and Chau Phong communes, Quy Chau 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 Pong hydropower plant which is located on Nam Pong stream, Chau Hanh and Chau Phong communes, Quy Chau district, Nghe An province. This project has the following co-ordinates[7]:

Co-ordinates of dam:	$19^0$31'15''	Northern latitude
	$105^0$02'10''	Eastern longitude

The site of the project is showed in Figure 1.

[7] Technical Design Report. The coordinates of the proposed project will be confirmed by the DOE during the site visit.

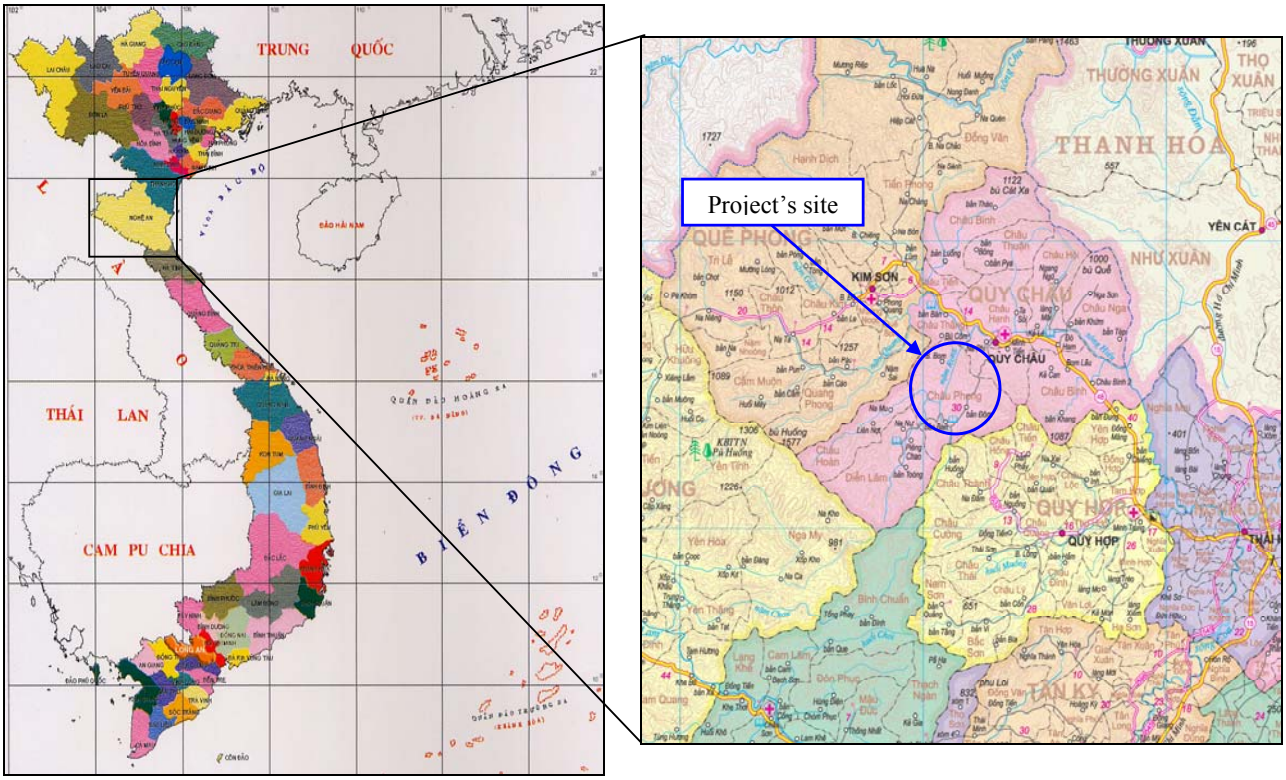

Figure 1: Map of the location of the project activity

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

Sectoral scope/ Category: 1: Energy industries (renewable sources)
Grid-connected electricity generation from renewable sources

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

The project activity involves the construction of main facilities including a dam, power house, discharge canal in order to convert potential flowing energy from Nam Pong stream into clean electrical energy, which will be supplied to the national grid through transmission line. It also involves the construction of a reservoir with a power density of 93.75 W/m^2, significantly greater than the 10 W/m^2 threshold established in version 12.2.0 of ACM0002. Accordingly, GHG emissions from the reservoir no need to be accounted under this the project activity.

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

Figure 2 shows the layout of the project.

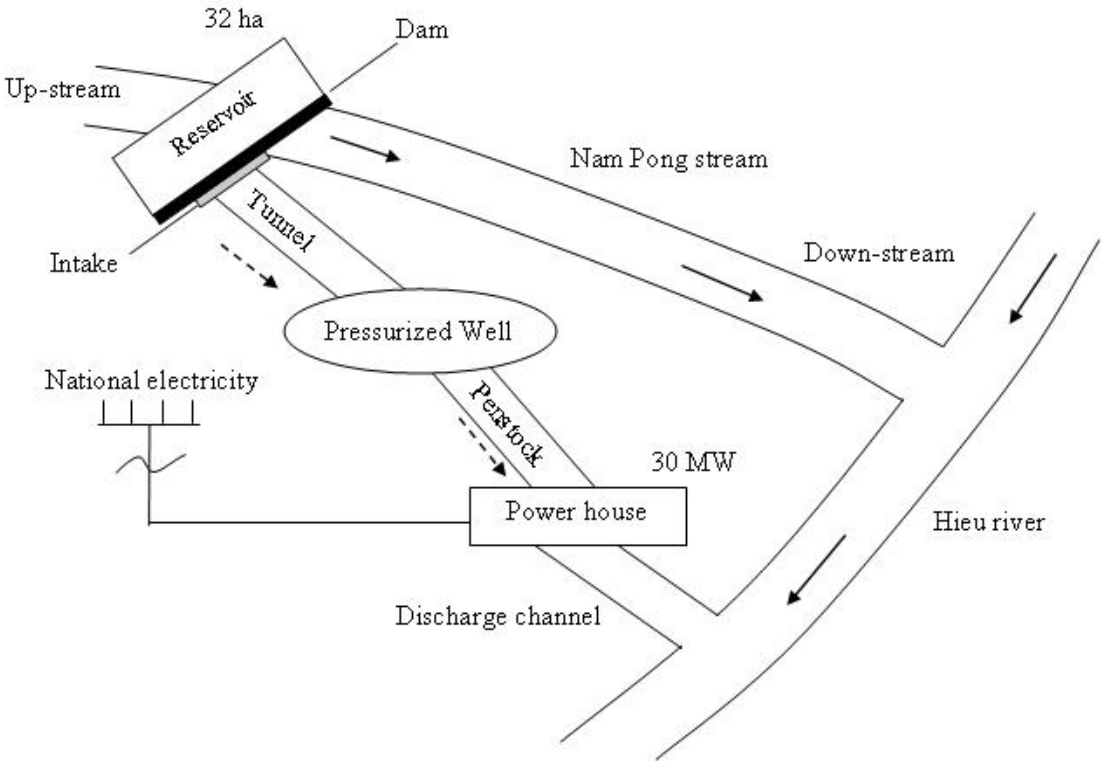

Figure 2: Nam Pong hydropower plant's lay-out

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

Table 1: Main technical parameters of the proposed project activity

Main parameters	Units	Values
1. Turbine[8]		
• Type		Francis – Vertical
• Number of turbine	set	2
• Turbine discharge	m^3/s	10.75
• Rated capacity	MW	15.56
• Speed	rpm	750
2. Generator[9]		
• Number	set	2
• Type		Synchro – 3 phases- vertical
• Rated voltage	kV	10.5
• Rated capacity	MW	15.0
3. Transformer[10]		
• Number	set	2
• Type		3 phases, 2 windings
• Rated capacity	MVA	20
• Voltage	kV	115±2×2.5%/10.5
4. Annual river flow[11]	m^3/s	12.15
5. Load factor[12]	%	46.91

The main equipment utilized in this project is imported from China. The supplier was chosen via tender. All the turbines and alternators must be the state-of-art technology and met the criteria of the tender document. The professional technicians and engineers will train the hydropower plant staffs on the monitoring procedures, operation regulation, maintenance procedures and other required knowledge regarding the hydropower plant before the start of operation of the project. Furthermore, there will be regular training courses regarding monitoring and operation for plant staffs during operation period. So the modern technology would be transferred to the host country.

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

[8] Equipment contract of Nam Pong HPP
[9] Technical Design Report of Nam Pong HPP
[10] Technical Design Report of Nam Pong HPP
[11] Technical Design Report of Nam Pong HPP
[12] The Plant load factor (PLF) for this proposed project was determined by the annual electricity output and the capacity which were provided by the third party contracted by the project owner. So it is in line with the EB 48 annex 11 "The plant load factor determined by a third party contracted by the project participants (e.g. an engineering company)"
PLF = (Total electricity output / Maximum electricity could be generated) or
PLF = (the annual electricity output / (the capacity*8760) * 100%). In which 8760 is hours of one year.
So PLF for this proposed project = 123,290 / (30 * 8760) * 100% = 46.91%.

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

The project activity will achieve GHG emission reduction by displacing power generated by fossil fuel fired plants connected to the national grid. The project will apply for a seven-year crediting period, renewable twice up to a total of 21 years. The estimated emission reductions for the first crediting period are presented in Table 2.

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

Year	Annual estimated emission reduction tCO_2 e
2013 (From 1/7/2013 to 31/12/2013)	35,176
2014	70,353
2015	70,353
2016	70,353
2017	70,353
2018	70,353
2019	70,353
2020 (From 1/1/2020 to 30/06/2020)	35,177
Total estimated reductions (tCO2e)	**492,471**
Total number of crediting years	**7**
Annual Average estimated reduction over the crediting period (tCO2e)	**70,353**

A.4.5. Public funding of the project activity:

No public funds or ODA from Annex I countries is involved in this project[13].

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

Related tools:

- Version 02.2.1 of the "Tool to calculate the emission factor for an electricity system"
- Version 06.0.0 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/C505BVV9P8VSNNV3LTK1BP3OR24Y5L

[13] Non ODA declaration

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 hydroelectric generation plant, which falls under the scope of ACM0002 version 12.2.0. More details of the comparison of the project's characteristics and the applicability criteria as specified in, Version 12.2.0 of ACM0002 is given in Table 3.

Table 3: Comparison of project's characteristics and eligibility criteria of Version 12.2.0 of ACM0002

Applicability conditions in Version 12.2.0 of ACM0002	Characteristics of the project activity	Applicability criterion met?
This methodology is applicable to grid-connected renewable power generation project activities that (a) install a new power plant at a site where no renewable power plant was operated prior to the implementation of the project activity (green field plant); (b) involve a capacity addition; (c) involve a retrofit of (an) existing plant(s); or (d) involve a replacement of (an) existing plant(s).	The project activity consists in the installation of a new grid connected renewable power plants at a site where no renewable power plant was operated prior to the implementation of the project activity (green field plant).	Yes
The project activity is the installation, capacity addition, retrofit or replacement of a power plant/unit of one of the following types: hydro power plant/unit (either with a run of river reservoir or an accumulation reservoir), wind power plant/unit, geothermal power plant/unit, solar power plant/unit, wave power plant/unit or tidal power plant/unit;	The project activity involves the installation of a new hydropower plant.	Yes
In the case of the capacity additions, retrofits or replacements (except for wind, solar, wave or tidal power capacity addition projects which use Option 2: on page 11 to calculate the parameter $EG_{PJ,y}$): the existing plant started commercial operation prior to the start of a minimum historical reference period of five years, used for the calculation of baseline emissions and defined in the baseline emission section, and no capacity expansion or retrofit of the plant has been undertaken between the start of this minimum historical reference period and the implementation of the project activity;	The project activity is to install a new hydro power plant.	Not applicable
In case of hydro power plants, one of the following conditions must apply: • The project activity is implemented in an existing single or multiple reservoirs, with no change in the volume of reservoir; or	The project activity is to create a new reservoir.	Not applicable

• The project activity is implemented in an existing single or multiple reservoirs, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the project emissions section, is greater than 4 W/m^2; or	The project activity is to create a new reservoir.	Not applicable
• The project activity results in new single or multiple reservoirs and the power density of the power plant, as per definitions given in the project Emissions section, is greater than 4 W/m^2.	The project activity results in a new reservoir, with a power density of 93.75 W/m^2, which is greater than 4 W/m^2.	Yes
In case of hydro power plants using multiple reservoirs where the power density of any of the reservoirs is lower than 4 W/m_2 all the following conditions must apply: • The power density calculated for the entire project activity using equation 5 is greater than 4 W/m^2; • Multiple reservoirs and hydro power plants located at the same river and where are designed together to function as an integrated project[1] that collectively constitute the generation capacity of the combined power plant; • Water flow between multiple reservoirs is not used by any other hydropower unit which is not a part of the project activity; • Total installed capacity of the power units, which are driven using water from the reservoirs with power density lower than 4 W/m_2, is lower than 15MW; • Total installed capacity of the power units, which are driven using water from reservoirs with power density lower than 4 W/m_2, is less than 10% of the total installed capacity of the project activity from multiple reservoirs.	The project activity results in a new reservoir, with a power density of 93.75 W/m2, which is greater than 4 W/m2.	Not applicable
This methodology is not applicable to • Project activities that involve switching from fossil fuels to renewable energy sources at the site of the project activity, since in this case the baseline may be the continued use of the fossil fuels at the site.	It is a renewable energy project with no fuel-switch involved.	Yes
• Biomass fired power plants.	The project activity is to install	Yes

• Hydropower plants that result in new single or multiple reservoirs or in the increase in an existing reservoirs where the power density of the power plant is less than 4 W/m^2.	a new hydro power plant. The project activity results in a new reservoir, with a power density of 93.75 W/m^2, which is greater than 4 W/m^2.	Yes

This comparison shows clearly that the proposed project activity fulfils all applicability criteria to be eligible under Version 12.2.0 of ACM0002.

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

According to Version 12.2.0 of ACM0002, the spatial extent of the project boundary includes the Nam Pong 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.

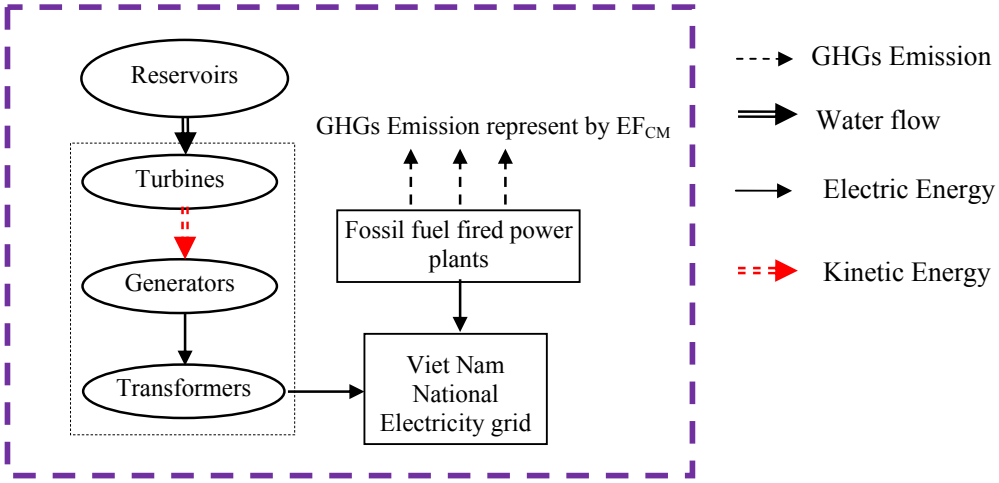

Figure 3: Project boundary

The GHGs and emission sources included in the project boundary are shown in Table 4.

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

	Source	Gas	Included?	Justification/Explanation
Baseline	CO_2 emissions from electricity generation in fossil fuel fired power plants that are 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, the power density of the project is greater than 10 W/m^2 so CH_4 emissions are neglected, according to ACM0002, Version 12.2.0.
		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 12.2.0 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 (CM) calculations described in the "Tool to calculate the emission factor for an electricity system"".

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

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

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 12.2.0 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 06.0.0 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 06.0.0 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 alternatives to the project activity will be considered:

Alternative 1: The proposed project activity undertaken without being registered as a CDM project activity.

The construction and operation of Nam Pong hydropower project with the total installed capacity of 30MW, without being registered as a CDM project activity.

Alternative 2: Continuation of the current situation

In this case, the project activity will not be constructed and the power will be supplied by other power producers to the Vietnam national grid.

Alternative 3: Adding a new fossil fuel-fired power plant with equivalent power output

The construction and operation of a new fossil fuel power plant

Alternative 4: Adding a new renewable energy power plant other than hydropower plant

The construction and operation of another renewable power plant (e.g. solar, wind, biomass).

Alternative 3 cannot be the baseline scenario because according to the Master Plan of Electricity Expansion for period of 2006-2015 with perspective to 2025 - EVN (Master Plan VI) approved by the Prime Minister in July 2007[14] which is the latest publicly information source listed all operated and planned power plants in Vietnam, there is not any fossil fired power plant with the equivalent and lower power output is constructed/under construction and/or planned in Vietnam or Nghe An province. According to the Electricity Law, the investment in electricity generation must be in line with the potential power generation projects listed in the latest Master plan. In the point of view for electricity development by Ministry of Industry and Trade[15], the common capacity of thermal power unit within next 10 years is 300 MW and in the future the higher capacity (600 MW and higher) will be chosen for the economic scale reason. Therefore, the investment and operation of such thermal power plants with the capacity equal and below 30 MW is not realistic in Vietnam.

Furthermore, the Project Owner only has experience and right to invest and do business in hydroelectric power[16]. The construction of fossil fuel power plants by the project proponent is not a plausible investment option as the project participant has no know-how and experience as well as a plan for investing in a fossil fuel power plant.

Alternative 4 cannot be the baseline scenario because the project location does not provide sufficient renewable resources except for the water resource[17].

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 Viet Nam 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 Pong hydropower project received the Investment License No.271110000013 issued by People’s Committee of Nghe An Province on 21 November 2007 for Ha Do Joint Stock Company (Ha Do JSC) and the Modificative Investment License No.271110000013/GCNĐC/01 issued by People’s Committee of Nghe An Province on 15 May 2009 for ZaHung Joint Stock Company (ZaHung JSC), which accredits the legal right of the project owner to invest in and construct the Nam Pong hydropower project. Therefore, the alternative 1 “the proposed project is undertaken without the CDM” is consistent with mandatory laws and regulations of Viet Nam.

[14] Decision 110/QD-TTg dated 18 July 2007
[15] Industrial Review of Vietnam, http://www.tapchicongnghiep.vn/News/channel/1/News/89/3751/Chitiet.html
[16] Business Registration License of Za Hung Join Stock Company
[17] Chapter VI - Master Plan VI

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. As indicated in Guidelines on the assessment of investment analysis - version 05, Annex 05, EB62, "*Local commercial lending rates or weighted average costs of capital (WACC) are appropriate benchmarks for a project IRR*", the project participant applies the average long-term local commercial lending rates available at the time of making the investment decision as the benchmark.

Weekly, the State Bank of Vietnam publishes a monetary report that provides the statistic data of the local commercial lending rates prevailing in the market during the reporting period. Such a report is published at the website of the State Bank weekly (www.sbv.gov.vn/en/). The benchmark of the Nam Pong project is 13.6%. This benchmark is derived from the average long-term commercial lending rates available from the beginning of 2010 up to the date of making the investment decision.

The benchmark of Nam Pong project is derived from the average long-term commercial lending rates available from the beginning of 2010 up to the date of making the investment decision and equal 13.6%.

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 5

Table 5: Key assumption for investment analysis

No	Parameter	Unit	Value	Source
1	Gross capacity	MW	30	The Technical Design Report of Nam Pong HPP.
2	Annual net electricity generation	MWh	122.057	The gross power generation subtracts 1 % for parasitic and loss load. The Technical Design Report of Nam Pong HPP.
3	Total investment cost	billion VND	695.571	The Technical Design Report of Nam Pong HPP.
4	Total annual O&M cost	%	1	The Technical Design Report of Nam Pong HPP.
5	Preparation period pre-construction	year	1	The Technical Design Report of Nam Pong HPP.
6	Construction period	year	2.5	The Technical Design Report of Nam Pong HPP.
7	Life time	year	40	The Technical Design Report of Nam Pong HPP.
8	Depreciation period for construction	year	20	Decision No. 206/2003/QD-BTC issued on 12 December 2003by the Ministry of Finance
9	Depreciation period for	year	10	Decision No. 206/2003/QD-BTC

	equipment			issued on 12 December 2003by the Ministry of Finance
10	Annual operation hours	hour	4110	The Technical Design Report of Nam Pong HPP.
11	Fair value		0	The project participants chose a lifetime of 40 years to assess the cash flows for the project IRR while a linear depreciation over 20 years period is chosen as regulated by the government. Full value of assets has been completely depreciated. No fair value remains.
12	Electricity price.	VND/kWh	720.35	Refer to the estimate of average price applied for power generation projects with the capacity equal and below 30MW in the regulation for avoided cost tariff for 2010 issued on 30 December 2009 by the Ministry of Industry and Trade.
13	Resources tax	%	2	The Circular No 45/2009/TT-BTC was issued by Ministry of Finance on 11 March 2009 regulates that the resource tax will be calculated as the net electricity outputs supplied to the national electricity grid x 2% x average electricity price which is issued by Ministry of Finance in annual January.
14	**Project IRR**	**%**	**9.96**	

This table shows that the Project IRR of the project was lower than the benchmark at the time of decision making which is defined as the date of issuing the Investment Decision on implementing the investment project by the Management Board on 17 July 2010.

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. As guided in Annex 05 "Guidelines on the Assessment of Investment Analysis"/Version 05, EB 62, "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
- Total investment cost
- Electricity price
- O&M cost (though it constitutes less than 20% of the total project cost or total project revenue but still considered in this analysis)

Table 6 shows the impact of variations in key factors on the Project IRR considering a ±10% variation in the parameters.

Table 6: Sensitivity analysis

No	Parameter	Variation[18]	IRR	Likelihoods to happen
1	Annual amount of electricity exported to the national grid	+10%	11.01%	Lower than the benchmark of 13.6%
		-10%	8.87%	Lower than the benchmark of 13.6%
2	Total investment costs	+10%	9.06%	Lower than the benchmark of 13.6%
		-10%	11.03 %	Lower than the benchmark of 13.6%
3	Electricity price	+10%	11.04 %	Lower than the benchmark of 13.6%
		-10%	8.84%	Lower than the benchmark of 13.6%
4	O & M cost	+10%	9.87%	Lower than the benchmark of 13.6%
		-10%	10.05%	Lower than the benchmark of 13.6%

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 on power generation and consumption, which was issued on 2 August 2001 and was entered into force 15 days after the issuance date, created a legal basis to allow other entities to invest in and generate electricity rather than only state-owned entities as previously regulated. Before that time, all power plants have been invested from the state budget sources and operated by state owned companies. Hence, any hydropower projects that have started the construction activities before August 2001 are not subject to this analysis.

According to Viet Nam Construction Code - TCXDVN 285:2002 "Irrigation projects - Major standards on designing"[19] hydropower projects are categorized as follows:

Table 7: Groups of hydropower projects according to Viet Nam 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

[18] ±10% is selected according to the Decision No. 2014/QĐ – BCN issued by the Ministry of Industry, dated 13 June 2007 to provide temporary guidelines for conducting the economic, financial and investment analysis and providing the purchasing-selling price frame for power generation projects. It is also common-practice for sensitivity analysis for additionality demonstration. Furthermore, ±10% is also a common practice rate for sensitivity analysis of a CDM project.

[19] Construction Code regulates the basic technical standards that are mandatory for construction activities in Viet Nam.

According to Table above, this proposed project activity falls into Group III which includes the hydropower project similar scale and taking place in a comparable environment to the proposed project activity.

Table 8: Hydropower plants which belong to range (5MW to 50MW) were developed and operated in Viet Nam[20]

No	Name	Capacity MW	Construction starting year	Commissioning year	Developed as CDM project
1.	Na Loi	9.3	2000	2003	No
2.	Nam Mu	12	2002	2004	No
3.	Ea Krong Rou	28	2003	2007	No
4.	Suoi Sap	14.4	2004	2007	No
5.	Nam Tha 6	6.0	2006	2007	Yes
6.	Ngoi Xan 1	8.1	2006	2007	Yes
7.	Bac Binh	33.0	2006	2009	Yes
8.	Nam Chien 2	33.0	2007	2009	Yes

Because the Na Loi hydropower project started construction from 2000, it is excluded from this common practise analysis. It is also applied to the four projects that are developed as CDM projects. Thus, only 3 projects are relevant in this analysis.

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

Table 9: Hydropower plants which belong to group III (5 < Pdm ≤ 50 MW) were developed in Viet Nam

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**	***30***	***123.29***	***46.9%***	**2011**	**2013**	**ZaHung Joint Stock Company** (private owned company)

[20] List of power plants supplied by Institute of Energy.

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)[21].
2	Ea Krong Rou	28	110.7	45.1	Otc. 2003	2007	Mien Trung 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) [22]. In addition, this project had received 4 million USD from India's ODA loan[23].
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 from 1 - 2*: As can be seen in the Table above, these projects have been invested in by either large state-owned corporations or joint stock companies whose majority shares held by large state-owned corporations. These projects do not face the barriers that the proposed project faces because:

  1. The state-owned corporations mentioned above are among the largest state-owned power and construction corporations in Viet Nam. They are financed by the state budget as well as their investment activities. In 1990s, Song Da Construction Corporation have been assigned by the government to construct national hydropower plants like Hoa Binh - Song Da (1920 MW), Yaly (720 MW), Tri An (400 MW), Ham Thuan (300 MW), Thac Ba (108 MW)... And from 2000, Song Da Corporation had been studying and investing in a series of hydropower plants like: Ry Ninh 2, Na Loi, Can Don, Se San 3A…[24] Therefore, they have

[21] Prospectus of Nam Mu Hydropower Joint Stock Company http://images1.cafef.vn/Images/Uploaded/DuLieuDownload/Ban%20Cao%20Bach/HJS_BCB.doc
[22] http://www.cophieu68.com/profilesymbol.php?id=seb
[23] http://www.mientrungpid.com.vn/?page=13
[24] http://www.songda.vn/info/en/

substantial experiences in designing, investing, constructing and operating hydropower plants.

2. The state-owned corporations mentioned above were established according to the Prime Minister's Decisions No 90/TTg and 91/TTg dated on 07th March 1994. The formulation of these corporations is to aim at developing power and construction industries in order to meet national socio-economical development goals and strategies and to implement development tasks assigned by their ministries and/or Prime Minister in certain development periods. Therefore, the key target of these corporations is to serve as the governmental tool for macroeconomic interferences rather a profit making[25].

Project 3: The initial main objective of this project by the government was to invest in an irrigation project to provide water for 700 ha commercial plantation and rice fields in order to alleviate poverty and to develop local agriculture and rural targeted communes in Phu Yen District, Son La Province. Then the project owner decided to synergise this objective with the construction of a hydropower plant. According to the Government Decree No. 17/2001/ND-CP, this project is given priorities to access ODA. Therefore, this project has borrowed ODA soft-loan from India at a very favourable interest rate[26] 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, the project activity is not a common practice in Viet Nam.

Implementation timeline of the proposed project activity

The incentive from the CDM was seriously considered in the decision of Ha Do JSC (old project owner). In order to secure the CDM status Ha Do JSC has conducted the meeting with local stakeholders to consult their opinions on the implementation of the investment project as a CDM project on 05 September 2007. The proposed project is supported by the People's Committee of Nghe An province via the official letter sent by them to the DNA on 21 August 2008. Then Ha Do JSC transferred the right to invest in this project to ZaHung JSC (new project owner) on 12 September 2008. The Nghe An Provincial People's Committee approved the transfer of the right to invest in the Nam Pong hydropower project from the Ha Do JSC to the ZaHung JSC on 18 December 2008. On 10 April 2009, Vietnam DNA issued the LoA for the proposed project. ZaHung JSC was acknowledged CDM opportunities for renewable energy project via the application of CDM for another project, namely ZaHung hydropower project which was started the CDM application since 2006 that was validated by TÜV SÜD Industrie Service GmbH[27]. On 06 August 2009, ZaHung JSC informed the DNA about continuous development and registration for the CDM project. Nam Pong Hydropower project was notified to the Executive Board as CDM project on 14 August 2009. On 17 July 2010, Management Board of ZaHung JSC decided to invest the project as the CDM project. These are all prior to the starting date of the project which is defined as the date of signing the first main works construction contract on 14 January 2011.

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

Development of the hydropower project	Activities taken to achieve CDM registration	Time	Implication on CDM
I. Legal & administrative formality to be considered as the project owner			

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

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

[27] The PO has developed the ZaHung hydropower project as CDM project since 2006. This project is submitted to UNFCCC website as follows:
http://cdm.unfccc.int/Projects/Validation/DB/ZQ3Z9OYIKH1GE0LJ5NCM0LY07S7I0K/view.html

Finalising the Basic Design report by the technical consultant.		Jun 2007	
	Achieving the Minutes of a meeting to consult public opinions (local people and local authorities) on the social and environmental impacts of the hydropower project in order to develop it as a CDM activity.	05 Sep 2007	*CDM early consideration evidence*
	Signing CDM consultancy contract by Ha Do JSC	10 Jun 2008	*CDM early consideration*
	Official letter submitting by Ha Do JSC to Nghe An Provincial People's Committee (PPC) and DNA requests to verify and support for the CDM project.	31 Jul 2008	*CDM early consideration*
	Official letter submitting by the Nghe An PPC to the DNA requests to verify and support for the CDM project.	21 Aug 2008	*CDM early consideration*
Approving the transfer of the right to invest in the hydropower project from the Ha Do JSC to the ZaHung JSC issued by Nghe An PPC		18 Dec 2008	
	Issuing the LoA by DNA for the proposed project	10 Apr 2009	*CDM early consideration*
Issuing adjustment investment licence by Nghe An PPC for ZaHung JSC		15 May 2009	
	Terminating the CDM consultancy contract	05 Aug 2009	*CDM early consideration*
	Submitting the official letter by ZaHung JSC to inform the DNA the continuous development and registration for the CDM project.	06 Aug 2009	*CDM early consideration*
	Signing CDM consultancy contract between ZaHung JSC and VNEEC	10 Aug 2009	*CDM early consideration*
	Notifying the CDM project to the Executive Board [28] and the Viet Nam DNA[29]	14 Aug 2009	*CDM early consideration*
Finalizing the Technical Design Report		Jun 2010	

[28] http://cdm.unfccc.int/Projects/PriorCDM/notifications/index_html
[29] http://www.noccop.org.vn/Data/profile/Airvariable_Projects_77421Prior%20Consideration%20(TA).pdf

Issuing the Investment Decision on implementing the investment project and CDM project by the Management Board of ZaHung JSC		17 Jul 2010	*Date of making project investment decision*
Signing the first main construction contract for dam, tunnel and power house		14 Jan 2011	*Starting date of the project activity*
The expected date of commission		1 July 2013	

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 12.2.0 of ACM0002.

I. Project emissions *(PE_y)*

According to ACM0002, Version 12.2.0, 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)
$PE_{GP,y}$	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 single or multiple reservoirs and/or the increase of single or multiple 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 single or multiple reservoirs 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 single or multiple reservoirs 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:

$$PE_{HP,y} = \frac{\mathrm{EF}_{\mathrm{Res}} \cdot TEG_y}{1000}$$

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 $EG_{PJ,y}$

According to ACM0002, Version 12.2.0, for the proposed project activity is the installation of a new gird-connected hydropower plant:

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

Where:

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

$EF_{facility,y}$ Quantity of net electricity generation supplied by the project plant/unit to the grid in year *y* (MWh/yr).

Therefore:

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

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

The Version 02.2.1 of "Tool to calculate the emission factor for an electricity system" determines the CO_2 emission factor for the displacement of electricity generated by power plants in an electricity system, by calculating the "operating margin" and "build margin" as well as the "combined margin", including 6 steps as follows:

STEP 1. Identify the relevant electric power system.

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

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

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

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

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

Step 1. Identify the relevant electricity systems

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

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

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

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

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

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

a) Simple OM;

b) Simple adjusted OM;

c) Dispatch data analysis OM;

d) Average OM.

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

Table 11: Rate of low cost/must-run sources based on generation[30]

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

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

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

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

There are 2 Options proposed, including:

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

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

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

Where:

$EF_{grid,OM,y}$	is the Simple operating margin CO_2 emission factor in year y (tCO_2/GWh)
$EG_{m,y}$	is the net quantity of electricity generated and delivered to the grid by power unit m in year y (GWh)
$EF_{EL,m,y}$	is the CO_2 emission factor of power unit m in year y (tCO_2/GWh)
m	All power plants/units serving the grid in year y except low-cost/must-run power plants/units

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

y Either the three most recent years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option)

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

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

Where:

$EF_{EL,m,y}$ is the CO_2 emission factor of power unit *m* in year *y* (tCO_2/GWh)

$FC_{i,m,y}$ Amount of fossil fuel type *i* consumed by power plant/unit *m* in year *y* (mass or volume unit)

$NCV_{i,y}$ Net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ/mass or volume unit)

$EF_{CO2,i,y}$ CO_2 emission factor of fossil fuel type *i* in year *y* (tCO_2/GJ)

$EG_{m,y}$ Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost/must-run power plants/units, in year *y* (MWh)

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

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

Table 12: OM emission factor in 2008

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

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

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

Step 5. Calculate the (BM) emission factor

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

Option 1: For the first crediting period, calculate the build margin emission factor *ex ante* based on the most recent information available on units already built for sample group *m* at the time of CDM-PDD submission to the DOE for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of

submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period, or

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

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

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

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

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

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

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

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

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

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

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

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

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

Where:

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

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

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

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

The CM emissions factor is calculated as follows:

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

Where:

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

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

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

$$\boldsymbol{EF_{grid,CM,y} = 0.5 \times 0.6465 + 0.5 \times 0.5064 = 0.5764\ tCO_2/MWh}$$

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

III. Leakage *(LE_y)*

According to ACM0002, version 12.2.0, no leakage emissions are considered. These emission sources are neglected or ***$LE_y = 0$.***

IV. Emission reductions *(ER_y)*

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y$$

Where:

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

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

Data / Parameter:	**GWP_{CH4}**

Data unit:	tCO_2e/tCH_4
Description:	Global warming potential of methane valid for the relevant commitment period
Source of data:	IPCC
Value to be applied:	For the first commitment period: 21 tCO2e/tCH4
Any comment:	

Data / Parameter:	**EF_{Res}**
Data unit:	$kgCO_2e/MWh$
Description:	Default emission factor for emissions from reservoirs
Source of data:	Decision by EB23
Value to be applied:	90 $kgCO_2e/MWh$
Any comment:	

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
Measurement procedures (if any):	Determine the installed capacity based on recognized standards
Any comment:	For calculation of PD.

Data / Parameter:	**A_{BL}**
Data unit:	m^2
Description:	Area of the single or multiple reservoirs 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
Measurement procedures (if any):	Measured from topographical surveys, maps, satellite pictures, etc.
Any comment:	For calculation of PD.

Data / Parameter:	**$EG_{m,y}$**
Data unit:	GWh
Description:	The net quantity of electricity generated and delivered to the grid by power unit *m* in year.
Source of data:	Data published by DNA Viet Nam.
Value to be applied:	Value applied in Annex 3
Any comment:	For calculation of $EF_{grid,OM,y}$, $EF_{grid,BM,y,}$

Data / Parameter:	$FC_{i,m,y}$
Data unit:	mass or volume unit
Description:	Amount of fossil fuel type *i* consumed by power plant/unit *m* in year *y*
Source of data:	Data published by DNA Viet Nam.
Value to be applied:	Value applied in Annex 3
Any comment:	

Data / Parameter:	$NCV_{i,y}$
Data unit:	GJ/t
Description:	Net calorific value (energy content) of fossil fuel type *i* in year *y*
Source of data:	Data published by DNA Viet Nam (IPCC 2006).
Value to be applied:	Value applied in Annex 3
Any comment:	

Data / Parameter:	$EF_{CO2,i,y}$
Data unit:	tCO_2/GJ
Description:	The CO_2 emission factor of fossil fuel type *i* in year *y*
Source of data:	Data published by DNA Viet Nam.
Value to be applied:	Value applied in Annex 3
Any comment:	

Data / Parameter:	$EF_{EL,m,y}$
Data unit:	tCO_2/ GWh
Description:	The CO_2 emission factor of power unit *m* in year *y*
Source of data:	Data published by DNA Viet Nam.
Value to be applied:	Value applied in Annex 3
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:	$\mathbf{EF}_{grid,BM,y}$
Data unit:	tCO_2/MWh
Description:	Build margin CO_2 emission factor for grid connected power generation in year *y* calculated using the 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:	Combined 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".
Any comment:	Fixed for crediting period.

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

Project emissions (PE_y)

The proposed project activity involves the construction of a new hydropower plant with capacity (Cap_{PJ}) of 30MW and a new reservoir with surface (A_{PJ}) of 32 ha, thus $A_{BL} = 0$ and $Cap_{BL} = 0$.

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

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}} = \frac{30 \times 10^6 - 0}{32 \times 10^4 - 0} = 93.75(W / m^2)$$

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

Baseline emissions (BE_y)

Baseline emissions include only CO2 emissions from electricity generation by fossil fuel fired power plants that are displaced due to the project activity. It is calculated as follows:

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

Where:

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

$EG_{facility,y}$ Quantity of net electricity generation supplied by the proposed project in year y (MWh/yr), and equal to 122,057 MWh/yr.

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

Therefore:

$$BE_y = 122,057 \times 0.5764 = 70,353 \text{ } (tCO_2/yr)$$

Reduction emissions (ER_y)

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y = 70,353 - 0 = 70,353 \text{ } (tCO_2e/year)$$

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

The estimated emission reduction of the project activity is provided in Table 13.

Table 13: Emission reduction of the project activity

Year	Estimation of baseline emissions (tonnes of CO_2e)	Estimation of project activity emissions (tonnes of CO_2e)	Estimation of leakage (tonnes of CO_2 e)	Estimation of overall emission reductions (tonnes of CO_2e)
2013 (From 1/7/2013 to 31/12/2013)	35,176	0	0	35,176
2014	70,353	0	0	70,353
2015	70,353	0	0	70,353
2016	70,353	0	0	70,353
2017	70,353	0	0	70,353
2018	70,353	0	0	70,353
2019	70,353	0	0	70,353

2020 (From 1/1/2020 to 30/6/2020)	35,177	0	0	35,177
Total (tCO_2 e)	**492,471**	**0**	**0**	**492,471**

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

B.7.1 Data and parameters monitored:

The power densities of the proposed project are larger than 10 W/m^2 so it is no need to monitor the TEG_y of this proposed project.

Data / Parameter:	**$EG_{y, export}$**
Data unit:	MWh
Description:	Electricity supplied by the proposed hydropower plant to the national grid.
Source of data to be used:	Direct measurement at the connection point.
Value of data applied for the purpose of calculating expected emission reductions in section B.6	122,057
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 $EG_{facility, y} = EG_{y, export} - EG_{y, import}$

Data / Parameter:	**$EG_{y, import}$**
Data unit:	MWh
Description:	Electricity supplied by the national 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 and procedures to be applied:	Two-way power meters will be installed at the grid-connected point to measure the amount of electricity supplied by the grid to the proposed hydropower plant. 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 $EG_{faciclity,\ y} = EG_{y,\ export} - EG_{y,\ import}$

Data / Parameter:	$EG_{facility,\ y}$
Data unit:	MWh
Description:	Net electricity supplied to the national grid by the proposed hydropower plant.
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	122,057
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.
Any comment:	For CERs calculation.

Data / Parameter:	$\mathbf{A_{PJ}}$
Data unit:	m^2
Description:	Area of the single or multiple reservoirs measured in the surface of the water, after the implementation of the project activity, when the reservoir is full.
Source of data to be used:	Project site.
Value of data applied for the purpose of calculating expected emission reductions in section B.6.3.	320,000
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:	Use 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.	30,000,000
Description of measurement methods and procedures to be applied:	As indicated on the manufacturer's nameplate
Monitoring frequency	Yearly
QA/QC procedures to be applied:	
Any comment:	Use for calculating the power density

B.7.2. Description of the monitoring plan:

Because the baseline emission factor of Viet Nam National Grid ($EF_{grid,CM,y}$) is fixed ex-ante (detail in Section B.6), the main data to be monitored is $EG_{facility, y}$. $EG_{facility, y}$ will be calculated according to the 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 failing 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: 29/11/2011

The responsible entity: **Energy and Environment Consultancy Joint Stock Company (VNEEC)** which is the project developer 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:

14/01/2011

This is the date on which the project owner has signed the construction contract for dam, tunnel and power house which is the first contract to implement and/or to construct the project.

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

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

40 years 0 month[31]

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:

01/07/2013

C.2.1.2. Length of the first crediting period:

7 years

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not applicable

C.2.2.2. Length:

[31] Technical Design Report of Nam Pong HPP

Not applicable

SECTION D. Environmental impacts

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

Pursuant to Environment Protection Law of Viet Nam 2005 (Article 20) 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 on details of regulations and guidance on implementing some Articles of the Environment Protection Law of Viet Nam 2005 issued on 09 August 2006, the Environmental Impact Assessment (EIA) for this project has been carried out. The EIA report has already been approved by the People Committee of Nghe An Province on Decision No.5023/QĐ-UBND.ĐC dated 13 December 2007.

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 environmental impacts and mitigation measures are summarized as follows.

1.1. Environmental Impacts

1.1.1. Impact on land

The proposed project will temporarily occupy about 1.75 km^2 land[32] of which 1.35 km^2 is used for the construction of traffic, energy alignment works, etc., include primary forest land. And the rest is for reservoir (0.40km^2) which includes 0.35 km^2 water surface land, 0.05 km^2 the bush. The occupied land will be compensated adequately in comply with government law and regulations.

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

1.1.2. Impacts on air and noise

The preparation and construction phase might cause air pollution. Pollutants are almost generated from the operation of auxiliary plants, material vehicles and executing machines. Pollution sources include dust, noise and waste gases from executing machines. This pollution is temporary and will be terminated upon the completion of the construction.

1.1.3. Impacts on water flow

The project will create a reservoir with surface area of about 0.32[33] km^2, include primary river land so faculty of regulating low. The water flow of the Nam Pong stream and Hieu river will be affected low in quality and quantity. Negative impacts relate to erosion and accumulation construction wastes but the project owner has effective methods to reduce impacting to the minimum.

1.1.4. Impacts on ecological system

- *Flora*

[32] EIA report of Nam Pong hydropower project
[33] General Description Report

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

The project site has only shrub forest, floristic composition is restoring and developing, which are all of low biological diversity. During the project implementation, there will be a large number of workers gathering in the project site, which causes forest destruction for wood, and crop cultivation. The formation of water transportation activities during the reservoir water retaining period will further bring human beings to forests around the reservoir, which is to disturb ecological system and vegetable cover in here. The reservoir creates a microclimate which advantage to developing of flora and crops.

- *Fauna*

The project implementation will pose negative impacts on the fauna due to loss of habitats, road construction, animal hunting for food, pharmaceutical products, trade, etc. The creation of transport paths will isolate the movement of wild animals.

After commissioning, the reservoir with its large water surface will cause the local climate to become milder with positive effects on the local fauna and flora, as well as surrounding communities.

1.1.5. Impacts on local environment surrounding the construction site

- *Dusts and gas emissions*: During the construction phase, activities such as area levelling, road making, exploitation/transportation of building materials etc. may emit to the air dusts and gases like CO_x, NO_x, SO_x. These gases have negative impacts on the health of people and animals.
- *Noise:* Noise is caused by mine explosions during the construction and by operation of vehicles. The magnitude of noise and of vibration from mine explosion will affect the exploitation and construction sites.

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

1.2. Socio-economic impacts

1.2.1. Negative impacts

The main negative impact is related to the occupation of the land. The proposed project will temporarily occupy about 1.75 km^2 for the construction of project structures such as dam, power house, reservoir, etc. No historical culture and archaeological places exist in the project site.

1.2.2. Positive impacts

As presented in Section A.2

1.3. Mitigation measures to reduce negative impacts

1.3.1. Construction phase

- *On soil:*

– All excavated rock and aggregate will be used in construction where possible, while the spoil will be deposited in areas with minimum landslide potential; layered and covered with soil; and planted with trees, shrubs, and grasses.

- *On water quality:*

– Avoiding the direct discharge of untreated waste or oil to the river. All waste including domestic and industrial waste shall be collected and transported to proper location (i.e. septic tanks) for the treatment.

– Clearing the reservoir bed: clearing the designated areas of all trees, down timber, snags, vegetation, rubbish and objectionable material and shall include grubbing stumps and roots and disposing of all material resulting from the clearing or grubbing.

– Regular monitoring of water quality at stations in the river or auxiliary and resettlement zone.

- *On air quality*

– Using water spray trucks for dust suppression will mitigate dust generation from construction traffic.

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

– Regular monitoring of air quality included dust, CO, NO_2, SO_2… at stations in the construction area.

– Increasing green cover at the residential area, office, workers place and other places where can condition the local climate, restricting the diffusion of dust and noise during the construction period.

- *On noise*

– Reduce noise from machine via maintenance, turn off intermittent operation machines that are not necessary.

– Arrange works on day tour, constrain working by night.

– Explosive stores shall be located 1.3 kilometres far from inter-commune road and 700 m far from concrete pipe no.3[35].

– Using standardized and registered machines to reduce noise and waste gas during their operation.

- *Waste collection and treatment*

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

– Raise awareness of the environmental protection for workers and local people.

- *On flora and fauna*

– All work will be carried out in a manner such that damage or disruption to vegetation is minimized. After completion of construction activities, temporarily occupied areas will be re-vegetated.

– Provision of heating and cooking options without use of wood.

– Provision of environmental training on environmental management issues.

– Environmental protection by guards, capacity building of forest rangers, and control the illegal activities.

- *Mitigation measures for socio-economic impacts*

- The project owner shall make a plan to implement the measures for protecting human health, examining food safety and hygiene in accordance with regulations of Ministry of Health, Viet Nam, associating with local medical stations in preventing common diseases.

- Project owner shall effectively disseminate the benefits of the implement of the project, provide sufficient information of project implementation, compensation policy as per laws.

- Give prior opportunities to the local resident to work for the plant during the construction and operation

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 the environment are due to construction. However, all these impacts will be mitigated by implementing adequate mitigation measures and then will cease after the completion of

[35] EIA report, page 10

the construction phase. Preventive and mitigation measures are planned to be conducted during the operation period to prevent and/or reduce any adverse impacts.

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

Not applicable

SECTION E. Stakeholders' comments

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

The following stakeholders have been consulted since the starting of the project idea:

- People Committee of Nghe An province (the highest local authority): the People Committee Nghe An was informed about the CDM development of the proposed project by the project owner via Official letter No. 632/CTHĐ-BTĐ dated 31 July 2008 and supported to develop this project as a CDM project activity via issuance of the official letter No. 5344/UBND.ĐT on 21 August 2008 which is to be sent to Viet Nam DNA.
- Local people in the project area in Chau Phong and Chau Hanh communes, Quy Chau district, Nghe An province involved directly and actively in commenting on the project and the negotiations on impacted lands and assesses due to the project activity.

Besides, the local people of Chau Phong and Chau Hanh communes were involved in the CDM consultation process.

On 05 September 2007, a meeting between the project owner and the following representatives of the local people was held in order to consult local people on the social-economic and environment impacts of the proposed project in order to develop this project as a CDM activity.

- Commune's People Committee (CPC): CPC is the lowest administration level in Viet Nam 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: this is one of the key government bodies in making development strategies at the communal level.
- Village's representative: head of village, secretary of young union, head of farmers' association, head of women's association. Such associations are NGOs and represent the interests of different groups.

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

E.2. Summary of the comments received:

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

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

a. Positive impact:

- Contribute to completing traffic system, creating favourable conditions for living and production of local people.
- Create jobs for local people, especially for minority ethnic in highland, reducing the unemployment rate of local.
- Contribute to local budgets through tax.
- Contribute to improving the lives of local people, narrowing the gap in economic and cultural among ethnic groups and among areas in there.
- The project activity will generate renewable power with negligible Greenhouse Gas (GHG) emissions, which will displace part of the electricity otherwise supplied by fossil fuel fired power plants. Thus, the project contributes to Environmental protection, limiting climate change process.
- Advantage to tourism of local.

b. Negative impact:

- Project Activity will occupy area of farmland, affecting the lives of local people

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

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

- Propose and implement appropriate compensation plans for compensation and resettlement farming land in accordance with the existing law that then have to be agreed by each impacted household and approved by the local authorities.
- Seriously apply and implement mitigation activities as stated in the EIA report in order to minimise negative impacts on local environment.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

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

Annex 3

BASELINE INFORMATION

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

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

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

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

Table 14: Data for calculating of $EF_{grid, OM, 2006}$

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

Bà Rịa	1,308,583	Gas	436.24	34.85	34,850	56,100	0.0561	-		0	0	0	0	852,889
Phú Mỹ	10,073,917	Gas	2,432.92	37.17	37,173	56,100	0.0561	-		0	0	0	0	5,073,624
		Gas	523.22	38.80	38,797	56,100	0.0561	-		0	0	0	0	1,138,792
Phú Mỹ 3	2,531,004	Gas	703.82	38.75	38,750	56,100	0.0561	-		0	0	0	0	1,530,021
Nhơn Trạch	0	Gas	0.00	0.00	0	56,100	0.0561	-		0	0	0	0	0
Cà Mau 1&2	0	Gas	0.00	0.00	0	56,100	0.0561	DO	0	0	0	74100	0.0741	0
Phú Mỹ 2.2	4,838,810	Gas	1,354.87	38.75	38,750	56,100	0.0561	-		0	0	0	0	2,945,311
VĨ ĐAN	47,894	Gas	236.67	42.80	42,800	56,100	0.0561	FO	1.09	9,665	40,465	77400	0.0774	571,687
Đạm Phú Mỹ	38,556	Gas	55.49	42.50	42,500	56,100	0.0561	-						132,307
Gas-Turbine-Oil														
Bà Rịa	13,958	DO	4	10,300	43,124	74,100	0.0741	-			0	0	0	14,188
Phú Mỹ	67,721	DO	18	10,895	45,615	74,100	0.0741	-			0	0	0	61,889
Phú Mỹ 3	12,615	DO	3	10,255	42,936	74,100	0.0741	-			0	0	0	10,583
Phú Mỹ 2.2	0	DO	0	0	0	74,100	0.0741	-			0	0	0	0
CẦN THƠ	106,998	DO	33	10,860	45,469	74,100	0.0741	-			0	0	0	112,583
THỦ ĐỨC	32,290	DO	11	10,800	45,217	74,100	0.0741	-			0	0	0	35,684
Steam tail														
Bà Rịa	660,965	Đuôi hơi			0	0	0	-			0	0	0	0
Phú Mỹ	5,336,388	Đuôi hơi			0	0	0	-			0	0	0	0
Phú Mỹ 3	1,473,329	Đuôi hơi			0	0	0	-			0	0	0	0
Nhơn Trạch	0	Đuôi hơi			0	0	0	-			0	0	0	0
Cà Mau 1&2	0	Đuôi hơi			0	0	0	-			0	0	0	0
Phú Mỹ 2.2	0	Đuôi hơi			0	0	0	-			0	0	0	0
Oil-fired														

HIỆP PHƯỚC	453,303	FO	229	10,220	42,789	77,400	0.0774	DO	0.011	10,150	42,496	74100	0.0741	758,788
CẦN THƠ	118,748	FO	36	10,226	42,814	77,400	0.0774	DO	1.9693	10,860	45,469	74100	0.0741	126,004
THỦ ĐỨC	471,940	FO	133	10,300	43,124	77,400	0.0774	DO	0.132	10,800	45,217	74100	0.0741	442,801
Diesel FO														
CÁI LÂN - VINASHIN	0	FO	0	0	0	77,400	0.0774	-			0	0	0	0
AMATA	80,000	FO	16.60	9,600	40,193	77,400	0.0774	-			0	0	0	51,642
Diesel DO														
NM điện Đồng Khởi (Bến Tre)	3,150	DO	0.81	10,700	44,799	74,100	0.0741	-			0	0	0	2,676
NM điện Diesel Cà Mau	3,123	DO	0.83	10,970	45,929	74,100	0.0741	-			0	0	0	2,834
NM điện Diesel An Giang	1,505	DO	0.39	10,305	43,145	74,100	0.0741	-			0	0	0	1,247
Điện lực Đồng Tháp	119	DO	0.03	10,320	43,208	74,100	0.0741	-			0	0	0	109
Điện lực Bình Thuận	6,372	DO	1.54	10,150	42,496	74,100	0.0741	-			0	0	0	4,843
Diesel khác	10,732	DO	2.79	10,150	42,496	74,100	0.0741	-			0	0	0	8,787
Import	**937,000**	-			0	0	0	-			0	0	0	0
Total generated electricity	MWh	37,618,249												
Total emissions	tCO2	25,702,898												
Emission factor	tCO2/MWh	0.683												

Table 15: Data for calculating of $EF_{grid, OM, 2007}$

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

		Gas	99.85	38.49	38,486	56,100	0.0561	-		0	0	0	0	215,576
Phú Mỹ 3	2,393,620	Gas	665.69	38.56	38,560	56,100	0.0561	-		0	0	0	0	1,440,029
Nhơn Trạch	0	Gas	0.00	0.00	0	56,100	0.0561	-		0	0	0	0	0
Cà Mau 1&2	697,572	Gas	15.82	39.00	39,000	56,100	0.0561	DO	20.669	10,909	45,674	74100	0.0741	104,554
Phú Mỹ 2.2	4,942,360	Gas	1,383.86	38.56	38,560	56,100	0.0561	-		0	0	0	0	2,993,590
VĨ ĐAN	26,742	Gas	229.22	42.80	42,800	56,100	0.0561	FO	0.44	9,665	40,465	77400	0.0774	551,758
Đạm Phú Mỹ	18,542	Gas	59.23	42.50	42,500	56,100	0.0561	-			0	0	0	141,217
Gas-Turbine-Oil														
Bà Rịa	80,828	DO	25.33	10,300	43,124	74,100	0.0741	-			0	0	0	80,957
Phú Mỹ	240,652	DO	64.92	10,895	45,615	74,100	0.0741	-			0	0	0	219,435
Phú Mỹ 3	17,278	DO	4.50	10,244	42,890	74,100	0.0741	-			0	0	0	14,317
Phú Mỹ 2.2	0	DO	0.00	0	0	74,100	0.0741	-			0	0	0	0
CẦN THƠ	148,862	DO	45.10	10,880	45,552	74,100	0.0741	-			0	0	0	152,247
THỦ ĐỨC	70,260	DO	23.41	10,800	45,217	74,100	0.0741	-			0	0	0	78,438
Steam tail														
Bà Rịa	618,330	Đuôi hơi			0	0	0	-			0	0	0	0
Phú Mỹ	5,986,285	Đuôi hơi			0	0	0	-			0	0	0	0
Phú Mỹ 3	1,377,820	Đuôi hơi			0	0	0	-			0	0	0	0
Nhơn Trạch	0	Đuôi hơi			0	0	0	-			0	0	0	0
Cà Mau 1&2	911,012	Đuôi hơi			0	0	0	-			0	0	0	0
Phú Mỹ 2.2	0	Đuôi hơi			0	0	0	-			0	0	0	0
Oil-fired														
HIỆP PHƯỚC	1,102,498	FO	410	10,196	42,690	77,400	0.0774	DO	0.018	10,150	42,496	74100	0.0741	1,355,716
CẦN THƠ	128,641	FO	38	10,215	42,768	77,400	0.0774	DO	3.1779	10,880	45,552	74100	0.0741	136,341

THỦ ĐỨC	603,270	FO	166	10,300	43,124	77,400	0.0774	DO	0.24	10,800	45,217	74100	0.0741	554,312
Diesel FO														
CÁI LÂN - VINASHIN	104,626	FO	25.15	9,800	41,031	77,400	0.0774	-			0	0	0	79,867
AMATA	0	FO	0.00	9,600	40,193	77,400	0.0774	-			0	0	0	0
Diesel DO														
NM điện Đồng Khởi (Bến Tre)	4,483.00	DO	1.14	10,700	44,799	74,100	0.0741	-			0	0	0	3,794
NM điện Diesel Cà Mau	6,820.60	DO	0.18	10,870	45,511	74,100	0.0741	-			0	0	0	600
NM điện Diesel An Giang	1,628.51	DO	0.42	10,305	43,145	74,100	0.0741	-			0	0	0	1,343
Điện lực Đồng Tháp	272.26	DO	0.08	10,320	43,208	74,100	0.0741	-			0	0	0	248
Điện lực Bình Thuận	7,246.00	DO	1.73	10,150	42,496	74,100	0.0741	-			0	0	0	5,460
Diesel khác	21,549.63	DO	5.60	10,150	42,496	74,100	0.0741	-			0	0	0	17,643
Import	**2,629,000**	-			0	0	0	-			0	0	0	0

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

Table 16: Data for calculating of $EF_{grid, OM, 2008}$

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

Phú Mỹ	11,085,997	Gas	3,193.95	36.99	36,991	56,100	0.0561	-		0	0	0	0	6,628,061
		Gas	72.54	38.18	38,184	56,100	0.0561	-		0	0	0	0	155,387
Phú Mỹ 3	3,167,237	Gas	883.26	38.59	38,590	56,100	0.0561	-		0	0	0	0	1,912,160
Nhơn Trạch	544,809	Gas	166.38	40.50	40,500	56,100	0.0561	-		0	0	0	0	378,023
Cà Mau 1&2	2,106,807	Gas	647.24	39.00	39,000	56,100	0.0561	DO	4.417	10,909	45,674	74100	0.0741	1,431,048
Phú Mỹ 2.2	4,141,980	Gas	1,159.75	38.59	38,590	56,100	0.0561	-		0	0	0	0	2,510,751
VÊ ĐAN	12,780	Gas	209.48	42.80	42,800	56,100	0.0561	FO	0.79	9,665	40,465	77400	0.0774	505,453
Đạm Phú Mỹ	4,716	Gas	56.15	42.50	42,500	56,100	0.0561	-			0	0	0	133,868
Gas-Turbine-Oil														
Bà Rịa	34,460	DO	10.64	10,300	43,124	74,100	0.0741	-			0	0	0	34,014
Phú Mỹ	69,324	DO	18.69	10,895	45,615	74,100	0.0741	-			0	0	0	63,174
Phú Mỹ 3	0	DO	0.00	10,246	42,898	74,100	0.0741	-			0	0	0	0
Phú Mỹ 2.2	0	DO	0.00	0	0	74,100	0.0741	-			0	0	0	0
CẦN THƠ	62,274	DO	19.39	10,890	45,594	74,100	0.0741	-			0	0	0	65,515
THỦ ĐỨC	17,030	DO	5.62	10,800	45,217	74,100	0.0741	-			0	0	0	18,830
Steam tail														
Bà Rịa	658,459	Steam Tail			0	0	0	-			0	0	0	0
Phú Mỹ	6,037,037	Steam Tail			0	0	0	-			0	0	0	0
Phú Mỹ 3	1,853,448	Steam Tail			0	0	0	-			0	0	0	0
Nhơn Trạch	0	Steam Tail			0	0	0	-			0	0	0	0
Cà Mau 1&2	2,728,872	Steam Tail			0	0	0	-			0	0	0	0
Phú Mỹ 2.2	0	Steam Tail			0	0	0	-			0	0	0	0
Oil-fired														

HIỆP PHƯỚC	877,631	FO	366	10,195	42,685	77,400	0.0774	DO	0.019	10,150	42,496	74100	0.0741	1,209,684
CẦN THƠ	66,709	FO	20	10,220	42,789	77,400	0.0774	DO	3.7286	10,890	45,594	74100	0.0741	78,681
THỦ ĐỨC	537,540	FO	149	10,300	43,124	77,400	0.0774	DO	0.228	10,800	45,217	74100	0.0741	496,461
Diesel FO														
CÁI LẬN - VINASHIN	90,465	FO	22.48	9,800	41,031	77,400	0.0774	-			0	0	0	71,385
AMATA	0	FO	0.00	9,600	40,193	77,400	0.0774	-			0	0	0	0
Diesel DO														
NM điện Đồng Khởi (Bến Tre)	860.00	DO	0.22	10,700	44,799	74,100	0.0741	-			0	0	0	734
NM điện Diesel Cà Mau	1,273.50	DO	0.33	10,940	45,804	74,100	0.0741	-			0	0	0	1,118
NM điện Diesel An Giang	252.86	DO	0.07	10,305	43,145	74,100	0.0741	-			0	0	0	224
Điện lực Đồng Tháp	51.25	DO	0.01	10,320	43,208	74,100	0.0741	-			0	0	0	46
Điện lực Bình Thuận	7,575.00	DO	1.80	10,150	42,496	74,100	0.0741	-			0	0	0	5,675
Diesel khác	4,987.39	DO	1.30	10,150	42,496	74,100	0.0741	-			0	0	0	4,083
Import	**3,220,000**	-			0	0	0	-			0	0	0	0

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

Table 17: Data for calculating of $EF_{grid, BM, 2008}$

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

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

Mieng IDICO															
SÊ SAN 3A	2006	394,895.70	Hydropower												
Tuyên Quang	2008	1,136,112.18	Hydropower												
Đại Ninh	2008	1,145,108.50	Hydropower												
SÊ SAN 3	2006	1,131,614.00	Hydropower												
Quảng Trị	2007	250,804.40	Hydropower												
Uông Bí 2	2007	532,000.00	Coal	281.759	4995	20,913	98300	0.0983	FO	*0.548*	*10,087*	42,231	77400	0.0774	581,018
Na Dương	2005	627,930.00	Coal	532	4,034	16,889	98300	0.0983	FO	0.20	9,923	41,545	77400	0.0774	883,846
Cao Ngạn	2007	708,693.00	Coal	526	4,980	20,850	98300	0.0983	FO	0.75	9,800	41,031	77400	0.0774	1,081,145
Formosa	2004	560,295.00	OtherBituminousCoal	495	6,579	27,545	94600	0.0946	FO	0.28	9,808	41,064	77400	0.0774	1,291,302
Nhơn Trạch	2008	544,808.60	Gas	166.38	40.50	40,500	56100	0.0561	-		0	0	0	0	378,023
Cà Mau 1&2	2007	2,106,807.24	Gas	647.24	39.00	39,000	56100	0.0561	DO	4.417	10,909	45,674	74100	0.0741	1,431,048
		2,728,872.00	Steam tail												
Phú Mỹ 2.2	2004	4,141,980.00	Gas	1,159.75	38.59	38,590	56100	0.0561	-		0	0	0	0	2,510,751
Đạm Phú Mỹ	2006	4,716.00	Gas	56.15	42.50	42,500	56100	0.0561	-			0	0	0	133,868
CÁI LÂN - VINASHIN	2007	90,465.01	FO	22.48	9,800	41,031	77400	0.0774	-			0	0	0	71,385
Total		**16,514,761.12**													**8,362,386**

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

Table 18: CO_2 emission factor according to IPCC

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

ANNEX 4

MONITORING INFORMATION

A. Description of technical equipment

The metering system will be installed at the connecting point. 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 technical designing report developed by the project proponent.

This proposed project will supply the electricity to the national grid. The metering system includes the main system and back-up system:

- Main system: Main meter will be set up at the collection point to measure the electricity exported to and imported from the national grid.
- Backup system: Backup meter preceding the main power meters it is working in parallel with the main meter. Its recorded data will be used if there is a problem with the main system.

The following figure mentions the position of installed meter at the connected point.

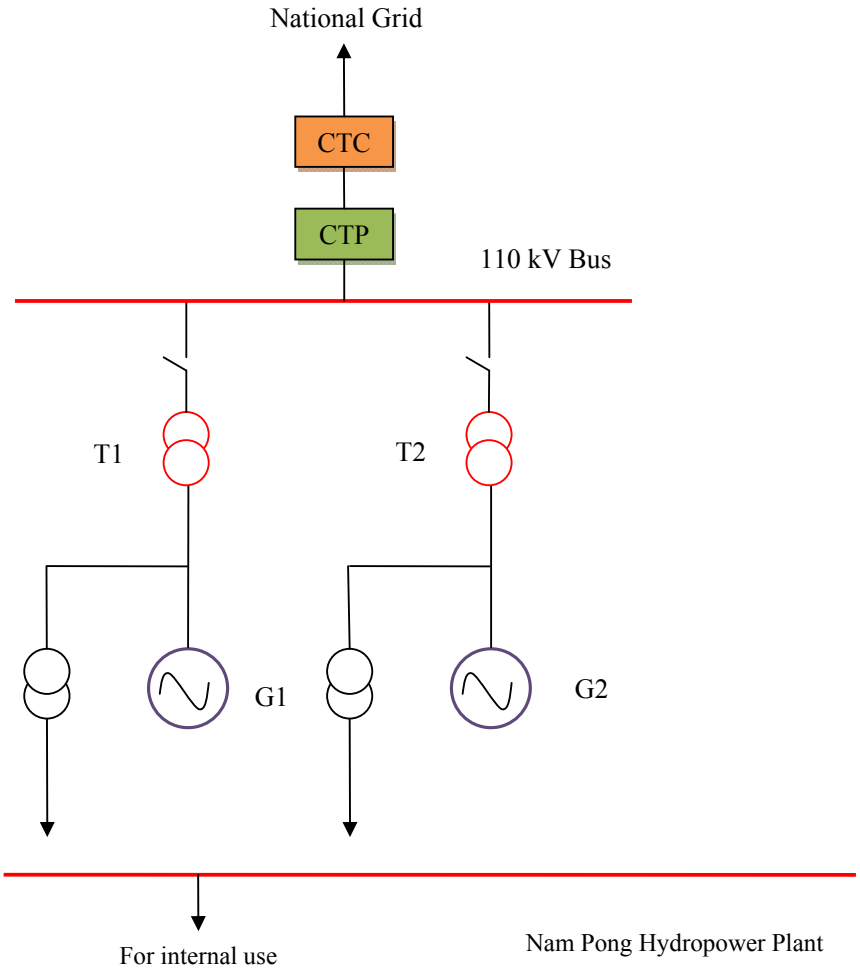

Figure 4: Monitoring system

Note:

CTC : Main power meter
CTP : Back-up power meter
T1, 2 : Transformers
G1, 2 : Generators

B. Monitoring organization

The structure of the monitoring group is as follows:

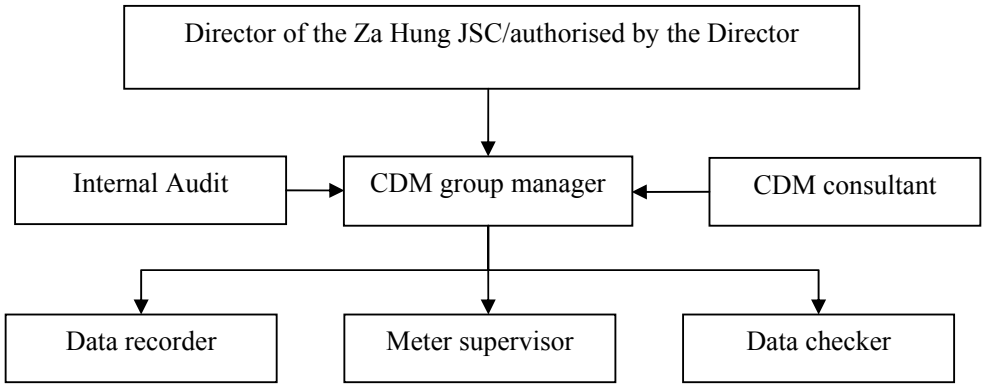

Figure 5: Structure of the monitoring group

The responsibilities of each person involved are elaborated as follows:

Group members and their responsibilities

Person	Responsibility
Director of ZaHung JSC/authorised by the Director	Check and sign the monitoring report annually.
CDM group manager	Managing the whole CDM business of Nam Pong power plant, guiding and supervising data recorder after trained by CDM consultant.
CDM consultant	Providing CDM group manager training and technical support about CDM monitoring plan.
Internal auditor	Check the monitoring procedure at least once in a year.
Data recorder	Collecting and recording data every month.
Meter supervisor	Checking power meter periodically according to relevant regulation.
Data checker	Double checking the collected data measured by power meter.

C. Monitoring procedure

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

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

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

(3) Nam Pong power plant provide electricity sales invoice to EVN, and keeps the copy of invoice.

(4) ZaHung Joint Stock Company shall hire the third party for measuring the surface area of reservoir at the normal water level yearly.

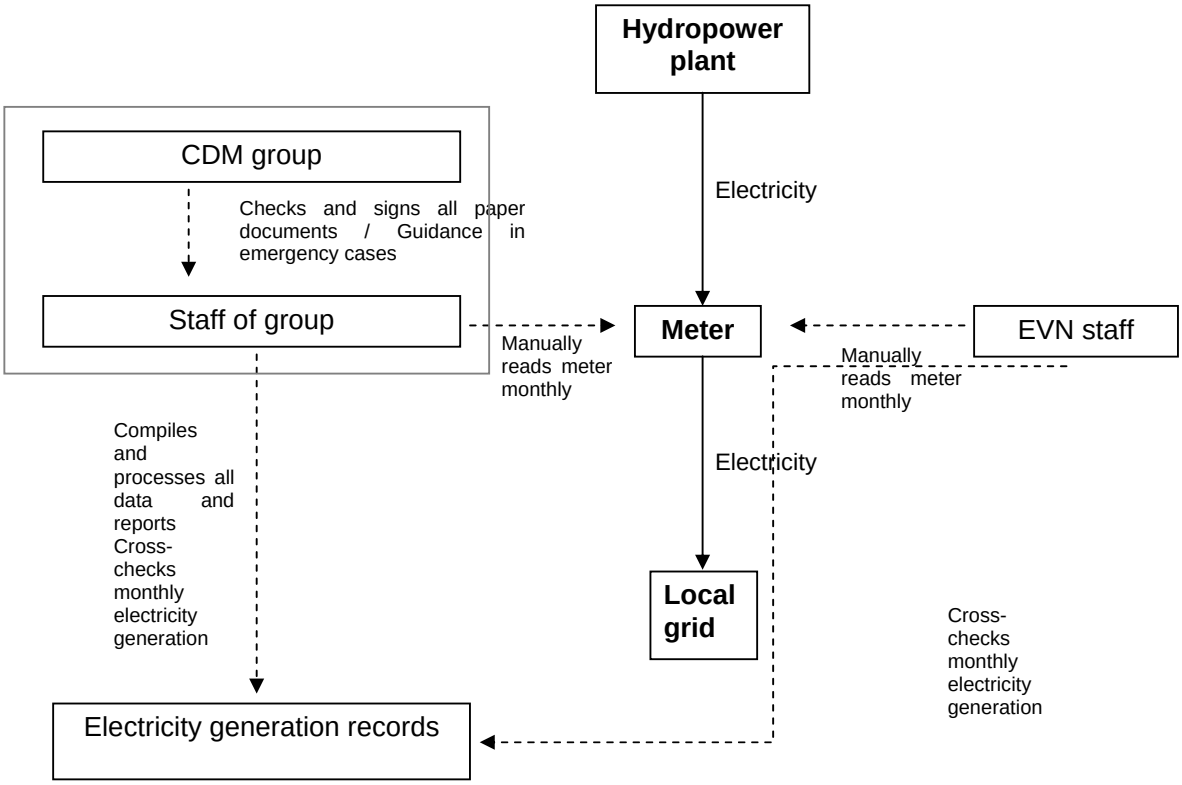

Figure 6: Monitoring process

D. Calibration of metering equipment

The meters will be calibrated and verified pursuant to national standard. According to the Decision No 65/2002/QD-BKHCNMT[36] calibration and verification for 3 phase meters must be conducted every two year by the third accredited party during the project operation. After every calibration, the third party will seal the meters so that no illegal interference is possible.

E. Data recording and archiving procedures

- The CDM group appointed by Nam Pong power plant shall keep monitored data in electronic archives at the end of every month. Paper documents should be stored in electronic format and copied by CD. Electronic documents should be printed out and kept.
- Nam Pong hydropower plant shall keep the copy of electricity sales/purchase invoices (the original electricity sales/purchase invoices shall be kept by Finance Department of ZaHung JSC).
- In order to help verifiers obtain documents and information related to the emission reduction of the proposed project, ZaHung JSC shall prepare an index of the data documents and monitoring report.

[36] Decision No 65/2002/QD-BKHCNMT[36] 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.