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

CONTENTS

Annexes

SECTION A. General description of project activity

A.1. Title of the project activity:

Project title: Dak Srong 2 Hydropower Project.
Version: 3.6 updated for post registration changes
Completed: 19/06/2012

A.2. Description of the project activity:

Project Entity and Purpose of the Project Activity

The Dak Srong 2 hydropower project is being developed by Hoang Anh Gia Lai Hydropower Joint Stock Company and is the first hydropower project being set up by the company. The proposed project activity aims to construct and operate a run-of-river hydropower project. Being a run-of-river (rather than accumulation reservoir plant), it offers an environmentally friendly solution to growing energy demand. It will be located in Yang Nam, Ya Ma, and Dak Hninh Communes, Kong Chro District, Gia Lai Province in the highland area of Viet Nam and is hereafter referred to as "the project activity". Gia Lai is located in the central mountainous region of the country, which is one of the poorest areas in Viet Nam[1]. The nearest habitation to the project is situated 2.5 km from the project site. The proposed project utilises water resources of the Ba River, which links to the Da Rang River and eventually to the East Sea of Viet Nam.

The project will generate approximately 91,816 MWh/pa of power by using three turbines, resulting in estimated emission reductions of 44,466 tCO_2 / pa during the first seven year crediting period. This will offset the combustion of thousands of tonnes of fossil fuels, which are used to generate electricity for the Viet Nam electricity grid. In doing so, this project will help preserve non-renewable resources by promoting the exploitation and use of renewable resources. This is particularly important in Viet Nam where the share of hydropower and other renewable energy in the country's total generation has fallen year after year for the past five years. Currently, due to shortfalls in the amount of electricity available, Viet Nam imports electricity from China, where the grid emission factor is higher than that of Viet Nam.

Contribution to Sustainable Development

An analysis of the economic, social and environmental aspects of the project shows that the project meets the host country's sustainable development criteria for a Clean Development Mechanism project. The project has positive impacts with respect to the environment (offsetting fossil fuel use and lowering greenhouse gas emissions), society (providing jobs, development of roads), technologically (technology transfer) and economy (satisfying growing energy demands to allow the country and region to develop and alleviate poverty). In order to quantify the sustainable development contribution of this project, the project owner has voluntarily agreed to donate 2% of the CER revenue from the project towards sustainable development initiatives. However, in the context of high inflation and interest rates in Viet Nam, the project is financially unattractive and the support of the CDM is imperative if the project is to be executed and emission reductions realised.

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[1] The province has been classified as Class C by No.24/2007/ND-CP dated February 14, 2007 and Law No.14/2008/QH dated June 03rd 2008, and hence eligible for highest tax exemption.

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)
Socialist Republic of Viet Nam (host)	Private Entity: Hoang Anh Giai Lai Hydropower Joint Stock Company (as the project owner)	No
Switzerland	Private Entity: Bunge Emissions Holdings Sarl	No

Hoang Anh Gia Lai Hydropower J.S.C: a company set up for generating and supplying electricity, based in Pleiku City, Gia Lai province, Viet Nam.

Bunge Emissions Holdings Sarl: Bunge is an integrated, global agribusiness and food company operating in the farm-to-consumer food chain. With respect to carbon emission reductions, Bunge has been active in this sector through is subsidiary Ecoinvest carbon SA for a number of years. Bunge Emissions Holdings Sarl, one of the subsidiaries that act as a buyer of CERs, VERs and ERUs and as financial partner, has been active for more than one year with expertise in more than thirty projects in more than ten countries across three continents.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Socialist Republic of Viet Nam

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

Gia Lai Province

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

Yang Nam, Ya Ma, and Dak Hninh Communes, Kong Chro 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 is situated on the Ba River, in the central highland province, which joins with the Da Rang River to run into the East Sea. The Ba River originates from the mountains Ngoc N'Go and Ngoc Roo with the height of 1,500m**.** The terrain around the project site is quite plain while after this area, there are many water falls in the river and it meanders strongly. With a gross head of 41m, this area has facilitated the construction of the proposed hydropower plant. The nearest town and city to the project site is Kong Chro town (~15 km South), Pleiku City (~ 150 km Southern East). Figure A.2 shows the location of the project.

The co-ordinates of the site are latitude of 13°41'45''N and longitude of 108°33'30''E.

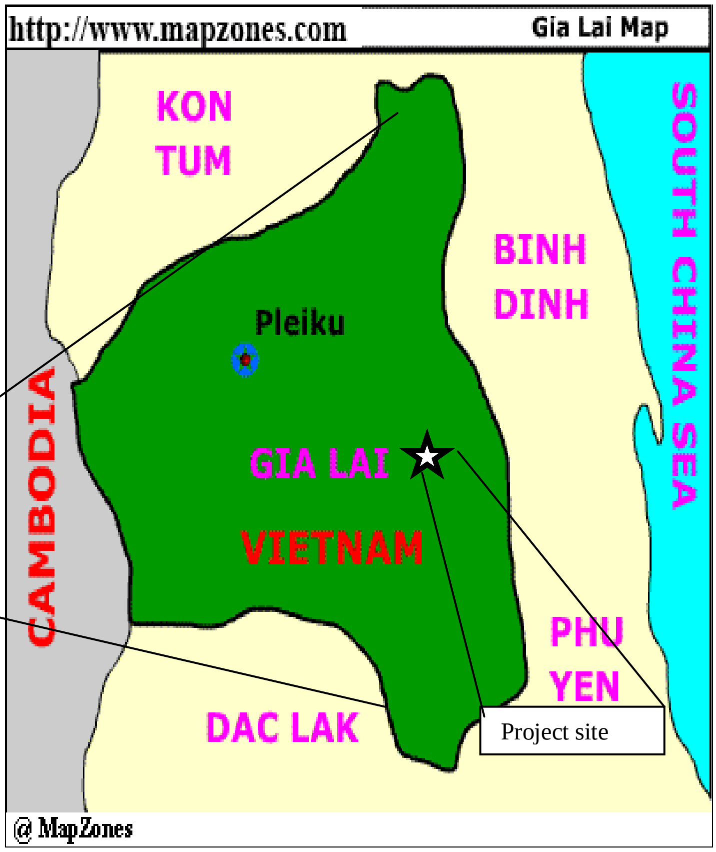


Figure A.2. Project location

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

Sectoral Scope 1: Energy industries (renewable/non renewable sources)

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

The proposed project is a run-of-river hydropower plant with a small run-of-river reservoir and consists of a weir, a penstock, a powerhouse (containing turbines and generators) and a tailrace as shown in Fig. A.3. The installed capacity of the project is 24 MW with total expected annual net generated electricity of 91,816 MWh per annum.. The main items of equipment such as turbines, generators, governors etc are imported from China. This will contribute to the transfer of technology to Vietnam. The electricity generated by the project will be delivered to the Vietnam national grid via a new single-circle 110 kV transmission line.

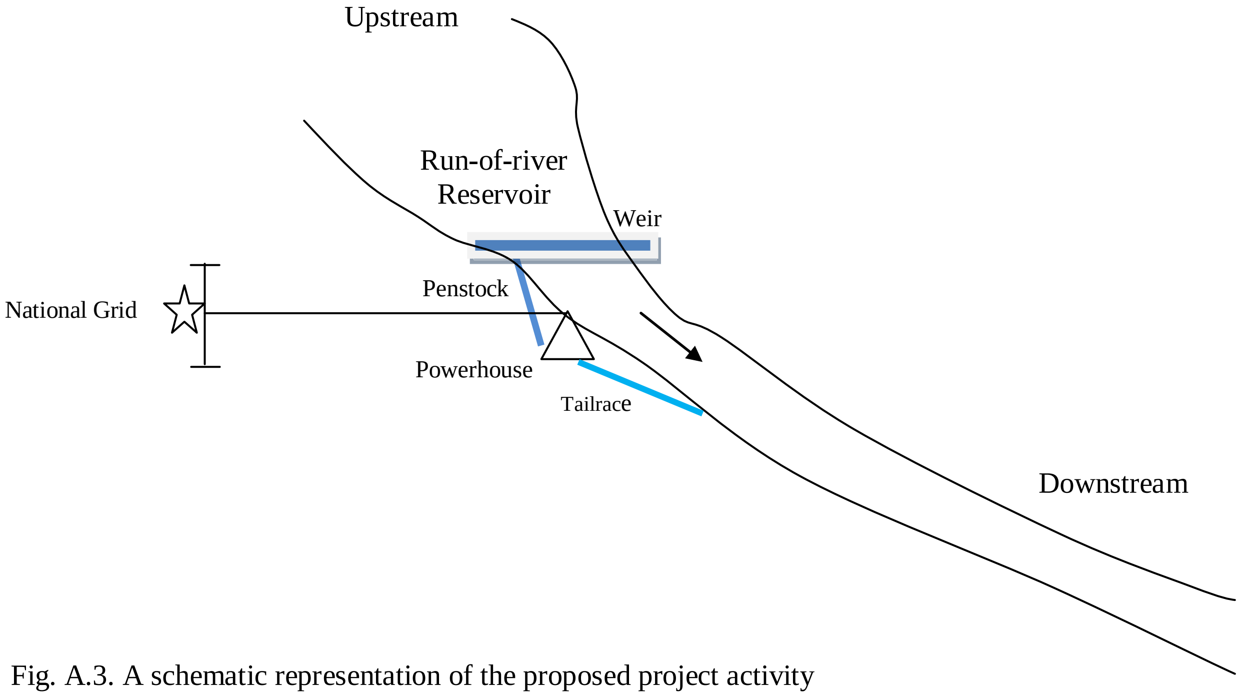


Fig. A.3. A schematic representation of the proposed project activity

The technology of the project is detailed in the Table A.2. This technology is considered to be relatively environmentally safe as the plant is a run-of-river project with a small run-of-river reservoir. The plant can therefore be constructed and operated in a manner, which does not involve significant land clearance, development or resettlement, as in the case of accumulation reservoir types of projects. This is in addition to the fact that power is generated by a renewable resource resulting in a relatively small amount of project emissions (detailed in Section B6). The baseline scenario is the same as the scenario existing prior to the start of implementation of the project activity

Table A.2. The main technologies used in the project, imported from China.

	Items	**Specification**
Turbines	Quantity	3
	Capacity	8,290.2 kW
	Type	HLA551C-LJ-176
	Design head	37.5 m
	Rated speed	300 rpm
	Rated efficiency	93.5 %
	Turbine discharge at design head	24.11 m^3/s
Generators	Quantity	3
	Capacity	8,000 kW
	Type	SF 8,000-20/3250
	Cosα	0.8
	Rated speed	300 rpm
	Runaway speed	527.6 rpm
	Rated voltage	6.3 kV
	Rated Efficiency	96.50%

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

The annual emission reductions of the proposed project are estimated to be 44,466 tCO_2e as shown in Table A.3. The project will employ a renewable crediting period and the total emission reductions are estimated to be 311,262 tCO_2e for the first seven year crediting period.

Table A. 3. The annual emission reductions of the proposed project for the first crediting period

Years	Estimation of annual emission reductions in tonnes of CO_2e
01/01/2010-31/12/2010	44,466
01/01/2011-31/12/2011	44,466
01/01/2012-31/12/2012	44,466
01/01/2013-31/12/2013	44,466
01/01/2014-31/12/2014	44,466
01/01/2015-31/12/2015	44,466
01/01/2016-31/12/2016	44,466
Total estimated reductions (tCO_2e)	**311,262**
Total number of initial crediting years	**7**
Annual average of the estimated reductions over the crediting period	44,466

A.4.5. Public funding of the project activity:

There is no public funding from Annex 1 Parties for the proposed project.

SECTION B. Application of a baseline and monitoring methodology

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

Methodology: ACM0002, Consolidated Methodology for Grid Connected Electricity Generation from Renewable Sources, Version 11.

As the project's total installed capacity is 24 MW (above the 15MW CDM small / large scale project threshold) and employs a renewable source of energy (hydropower) to be exported to a national grid system, the proposed project should be considered under the above methodology and the accompanying tools:

- Tool for the demonstration and assessment of additionality (Version 5.2)
- Tool to calculate the emission factor of an electricity system (Version 1.1)

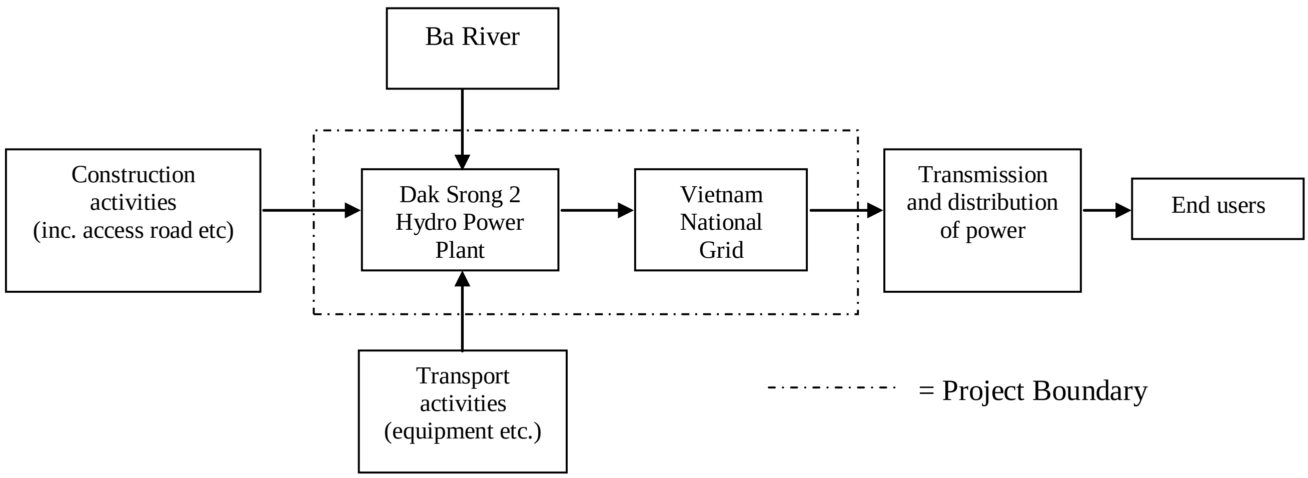
B.2. Justification of the choice of the methodology and why it is applicable to the project activity:

	Applicability Criteria	Project Activity
1	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 project with a small run-of-river reservoir.
2	The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the Project Emissions section of ACM0002, is greater than 4 W/m^2.	The new reservoir associated with this project has a power density of 4.76W/m^2 as defined in ACM0002

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

In the proposed project activity, the generated electricity of the project will be delivered to the Vietnam national grid system. As per the guidance set out in ACM0002, the project boundary is the Vietnam national grid system, which mainly comprises a range of thermal, gas, diesel oil and hydropower plants (please see section B.4.). This is represented diagrammatically in Fig. B.1.

Figure B.1. The project boundary



As per ACM0002/Ver 11, the following sources and gases are included the project boundary

Table B.1. Source and gases in 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	Excluded for simplification. This is conservative
		N_2O	No	
Project activities	Run-of-river hydropower plant with the power density of a run-of-river reservoir of 4.76 W/m^2	CO_2	No	Minor emission source, excluded
		CH_4	Yes	As per the guidance in the ACM0002 (Version 11), the project emission is 90 kg CO_2e/MWh
		N_2O	No	Minor emission source, excluded

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

As per the guidance of ACM0002, if the project activity is the installation of a new grid-connected renewable power plant/unit, the baseline scenario is the following:

Electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the "Tool to Calculate the Emission Factor for an Electricity System".

The state-owned company Electricity of Vietnam (EVN) dominates power production, transmission, and sale in Vietnam. One of the key assumptions made in determining the baseline is to treat the whole grid system as one entity. The grid system is not divided into provincial sub-groups (as in China for example); the only distinction made by the EVN is categorising power stations by type (coal, gas, hydropower etc.), informally by geographical location (North, Central and South) and ownership (state, independent power producer, "build-operate-transfer"). Over the period 2001-2005, total installed capacity of power increased from 6,192 MW in the year 2000, to 11,298 MW in 2005 and the greatest contributors are fossil fuel fired plants.[2]

Data Used to Determine Baseline Emissions

The baseline emission factor used in this project for the grid was based on the report published by the Vietnamese DNA - "Study, Definition of Vietnam Grid Emission Factor prepared by the Department of Meteorology, Hydrology and Climate Change"[3].

The data is :

- The latest source of data which is also publically available;
- Its results are published in a transparent manner; and
- The calculations are carried out in a conservative manner

[2] Source: Electricity of Vietnam

[3] http://www.noccop.org.vn/Data/vbpq/Airvariable_ldoc_vnHe%20so%20phat%20thai.pdf (last accessed on 12/09/2010)

Table B.2 shows the parameters required to calculate the emissions of the power plants that serve the national grid system.

Table B.2: Data used to determine baseline emissions

Parameter	Detail	Source
$EF_{grid,OM,y}$	Operating margin CO2 emission factor for grid connected power generation in year y.	Study, Definition of Vietnam Grid Emission Factor prepared by the Department of Meteorology, Hydrology and Climate Change
$EF_{grid,BM,y}$	Build margin CO2 emission factor for grid connected power generation in year y.	Study, Definition of Vietnam Grid Emission Factor prepared by the Department of Meteorology, Hydrology and Climate Change
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)	Study, Definition of Vietnam Grid Emission Factor prepared by the Department of Meteorology, Hydrology and Climate Change
$EF_{EL,m,y}$	CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)	Study, Definition of Vietnam Grid Emission Factor prepared by the Department of Meteorology, Hydrology and Climate Change
m	All power units serving the grid in year *y* except low-cost / must-run power units	Study, Definition of Vietnam Grid Emission Factor prepared by the Department of Meteorology, Hydrology and Climate Change
y	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)	Study, Definition of Vietnam Grid Emission Factor prepared by the Department of Meteorology, Hydrology and Climate Change
$FC_{i,m,y}$	Amount of fossil fuel type *i* consumed by power unit *m* in year *y* (Mass or volume unit)	Study, Definition of Vietnam Grid Emission Factor prepared by the Department of Meteorology, Hydrology and Climate Change
$NCV_{i,y}$	Net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ / mass or volume unit)	Study, Definition of Vietnam Grid Emission Factor prepared by the Department of Meteorology, Hydrology and Climate Change
$EF_{CO2,i,y}$	CO_2 emission factor of fossil fuel type *i* in year *y* (tCO_2/GJ)	Study, Definition of Vietnam Grid Emission Factor prepared

		by the Department of Meteorology, Hydrology and Climate Change

In the report referenced, the operating margin is derived through a combination of using Simple OM methodology, as it is demonstrated that low cost / must run power stations contribute less than 50% of total power generation between 2004 and 2008. For build margin, option 1 is employed whereby build margin is defined as the generation weighted average of the most recently built power plants which contribute 20% of total power generation. This is detailed in section B.6 and annex 3.

Following the end of the first crediting period, it is anticipated at this stage that a new ex-ante calculation of emission factor will be performed based on the latest data available from the Vietnamese DNA.

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):

With the implementation of the project activity, the emissions of GHG by sources would be reduced below those that would have occurred in the absence of the registered CDM project activity. The project activity is additional and would not have occurred due to the barriers identified below.

In compliance with the "Tool for the Demonstration and Assessment of Additionality", the investment analysis (step 2) has been selected as an appropriate method to demonstrate additionality, though additional barriers have also been highlighted.

Step 1. Identification of Alternatives to the Project Activity Consistent with Current Laws and Regulations

Sub-step 1a: Define Alternatives to the Project Activity

The following three scenarios are presented for consideration with respect to likelihood and credibility:

a. The proposed project activity undertaken without being registered as a CDM project activity;
b. Construction of a fossil-fuel fired power plant or any other energy renewable power plants with equivalent amount of annual electricity generation;
c. Continuation of the current situation (no project activity or other alternatives undertaken)

An analysis of the three options identified above to identify the most realistic and credible alternative is presented below:

- Alternative (a) is not a credible nor realistic alternative as, according to the investment analysis presented in section B.5 below, without the assistance of the CDM, the project is not a financially attractive for investment.
- Alternative (b) is neither realistic nor credible because, with respect to energy, the Hoang Anh Gia Lai Hydropower J.S.C is only involved in hydropower project development and therefore a coal fired power station or wind farm is not an option. Besides, solar and wind power projects are of very small scale and are rare in Vietnam. Being in a mountainous location with no access roads, it is an unsuitable site for a fossil fuel power station for either the Project Entity or state to build a fossil fuel powered plant.

- Alternative (c), which is a continuation of the current situation (no project activity or other alternatives undertaken) with electricity provided from the Vietnam national grid is a credible and realistic scenario (hence it is the baseline scenario).

Sub-step 1.b: Consistency with Mandatory Laws and Regulations

The only identified alternative to the project is alternative (c) and this is in compliance with all Vietnam legal and regulatory requirements.

Step 2: Investment Analysis

Sub-step 2a: Determine Appropriate Analysis Method

This is a large scale project activity. Hence, additionality of the project has to be demonstrated as per the Additionality Tool, version 05.2. The Tool for the Demonstration and Assessment of Additionality provides three methods of analysis: simple cost analysis (option I), investment comparison analysis (option II) and benchmark analysis (option III).

The simple cost analysis (option I) cannot be employed because the proposed project produces economic benefits other than CDM related income (through the sale of electricity). Therefore, the project developer has the choice of using either Option II - "investment comparison analysis" or Option III - benchmark analysis. Of the alternatives, the project developer has chosen option III- benchmark analysis to demonstrate the additionality of the proposed project activity.

Sub-step 2b: Option III. Apply Benchmark Analysis

Additionality Tool, version 05.2 stipulates that the project developer should identify the financial / economic indicator, such as IRR, most suitable for the project type and decision context. As prescribed by the Additionality Tool itself, the project developer has chosen project IRR to demonstrate the additionality.

The project IRR needs to be compared with a benchmark to prove the financial unattractiveness of the project. The Additionality Tool stipulates that the benchmark/discount rates shall be derived from *inter alia* "Government/official approved benchmark where such benchmarks are used for investment decisions";The 'Guidance on the Assessment of Investment Analysis', issued by EB in its 41st meeting, requires that "*In the cases of projects which could be developed by an entity other than the project participant the benchmark should be based on publicly available data sources which can be clearly validated by the DOE".* Hence, when the Additionality Tool and Guidance are read together, the selected benchmark should satisfy three conditions: it should be Government/official approved; it should be used for investment decisions; and it should be publicly available data source so that DOE can validate.

Guidance on the Assessment of Investment Analysis states that, "In cases where a benchmark approach is used the applied benchmark shall be appropriate to the type of IRR calculated. Local commercial lending rates or weighted average costs of capital (WACC) are appropriate benchmarks for a project IRR". Keeping the above in view, the project developer has selected the commercial lending rate offered by commercial banks in Vietnam at the time the decision making. At the time of decision making, the State Bank of Vietnam's base rate was 8.25%[4]., The commercial lending rate is regulated by the Civil Code in Vietnam. As per the Civil Code, commercial banks cannot charge a rate of interest more than 1.5 times the prime

[4] http://www.sbv.gov.vn/vn/CdeCSTT-TD/tracuu.jsp

rate[5]. Thus, the project owner chose a benchmark rate of return of 12.38 %. This benchmark satisfies all the three conditions listed above:

- The lending rate of commercial banks is based on the state rate and hence it is *official rate*;
- The benchmark is *used* by commercial banks *to take a financing decision* in as much as a project which cannot service the interest does not merit consideration by bank; and
- the benchmark is *publicly available* data source and *verifiable by DOE*.

The benchmark of 12.38% chosen, therefore, fulfils all the criteria laid down by the Additionality Tool[6] and is considered conservative. The project developer has selected this rate as the benchmark as this covers the cost of the loan and also provides a return on equity (which is much riskier than term loan).

The inherent conservatism of the benchmark can be substantiated by the publication brought out by the International Monetary Fund (IMF). In its publication "Vietnam – Statistical Appendix", the annual lending rate for medium term loan has been stated as 13.7%[7] (the actual rate paid when interest is compounded over the year).

Finally, and in addition to the above, the EVN (State Utility) has also determined the internal rate of return for investment into hydropower projects should be over 12%[8]. The benchmark of 12.38% therefore fulfils all the criteria laid down by the Additionality Tool and is conservative.

Sub-step 2c: Calculation and Comparison of Financial Indicators

The following input parameters were considered in making the projected income statement and IRR computation:

[5] Civil Code, Article 476.

[6] And also the *Guidance on the Assessment of Investment Analysis*, Point No.11 (page No.3)

[7] IMF Country Report No. 07/386, Vietnam – Statistical Appendix, Table 21. The report can be accessed at http://www.imf.org/external/pubs/ft/scr/2007/cr07386.pdf

[8] Electricity of Vietnam Masterplan 6

Table B.3: Key input parameters

Parameters	Value	Basis
Installed capacity (MW)	24	Feasibility study
Plant load factor (%)	44.6%	Feasibility study
Annual power supplied to the grid (MWh)	91,816	Computed
Auxiliary consumption (as percent of generation)	2.0	General norm, transmission and distribution losses
Total Investment (million VND)	539,797	Feasibility study
Loan: equity ratio	50:50	Feasibility study
Power tariff (Dong/ kWh)	732.96	Feasibility study
O&M cost (as percent of project cost)	1.0	Decision 2014/QD-BCN, dt on 13.6.2007
Escalation in O&M cost (per annum)	3%	Estimate
Insurance (as percent of project cost)	0.25	Estimate
Interest rate on term loan – Commercial bank	12%	Feasibility study
- Equipment loan	8.5%	Feasibility study
Loan repayment period (years)	10	Feasibility study
Initial moratorium period (years)	1	Estimate, conservative
Depreciation – Equipment	10%	Present practice in Vietnam
-Civil works	5%	Present practice in Vietnam
Natural Resource Tax (as percent of revenue)	2.0	Ordinance on Natural Resource Tax
Enterprise Income Tax	0-25%	Law No 14/QH/2008 dt.03/6/2008

Investment in the construction of electric power plants falls under List A domains and lines of business and hence is eligible for investment preferences as per the Decree No. 24/2007 dated 14th February 2007 and Law No 14/QH/2008, dated on 03/6/2008. Moreover, the project activity is located in List C of geographical area with special economic difficulties and hence is eligible for investment preferences by the said Law and Decree. The line of activity and the location of the project, therefore entitles it to certain tax concessions, which have been duly accounted for in computation of tax. Moreover, it has been ensured that all the expenditures are allowable as charge on the profit and loss account as per the Decree. Even with such allowances and strictly adhering to the Decree in accounting for expenditures, the project is unable to generate a return commensurate with the benchmark.

The income statement of the project and the project IRR has been computed based on the above input parameters. In computing the project IRR, profit after tax, depreciation, interest on term loan and salvage value have been taken as cash inflow and the entire project cost as cash outflow as suggested by the Guidance on the Assessment of Investment Analysis. As the IRR has been computed for a period of 30 years and the entire assets are fully depreciated[9], the question of salvage value does not arise. Based on the above, the project IRR works out to 10.36 % as against the benchmark return of 12.38 %.

Table B.4 presents the result of the IRR analysis in comparison with the bench mark identified in sub-step 2b.

[9] Including the additional investment provided in the 16 the year as permitted by the Guidance on the Assessment of Investment Analysis (item No.1)

Table B.4: Comparison of IRR with the benchmark rate of return

	Project IRR	Benchmark
Values	10.36 %	12.38 %

The IRR estimate is quite conservative in the sense that the project cost does not include interest during construction or any of the administrative and operational expenses during construction. Likewise, the operating statement is also conservative as the escalation in Operation and Maintenance (O&M) expenses has been taken only at 3% as against the inflation rate of over 25%[10] and administrative salaries have not been provided. If provisions are made for this, IRR will come down.

Inflation at 3% per annum on O&M costs (conservative given the macroeconomic conditions described below) is provided for, whereas in the computation of IRR the tariff price is locked. The project's feasibility study is based on a fixed price PPA as at the time of taking the investment decision, only fixed price PPAs with an option to enter the spot market once established were offered by the State run electricity company, EVN. The date of establishment of the spot market is however still not confirmed (anticipated to be 2014) and the prices to be expected once established (if the PP decided to enter) are impossible to predict. Further, the decision by the Prime Minister with respect to the spot market[11] states, "The Independent Power Plants (IPPs) which are not owned by EVN will keep selling to EVN following the signed long term power purchase agreement (PPA)" Even when the competitive spot market starts, "the establishment of and adjustments to the electricity tariff will be based on various factors: the pricing policy mentioned above, the country's socioeconomic conditions and the people's income in each period, the relation between electricity supply and demand, the cost of electricity production and trading, the right of electricity entities to a reasonable profit and the level of development of the electricity market"[12].Considering the above factors as well as the socialistic pattern of society prevailing in Viet Nam, the tariff is unlikely to be allowed to rise beyond the tariff already contracted by the PP with EVN.

It is for this reason that tariff was kept constant.

Sub-step 2d: Sensitivity Analysis

The robustness of the conclusion drawn above has been tested by subjecting critical assumptions to reasonable variations. Guidance on the Assessment of Investment Analysis defines critical assumptions as those, which constitute more than 20% of total project costs or total project revenue and reasonable variation has been defined as a range of +10% and - 10% (item No 16 and 17 of the Guidance). Three factors have been identified as sensitive, viz., project cost, PLF and O&M cost. Though O&M cost does not account for 20% of total cost (total operating cost), it has been considered, as interest on term loan and depreciation are not subject to variations as they are determined by project cost and loan documentation. Likewise, both civil works and equipment cost account for more than 20% of the total cost. Though non-tangible costs account for less than 20%, as they are eventually apportioned to tangible

[10] http://www.iht.com/articles/ap/2008/05/27/business/AS-FIN-ECO-Vietnam-Inflation.php, and http://www.time.com/time/world/article/0,8599,1817174,00.html
[11] Decision: Approval of the Roadmap, the Conditions to Establish and Develop the levels of the Power Market in Vietnam Prime Minister, Article 1.2

[12] http://www.mekongsources.com/doc/Briefing%20on%20Vietnam%27s%20Electricity%20Law%202005.pdf

fixed assets, entire project cost has been subjected to reasonable variation. The impact of a 'reasonable variation' in these three parameters on the project IRR have been worked out and the results are as follows:

Table B5: Sensitivity Analysis

Project IRR	-10%	0	10%
PLF	8.93%	10.36%	11.76%
Project cost	11.78%	10.36%	9.15%
O&M cost	10.49%	10.36%	10.23%
Tariff price	8.93%	10.36%	11.76%
Benchmark		12.38%	

It could be seen from the above that even under the most optimistic conditions, the project IRR will not cross the benchmark. The financial unattractiveness of the project is thus evident. It may be noticed that the project IRR remains the same under sensitivity analysis irrespective of whether the PLF is subjected to variation or tariff, since in the ultimate analysis, what is subjected to variation is the project revenue, which is nothing but a product of generation (derived from PLF) and tariff. Strictly speaking tariff cannot be subjected to variation as it is locked by the PPA, details of which have been discussed earlier. Having said that, it needs to be mentioned that the PLF is based on the hydrological study and the most optimistic scenario has been considered while preparing the income statement. Since it is dependent upon climatic conditions, higher PLF is a very remote possibility. O&M costs is not a very major assumption at all and the project is absolutely insensitive to the change in the O&M cost as could be seen that project IRR goes up by only 13 basis points when the O&M cost is brought down by 10%.

Reduction in project cost is also equally highly unlikely as the country hits the highest inflation within a decade. Though the inflation rate has touched 15.70% in February 2008[13] and still had gone up further to 25.20 % in May. In the above background, the possibility of any reduction in project cost is highly unlikely. In fact, the costs associated with the project have risen significantly since the feasibility study whilst the power tariff will be locked in the power purchase agreement (PPA). In the above background, the most plausible scenario is only a reduction in the PLF and increase in project cost and not the other way round. Such an occurrence will undoubtedly worsen the project's IRR further and gives greater need for assistance from the CDM.

The project, therefore is not a business-as-usual scenario and hence additional. The CDM benefits will enable the project to improve its return and become viable, as evident from the fact that with CDM benefits, the project will earn a return of 13.24%. It is with respect to the above background that CDM registration is requested.

[13] http://www.iht.com/articles/ap/2008/02/28/business/AS-FIN-ECO-Vietnam-Inflation.php, downloaded on August. 15, 2008

Step 3: Barrier Analysis

Sub-step 3a: Identify Barriers That Would Prevent the Implementation of the Proposed CDM Project Activity

As per the Additionality Tool, the project developer can choose either investment analysis or barrier analysis to demonstrate the additionality of the project. The foregoing paragraphs have already established the additionality of the project based on investment analysis. However, since the project faces other barriers also, which cannot be succinctly brought out by the investment analysis, the project developer has chosen to highlight some of the non-investment barriers faced by the project activity as well. The Additionality Tool lists out the following four barriers of which at least there should be one barrier preventing the implementation of the proposed project activity without CDM benefits:

a) investment barrier
b) technological barrier
c) barrier due to prevailing practice and
d) other barriers

Of the above, the project faces an instance of each barrier.

Technological Barrier: The project suffers from the lack of availability of a skilled and/or trained labour force to operate the plant, lack of infrastructure and risk of technological failure. As mentioned earlier, the project is located in Category 'C' area, which has been classified as geographical area with *special economic difficulties*. The nearest habitation is about 2 km from the site. The location and lack of availability of social infrastructure near the project location renders the project susceptible to the barrier of non-availability of skilled and /or trained labour force to operate the plant.

The project area suffers from want of infrastructure. Since it is located in a deprived rural area and human habitat is quite far away, the site does not have proper physical infrastructure. Therefore, the project participants will be required to spend approximately VND 1.8 billion to construct access roads to the project site. Whilst the construction of road no doubt brings benefits to the location in terms of improved infrastructure, the additional cost does negatively impact the profitability of the project.

The project also runs the risk of technological failure; the feasibility study concludes that the area, where the project is located, suffered earthquakes with intensity of 6 (MSK-64 scale) in the past. Being in such a remote area, it means that the computation of O&M cost is very conservative for this project. Should there be a technological failure, access to the site could be difficult (and therefore costly) to rectify and some items of plant would be required to be imported.

Barrier Due To Prevailing Practice: The clear majority of hydro power plants are developed by the State in the form of state owned IPPs, EVN ownership or by the state taking a shareholding in the project (76% of projects). Of the plants remaining, there are very few that would cross the large scale threshold of 15MW generation capacity, as Dak Srong (only 21% of projects). This is discussed further in the common practice analysis below.

Other Barriers- Policy. Private investment has become possible in Vietnam only recently and the EVN does not have any policies in place to promote the development of hydropower plants, e.g. ,through preferential tariffs or incentives. Neither are there any preferential policies for projects which are located in remote areas or do not employ reservoirs. There is however a policy in place to promote the use of

accumulation reservoir projects (Ministry of Industry issued Decision No. 3837/QD-BCN on 22/11/2005). Whilst they may be able to generate electricity on a larger scale, their development is more often than not associated with deforestation, resettlement and flooding. Also, the development of hydropower projects located in areas such as those where the proposed project is planned is discouraged, Further, due to the state owned EVN's monopoly position, the negotiation of a power purchase agreement is difficult for the independent project developer, where there is no State involvement in the project (it is still common for the state to take a shareholding position) as the market is far from transparent.

Further, the financing and construction phase of the proposed project have taken place during the period of the high inflation rate Vietnam has experienced since 1996. The rate of inflation recorded in /Vietnam was as high as 25% in May 2007. High inflation will affect the construction costs adversely as domestic material and transportation costs are bound to rise. The CDM revenue would surely help in absorbing a part of this unforeseen additional cost burden.

Sub-step 3b: Show That the Identified Barriers Would Not Prevent the Implementation of Atleast One of the Alternatives (Except the Proposed Project Activity).

None of these barriers would apply to State owned thermal power projects and hydropower power projects as these projects are invariably located in regions with well developed infrastructure and human habitation. Indeed, the share of hydropower as a percentage of total generation capacity has fallen in Vietnam over the last five years as the most accessible and / or economically attractive sites have already been developed by the Government.(please refer to table B7).

Setting up of hydro power projects of this size and that too in the private sector is not a common practice in Viet Nam. Most of the hydro power plants are owned by the State or benefit from State involvement at some level, most important in a country such as Viet Nam where contacts and government connections are the key. Based upon an exhaustive research on the hydropower projects in Viet Nam, 143 hydropower plants (those seeking CDM registration or not yet started construction were not included in the study) were identified which included details of hydro power plants presently in operation[14], those that have permission granted to build power plants from 2006-2008[15] and those that fall into the build own operate (BOO) or build operate transfer (BOT) category of projects[16].

The results of this study has been provided to the DOE and its results are categorised into those which are privately owned and those that benefit from some kind of state involvement. Examples of the latter may be power plants which are wholly owned by the EVN, are state owned IPPs or have the EVN as a shareholder / equity investor.

It can be seen from the study that:

- The majority of hydro power plants are developed by the State in the form of state owned IPPs, EVN ownership or by the state taking a shareholding in the power producer (121 or 85% of projects listed).

[14] http://www.industcards.com/hydro-vietnam.htm, downloaded on August 14, 2008

[15] EVN Masterplan for Electricity production 2005-2015

[16] Overview of Policy Instruments for the Promotion of Renewable Energy and Energy Efficiency in Vietnam, 2005: http://www.serd.ait.ac.th/cogen/62/reports/countries/vietnam.pdf

- Of the plants remaining, there are few that are considered privately owned (22 or 15% of identified projects) and fewer still would cross the CDM large scale / small scale threshold of 15MW generation capacity as Dak Srong 2 does (only 7 or 5% of projects).

Hence, construction of hydropower plants of the size of Dak Srong 2 by private corporations is not a common practice in Viet Nam.

It should be noted that in the interest of conservatism, for those plants for which no information could be publically found (the market is not transparent), it has been assumed that they are privately owned. I In fact, the figures above could further demonstrate that the Dak Srong 2 project is not common practice.

Further, the companies that have been identified as private investors have been found to be large corporations. Hoang Anh Gia Lai Hydropower J.S.C, the developer of the Dak Srong 2 project, is incorporated by individuals and private companies and hence mobilisation of capital resources is not an easy task.

It is not only that the State Utility has monopolized all the large power plants; it is proposing to enter into small scale hydro power projects as well. A news report in Viet Nam Business Finance reveals that “the State-owned Electricity of Viet Nam Group (EVN) plans to build 37 small hydropower plants with the total investment of VND3.1 trillion (US$193.75 million) in the Viet Nam-China border by 2010”[17]

The fact that setting up of hydro power plants such as Dak Srong 2 by the private sector is not a common practice, places the project in a disadvantageous situation vis-à-vis its counterpart, viz., the State Utility – EVN. The involvement of state owned companies in a country like Viet Nam helps the project significantly, as in the power purchase agreement, permit application and People’s Committee approval processes they can use their Government contacts. However, in the case of Hoang Anh Gia Lai, the project developer, there is no state involvement. Besides, by virtue of the fact that the State projects are large in size as revealed in the above table, the economies of scale work in favour of the projects and render them more profitable. This renders the investment safer. The Dak Srong 2 hydropower project is located in a very remote part of one of the poorest provinces in Viet Nam and employs a relatively small run-of-river reservoir. Hence, the project has to confront more barriers than even a similar sized project if it is set up by the State Utility. The CDM registration will therefore enable the Dak Srong 2 hydropower plant to overcome the barriers and contribute its mite to the global emission reduction effort.

Perhaps most significantly however, the projects detailed above have not been subject to the recent surge in inflation. As normal, with inflation, interest rates have also risen sharply and this has led to a large number of hydropower plants’ development being shelved. The CDM will enable the Dak Srong 2 hydropower plant to be developed despite this, and ensure emission reductions takes place.

[17]3 http://www.vnbusinessnews.com/2008/06/evn-to-build-37-small-hydropower-plants.html downloaded on August 14, 2008

Serious consideration of CDM

The CDM benefit was identified by the Board of Directors of the Dak Srong 2 hydropower plant project as imperative to make the project financially attractive. The following timeline shows the decision process of the project:

Action	Date
Resolution passed from Board of Directors showing the CDM as critical if the project is to be economically viable.	30th October 2007
Negotiations with CDM consultant culminating with the signing of a contract to provide writing PDD services and authorisation for the sale of carbon credits.	1st November 2007 – 12th March 2008 (signing date)
First contract signed for construction works with respect to the project*	25th January 2008
First equipment purchase by the project proponent	25th August 2008
Emissions reduction purchase agreement signed	24th December 2008
Project submitted for global stakeholder consultation	25th March 2009
Commercial operation date	1st May 2010 (anticipated)

*taken as project activity start date.

It could be seen from the above that the PP had taken simultaneous action to secure CDM status with the implementation of the project. Therefore, the project activity fulfils both the conditions stipulated by EB vide annex 46 in its 41st Meeting.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

In order to calculate the baseline, project and leakage emissions and hence emission reductions, methodology ACM0002, version 11 is used in conjunction with the "Tool to calculate the emission factor for an electricity system (Version 1.1, this was the latest version of the tool available when the DOE carried out the study)" including the following steps:

1. Calculation of baseline emissions;
2. Calculation of project emissions;
3. Calculating leakage emissions;
4. Calculating emission reductions.

1. Baseline Emissions

Step 1: Identify the Relevant Electric Power System

As per section B.4., the identified business as usual scenario is the continued generation of power by the Vietnamese national grid system, and baseline emissions are those produced as a result of this. Therefore, the Viet Nam national grid is identified as the relevant electric power system.

Step 2: Select an Operating Margin (OM) Method

In this case, the Simple Operating Margin has been calculated. In order to use the Operating Margin, assumption has been made with respect to "low cost" and "must run" resources. These are defined as "as power plants with low marginal generation costs or power plants that are dispatched independently of the daily or seasonal load of the grid. They typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation. If coal is obviously used as must-run, it should also be included in this list, i.e., excluded from the set of plants."

As per the study the contribution of "low cost" and "must run" sources to overall power generation in Viet Nam is well below 50% (please refer to table B7). Therefore the "Simple Operating Margin" can be calculated for the purpose of deriving the grid emission factor as per Step 2 of the tool to calculate emission factor from an electricity system.[1]

Table B.7. Contribution of low cost and "must run" sources to overall power generation in Viet Nam[18]

Year	2004	2005	2006	2007	2008	Average
Percentage share of low cost and "must run" power stations	39.71	32.52	34.13	33.74	34.72	34.77

[18] Source: EVN data and interview with EVN expert (attended by DOE)

The Ex ante option has been chosen. The emission factor using the Simple Operating method has been calculated using a three year generation-weighted average, , without requirement to monitor and recalculate the emissions factor during the crediting period. The years used are therefore 2004-08 inclusive.

Step 3: Calculate the Operating Margin Emission Factor According to the Selected Method

Option A under Step 3 of the tool to calculate grid emissions is employed. Here the Simple OM emission factor is calculated based on the electricity generation of each power unit and an emission factor for each power unit, as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_i FC_{i,m,y} \cdot NCV_{i,y} \cdot EF_{CO2,i,y}}{\sum_m EG_{m,y}} \quad (2)$$

Where:

$EF_{grid,OMsimple,y}$	=	Simple operating margin CO_2 emission factor of power unit m in year y (tCO_2/MWh)
$FC_{i,m,y}$	=	Amount of fossil fuel type *i* consumed by power 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 quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
m	=	All power units serving the grid in year *y* except low-cost / must-run power units
I	=	All fossil fuel types combusted in power unit *m* in year *y*
y	=	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) or the applicable year during monitoring (*ex post* option), following the guidance on data vintage in step 2

Viet Nam currently imports electricity from China to make up for the shortfall in supply from its own generation system. Whilst the emission factor of China's grid is higher then that of Viet Nam's, as a conservative approach, this PDD has considered these imports as zero emissions whilst taking into account their contribution to the overall power generation of Viet Nam.

Step 4. Identify the Cohort of Power Units to be Included in the Build Margin

It was found that the most recent set of power plants, which generate 20% of the country's electricity generated more power (MWh) in 2008 than the five most recently built power stations. As such, the weighted carbon emissions from the former were used to calculate the build margin. Option (b) is chosen in the first step.

For the first crediting period, the build margin emission factor will be calculated *ex-ante* based on the most recent information available on units already built for sample group *m* at the time of the preparation of the report (Option 1). Imports from China are not considered in the build margin calculation because as per the Tool to Determine Emissions from an Electricity System, recent or likely future additions to transmission capacity are not planned so as to enable significant increases in imported electricity from China.

Step 5. Calculate the Build Margin Emission Factor

The build margin 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, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_{m} EC_{m,y} \times EF_{EL,m,y}}{\sum_{m} EG_{m,y}} \quad (4)$$

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

The CO_2 emission factor of each power unit *m* ($EF_{EL,m,y}$) will be determined as per the guidance in step 3 (a) for the simple OM, using options B1, B2 and B3, using for *y* the most recent historical year for which power generation data is available, and using for *m* the power units included in the build margin.

Step 6. Calculate the Combined Margin Emissions Factor

The combined margin emissions factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM} \quad (5)$$

Where:

$EF_{grid,BM,y}$	=	Build margin CO_2 emission factor in year y (tCO_2/MWh)
$EF_{grid,OM,y}$	=	Operating margin CO_2 emission factor in year y (tCO_2/MWh)
w_{OM}	=	Weighting of operating margin emissions factor (%)
w_{BM}	=	Weighting of build margin emissions factor (%)

The weight used are as follows: w_{OM} = 0.5 and w_{BM} = 0.5 for the first crediting period, and w_{OM} = 0.25 and w_{BM} = 0.75 for the second and third crediting period.

Calculate the Baseline Emission *(BE_y)*

The baseline emissions (*BE_y* in t CO_2e) are the product of the baseline emission factor (*EF_y* in tCO_2e/MWh) multiplied with the electricity supplied by the project activity to the grid *EG_y* in MWh)

$$BE_y = EF_y \times EG_y \quad (6)$$

This is analogous to the guidance laid out in ACM0002 v11 which states:

BE = $EG_{PJ,y}$ x $EF_{grid,CM,y}$ (equation 6 of the methodology).

Further, ACM0002 v11 states:

$$EG_{PJ,y} = EG_{facility,y} \quad \textbf{(7)}$$

Where:

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

Description of monitoring $EG_{facility,y}$ is presented below.

2. Project Emissions

The Dak Srong 2 hydropower project has a total installed capacity of 24 MW (or 24,000,000 W) and its run-of-river reservoir has a surface area of 5,037,000 m^2. To calculate the power density, the below formula is used:

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}} \quad (8)$$

Where:

PD = Power density of the project activity, in W/m^2
Cap_{PJ} = Installed capacity of the hydropower plant after the implementation of the project activity (W).
Cap_{BL} = Installed capacity of the hydropower plant before the implementation of the project activity (W). For new hydropower plants, this value is zero
A_{PJ} = Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m^2)
A_{BL} = Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m^2). For the new reservoir, this value is zero

The power density of the Dak Srong 2 hydropower plant is therefore

PD= 24,000,000 (W) / 5,037,000 (m^2) = $\underline{4.76\ W/m^2}$

Because the power density of the project is greater than 4 W/m^2 and less than or equal to 10 W/m^2, the project emissions are calculated as follows

$$PE_y = \frac{EF_{Res} \cdot TEG_y}{1000} \quad (9)$$

Where:

PE_y = Emission from reservoir expressed as tCO_2e/year
EF_{Res} = is the default emission factor for emissions from reservoirs, and the default value as per EB 23 is 90 kg CO_2e/MWh
TEG_y = Total electricity produced by the project activity, including the electricity supplied to the grid and the electricity supplied to internal loads in year y (MWh)

The annual emission from the reservoir of the Dak Srong 2 hydropower plant is therefore

$$PE = \frac{90 \times 93{,}960}{1000} = 8{,}457\ tCO_2e$$

3. Leakage

As per methodology ACM0002, version 11, the project owner does not need consider leakage.

Therefore:

$$LE_y = 0 \qquad (10)$$

4. Emission Reductions

Emission reductions are calculated as follows

$$ER_y = BE_y - PE_y \qquad (11)$$

Where:

ER_y = Emission reductions in year y (t CO_2e/yr)
BE_y = Baseline emissions in year y (t CO_2e/yr)
PE_y = Project emissions in year y (t CO_2e/yr)

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

Data / Parameter:	**$EF_{grid,CM,y}$**
Data unit:	tCO_2/MWh
Description:	Combined margin CO_2 emission factor for grid connected power generation as calculated in DNA issued “Study, Definition of Viet Nam Grid Emission Factor, 2009”[19]
Source of data:	As per the “Tool to calculate the emission factor for an electricity system”.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.5764 tCO_2/MWh
Measurement procedures (if any):	As per the “Tool to calculate the emission factor for an electricity system”.
Monitoring frequency:	As per the “Tool to calculate the emission factor for an electricity system”.
QA/QC procedures to be applied:	As per the “Tool to calculate the emission factor for an electricity system”.
Any comment:	

[19] Study, Definition of Viet Nam Grid Emission Factor, 2009 by the Department of Meteorology, Hydrology and Climate

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 tCO_2e/tCH_4
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:	

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

Based on the proposed project's feasibility study, the annual electricity generated and supplied to the grid is 91,816 MWh. Therefore, according to formula (6) and (9), repeated below for convenience, the annual emission reductions in the first crediting period can be calculated as follows:

$BE_y = EF_y \times EG_y$ (6)

$ER_y = BE_y - PE_y - LE_y$ (10)

ER_y = (91,816 x 0.5764) – 8,457 – 0 = 44,466 tCO_2e

Thus the annual emission reductions attributable to the proposed project activity are 44,466 tCO_2e.

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

Year	Project Activity Emissions (tCO_2e)	Baseline Emissions (tCO_2e)	Leakage (tCO_2e)	Overall Emission Reductions (tCO_2e)
01/01/2010-31/12/2010	8,457	52,9234	0	44,466
01/01/2011-31/12/2011	8,457	52,9234	0	44,466
01/01/2012-31/12/2012	8,457	52,9234	0	44,466
01/01/2013-31/12/2013	8,457	52,9234	0	44,466
01/01/2014-31/12/2014	8,457	52,9234	0	44,466
01/01/2015-31/12/2015	8,457	52,9234	0	44,466
01/01/2016-31/12/2016	8,457	52,9234	0	44,466

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

B.7.1 Data and parameters monitored:

Data / Parameter:	**$EG_{facility,y}$**
Data unit:	MWh/yr
Description:	Quantity of net electricity generation supplied by the project plant/unit to the grid in year *y*
Source of data:	Project activity site
Measurement procedures (if any):	Bi-directional electricity meters to account for both export and import to arrive at net electricity
Monitoring frequency:	Continuous measurement and at least monthly recording
QA/QC procedures to be applied:	Cross check measurement results with records for sold and purchased electricity
Any comment:	

Data / Parameter:	**TEG_y**
Data unit:	MWh/yr
Description:	Total electricity produced by the project activity, including the electricity supplied to the grid and the electricity supplied to internal loads, in year *y*
Source of data:	Project activity site
Measurement procedures (if any):	Electricity meters
Monitoring frequency:	Continuous measurement and at least monthly recording
QA/QC procedures to be applied:	Applicable to hydro power project activities with a power density of the project activity (PD) greater than 4 W/m^2 and less than or equal to 10 W/m^2
Any comment:	

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:	Project site
Measurement procedures (if any):	Determine the installed capacity based on recognized standards
Monitoring frequency:	Yearly
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	**A_{PJ}**
Data unit:	m^2
Description:	Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full
Source of data:	Project site
Measurement procedures (if any):	Measured from topographical surveys, maps, satellite pictures, etc
Monitoring frequency:	Yearly
QA/QC procedures to be applied:	
Any comment:	

B.7.2. Description of the monitoring plan:

A final monitoring plan will be prepared prior the start crediting date based on the as-built project activity. The following indicative plan is provided in the meantime. It will address the following aspects:

1. The **CDM monitoring team** and allocation of responsibility to ensure compliance with the monitoring requirement of the methodology is given here below:

Position	**Responsibilities**
Operational staff	• Ensure meter readings are captured in standard format
Site Supervisor	• Ensuring monitoring takes place • Initial check for anomalies (e.g. Significant changes against previous readings or expected values) • Site record management • Communication of meter readings to Project Director • Attendance at annual verification
Project Director	• Collation of metered data from the project site • Collation of confirmation records from EVN (see Annex 4) • Monthly cross-check of confirmation records against metered data

	Tasks description	Operator	Supervisor	Project director	CDM Consultant
Monitoring activity					
1	Recording of monitored data	✓			
Quality Assurance & Quality Control					
2	Verification of data monitored (consistency and completeness)		✓		
3	Ensuring adequate training of staff		✓		
4	Ensuring adequate maintenance		✓		
	Ensuring calibration of monitoring instruments		✓		
5	Data archiving: ensuring adequate storage of data monitored (integrity and backup): 2 years after the end of the crediting period			✓	
6.	Identification of non-conformance and corrective/preventive actions and monitoring plan improvement		✓		
7	Emergency procedures		✓		
8	External audit				✓
Calculation of GHG emission reductions and reporting					
9	Processing of data and calculation of emission reductions			✓	
10	Monitoring report: management review of monitoring report (internal audit)			✓	

2. Monitoring point

Please refer to Annex 4 for details of the connection point with the EVN grid.

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):

Mr. D. L. Shaw
Head of Consultancy Services
KYOTOenergy Pte. Ltd.

80 Raffles Place, UOB Plaza 1, Level 36-01
Singapore 048624, SINGAPORE

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:

As per the guidance of EB49 meeting report, the project activity started with the Project Proponent signing the construction contract for the project on the 25th January 2008.

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

30 years

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

C.2.1. Renewable crediting period:

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

31/12/2009 or registration date, whichever is later.

C.2.1.2. Length of the first crediting period:

7 years, 01/01/2010 – 31/12/2016

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

C.2.2.2. Length:

SECTION D. Environmental impacts

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

The project will reduce the environmental impact associated with the production of electricity by substituting fossil fuels with water as a fuel supply. According to Vietnamese law, hydropower plants need to have their environmental impacts assessed with either an Environmental Impact Assessment (EIA), Environmental Impact Evaluation (EIE) or Environment Protection Commitment. The requirement as to which is required depends on the specific project (generally determined due to its reservoir size).

For the Dak Srong 2 project the reservoir volume is $85.6 x 10^6$ m^3 (exceeding 10^6 m^3 as required in Decree 80/2006/ND-CP), therefore it has undergone an Environmental Impact Assessment. This EIA has been approved by the relevant local authorities, Gia Lai Provincial People's Committee, dated 31st January 2008.

The environmental study has been conducted at the feasibility study stage. The EIA study concludes that for the project, negative environmental impacts are small because it is a run-of-river type. Moreover, it is situated in a remote area. Environmental impacts from the project have been clearly stated and approved by the local environmental authorities as described below.

<u>Impact sources</u>

Main pollution sources regarding the project activity

- Land clearance
- Assembling fuel-materials, machines, equipments and workers
- Constructing access roads
- Land levelling and excavation
- Building the support areas
- Constructing main items: nodal sites, a energy route, a powerhouse and a tailrace.
- Reservoir bed cleaning
- Repairing, maintaining vehicles, machines, and equipment
- Maintaining and repairing during the operation phase
- Operative's activity

Table of pollution sources and waste types from project activities

No	Waste type	Pollution source
1	***Preparation and Construction phase***	
1.1	Air pollution • Dust • Exhaust gases: SO_2, NO_x, CO, VOC	• Land clearance, excavation, smoothing activities and mining. • Operation of machines, equipment and vehicles • Material and fuel transport activities
1.2	Wastewater • Domestic wastewater • Industrial wastewater • Oil and degreaser	• Workers' activities • Cement mixing means, car-cleaning places • Material and fuel stores, vehicle repair activities
1.3	Solid waste • Soil, stones and concrete • Iron, steel, wood pieces • Trees • Domestic solid waste	• Material mining activities, leaking during the transportation • Steel rod processing activities and casing • Reservoir's bed and project layout cleaning activities • Worker's activities
2	***Operation phase***	
2.1	Oil, degrease and lubricant	• Repairing and maintaining activities; oil from transformers…
2.2	Domestic waste	• Operative's activities

Assessing the impacts of the project on the environment

- *Solid waste*
  This is mainly generated from worker's activities, which involves between 700-800 persons: around 144 tonnes/year. Components of domestic wastes:
  - ✓ Organic matters such as food leftovers, vegetable and fruits.
  - ✓ Inorganic matters such as plastic and glass
  - ✓ Metal items such as tin and aluminium cans.
- *Wastewater*: oil, degrease, lubricant: around 2,400 litres / year, domestic wastewater ~ 90 m^3/day
- *Dust and exhaust gases*:
  - ✓ The rock volume needed to be excavated to construct the project is 500,000 m^3 or 750,000 tonnes. The dust generated is projected at 300 tonnes, mainly from rock excavation activities. Sometimes and some cases, this dust amount will make dust concentration in the air up to 30-40 mg/m^3, exceeding the standard by around 80-100 times. Dust generated from other activities like earth excavation and filling works has a potential to cause air pollution ~ 500

kg/month. The affected areas are mainly access roads and construction sites (e.g. weir construction).

- ✓ Air pollution from transportation: air pollution load per month by this source is low, for dust ~0.42-5.25, SO_2 ~2.42-25.03, NOx 1.46-68.83, VOCs 0.31-15.17. However, the project site is quite far from any residential area and the population density is low. Therefore, these impacts are negligible.
- ✓ Noise and vibration come from digging and transport activities as well as from the operation of equipment and machines, but their impacts are considered small.

- *Impacts on ecosystems*
  - ✓ Impacts on flora: Some poorly established forest area without any precious species will be lost due to the project construction. In addition, some agricultural land, natural forest and eucalyptus plantation land will be affected by the project activity.
  - ✓ Impacts on fauna: The project appearance can make habitation for many animals fragmented. The impacts are only temporary; it will be gradually recovered after the construction completion. And there are no valuable and threatened species on the area
  - ✓ Impacts on the aquatic systems: The impacts are not big; however the density of certain species might be reduced during the construction phase. When the construction is completed, it will promote the development of fishery.

- *Impacts on Socio-Economic Environments*
  - ✓ Impacts on inhabitant's livelihood: Total land occupied is 544.6 ha of which agricultural land 87.8 ha, natural forest 155.6 ha, eucalyptus growing land 21.7 ha, unused land 90.5 ha, and others (river, stream) 189 ha. This affects 42 households with 261 persons.
  - ✓ Other negative impacts are small

- *Other impact sources*

  Other impacts include land erosion, landslide, subsidence, collapse, etc. River and reservoir' bank washout are not predicted to occur in the construction phase. When storing water in the reservoir, reservoir's bank could get washed out.. However, corrective actions can be taken by planting trees to enhance cover. Sedimentation only happens during the construction phase and the impact will be negligible as the river meanders 3 km after the construction site. In the reservoir, the expected sedimentation rate is small (~4% volume within 100 years). Besides this, the risk of fire and explosion also exists.

These above impacts identified are not considered as significant and are mainly temporary. Moreover, the project also creates many positive impacts such as: upgrading infrastructure, supplementing energy sources, promoting positive transformation of economic structure, positive impact on agricultural-tourism-fishery activities, etc. However, to reduce these negative impacts the project owner has proposed a number of measures. They are summarised as bellow:

No	Activities/ Impact sources	Main negative impacts	Mitigating measure
I	***Construction preparation & execution phase***		
1	Land clearance	- Loss of agricultural land and assets on the land; - Changing inhabitant's life	- Compensating and supporting consistently as required by the laws - Implementing a reforestation plan in order to address the loss of any natural forest and eucalyptus plantation land
2	Assembling machines, equipments and workers	- Causing environmental pollution due to waste, domestic wastewater	- Placing car-parks - Building a waste collection and treatment system
3	Building and upgrading access roads	- Landscape changed - Polluting the environment by dust and exhaust gases	- Design by qualified persons - Spraying water to limit dust
4	Land smoothing	- Loss of vegetation cover - Landscape changed	- Reforesting after completing the construction
5	Land excavation and filling	- Losing land, changing topography and geomorphology of the area - Polluted by dust and exhaust gases - Increasing the likelihood of landslide and erosion of the construction site	- Reforestation - Spraying water to limit dust - Wasted earth is compressed by earth movers - Collecting surface water
7	Building access roads	- Loss of land and landscape changed - Pollution to atmospheric environment by dust and exhaust gases	- Spraying water to limit dust - At the end of construction phase, upgrading to make it into roads
8	Removing the cover of mines and exploiting construction materials	- Land loss, changing topography and geomorphology of the area - Causing air pollution by dust and exhaust gases - Increasing the likelihood of erosion and landslide	- Spraying water to limit dust - Reforesting
9	Constructing main items including weir, spillway dam, water receiving gate, powerhouse, tailrace, electricity distribution stations (OPY)	- Land loss, changing topography and geomorphology of the area - Causing air pollution by dust and exhaust gases, noise - Increasing the likelihood of erosion and landslide - Likelihood of accidents	- Spaying water - Using the advanced execution means - Strictly complying with safety regulations
10	Equipment and Fuel-material transportation	- Causing air pollution by dust and exhaust gases, noise	- Spraying water - Using the advanced execution means
11	Reservoir's bed clearance and cleaning	- Loss of vegetation cover - Changing the landscape - Loss of habitats for some creatures	- Clearing only the area necessary - Strictly prohibiting workers to hunt wild animals
12	Impoundment (river	- Loss of land	- Selecting the suitable time to

	closure), creating a reservoir	- Changing the landscape of the area - Changing flow hydrological regimes on the river where the construction site is implemented - Changing habitats, living environments of aquatic organisms (water flowing-like creatures)	river closure (dry season or low flow season)
13	Waste oil, degrease, lubricant etc including transformer's oil	- Polluting soil and water - Risk at fires - Dangerous to human' health and organisms	- Oil, degrease and lubricant including oil used in the transformer will be replenished and removed in a safe manner by a third party contractor with the necessary experience and developed handling procedures required for the task. Staff onsite will however be trained so they are aware how potentially damaging to the environment the transformer oil can be.

The project participants also make an emergency preparedness and response plan as follows:

Risk sources and a plan for them

- ✓ Fire and explosion in the fuel tanks and mine- explosive stores – The fuel tanks and explosive stores will be located far from residential areas, designed as required by relative standards and safety code of the state, and workers provided with appropriate equipment. Training workers to comply with regulations and know how to responds to accidents
- ✓ Accidents regarding mines, and other explosive items leftover from the Viet Nam War - the project owners will hire a functional unit to survey the area before implementing any activities Cutting trees, forest fires and animal hunting – strictly prohibited as well as educating workers not to hunt and catch wild animals.
- ✓ Other risks regarding natural hazards - a board will be set up to deal with other risks
- ✓ Accidents of weir collapse (*very unlikely*) or landsides – reforestation, enhancing to check the area.

In addition, the project owner also commits to an environmental monitoring plan and strictly comply with all related Vietnamese laws.

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:

The environmental impacts of the project are not considered significant by Vietnamese authorities, the Environmental Impact Assessment report (EIA) was approved by the Gia Lai Provincial People's Committee on January 31st 2008.

SECTION E. Stakeholders' comments

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

The stakeholder consultation meeting was held at the Administrative Building of Kong Ch'ro District People's Committee, Gia Lai Province, Viet Nam at 0900hrs on 28/07/2008. Personal invitations were sent to community leaders, local People's Committee representatives and placed in the media. Public notices of the planned consultations were placed in *National Resources and Environmental Newspaper* which is widely published and read in the provinces. Across the consultation, presentations were made by the project owner and consultant who outlined the planned project activity in a non-technical manner (including environmental, social and technological considerations), climate change, the role of the Clean Development Mechanism and annual emission reductions potential. In addition, questionnaires were circulated and filled in by the attendees. In all, there were 20 participants attending the meeting.

Figure E.1 Picture of the stakeholder meeting in the project site in 28/07/2008

E.2. Summary of the comments received:

Looking at the above summary table, the stakeholders have not identified any major negative impact of the project. Local stakeholders appreciated and expressed that the project will have many positive aspects regarding a job creation.

- 100% participants identified that there are no negative impacts from the projects;
- 100% attendees agreed that the project will create jobs for them;
- 100% attendees also stated that the project will not lead to any changes to existing land-use. In fact, the projects (there is a second planned project, Dak Srong 2a) occupy some 700 hectares in total for construction of the project. It will affect some of the participants; but the project owner has committed to consistently compensate and attendees were happy with that assurance.

In general, the project has many positive responses from local communities. They are also expecting positive impacts on social, economic and environmental aspects of the project. Moreover, all concerns about environmental aspects have already been addressed by the project owner prior to the implementation of the project.

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

The project owner assured that:

- The project’s construction and operation would be in line with the environmental and health and safety laws of Viet Nam;
- As the project is run-of-river with a run-of-river reservoir, its environmental impact is relatively low;
- That reforestation of the land will take place .

In addition, the participants were informed of the voluntary pledge of 2% of CER revenue by the project developers to sustainable development and cultural aspects such as:

- Building and improving infrastructure of the locality such as schools or healthcare centres etc.
- Sponsoring social activities of the local communities such as cultural or sports events etc.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Represented by:	Mr Nguyen Van Hung
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Salutation:	
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

Neither public nor ODA funding from countries in Annex 1 was applied for by the project proponent for the project.

ANNEX 3 - BASELINE INFORMATION

Table AN.1 Amount of consumption, emission and power generation in the most recent 3 years (2006, 2007, 2008)

Power plants	**Fuel consumption** Coal, oil: kton Gas: mm^3)	**Power generating to the grid** (MWh)	**Emission** (t CO_2)
2006			
Coal thermal power plants	5,645.86	8,989,230	11,823,610
Gas turbines		26,543,028	12,479,558
Gas turbine using gas	5,743,235.28	18,838,764	12,244,632
Gas turbine using oil	70.14	1,308,583	234,927
Add-on	0	10,073,917	0
Diesel thermal power plant	397.65	1,043,991	1,327,593
Diesel power plant using FO	16.60	80,000	51,642
Diesel power plant using DO	6.39	25,000	20,495
Imported power		937,000	0
Total		37,618,249	25,702,898
2007			
Coal thermal power plants	6,386.09	9,836,406	13,272,897
Gas turbines		29,474,917	13,116,062
Gas turbine using gas	5,910,941.84	20,023,590	12,570,669
Gas turbine using oil	163.27	557,880	545,394
Add-on	0	8,893,446	0
Diesel thermal power plant	614.06	1,834,408	2,046,368
Diesel power plant using FO	25.15	104,626	79,867
Diesel power plant using DO	9.16	42,000.00	29,087.81

Imported power		2,629,000	0
Total		43,921,357	28,544,283
2008			
Coal thermal power plants	6,483.99	10,055,394	13,378,811
Gas turbines		33857134.85	14716799
Gas turbine using gas	6,839,114.84	22,396,231	14,535,266
Gas turbine using oil	54.35	183,088	181,533
Add-on	0	11,277,816	0
Diesel thermal power plant	534.59	1,481,880	1,784,825
Diesel power plant using FO	22.48	90,465	71,385
Diesel power plant using DO	3.73	15,000.00	11,878.75
Imported power		3,220,000	0
Total		48,719,874	29,963,699

Table AN.2 Total emission and power generation of the most recent 3 years

	2006	2007	2008	Total
Total power generation (MWh)	37,618,119	43,921,501	48,719,874	**130,259,494**
Total emission (tCO2)	25,702,918	28,544,283	29,963,699	**84,210,900**

Table AN.3 Result of OM emission factor in 2008

Year	Total power generation (MWh)	Total emission(tCO_2)	OM $_{2008}$ (tCO_2/MWh)
	A	B	(∑B/∑A)
2006	37,618,119	25,702,918	
2007	43,921,501	28,544,283	
2008	48,719,874	29,963,699	
Total	**130,259,494**	**84,210,900**	**0.6465**

Table AN.4 Calculation of BM emission factor in 2008

Power plant	COD year	Fuel consumption (Coal, oil: kton Gas: mm^3)		Power generated to the grid (MWh)	Emission (t CO2)
The set of 5 power plants most recently constructed					
A Vuong	2008	Hydropower		168,103.50	
Tuyen Quang	2008	Hydropower		1,136,112.18	
Dai Ninh	2008	Hydropower		1,145,108.50	
Nhon Trach	2008	Gas	166.38	544,808.60	378,023
Ca Mau 1&2	2007	Gas	647.24	2,106,807.24	1,431,048

		Add-on		2,728,872.00	
Total				**7,829,812.02**	
The set of power plants most recently constructed contributes 20% of total power generation					
A Vuong	2008	Hydropower		168,103.50	
SROC Phu Mieng IDICO	2006	Hydropower		241,556.00	
Se San 3A	2006	Hydropower		394,895.70	
Tuyen Quang	2008	Hydropower		1,136,112.18	
Dai Ninh	2008	Hydropower		1,145,108.50	
Se San 3	2006	Hydropower		1,131,614.00	
Quang Tri	2007	Hydropower		250,804.40	
Uong Bi 2	2007	Coal	281,759	532,000.00	581,018
Na Duong	2005	Coal	532	627,930.00	883,846
Cao Ngan	2007	Coal	526	708,693.00	1,081,145
Formosa	2004	Coal	495	560,295.00	1,291,302
Nhon Trach	2008	Gas	166.38	544,808.60	378,023
Ca Mau 1&2	2007	Gas	647.24	2,106,807.24	1,431,048
		Add-on		2,728,872.00	
Phu My 2.2	2004	Gas	1,159.75	4,141,980.00	2,510,751
Phu My Nitrogen	2006	Gas	56.15	4,716.00	133,868
CAI LAN - VINASHIN	2007	FO	22.48	90,465.01	71,385
Total				**16,514,761.12**	**8,362,386**
Result of BM emission calculation (BM)					
Total emission			8,362,386.08 (tCO_2)		
Total power generation			16,514,761.12 (MWh)		
BM_{2008}			**0.5064 (tCO_2/MWh)**		

Table AN.5 Calculation of Combined Margin

A	Estimated operating margin emission rate	tCO2/MWh	**0.6465**
B	Estimated build margin emission rate	tCO2/MWh	**0.5064**
C	Estimated baseline emission rate	tCO2/MWh	**0.5764**

Annex 4

MONITORING INFORMATION

Power purchasing company name: Electricity of Vietnam (EVN)

Connection point details: The electricity generated from Dak Srong 2 hydropower plant will be connected to the National Grid through a new 110 kV single circuit transmission line from 110 kV Transformer Station of the Dak Srong 2 to 110 kV transformer station of the Dak Srong 2 A hydropower plant and then connect through the 110 kV transformer station of Dak Srong hydropower plant to the National Grid.

Monitoring point:

- Net electricity generation of the project will be measured and monitored through the use of on-site metering equipment at the outgoing feeder the hydropower plant.
- There are two systems, one main and the other one is the backup system.

Project Manager Name: Mr Nguyen Van Hung, Director of the company

Site Manager Name: Mr Nguyen Le Anh Duy, Person in charge of the project