**PROJECT DESIGN DOCUMENT FORM
FOR CDM PROJECT ACTIVITIES (F-CDM-PDD)
Version 04.1**

PROJECT DESIGN DOCUMENT (PDD)

Title of the project activity	Nam Khan 2 Hydropower Project
Version number of the PDD	01
Completion date of the PDD	16.09.13
Project participant(s)	Electricite du Laos, Lao PDR Gazprom Marketing & Trading Limited
Host Party(ies)	Lao Peoples' Democratic Republic
Sectoral scope and selected methodology(ies)	Scope Number 1 – Energy industries (renewable), hydropower ACM0002: Grid-connected electricity generation from renewable sources Version 14
Estimated amount of annual average GHG emission reductions	239,214 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The Nam Khan is located in northern Laos and joins the Nam Mekong near the city of Luang Prabang. The proposed Nam Khan 2 dam site is located about 30 km SE of Luang Prabang, in a narrow valley with steep slopes where the bedrock consists of limestone intermixed with sandstone. The site conditions are appropriate for construction of a roller compacted concrete (RCC) dam, into which, the spillway and power intake are incorporated.

The watershed drainage basin area tributary to the dam site is 5,221 km2 and the average annual flow is 64.4 m3/s.

The dam will be a RCC gravity dam with abnormal concrete veneer on the upstream dam surface. With a crest level at EL. 488m, the dam will have a maximum height of 160m and a crest length of 405m.

The current scenario is a situation where Lao PDR faces a shortage of electricity and is importing power from neighbouring Thailand. Thailand is heavily dependent on fossil fuels for power generation.

The proposed project will result in CO_2 emission reduction, as it will displace the power generation that otherwise would be based on a mix of fossil fuels. The reduction in carbon dioxide emissions is estimated to be 239,214 tonnes per year.

The overall purpose of the project is the generation of electricity based on renewable energy sources. The electricity will be delivered to the grid. The projected income from the sale of CERs will contribute not only to the socio-economic situation of the region but also to sustainable development in Lao PDR. Furthermore, the hydro power generated will increase the share of renewable energy in the regional grid, replacing imported power generated by fossil fuels
.

For Lao PDR, the project will add great benefit to the national economy and environmental sustainability while reducing CO_2 emissions in the grid.

Furthermore, implementation of this project in Lao PDR is carried out within an overall CDM capacity building project, thereby providing the Waters, Rivers and Environment Authority (WREA) , Lao PDR, with necessary skills and know-how to utilize its CDM potential for further projects.

At the regional level, the local population currently has limited access to public services, telephone services, roads, water supply and electricity. This project also foresees the construction of a transmission line as well as new access roads and the upgrading of existing roads.

Consequently, a significant improvement of the infrastructure in the region is expected. An improvement in tourism is also anticipated due to these measures. In general, the project will provide significant local social benefits due to additional employment and business opportunities, better road access and electrification of the area.

All of the households in the vicinity of the project area will receive electricity which will drastically improve living conditions. Currently, the majority of households use kerosene for lighting and firewood for cooking.

The project will replace firewood consumption and save cutting down of trees contributing to the overall environmental sustainability of Lao PDR.

A.2. Location of project activity
A.2.1. Host Party(ies)

Lao PDR

A.2.2. Region/State/Province etc.

Louang Prabang Province

A.2.3. City/Town/Community etc.

B.Viengsamay, B. Nakeun villages of Phoukhoun District, Luangprabang Province

A.2.4. Physical/Geographical location

The geographical co-ordinaries of the main elements of the project are as follows :

The project reservoir co-ordinates are 19°40’38.42” N / 102°22’41.90” E at the south western end and 19°41’20.87” N / 102°35’52.96” E at the north eastern end. The Powerhouse is at 19°41’8.89” N / 102°21’40.42” E.

A map of the Project Area is shown below.

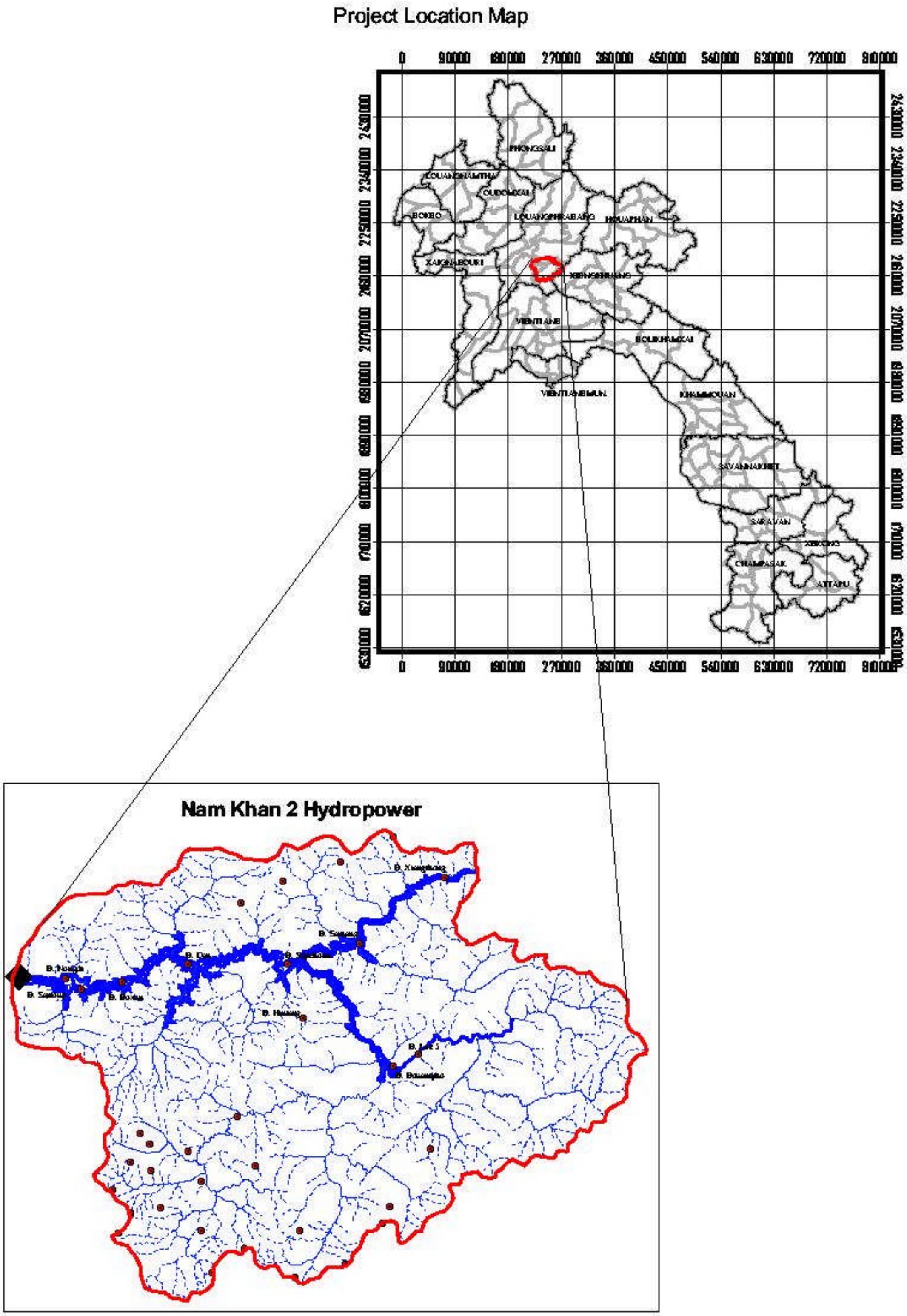
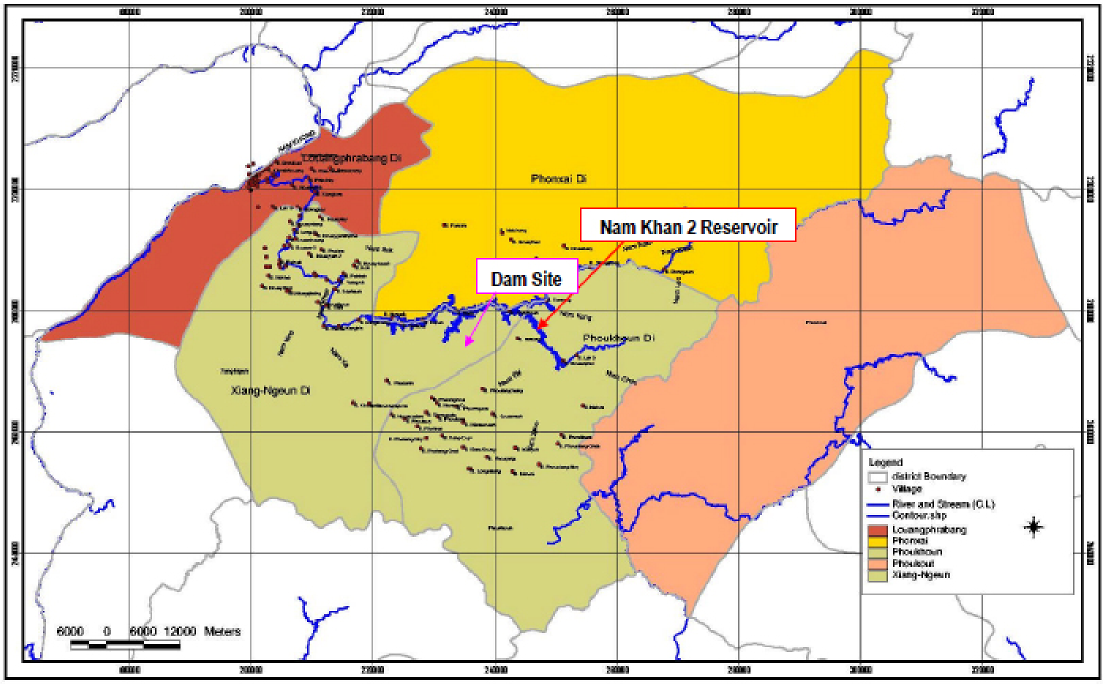


Figure 1 - Project Location Map 1

Figure 2 - Project Location Map 2



A.3. Technologies and/or measures

The baseline scenario is that the grid will continue to be supplied by power plants generating electricity using fossil fuels. This project will replace that generation with electrical power generated in a hydo electric plant which will result in zero CO2 emissions and only minimal greenhouse gas emissions from the reservoir. This is due to the project design and power density. The project will deliver 567.80GWh per year of electricity to the grid and will result in average emissions reductions of 239,214 tCO2e per year.

The Nam Khan 2 Hydropower Project has been planned to meet the following objectives;

1) To increase the electrification ratio in the central region,
2) To reduce power import from neighboring countries in the dry season,
3) To increase power export to neighboring countries in the wet season.

The main features of the project are detailed in the table below.

Item		Main Features
Output	Installed Capacity	130MW (2x65MW Francis Turbines) Plant Factor 45%
	Expected Lifetime of Turbines	25 years before major overhaul
	Annual Generated Energy	567.80GWh
	Reservoir Area (HWL)	30.568 km2
Dam	Type	RCC Dam
	Maximum Dam Height	160 m
	Dam Length	405 m
Power Station	Type	Surface
	Number of Units	2
	Turbine Type	Francis
	Turbine Discharge	52.00 m3/s
	Gross Head	140 m
	Reted Effective Head	137.5 m
Transmission	Line Length	15 km
	Voltage	115 kV, 2cc

Table 1 - Key Technical Data[1]

The dam will be a gravity RCC structure with conventional concrete veneer on the upstream and downstream slopes. With a crest level at El. 488m, the dam will have a maximum height of 160m and a crest length of 405m. Due to the potential for karstic bedrock at the site, special attention was devoted to the design of the grout curtain, which extends into both abutments using excavated galleries along the dam axis Separate service and emergency spillways will be incorporated in the dam. The service spillway will be located in the centre section of the dam and will have an ogee-shaped crest structure, a ski-jump terminal structure and a pre-excavated plunge pool in the river bed. The spillway will have two bays equipped with 14m wide radial gates with a spill level at El. 460 m. The emergency spillway will consist of a free overflow over the dam crest near the left abutment of the dam. The emergency spillway section will include a stepped chute on the downstream face of the dam to dissipate a significant portion of the energy. The spillway will have an overflow width of 49m and a crest level at El. 481 m. Overtopping of the dam is anticipated during the passage of the PMF, but the dam will be designed to withstand this condition without failure.

The powerhouse and related structures will be located on the right bank at the foot of the dam. The project will produce a peak output of 130 MW from a rated plant discharge of 104 m3/s under a net head of 137.5 m. The two units will be fed individually by an intake and a penstock. The intake structure will be incorporated into the dam and the 4.1m diameter penstocks will be placed on the downstream face of the dam. The powerhouse will house two generating units driven by vertical Francis turbines. The structure will be conventional, with a concrete substructure and mixed concrete and steel super-structure.

The project will connect to the national grid which is part of the Laos and Thai grid. Under the baseline scenario additional fossil fuel plants would be connected to the grid, thereby increasing CO2 emissions.

[1] Feasibility Study Report and Letter from EdL 27.2.12.

A.4. Parties and project participants

Party involved (host) indicates a host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Lao PDR	Electricite du Laos, Lao PDR	No
United Kingdom	Gazprom Marketing & Trading Limited	No

A.5. Public funding of project activity

No public funding is foreseen for the implementation of the Nam Khan 2 Hydropower Project.

SECTION B. Application of selected approved baseline and monitoring methodology
B.1. Reference of methodology

The project follows the ACM0002 Grid-connected electricity generation from renewable sources, Version 14.0.0, Scope 1, EB 75. (http://cdm.unfccc.int/methodologies/PAmethodologies/approved)

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 (greenfield plant); (b) involve a capacity addition; (c) involve a retrofit of (an) existing plant(s); or (d) involve a replacement of (an) existing plant(s).

Methodological tool "Tool to calculate the emission factor for an electricity system", version 04.0.0, EB 75.

Methodological tool "Tool for the demonstration and Assessment of Additionality" version 07.0.0, EB 70.

B.2. Applicability of methodology

The baseline and monitoring methodology ACM0002 Version 14.0.0 is applicable to the proposed project, because the project meets all the applicability criteria stated in the methodology:

Condition: The project activity is the installation or modification/retrofit 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.

Project: The proposed project is a newly-built grid-connected hydropower generation project. Thus the project is in compliance with this applicability condition.

Condition: In case of hydro power plants:

- The project activity is implemented in an existing reservoir, with no change in the hose volume of reservoir.
- The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the Project Emissions section, is greater than 4 W/m2.
- The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the Project Emissions section, is greater than 4 W/m2.

Project: The project will create a new reservoir with a power density greater than 4 W/m2 (see also section B.6.). Thus the project is in compliance with this applicability condition. The methodology ACM0002 (Version 14.0.0) is applicable to the proposed project, because the proposed project meets all the applicability criteria stated in the methodology:

The methodology furthermore includes a number of disqualifying conditions, as indicated below:

Condition: The 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 fossil fuels at the site.

Project: The project does not involve an on-site switch from fossil fuels to a renewable source.

Condition: The methodology is not applicable to biomass fired power plants.

Project: The project is a hydropower plant and does not involve the firing of biomass.

Condition: The methodology is not applicable to hydro power plants that result in new reservoirs or in the increase in existing reservoirs where the power density of the power plant is lower less than 4 W/m2.

Project: The power density of the project is greater than 4 W/m2

• The project activity results in new reservoirs and the power density of the power plant, is greater than 4 W/m^2. The total installed capacity of the proposed project is 130.0 MW; the surface area at full reservoir level is 30.57KM2,

• The geographic and system boundaries for the relevant electricity grid can be clearly identified and information on the characteristics of the grid is available;

• Project activity does not involve switching from fossil fuels to renewable energy sources at the site of the project activity,

B.3. Project boundary

The project boundary for the purpose of calculating project and baseline emissions consists of the physical hydropower project site and the interconnected electricity grids of Lao PDR and Thailand. The only relevant emission source is the CO2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity. For more details refer to the table below.

Source		GHGs	Included ?	Justification/Explanation
Baseline	CO2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity.	CO_2	Yes	According to ACM0002 methodology: For the baseline determination, project participants shall only account CO_2 emissions from electricity generation in fossil fuel fired power that is displaced due to the project activity
		CH_4	No	
		N_2O	No	
Project Activity	Proposed Project	CO_2	No	Minor emission source
		CH_4	Yes	Main emission source
		N_2O	No	Minor emission source

Table 2 - GHG Included

According to methodology ACM0002, the spatial extent of the project boundary includes the project power plant and all power plants connected physically to the electricity system that the CDM project power plant is connected to. The Project boundary is the Project site, the Central Supply Area and EGAT Grid System (GS) with its extension into Lao PDR.

The CDM Executive Board (EB) in its 28th meeting in December 2006 clarified that the word "regional", in context of "regional electricity system" used in ACM0002, can also be interpreted as extending across international boundaries. The Board further clarified that trans-national electricity systems are eligible under ACM0002 and that the grid emission factor in this context shall be estimated for the "regional electricity system". Therefore, the EGAT Grid System with its extension into Lao PDR, can be considered as a "connected international electricity system", and determined as the "project boundary" for the proposed Project.

In its 70th meeting in November 2012 the EB made a further clarification as follows :

The Board agreed to clarify that:

(a) A project activity and a bundled project activity shall have only one host Party.
(b) In relation to the identification of the host Party for any project activity or bundled project activity, the host Party is the Party in which the project activity is located, as set out in the project design document (PDD).

(c) Where a methodology provides for the application of a system, such as an electricity grid, and that system extends across more than one Party, a letter of approval from the designated national authority is only required from the host Party.

d) In relation to its decision at its twenty-eighth meeting (EB 28 report, paragraph 14), a letter of approval is only required from the Party in which the project activity is located, as set out in the PDD.

Since 1971, there have been regular power exchanges and interconnections between Lao PDR and Thailand. Currently there are 9 such interconnecting lines situated along the border of Lao PDR and Thailand for import and export purposes (see Figure 3). Historical import and export data for Lao PDR and neighbouring countries including Thailand is also available (see Annex 4).

The Nam Khan 2 Project will be connected to the Central Supply Area of Lao PDR, which forms an integral part and extension of the EGAT Grid System (see Figure 3). The Central Supply Area is isolated from all other electricity supply areas in Lao PDR and is connected only to the EGAT Grid System (see Figure 3). Regular exchanges between Lao PDR and Thailand occur without any transmission constraints and according to the blanket Power Purchase Agreement (PPA) between Electricite Du Laos (EDL) and EGAT, EDL can freely import surplus energy without committing to the quantity or timing of either

The linkage will increase reliability and guaranteed electricity supply to the Cebtral Lao and the EGAT Grid System in Thailand.

Based on the current electricity exchange agreements between Lao PDR and Thailand, the ACM0002 Methodology and the CDM EB meeting clarifications, the spatial extent of the Project boundary is the Project site, Central Supply Area and the EGAT Grid System (GS) with its extension into Lao PDR. can be considered as a "connected international electricity system", and determined as the "project boundary" for the proposed Project.

Project emissions associated with geothermal power plants (fugitive and combustion emissions) are not considered as the project involves a hydropower plant. In accordance with the ACM0002 methodology, project emissions from the reservoir have to be taken into account in case the power density of the project is between 4 W/m2 and less than or equal to 10 W/m2. The power density can be calculated as 4.2528 W/m2 (see for details section B.6.1). In accordance with the ACM0002 methodology, emissions from the reservoir are taken into account in the calculation of emission reductions.

The emission sources are the power plants connected to the Central Lao Grid and the Thai Grid, as defined below. The project's spatial boundary is the Central Lao Grid and the Thai Grid, and the Nam Khan 2 hydropower station, including:

• reservoir created by the project activity
• dam structure including flood gates and water intake
• power houses
• tailrace
• switching / transformer station (owned by the project entity)
• transmission lines to the grid

In agreement with the methodology leakage (arising from power plant construction, fuel handling, etc.) is ignored. The project participants also do not claim emission reductions resulting from a reduction of these emissions under the baseline level.

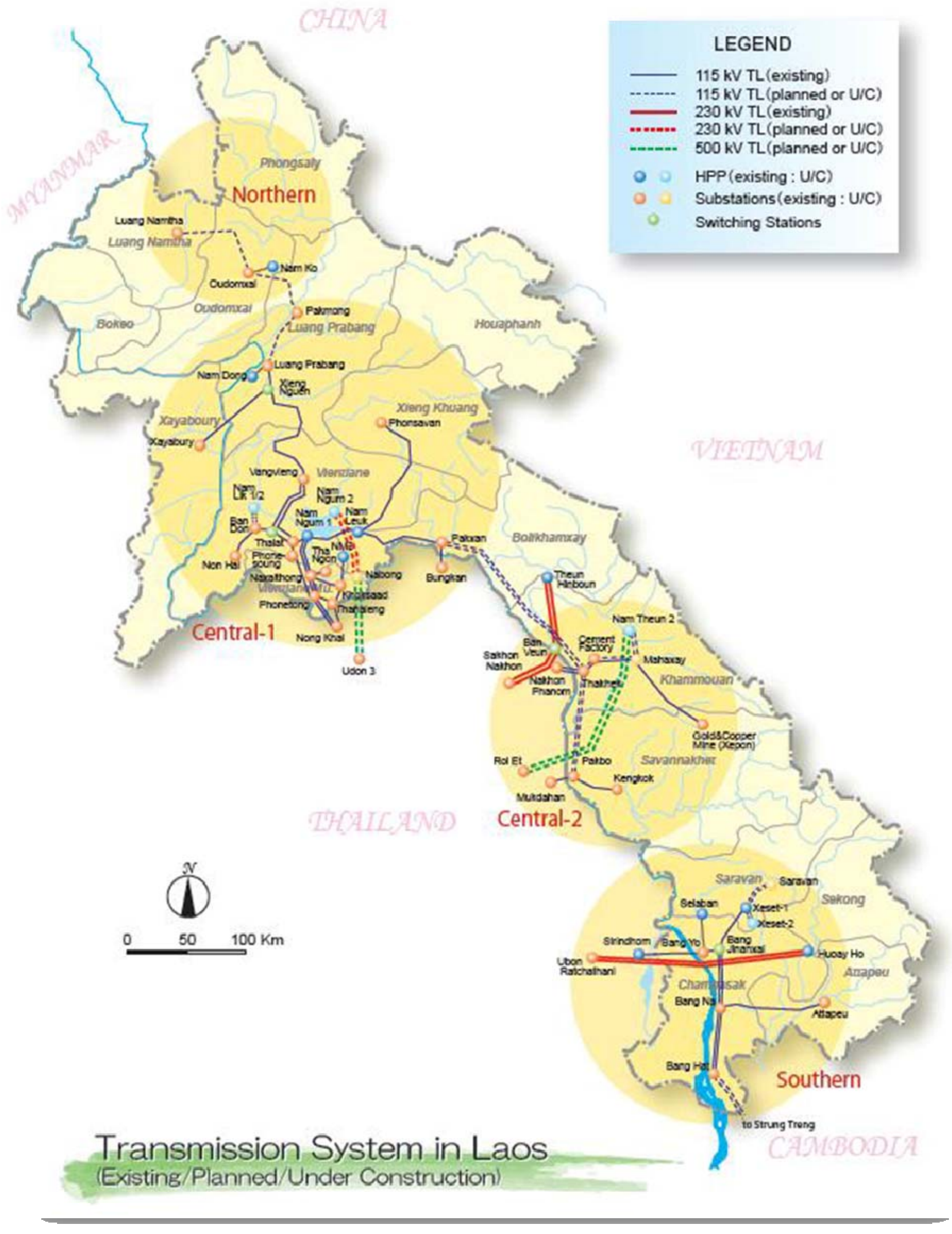


Figure 3 - Transmission System

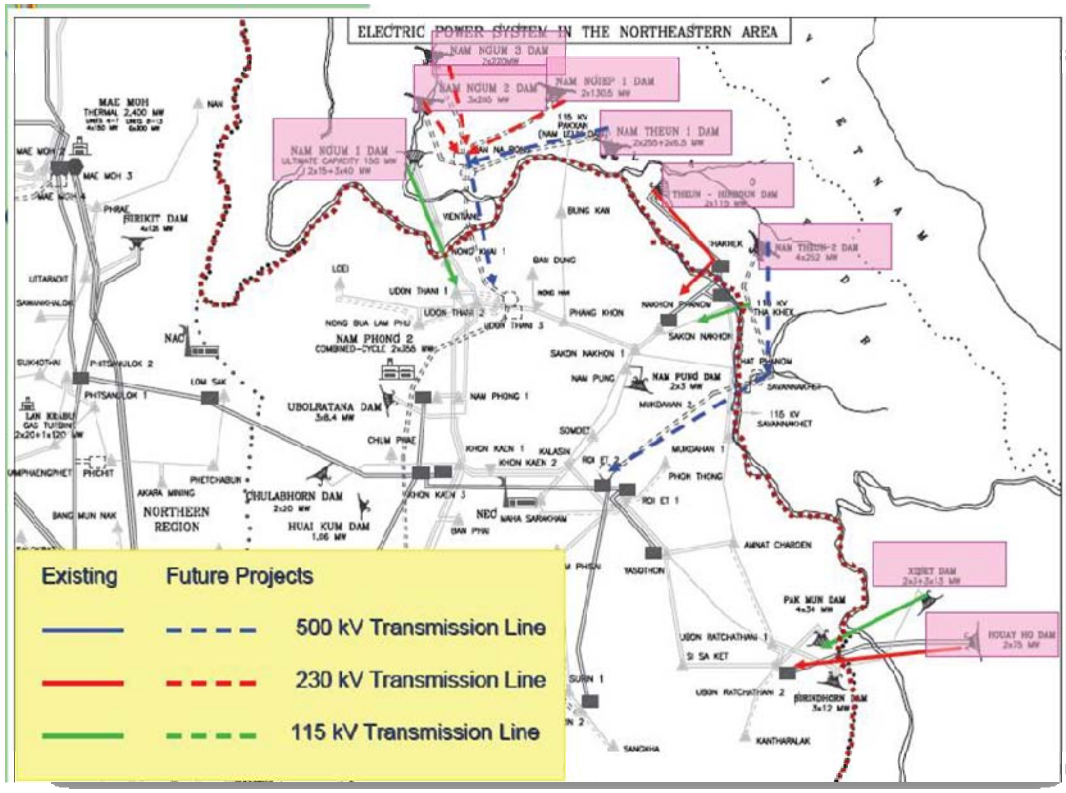


Figure 4 - Grid Connection Points

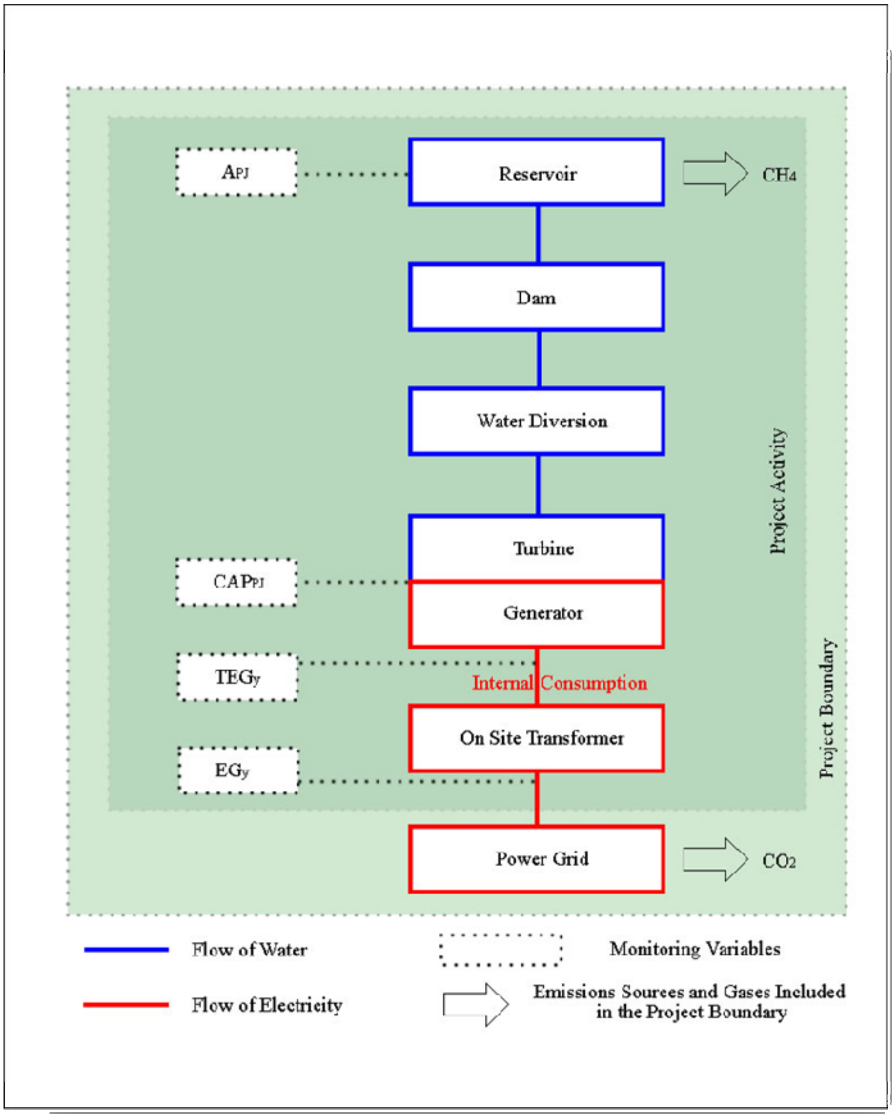


Figure 5 - Project Boundary

B.4. Establishment and description of baseline scenario

Identification of the baseline scenario

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.

ACM0002 also specified the step-wise approach for identifying the baseline for project activities which involve the retrofit or replacement of existing grid-connected renewable power plant/unit(s) at the project site.

The project is a newly built hydropower project, so the step-wise approach is not applicable.

The baseline scenario is determined by analysing the data from the electricity grid to which the Project causes emission reductions. The proposed Project is connected to the Central Supply Area of Lao PDR, which forms an integral part and an extension of the EGAT Grid System in Thailand. Currently, electricity exchanges between Laos and EGAT Grid occur regularly without any transmission constraints. Therefore, (as justified above), the emission reductions will occur within the extended regional EGAT Grid System.

Approach

The approach selected in the baseline methodology checks the additionality of the project activity and determines the baseline emission factor for selected baseline scenario.

For grid connected electricity generation projects it is important to ascertain whether the project has some impact on the grid's electricity generating pattern. It has been established in the CDM modalities and procedures that a combined margin (CM) which takes into account the operating margin (OM) and build margin (BM) can be used to determine the effect of the power project to the grid where:

a. The OM is the weighted average of all resources except low-cost/must-run facilities.
b. The BM is the generation-weighted average emission rate of the most recent 20% of plants built (on a generation basis) or the most recent five plants, whichever is greater.

Calculations for this combined margin are based on data from official sources from Electricite du Laos (EdL), the Electricity Generating Authority of Thailand (EGAT) and the Thailand Greenhouse Gas Office (TGO) which is the Thai Designated National Authority (DNA).

Power Supply Position – Lao PDR and Thailand Grid

The project will generate electricity to the public power grid of Lao PDR and the Thai grid.

Hence the hydro power generated from the project site being a must-run facility will replace the electricity generated from thermal power stations feeding into regional grid. Since hydro power is emissions free, the hydro power generated will save the anthropogenic Green House Gas (GHG) emissions that would have been generated by the fossil fuel based thermal power stations comprising coal, diesel, furnace oil and gas.

Identification of Baseline Scenario

The methodology lays down certain steps by which the baseline is determined. The baseline methodology identifies the project as being additional and not the baseline scenario. The methodology is designed to have the grid combined margin as the baseline scenario. The proposed hydro power plant will impact the combined margin which is calculated based on the weighted average of the operating margin (OM) emission factor and the build margin (BM) emission factor. Equal weights have been provided to the OM and BM by default as per the norms since the hydro power project is seen to have equal effects on both margins.

The project activity emissions are taken into account but does not take leakage into account as per ACM0002. Hence, the emission reductions that are calculated for the project activity are real.

The most plausible baseline scenario is identified in two steps. The first is the identification of all plausible alternatives. The second is the narrowing down of the plausible alternatives through assessment of barriers.

There are only two real and credible alternatives available to the project participants or similar project developers that provide outputs or services comparable with the Project. These are:

Alternative A: The proposed project activity undertaken without being registered as a CDM project activity; and
Alternative B: Continuation of the current situation (no project activity or other alternative undertaken).

Alternative A, wherein the proposed project activity is implemented without the assistance of the CDM, can be ruled out as a credible alternative. As demonstrated quantitatively in Section B.5 below, the Project, in the absence of additional revenue is clearly not financially attractive for the project proponent.

Therefore, the remaining Alternative B, which is the non-implementation of the Project and the continued electricity generation from the Central Lao Grid and the Thai Grid, is determined to be the baseline scenario.

The baseline scenario of the Nam Khan 2 Hydropower Project is the continued operation of the existing power plants and the addition of new generation sources on the Lao Central Grid and the Thai Grid to meet electricity demand. The project activity involves a construction of a zero-emission power source. Thus, the emission reductions are equal to the baseline emissions.

In accordance with the ACM0002 methodology, baseline emissions are equal to power generated by the project activity and delivered to the grid, multiplied by the baseline emission factor. The baseline emission factor is equal to the combined margin: a weighted average of the operating margin emission factor and the build margin emission factor.

There is ample evidence to show that the Project developer seriously considered the CDM from the very early stages of the project development.

The Project timeline is summarized in the table below.

Table 3 - CDM Milestones

Date	**Detail**
EPC Contract Agreed	3rd November 2010[2]
CDM Revenues referred to in EdL IPO prospectus	IPO Prospectus published December 2010[3]
CDM Consultant Proposal Requested	January 2011[4]
Project Approved by Lao Cabinet	28th January 2011[5]
Feasibility Study sent to CDM Consultant	22nd July 2011
CDM Consultant Proposal Agreed	28th July 2011[6]
CDM Consultant Contract Signed	September 2011[7]

[2] EPC Contract
[3] EdL IPO Prospectus
[4] CDM Consultant Presentation
[5] Approval Certificates
[6] E-Mail from EdL

Clarification regarding power density and updated design documents received	28th February 2012[8]
Confirmation of Project Start Date	26th March 2012[9]
Bids sought from Buyers	May 2012[10]
Termsheet Agreed	August 2012[11]
ERPA Signed	December 2012[12]

B.5. Demonstration of additionality

The additionality of the project activity is further demonstrated and assessed according to the applied methodology ACM0002 using the latest version of the “Tool for the demonstration and assessment of additionality” (Version 0.7.0.0). The tool provides a step-wise approach to demonstrate and assess additionality of the Nam Khan 2 hydropower project and is applied by completing the following steps within this section:

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

Step 2: Investment and sensitivity analysis to determine that the proposed activity is not the most financially attractive or is unlikely to be financially attractive;

Step 3: Barriers analysis to prove that there is at least one alternative scenario, other than the proposed CDM project activity, not prevented by any of the identified barriers;

Step 4: Common practice analysis to show essential distinction between the proposed CDM project activity and similar activities.

For the project activity, only Step 2 has been completed in order to give a sound overview of the project framework. Based on information about activities similar to the proposed activity, the common practice analysis is to complement and reinforce the investment and barrier analysis.

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

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

Realistic and credible alternatives to the proposed CDM project activity comparable with outputs and services include:

a) The proposed Project itself, but not undertaken as a CDM project activity.
b) Continuation of the current situation, where electricity is supplied by the EGAT Grid / Central Lao PDR grid and no project activity or other alternatives are undertaken.

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[7] Signed Contract
[8] Letter from EdL
[9] Letter from EdL dated 30th March 2012
[10] PIN sent to Gazprom
[11] Termsheet
[12] Signed ERPA

Alternative a) is in compliance with all applicable legal and regulatory requirements. But according to the investment analysis in step 2, this scenario is less attractive with a very low IRR and is not realistic without CDM financing.

Alternative c) is in compliance with all applicable legal and regulatory requirements.

Outcome of Sub-step 1a: demonstrates that the identified realistic and credible alternative scenarios to the project activity are Alternatives a), d).

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

In the development of the Lao power sector the government has identified two vital national priorities. The first priority encourages affordable and reliable power supply to both society and industry with community benefits. The other encourages the promotion of both hydropower and coal powered electricity exports (with both resources available abundantly in Lao PDR) in order to earn foreign exchange.

a) The proposed Project itself, but not undertaken as a CDM project activity.

The Lao Government encourages and promotes hydropower development through a series of laws, regulations and preferential policies. Therefore, alternative a) is in compliance with legal and regulatory requirements, but is not a realistic and credible alternative as, according to the investment analysis presented in section B.5 below, the project is not a financially attractive without CDM.

d) Continuation of the current situation, with no project activity or other alternatives undertaken (continuation of electricity supply from the EGAT Grid / Central Lao PDR grid). Alternative d) is in compliance with legal and regulatory requirements. The Central Lao PDR / EGAT grid is one interconnected grid (as discussed in Section B.3) and long-term PPAs have been signed between EDL and EGAT allowing a regular flow of electricity supply. Therefore alternative d) is a realistic and credible alternative and is considered as the baseline scenario.

Outcome of Step 1b: Based on the above analysis, the proposed Project activity is not the only alternative amongst the ones identified that is in compliance with the existing legal and regulatory requirements in Lao PDR.

Step 2 – Investment analysis

The purpose of investment analysis is to determine whether the proposed Project activity is not: the most economically or financially attractive; or economically or financially feasible, without the revenue from the sale of CERs. To conduct the investment analysis, the following sub-steps have been applied:

Sub-step 2a. Determine appropriate analysis method

The “*Tool for the Demonstration and Assessment of Additionality” (Version 7.0.0)* recommends three analysis methods, including simple cost analysis (Option I), investment comparison analysis (Option II) and benchmark analysis (Option III).

The proposed hydropower Project generates financial and economic benefits through the sales of electricity other than CDM related income, therefore the simple cost analysis (Option I) cannot be taken. The investment comparison analysis (Option II) is only applicable to projects where the alternatives are similar investment projects. The alternative baseline scenario of the proposed Project is the continuation of electricity supply from the Central Lao PDR / EGAT Grid System (alternative (d)) which is not considered to be an investment. Therefore, as per the Annex of the Additionality Tool (version 7.0.0) the benchmark analysis (Option III) is chosen for this Project activity and the Project Financial Internal Rate of Return (FIRR) is used in analysing whether the Project is financially feasible or not.

Sub-step 2b. Option III. Apply benchmark Analysis

During the financial assessment of the Nam Khan 2 Project activity in 2009 and the decision-making process in that period, a discount rate of 10% was used to evaluate the Project. This is in line with the discount rate of 10% for government projects confirmed by the Government of Lao PDR and reflected in the Power System Development Plan (PSDP) 2004 for Lao PDR. The Government of Laos adopted the figure in the Power Development Plan and this remains unchanged and is still the most up to date data. Based on this, the post-tax benchmark (FIRR) of 10% was selected by the Project proponent. A post-tax Project Financial Internal Rate of Return (FIRR) was selected as the appropriate financial indicator for the Project.

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

1) Parameters needed for calculation of key financial indicators.

The financial assumptions of the Project are outlined in the 2009 Feasibility Study (undertaken by Sinohydro). These are as follows in Table 4 below. This resulted in the Project being not financially viable without the income from CERs (see Table 3 below).

Paramenters for calculation of key financial parameters

Parameter	Value	Reference Source
Installed Capacity	130MW	Letter from EdL dated 27.2.2012.
Grid Connected Electricity Output	567,800 MWh	Feasibility Study "Summary and Concluisons Page 7
Construction Period	4 Years	Feasibility Study Chapter 1 0 Summary and Conclusions
Operational Lifetime	25 Years (plus 4 years construction	Feasibility Study Chapter 1 – Summary and Conclusions
Depreciation Period	25 Years	Consistent with Project Lifetime
Expected Tariff	Levelized USD 0.06KWh	Lahmeyer and Maunsell[13]
Cost without Financial Charges	USD 308,570,870	Signed EPC Contract Page 1
O & M Costs	USD 2,436,820	
Expected CER Price	USD 15.00	Historical Prices
Royalty Payment	Nil	
Salvage Value	Calculated at 5% and only considered for the dam, tunnel and property. With a total civil works value of USD 156,676,758 the salvage value is USD	Contract BOQ Page 1 of 4

[13] Fesasibility Study

	7,833,838	
Tax Rate	0%	

Table 4 - Key Financial Parameters

2) Comparison of IRR and NPV for the proposed Project and the financial benchmark

In accordance with benchmark analysis (Option III), if the financial indicators of the proposed Project, such as the Project IRR, are lower than the benchmark, the proposed Project is not considered to be most financially attractive.

Table XX shows the Project IRR and NPV of the proposed Project with and without the sale of CERs. Without the sale of CERs the Project IRR is 7.78% (after tax) which is lower than the financial benchmarks used for similar projects in Lao PDR. Taking into account the CDM revenues, the Project IRR would increase to 8.72% (after tax). The NPV of the proposed Project is USD (52.199 million) at a discount rate of 10%. Thus the proposed Project is not financially attractive.

Project Internal Rate of Return (IRR) of Nam Khan 2 HPP with and without CDM revenues

	Without CDM Related Income	**With CDM Related Income**
Project FIRR	7.78%	8.72%
NPV (USDM)	(52.199)	(30.318)

The CDM Project activity has a less favorable indicator (i.e. lower FIRR of 7.78%) than the benchmark applied (post tax FIRR of 10%). Therefore, it can be concluded that the Project activity is not the most economically or financially attractive.

Sub-step 2d - Sensitivity analysis (only applicable to options II and III):

The sensitivity analysis shall show whether the conclusion regarding the financial attractiveness is robust to reasonable variations in the critical assumptions. For the proposed Project, four parameters were selected as sensitive factors:

1) Total investment.
2) Annual Operation and Maintenance (O&M) costs.
3) Expected tariffs – domestic and export (excl. tax).
4) Annual electricity output.

The results of sensitivity analysis (on an after tax basis) are shown in Table XX and Figure XX below.

	Decrease			Base Case	Increase		
	-15%	-10%	-5%		5%	10%	15%
Total Investment without Financial Costs	9.51%	8.92%	8.38%	7.88%	7.41%	6.97%	6.56%
Annual Electricity Output	6.24%	6.80%	7.35%	7.88%	8.39%	8.89%	9.38%
Annual O&M Costs	7.99%	7.95%	7.91%	7.88%	7.84%	7.80%	7.76%
Tariff	6.24%	6.80%	7.35%	7.88%	8.39%	8.89%	9.38%

This is illustrated graphically in the chart below.

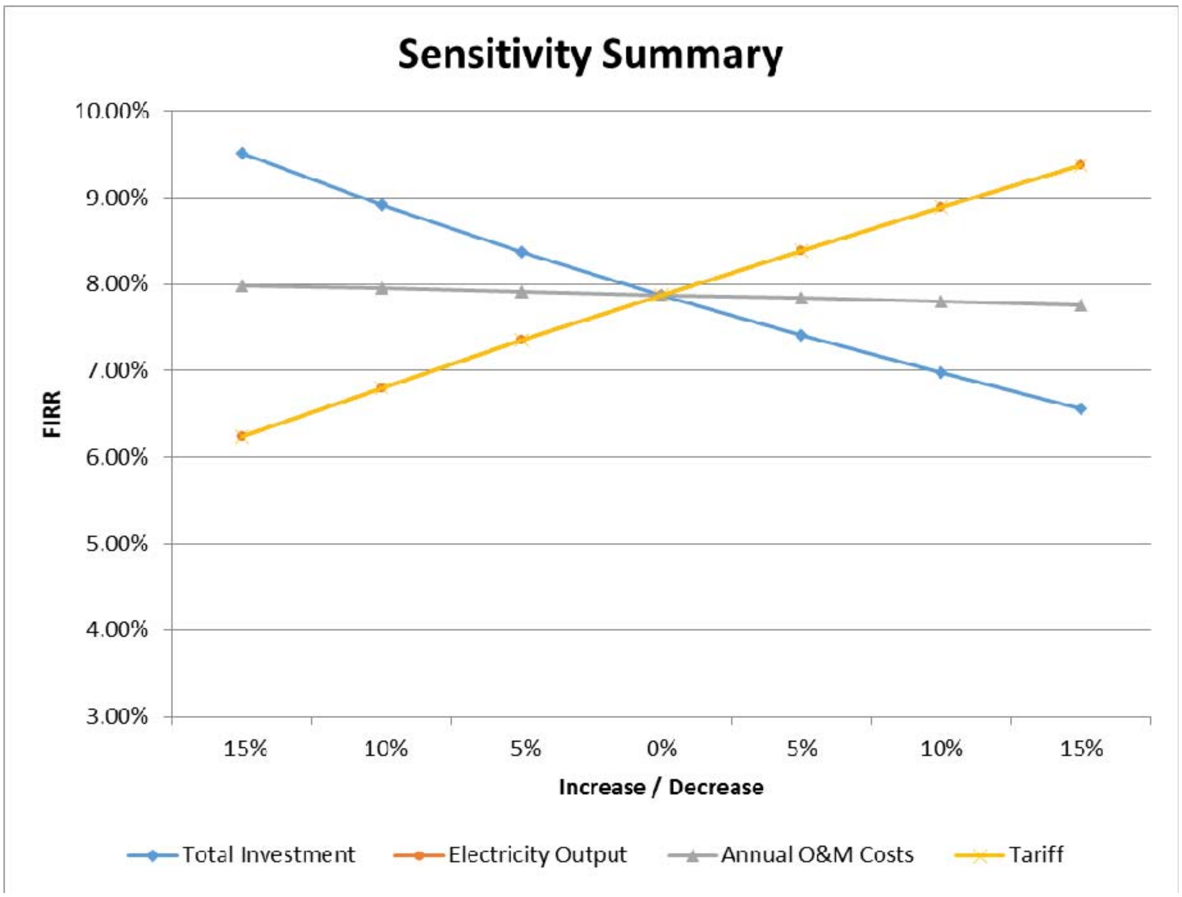

Figure 6 - Sensitivity Summary

Further analysis below shows the levels of increase / reduction which are required to achieve the Benchmark Return of 10.00%. These paramters are summarized in the table below.

Capacity / Output Increase	
Current Output	567,800,000
Output Required	690,500,000
IRR	10.00%
Increased Output	21.42%

Tariff Increase	
Current Levelized Tariff	0.06
Tariff Required	0.0781
IRR	10.00%
Tariff Increase	30.17%

Reduction in CAPEX	
Current CAPEX	308,570,870
CAPEX Required	250,400,000
IRR	10.00%
CAPEX Reduction	18.83%

Reduction in O&M	
Current O&M	2,436,820
O&M Required	(7,825,000)
IRR	10.00%
O&M Reduction	-421.12%

Table 5 - Sensitivity Analysis

Of the alternatives considered, the only way to achieve the benchmark would be a major increase in capacity (output), an increase in the tariff of a similar magnitude, or a reduction in the CAPEX.

None of these alternatives are feasible for the reasons stated below;

1) The output is estimated based on the hydrological measurements at the site. Many years of data have been analyzed by hydrological engineers, and it is not realistic to assume that the flow of water will increase significantly as the data has been observed over a number of years. It would not be appropriate to install more powerful turbines as the turbines selected reflect the optimum turbine configuration for the given water flow. No investors would entertain the project without reliable output assessments from an independent hydrological engineer. An output increase of 21.09% to 688,637,354 KWh may exceed the benchmark but this is simply not feasible. It is not feasible because the estimated output has already been set at the maximum which is realistically possible.
2) The Project Owner does not have a choice of offtaker – all power has to be distributed by the state owned utility, EdL. The tariff cannot be increased because the local population cannot afford a higher tariff. An increase of 29.34%, which is needed to exceed the benchmark return, is simply not possible.
3) The CAPEX is already at a minimum level. Prices for both civil and electrical mechanical contracts have escalated in recent years. However, currencies have not been stable and the most competitive bid for the civil works (a large proportion of the cost) was received in USD and the value of the USD is lower than it was at the time of bidding. A reduction of 18.73% in the CAPEX would compromise the safety of the project.

4) The O&M costs for the project are relatively minor and it is clear that no realistic or plausible amount of reduction in this area could achieve the benchmark.

Consequently, none of these alternatives are feasible.

In conclusion, since the project IRR is lower than benchmark, the project is considered as financially unattractive through investment analysis, so the proposed project is additional

Step 3. Barriers Analysis

Without CDM registration, the proposed Project faces a number of barriers that would prevent the successful implementation of the Project and significantly impact on the economics and sustainability of the Project.

At the same time, these barriers are much less likely to prevent the implementation of alternative projects.

Sub-step 3a: Identify barriers that would prevent the implementation of the proposed CDM project activity:

1. Financial and Investment Constraints

The total exploitable hydropower potential of Lao PDR is around 23,000 MW, yet only about 623 MW has been developed so far. This is largely due to financial and investment constraints faced by the renewable energy sector in Lao PDR. These are outlined below.

***Poor investment climate* -** Lao PDR is a Least Developed Country (LDC) and the second poorest country in East Asia (after Cambodia). The government has become dependent on foreign aid, and a generally poor investment climate and limited infrastructure make it difficult to attract foreign direct investment.

The main sectors which are able to attract foreign investment have been the mining and hydropower sectors, yet these sectors have experienced difficulty in attracting investment, especially in the wake of Asian Economic Crisis of 1997. During the crisis, FDI declined dramatically and most foreign investors withdrew from Lao PDR. Foreign direct investment commitments to Lao PDR fell by 91 percent in 1997, and actual flows declined by 41 percent.

The poor investment climate affected the project proponent's ability to secure funding for the Projectwhich initially began in 1995. The initial pre-feasibility study (in 1994) conducted by the Consortium HRA which was formed by RSW International, Hydro Quebec International and Acres International . However, the project did not go ahead due to country investment barriers that prevented the project proponent from obtaining financing. Changes in power tariffs due to the impacts of the Asian economic crisis in the late 1990s in the region lead to the further lowering of electricity sales prices and resulted in a high cost per unit energy produced. This and other increases in project development costs contributed to the lowering of the IRR and the delay in securing any further investment for the Project.

***Limited financing options* -** Lao PDR relies heavily on foreign aid for financing infrastructure and power projects. In the past EDL-owned projects have been financed by multilateral and bilateral agencies on concessional terms. In the early days of the sector, demand for electricity was low and capital needs were manageable. With a rapid growth in demand, the availability of concessional funds and grants could not keep up the with the increasing capital requirements of the sector. Furthermore, policy shifts of development agencies towards social and governance objectives have lead to a decline in support for power generation investments. This has also limited the financing options available to the project proponent.

Lao PDR wants to reduce its dependence on foreign aid, especially in the energy sector, yet faces barriers in attracting financing. Power generation projects involve high capital costs and returns over long time. Local banks operate on a shorter timeframe and do not grant sufficient long term credits, especially for power generation projects. Long-term financing from international sources is required, yet the country risk limits the ability to attract long-term financing.

2. Technology and Skill Barriers

Lao PDR is a least developed country (LDC) and access to technology and required skills in the construction and operation of a hydropower plant is a potential barrier within the country.

Outcome of Step 3a: Nam Khan 2 Hydropower Project faces several barriers to its development. The risks outlined above have imposed barriers impacting the financial viability of the Project that without registration as a CDM project activity would seriously threaten its long-term viability. This would discourage the implementation of similar projects planned by the project proponent, promoting the supply of electricity from non renewable energy projects in the region.

Sub-step 3 b: Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed project activity):

The barriers identified in sub-step 3a do not prevent the implementation of alternative projects. The most realist and credible alternative is to import power from the EGAT Grid in Thailand.

Lower risks - There is less risk involved with importing power from the EGAT Grid as this will not be subject to the perceived risks involved with investing in the renewable energy sector and in hydropower in particular.

Lower capital costs - Importing power from the EGAT Grid will involve lower capital costs than the development of Nam Khan 2 Hydropower Project.

Technology and skills barriers – Power from the EGAT Grid is supported by a more strongly supported technology and skills base in Thailand.

Step 4 - Common Practice Analysis

Sub-step 4a: Calculate applicable output range as +/-50% of the design output or capacity of the proposed project activity;

The installed capacity of the proposed project is 130MW, thus the applicable output range is from 65.00MW to 195.00MW.

Sub-step 4b: In the applicable geographical area, identify all plants that deliver the same output or capacity, within the applicable output range calculated in Step 1, as the proposed project activity and have started commercial operation before the start date of the project. Note their number N all. Registered CDM project activities and projects activities undergoing validation shall not be included in this step;

According to the definition of “applicable geographical area” given in Paragraph 5 of “Tool for the demonstration and assessment of additionality” (Version 07.0.0), the applicable geographical area covers the entire host country as a default. The proposed project is located in Lao PDR, thus, the applicable geographical area is the entire Lao PDR.

The starting date of the proposed project is 26/03/2012.

According to “Electricity Statistics in Lao PDR 2011”, there are two hydropower projects with the installed capacity in applicable output range from 65MW to 195MW started commercial operation before 26/03/2012:

Item	Project Name	Installed Capacity	CDM Application
1	Nam Lik 1/2	100MW	Yes
2	Nam Ngum 1	155MW	No
3	Houay Ho	152MW	No
5	Xeset 2	76MW	Yes

Nam Lik 1/2 Hydropower Project has been developed as CDM project, so it was excluded. So also was Xeset 2

Thus, the number N all is 2.

Sub-step 4c: Within plants identified in Step 2, identify those that apply technologies different that the technology applied in the proposed project activity. Note their number N diff.

All of the above plants are hydropower plants.

Thus, the number N diff is 2.

Sub-step 4d: Calculate factor F=1-N diff /N all representing the share of plants using technology similar to the technology used in the proposed project activity in all plants that deliver the same output or capacity as the proposed project activity.

As analyzed in Step 2 and Step 3, the number N all and N diff are all 2.

Therefore, the factor F is calculated to be 0 (F =1-2/2=0), which is not greater than 0.2; and N all –N diff is also calculated to be 0, which is not greater than 3.

Therefore, the proposed project is not common practice in hydropower sector in Lao PDR

B.6. Emission reductions
B.6.1. Explanation of methodological choices

Emission reductions from the proposed Project can be calculated based on the version 14.0.0 of ACM0002 (Consolidated methodology for grid-connected electricity generation from renewable sources) and version 04.0.0 of the tool to calculate the emission factor for an electricity system. The “tool to calculate the emission factor for an electricity system” defines project and connected electricity systems as the following:

A **project electricity system** is defined by the special extent of the power plants (includes the project site and all power plants connected physically to the electricity system) that can be dispatched without significant transmission constraints.

A **connected electricity system**, e.g. national or international, is defined as an electricity system that is connected by transmission lines to the Project electricity system. Power plants within the connected electricity system can be dispatched without significant transmission constraints but transmission to the project electricity system has significant transmission constraint.

In terms of applicability, the Project produces renewable energy from hydropower electricity. The Project activity will result in the plant having a grid connection and the renewable electricity supplied from the Project activity to the grid is expected to replace existing and planned projects (the majority of which are fossil fuel based) generating from the regional grid that covers the Central Supply area and the EGAT Grid System. The Project entity will only claim emission reductions for the energy generated from Nam Khan 2 hydropower plant (in line with the ACM0002 methodology requirements).

I. Project emissions *(PE_y)*

According to the AMS.ID, the project emission for the Hydropower project includes the two proponents of emission from backup power and a new reservoir. The following formula is applied:

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

Equation 1

$PE_{FF,y}$backup power emissions

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

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

Project Emissions

For hydro power project activities that result in new reservoirs, the project emissions is estimated as follows:

(a) If the power density (*PD*) of power plant is greater than 4 W/m2 and less than or equal to 10 W/m2:

$$PEy = \frac{EFRes \cdot TEGy}{1000}$$

Equation 2

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 EB23 is 90 $KgCO_2e$ /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).

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

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

Equation 3

Where:

PD = Power density of the project activity, in W/m2.
Cap_{PJ} = Installed capacity of the hydro power plant after the implementation of the project activity (W).
Cap_{BL} = Installed capacity of the hydro power plant before the implementation of the project activity (W). For new hydro power plants, this value is zero.

A_{PJ} = Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m2).

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 (m2). For new reservoirs, this value is zero.

Power density of Nam Khan 2 Hydropower Plant

Plant	Installed Capacity (MW)	Reservoir Surface Area (m^2)	Power Density (W/m^2)
Nam Khan 2 Hydropower Plant	130.00	30,570,000	4.2528

II. Baseline emissions *(BE_y)*

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

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

Equation 4

Where:

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

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

$EF_{grid,CM,y}$: Combined margin CO_2 emission factor of the national electricity grid in year y (tCO_2/MWh)

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

Version 04.0.0 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" (OM) and "build margin" (BM) as well as the "combined margin" (CM), including 7 steps as follows:

STEP 1. Identify the relevant electricity systems.
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 emission factor.
STEP 6. Calculate the combined margin emissions factor.

Step 1 – Identify the Relevant Electricity System

This hydropower project will be connected to the provincial electricity grid of Lao PDR, which is operated by EdL. This Grid is connected to the National Power Grid of Thailand which is owned and operated by EGAT. This electricity grid is the unique transmission and distribution line, to which all power plants in Thailand are physically connected. Hence the interconnected grid of Lao PDR and Thailand is the project electricity system.

According to the Tool to calculate the emission factor for an electricity system, the relevant grid definition should be based on the following considerations:

1. Use the delineation of grid boundaries as provided by the DNA of the host country if available; or
2. Use, where DNA guidance is not available, the following definition of boundary:

In large countries with layered dispatch system (e.g. state/provincial/regional/national) the regional grid definition should be used.

According to above requirements, the regional grid (Lao PDR Grid and Thailand Grid is selected as the project boundary.

Where the application of these criteria does not result in a clear grid boundary, use a regional grid definition in the case of large countries with layered dispatch systems (e.g. provincial / regional / national). A provincial grid definition may indeed in many cases be too narrow given significant electricity trade among provinces that might be affected, directly or indirectly, by a CDM project activity. In other countries, the national (or other largest) grid definition should be used 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 data vintage which is used to calculation the Simple OM emission factor is the Ex-ante option of a 3-year generation-weighted average (2008, 2009 and 2010) 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.

The simple OM (Option A) is used where low-cost / must run resources constitute less than 50% of the total grid generation in: 1) average of the five most recent years or 2) based on long-term norms for hydroelectricity production. Over 60% of the total grid generation (including total grid generation of EGAT and Lao PDR Grid) is produced from natural gas which is not a low-cost must run power resource.

Step 4 – Calculate the operating margin emission factor according to the selected method

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

- Option A: Based on data on the net electricity generation and a CO2 emission factor of each power unit,
- 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:

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

Equation 5

Where:

$EF_{grid,OM,y}$ the Simple operating margin CO_2 emission factor in year *y* (tCO_2/GWh)
$EG_{m,y}$ the net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (GWh)
$EF_{EL,m,y}$ the CO_2 emission factor of power unit *m* in year *y* (tCO_2/GWh)
m All power plants/units serving the grid in year *y* except low-cost/must-run power plants/units
y Either the three most recent years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option)

Operating Margin emission factor of the most recent 3 years (2008, 2009 and 2010)

Year	2008	2009	2010	$EF_{grid,OM}$ (tCO2 / MWh)
Total emissions of the Grid (tCO2e)	84,083,369	82,178,673	88,452,088	**0.5994**
Total electricity delivered to the grid by fossil power sources (MWh)	136,116,114	136,193,800	152,603,730	

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

$$EF_{grid,OM,y} = 0.5994 \text{ tCO2 / MWh}$$

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

The sample group of power units *m* used to calculate the build margin consists of either:

a) The set of five power units that have been built most recently, or
b) The set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

The group of power units that supply electricity to the grid most recently (sorted by the Commercial Operation Date (COD) which is the date when the power unit starts to supply electricity to the grid) and their annual quantity of electricity generation comprise larger than or equal to 20% of total annual electricity generation (in year 2010) are shown in Figure 11. Fuel consumption of these power units are shown in Table 4

Table 6 - Fuel Consumption

Power Unit	Grid Generation (GWh)	COD
North Bangkok Power Plant (Unit 01)	1,584.22	19/11/2010
Bangpakong Power Plant (Unit 05)	4,643.22	16/9/2009
Phu Kieaw Bio Power Project 2	79.46	15/9/2009
Dan Chang Bio Power Project 2	76.75	15/9/2009
South Bangkok Power Plant (Unit 03)	4,431.92	1/3/2009
Chana Power Plant (Unit 01)	5,090.02	15/7/2008
Ratchaburi Power Company Limited (RPCL) (Unit 1 & 2)	7,124.72	1/7/2008
Gulf Power Generation Co., Ltd. (Unit 1 & 2)	9,903.93	1/3/2008
Summary	32,934.25	
Percentage as of 2010 Grid Generation (160,190.96 GWh)	20.56	

Fuel Type	Fuel Consumption		CO² Emission (kgCO²/Unit)	CO² Emission (tCO²)
	Unit	Volume		
Total				
Natural Gas	scf.	251,512,881,819	0.0554	13,930,292
Lignite	ton	-	951.7230	-
Bituminous	ton	-	2,360.1150	-
Bunler	litre	-	3.0026	-
Diesel	litre	1,179,772	2.6441	3,119

Table 7 - Emissions Factors

Step 6. Calculate the build margin emission factor

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

$$EF_{grid,BM,y} = \frac{\sum_{m} EG_{m,y} * EF_{EL,m,y}}{\sum_{m} EG_{m,y}}$$

Equation 6

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

$$EF_{grid,BM,y} = 0.4231\ tCO_2/MWh$$

Step 7. Calculate the combine margin emissions factor

The CM emissions factor is calculated as follows:

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

Equation 7

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:

$$EF_{grid,CM,y} = 0.5994 * 0.5 + 0.4231 * 0.5 = 0.5113$$

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

III. Leakage *(LE_y)*

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

IV. Reduction emissions *(ER_y)*

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y$$

Equation 8

Where:

ER_y Emission reductions in year *y* (tCO_2e/y).
BE_y Baseline emissions in year *y* (tCO_2e/y)
PE_y Project emissions in year *y* (tCO_2/y).
LE_y Leakage emissions in year *y* (tCO_2/y).

B.6.2. Data and parameters fixed ex ante

Data / Parameter:	**$EF_{grid,OMsimple,y}$**
Data unit:	tCO_2/ MWh

Description:	Operating margin emission factor of the grid
Source of data used:	Study of Emissions Factor for an Electricity System in Thailand 2010, published by the Thailand Greenhouse Gas Office (TGO) and the EdL Annual reports 2008,2009 and 2010
Value applied:	0.5994
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated as per "Tool to calculate the emission factor an electricity system" version 04 with 3-year vintage data and option of *ex-ante* calculation based on Simple Operating Margin Method
Any comment:	NA

Data / Parameter:	**$EF_{grid,BM,y}$**
Data unit:	tCO_2/ MWh
Description:	Build Margin emission factor of the grid
Source of data used:	Study of Emissions Factor for an Electricity System in Thailand 2010, published by the Thailand Greenhouse Gas Office (TGO) and the EdL Annual reports 2008,2009 and 2010
Value applied:	0.4231
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated as per "Tool to calculate the emission factor an electricity system" version 04 with *ex-ante* calculation based on sample group m comprising of 20% of the system generation (in MWh)
Any comment:	NA

Data / Parameter:	**$FC_{i,y}$**
Data unit:	Million Tonnes, MMSCF, Million Litres
Description:	Amount of each fossil fuel consumption by type of fuel
Source of data used:	Study of Emissions Factor for an Electricity System in Thailand 2010, published by the Thailand Greenhouse Gas Office (TGO) and the EdL Annual reports 2008, 2009 and 2010
Value applied:	See table 3 in Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	For fossil fired generation units, EGAT and DEDE provide fuel consumption data. Likewise, the choice of data satisfies with the methodology in "Tool to calculate the emission factor an electricity system" version 04.
Any comment:	NA

Data / Parameter:	**$NCV_{i,y}$**
Data unit:	TJ/Unit
Description:	Net calorific value of the fuel combusted in grid based power plants used in the determination of the emission factor.
Source of data used:	Study of Emissions Factor for an Electricity System in Thailand 2010, published by the Thailand Greenhouse Gas Office (TGO) and the EdL Annual reports 2008, 2009 and 2010)
Value applied:	Varies for each fuel types

Justification of the choice of data or description of measurement methods and procedures actually applied :	Use for unit conversion.
Any comment:	Study of Emissions Factor for an Electricity System in Thailand 2010, published by the Thailand Greenhouse Gas Office (TGO)

Data / Parameter:	$\mathbf{EF_{CO2,i,y}}$
Data unit:	tCO_2/TJ
Description:	Emission Factor of Carbon dioxide gas emitted from fossil fuel combustion in grid based power plants used in the determination of the emission factor.
Source of data used:	default values from IPCC 2006
Value applied:	Varies for each fuel types
Justification of the choice of data or description of measurement methods and procedures actually applied :	NA
Any comment:	NA

Data / Parameter:	$\mathbf{EF_{grid,CM,y}}$
Data unit:	tCO_2/ MWh
Description:	Combined margin emission factor of the grid
Source of data used:	Calculated as weighted average of Simple OM and BM
Value applied:	0.5113
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated ex-ante as per "Tool to calculate the emission factor an electricity system" version 04 based on 50% of OM and 50% of BM values approach
Any comment:	NA

B.6.3. Ex ante calculation of emission reductions

Baseline emissions

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

$$EG_y = EG_{BL,y} \cdot EF_{grid,CM,y}$$

Equation 9

Where:

EG_y= Electricity supplied by the Nam Khan 2 Hydropower Plant to the grid

$EG_{BL,y}$ = 567,800,000 KWh = 567,800 MWh

$EF_{grid,CM,y}$ = 0.5113 tCO2/MWh

Therefore,

BE_y = 567,800 x 0.5113 = 290,316 tCO2/y

Project emissions

The project emission includes the two proponents of emission from backup power and a new reservoir.

The following formula is applied:

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

Equation 10

$PE_{FF,y}$ is backup power emissions

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

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

The proposed project activity involves the construction of a new hydropower plant with capacity (Cap_{PJ}) of 130.00 MW which will create a reservoir of 30.568km².

Therefore Project Emissions from the Reservoir must be included in the calculation of emissions reductions. The calculation is as follows :

$$PEy = \frac{EFRes \cdot TEGy}{1000}$$

EFRes = 90.00 kg CO2 / MW
TEGy = Totel Electricity Generated

$$PEy = \frac{90kgCO2 * 567,800MWh}{1000}$$ 51,102 t CO2 / yr

Emission from diesel backup generators ($PE_{FF,y}$)

In ex ante emission calculation, the diesel consumption is assumed as zero. Because in a very special case when the generation from the plant is temporarily terminated, diesel back-up generators with installed capacity of 250KVA will be used to generate electricity for internal use in the plant. However, this case rarely happens and is not at any frequency. Even in case it happens, it’s expected that it will last during a couple of days only. Furthermore, fuel consumed for the power backup is expected very small. It is not possible to estimate this emission *ex ante*. Therefore, the emission from this source is considered very negligible or $PE_{FF,y}$= 0 *ex ante*. The accurate emission is monitored and calculated PE_{FF} in year *y.*

Therefore the GHG emission from the project activity is considered as zero.

$$PE_y = PE_{FF,y} + PE_{HP,y} = 0$$

Leakage

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

Emission Reductions

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - L_y = 239{,}214 \text{ tCO2/y}$$

Summary of ex-ante estimates of emission reductions

Year	Baseline emissions (tCO_2 e)	Project emissions (tCO_2 e)	Leakage (tCO_2 e)	Emission reductions (tCO_2 e)
2015	290,316	51,102	0	239,214
2016	290,316	51,102	0	239,214
2017	290,316	51,102	0	239,214
2018	290,316	51,102	0	239,214
2019	290,316	51,102	0	239,214
2020	290,316	51,102	0	239,214
2021	290,316	51,102	0	239,214
Total	2,032,213	357,714	0	1,674,499
Total number of crediting years	7			
Annual average over the crediting period	239,214			

Table 8 - Summary of Ex Ante Emissions Reductions

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

All data to be monitored for verification and issuance will be kept for two years after the end of the crediting period or the last issuance of CERs for the project activity, whichever occurs later.

Data / Parameter:	**$EG_{y, export}$**
Data unit:	MWh
Description:	Electricity supplied by the proposed hydropower plant to the grid
Source of data to be used:	Direct measurement at the connection point
Value of data	567,800
Description of measurement methods and procedures to be	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 hourly measured and

applied:	monthly recorded. The recorded data will be confirmed by means of a joint balance sheet which will be signed by the representatives of EdL 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	Continuous monitoring, hourly measurement and at least 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 in accordance with the PPA
Any comment:	

Data / Parameter:	**$EG_{y, import}$**
Data unit:	MWh
Description:	Electricity supplied by the grid to the proposed hydropower plant
Source of data to be used:	Direct measurement at the connection point
Value of data	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 to the grid by the proposed project by the positive direction. The readings of electricity meter will be hourly measured and monthly recorded. The recorded data will be confirmed by means of a joint balance sheet which will be signed by the representatives of EdL 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	Continuous monitoring, hourly measurement and at least 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 in accordance with the PPA
Any comment:	

Data / Parameter:	**$EG_{BL,y}$**
Data unit:	MWh
Description:	Net electricity supplied to the grid by the proposed hydropower plant
Source of data to be used:	Calculated as the difference between **$EG_{y, export}$** and **$EG_{y, import}$**
Value of data	567,800
Description of measurement methods and procedures to be applied:	Calculating by subtracting $EG_{y, import}$ from $EG_{y, export}$.
Monitoring Frequency	Continuous monitoring, hourly measurement and at least monthly recording
QA/QC procedures to be applied:	The uncertainty level of this data is low
Any comment:	

Data / Parameter:	***Cap_{PJ}***
Data unit:	W
Description:	Installed capacity of the hydropower plant after the implementation of the project activity
Source of data to be used:	Project Site

Value of data	130,000,000
Description of measurement methods and procedures to be applied:	Manufacturer's Nameplate
Monitoring Frequency	Yearly
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	**$FC_{i,j\ y}$**
Data unit:	Mass or volume unit per year (e.g. ton/yr or m3/yr)
Description:	The quantity of fuel type I combusted in process j during the year y in the event of black out of the plant
Source of data to be used:	Onsite Measurements
Value of data	Use either mass or volume meters. In cases where fuel is supplied from small daily tanks, rulers can be used to determine mass or volume of the fuel consumed, with the following conditions: The ruler gauge must be part of the daily tank and calibrated at least once a year and have a book of control for recording the measurements (on a daily basis or per shift)
Description of measurement methods and procedures to be applied:	Continuously if backup system is in use
Monitoring Frequency	Yearly
QA/QC procedures to be applied:	The consistency of metered fuel consumption quantities should be crosschecked by an annual energy balance that is based on purchased quantities and stock changes. Where the purchased fuel invoices can be identified specifically for the CDM project, the metered fuel consumption quantities should also be cross-checked with available purchase invoices from the financial records
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:	-
Any comment:	-

B.7.2. Sampling plan

The data monitored will not be a sample but the actual data, therefore a sampling plan is not needed.

B.7.3. Other elements of monitoring plan

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

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

The electricity generated from the project activity will be sold to EdL for the complete project lifetime.

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

Data from the operating meters will be recorded hourly. Additionally, monthly manual readings will be taken from the operating meters.

Monthly, EdL 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.

When the electricity generation from the plant is cut off, a backup generator with installed capacity of 250KVA to generate electricity will be used internally within the plant. In such case, the CDM team will keep all relevant records for verification purposes.

CDM Training will take the form of CDM Workshop to be held in Lao PDR in both English and Lao language. This training will be very specific to the Nam Khan 2 Project and will follow on from the Workshop held at EdL in Vientiane in November 2011. This will take place initially during the construction period, and then as soon as practicable following Commissioning.

For further details see Annex 4.

CDM Training

The project owner will employ professional engineers and experts to train all staff before the operation of generators.

With regard to CDM training, specific CDM training will be provided by the CDM consultant as referred to above, and will take the form of workshops held for the relevant staff, and a CDM Monitoring manual.

Data Collection

The process of data collection will start on the date the Project commences its operations. The data measurement procedures, Quality Assurance and Quality Control procedures, person(s) responsible and frequency of monitoring are detailed in Table 1 and 2 in Annex 4. 100% of the data are monitored at the site by means of accurately calibrated instruments and authentic procedures dedicated for the intended purposes.

The main electricity meter which measures the electricity delivered to the grid will be installed at Vangvieng substation. When taking electricity meter readings a detailed account of the meter, specific uncertainty levels and associated accuracy level of measurement instruments will be recorded. Data from the generation meter will be collected continuously. This information will be printed out. In addition to the automatic system an Operator based at the substation will manually record information in a log.

Monthly, all the electricity generation data will be incorporated into an electronic master sheet which would act as the electricity generation data archive. Data collection on the back-up meter (at Vangvieng

Substation) will follow the same procedures as data collection on the revenue / generation meter outlined above.

The installed capacity of the Project and the area of the reservoir after the implementation of the Project activity will be monitored annually to monitor the power density of the Project.

Data records management procedure.

All information such as data records, maps and drawings, Environmental and Social Impact Assessment (ESIA) and Feasibility Study reports will be kept as records and made available to the verification party.

A documentation system (document register) will be developed to manage all the CDM documents and access all the records easily. All project related documents will be kept for the entire crediting period and two years thereafter. The CDM Manager has the overall responsibility for document maintenance and review. On a monthly basis, the CDM Manager will review all Project data, document registers and manage the data collection, storage and archiving of all relevant data records. The CDM Manager is responsible for preparing the annual CDM Monitoring Report.

Data Archiving

At the end of each month, all manually entered monitoring data will be filed electronically (e.g. spreadsheets) with paper or CD files as backup. The Project owner will keep all sales / billing invoices and records and these will be archived both electronically and manually for the entire crediting period and two years thereafter.

Maintenance Procedures

All equipment will be inspected regularly for functionality, integrity and corrosion. Equipment will be maintained in accordance with manufacturer’s instructions. Any defective components or materials shall be reported and replacements obtained and fitted within one day if there is a possibility of total failure, or otherwise within one week. The CDM Manager will retain all maintenance documents and a Maintenance Register will be implemented.

Training Procedures

The CDM Manager will manage the process of training new staff, and will ensure that trained staff performs their monitoring duties. Capacity building activities and training will be provided by EDL at the beginning of the Project construction and at the start of the operation to all Project related employees.

The training program will be delivered by external CDM specialists, and technical training by equipment suppliers. A Training Register will be implemented to keep track of all employee training and competence.

Quality Assurance / Quality Control (QA / QC) Procedures

Procedures for calibration of measurement equipments

All measurement equipment (fixed and portable) will be calibrated in accordance with relevant standards (national, international or industry standards). The electricity generation meters will be calibrated according to the IEC60521 or IEC61036 standards. A calibration record will be kept for every instrument irrespective of its frequency of usage and whether or not the equipment is an operational or spare unit. A Calibration Register will be maintained to keep track of all calibration records for the Project. The CDM Manager is responsible for organising the calibration and keeping all the calibration records.

Internal audit procedure

Internal audits will be undertaken to ensure all procedures are being adhered to and to confirm compliance with CDM rules and quality management. The internal audit will be carried out annually and no more than two months before each verification event. The CDM Manager is responsible for ensuring that the internal audits take place.

Error Handling, Corrective and Preventative Actions Procedure

Failure of monitoring equipment

In an event of main electricity meter failure, a backup meter shall be used in its place. If the backup meter fails, it will be replaced by an accredited equipment-testing organisation.

Error handling, corrective and preventative procedure

The CDM Manager will be notified of any errors found during internal audits. Specialists will be appointed to review the implications of the error and the proposed correction procedures. In case of emergency, the Project entity will not claim emission reductions due to the Project activity for the duration of the emergency. A procedure will be developed to outline the responsibility and authority for handling and investigating non-conformance, taking action to mitigate any impacts caused and for initiating and completing corrective and preventive action. All non-conformances and special events reports will be recorded in a register. This register will be maintained by the CDM Manager and reviewed at the end of each crediting year.

For further details see Annex 4

SECTION C. Duration and crediting period
C.1. Duration of project activity
C.1.1. Start date of project activity

26th March 2012[14]

C.1.2. Expected operational lifetime of project activity
25 years

C.2. Crediting period of project activity
C.2.1. Type of crediting period

7 years x 3

C.2.2. Start date of crediting period

1st January 2015

C.2.3. Length of crediting period

7 years

SECTION D. Environmental impacts
D.1. Analysis of environmental impacts

In accordance with the law in Lao PDR the following reports were completed in November 2010

- Environmental Impact Assessment
- Environmental Management and Monitoring Plan
- Watershed Management Plan
- Social Impact Assessment
- Social Management and Monitoring Plan
- Environmental Management Development Plan
- Resettlement Action Plan

All of these reports had to be approved by the Government before construction could commence.

The environmental impacts and relevant management and mitigation measures are summarised below:

Air Quality

Construction Period. The main impact to air quality during construction will be from increased dust levels from construction machinery, tunnel construction, rock blasting, foundation excavation, cement mixing, and road construction. The construction activity will generate airborne dust as well as NOX, SOX and particulate matter. The air quality impacts will, however, be limited and localized to the different project sites. Road dust from transport and wind generated dust from project areas may lead to impacts on crops, animals, villages and houses located nearby. Due to the fact that few people live close to the construction sites, the impact is considered as limited. To mitigate dust problems the main access road, from Highway 13 North to the dam and further and power station

[14] EdL Letter dated 30th March 2012

will be gravel paved. Other sections of the service roads in the vicinity of permanent houses should also be considered gravel paved. Water will be sprayed on the service roads and construction sites, during hot and dry periods at least twice a day. All trucks with construction material should be covered. The traffic on access and service roads should be regulated, in order to minimize the air pollution.

Operational Period. During operation the air pollution is expected to be very limited, and the main source will be vehicle emissions and dust from traffic on unpaved roads. In addition there might be some dust from construction sites before they are properly re-vegetated. Traffic on new roads to the resettlement areas will give a general increase in air pollution along these roads, mainly located in areas without proper roads today.

Noise

Construction Period. During construction, noise will be generated from vehicular movements, sand and aggregate processing, concrete mixing, excavation machinery, construction noise and blasting. Noise levels in the construction area from machinery and vehicles are estimated to be from 80 to 95 DBA at a distance of 15 m, which is higher than the Lao Standards 70 DBA (December, 2009) . Due to very few people living near the construction sites, impacts from the estimated noise levels is assessed to be at a low level. Noise disturbance will be experienced by the people living along the main road into the Project area, due to increase in traffic from transport of goods and workers. The main potential impact of high noise levels will be on construction workers. Mitigation measures for noise impacts on construction workers will include standard occupational health and safety practices such as ear protection and enforcement of exposure duration restrictions. Blasting activity should be limited or restricted during nighttime, if noise levels are unacceptable for people living in the vicinity and to reduce impacts on wildlife.

Operational Period. During operation, noise will mainly be generated in the power station. Noise reduction measures will be taken, where required to reduce the noise levels. Mitigation measures for noise impacts on workers will include standard occupational health and safety practices such as ear protection.

Soil

Soil will be impacted due to (i) loss of topsoil, (ii) failure to refill and re-vegetate borrow areas and temporarily used land, (iii) erosion, (iv) soil contamination by products used for the Project, and (v) failure to re-utilize displaced earth during the construction period. As much of the land cover of the Project has grass and shrub vegetation and is on slopes it is prone to erosion and soil-slides. All top soil will be scraped off while preparing project areas (including during scaling and planning of surfaces) and stored for re-use in rehabilitating temporary acquired land and spoil areas. Sand will be acquired from the riverbank where there is no top soil. The soil and rock pits (quarry) will be filled and appropriately planted with trees, shrubs and grasses. Disposal areas will be well marked and monitored so that appropriate procedures for disposal of different agents and waste materials are followed to minimize soil contamination. In all cases erosion can be minimized by regular rehabilitation of areas not in use for Project activities during construction. Rehabilitation will include

(i) re-grading and immediate re-vegetation (using fastgrowing species and different functional groups of plants for keeping soil in place) of slopes to minimize erosion, (ii) use of top soil removed and stockpiled from Project areas, (iii) installation of sediment runoff control devices, (iv) erosion and re-vegetation success monitoring. Soil erosion and siltation will be minimized by preventive measures and appropriately engineered storm water diversion, on a case-by-case basis. All Project areas will be 'greened' by planting of trees and were appropriate shrubs and grasses to reduce erosion during the construction period. Road constructions will potentially lead to erosion which will be minimized by suitable road engineering techniques and road edge buffer re-planting. All excavated rock and aggregate will be used in construction where possible, while the spoil will be deposited in an area with minimum landslide potential, multilayered and covered with soil, and planted with trees, shrubs and grasses.

During operation, potential impact to soil could occur from spillage of hazardous wastes and materials, including hydrocarbons, and from localized scour at the water outlet. Soil contamination will be prevented by installing oil separators at wash down and refueling areas, and by installing secondary containment at fuel storage sites. All hazardous wastes and hazardous materials will be stored in properly designed storage facilities.

Aquatic Ecology

Impact on aquatic habitats

The inundation will accomplish a loss of river habitat of 60 km, which will be replaced by a lake with large water level fluctuation (25 m between Full Supply Level (FSL) and Minimum Operation Level (MOL)).

In the first years after the regulation the fish productivity will be relatively good because of food and nutrients from the inundated terrestrial land. Over time fish productivity will be reduced, and the potential for fish harvest will be low.

Impact on biodiversity

Only a few fish species will succeed in adapting to the lake life. In the reservoir the biodiversity of fish will be reduced by. However, most of these species will survive in small populations in the upstream part of the river and in the tributaries.

Flora and Fauna

As pointed out and shown by field surveys for the EIA the vegetation cover of the Project areas has been subject to human influence over a long period of time. Subsistence use is not the main cause of loss of primary forest as is illegal logging by outsiders. The slash and burn practice which is that of the ethnic groups has also had its toll on the forest systems. Overall the value of the forest resources in the Project are poor, and even for local use (timber) it is not of high quality and people resort to logging from higher elevations and better forested areas. Wood for fuel abounds in the area and thus forests and woodlands will be encroached upon for this resource if no alternative fuel resources are available.

D.2. Environmental impact assessment

Due to the overall plant cover status of the Project Area, which is largely open forest and grassland dominated, it is prone to erosion as the soils are not all bound solidly by vegetation.

The Nam Khan 2 basin has been selected for development because it has some of the poorest inhabitants and is an area with one of the smaller population densities in Laos. Hence the potential social benefit to cost ratio of hydro electricity production is one of the highest in the Lao PDR. Despite the low population density, relatively speaking and in contrast to most other Provinces, slash and burn agriculture produces almost as much output as lowland cultivation. Accordingly it makes sense to undertake hydroelectricity projects in the Nam Khan 2 Basin.

SECTION E. Local stakeholder consultation
E.1. Solicitation of comments from local stakeholders

STAKEHOLDERS

Through extensive scoping of issues and a review of preliminary study findings, which have been subjected to public and professional review, it was agreed that project stakeholders comprise five main groups, including:

- People residing in the study area who may be affected directly and indirectly by the project
- Government officials at the district, government and national level
- The broader interested community
- NGOs operating in the Lao PDR
- International NGOs, international organizations and other interest groups, including the local, regional and national media.

The various interests of individuals, communities, government and non-government agencies, and organizations can be further defined as follows:

Local Interests: All households and villages on the NK2HP Project area.
Regional Interests: Community leaders, District agencies, Provincial agencies, Businesses and Contractors.
National Interests: GOL ministries, the people of the Lao PDR, National NGOs, National media.
International Interests: Project Investors and Financial Institutions, International NGOs.
1.2 PUBLIC The various interests of individuals, communities, government and non-government agencies, and organizations can be further defined as follows:
Local Interests: All households and villages on the NK2HP Project area.
Regional Interests: Community leaders, District agencies, Provincial agencies, Businesses and Contractors.
National Interests: GOL ministries, the people of the Lao PDR, National NGOs, National media.
International Interests: Project Investors and Financial Institutions, International NGOs.

PUBLIC CONSULTATION PROCESS

Dialogue has been established with stakeholders who are directly or indirectly involved and potentially affected by the NK2HP Project and who have expressed a wish to participate in the public consultation and participation process. Consultation at the local, regional and national levels will continue to progress through steps associated with the public consultation process:

Information collection and dissemination: This initial phase of consultation was aimed at collecting and disseminating information. Data have been collected on the human and physical characteristics of the current environment in order to predict project impacts. This information is important to adequately evaluate and plan for project implementation. As part of this phase, information was disseminated to stakeholders that detailed the project features and the implications in terms of potential changes to the social and physical environment.

Stakeholder concerns: Comments were and will continue to be sought from stakeholders in response to information gathered as part of the phase one studies. This information was disseminated with an ongoing discussion encouraged regarding the alternatives and proposed mitigation measures. Issues for stakeholders that may have been previously overlooked or are outstanding are given a forum for review through public consultation activities. This assessment of stakeholder needs provides a base from which decisions can be made.

Active involvement in project design and implementation: based on the discussion and subsequent commitments to the community as a result of phase two for this project, a set of mitigation measures develop that addresses direct project impacts. In addition, there are concessionary measures provided in terms of education, training, financial and institutional strengthening to communities that are directly and indirectly affected by project activities. The process of stakeholder involvement and identification will continue during project implementation.

METHODOLOGY

Transparency and openness through the dissemination of the information was a priority for the project in both the development of public consultation plans and in the implementation process. With the stakeholders being broadly identified, it has subsequently been the objective of the study team to understand the views of these groups. There has been a need to plan and develop appropriate interaction and information sharing techniques for these different stakeholders.

The key priorities for the design of consultation methodologies include:

- Ensuring stakeholders were able to fully understand the project information and the potential project impacts and mitigation plans.
- Ensuring stakeholders understood the composition of the project and the project's objectives.

Techniques developed for public consultation were designed to suit the needs of each target audience. These techniques also required careful consideration in order to meet the requirements of the diverse and numerous participants involved in this study. The techniques adopted included the following methods: ·

- Use of visual presentations including pictures, diagrams and posters, especially at the local and regional level.
- Practical, visual and face-to-face communication in places where levels of literacy were recognized as being low. This included use of seminars, workshops, general village meetings, semi-structured interviews, small group meetings, models, participatory rural appraisal techniques, and site visits.
- The translation into the Lao language of project documents and summaries. These were used in particular for local leaders, regional officials and national stakeholders.
- Direct discussion with the stakeholders through electronic or written media, group and individual briefings, distribution of detailed project information, and field trips to the project area for national and international stakeholders.

Public consultation activities conducted have been recorded and documented with summaries provided in the Laos and English languages. ·

Meetings with Provincial, District and Village Leaders were held between 2nd July and 21st July 2010.

Meeting With PWREO – 21 July 2010 (Mr. Chanthavong , Director)

Meeting PEMO -21 July 2010 (Mr. Houmphan Pormekmanolom, Deputy Director)

Figure 7 Meetings with Provincial Leaders

Meeting with Villagers

Ban Samang, Phoukhoun District, 10 July 2010

Ban Bouampor, Xieng Nguen District District 16 July 2010

Figure 8 - Meetings with Villagers

Ban Sopjune, Xieng Nguen District 8 July 2010

Ban DaneKhoa, Xieng Nguen District 7 July 2010

Figure 9 - Meetings with Villagers

E.2. Summary of comments received

The reaction to the Project was positive at all levels and the table below shows a summary of the reactions from individual villages.

Province	District	Focal Development Villages	Villages	Participants	Proposed Ideas	Attitude to Project
Luang Prabang	Phoukhoun	Tha Borkeo	Nakeun	5 (Meeting with Village Leaders)	Proposed to construct Road, School, Electricity, Health Center and Irrigation canal	Fully Support
			Viengsamai	5 (Meeting with Village Leaders)	Proposed to construct Road, School, Electricity, Health Center and Permanent Occupation support	Fully Support
			Buampho	60	Proposed to construct Road, School, Electricity, Health Center and Permanent Occupation support	Fully Support
			Samang	45	Proposed to construct Road, School, Electricity, Health Center and Permanent Occupation support	Fully Support
	Xieng Nguen	Sopchune	Sopchun	82	Proposed to construct Road, School, Electricity, Health Center and Permanent Occupation support	Fully Support
			Dankhoa	55	Proposed to construct Road, School, Electricity, Health Center and Permanent Occupation support	Fully Support
			Borseun	60	Proposed to construct Road, School, Electricity, Health Center and Permanent Occupation support	Fully Support
			Samui	60	Proposed to construct Road, School, Electricity, Health Center and Permanent Occupation support	Fully Support
			Nongdy	56	Proposed to construct Road, School, Electricity, Health Center and Permanent Occupation support	Fully Support
			Keng Koung	5 (Meeting with Village Leaders)	Proposed to construct Road, School, Electricity, clean water supply	Fully Support

Table 9 - Stakeholder Feedback

E.3. Report on consideration of comments received

All of the above comments and requests we considered and included in the Project Planning.

Items were included in the Project Budget for each of the requests from the affected stakeholders.

SECTION F. Approval and authorization

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Appendix 1: Contact information of project participants

Organization	Electricité du Laos, Lao PDR
Street/P.O. Box	PO Box 309, Mittaphab Lao-Thai Road
City	Vientiane
State/Region	-
Postcode	-
Country	Lao PDR
Telephone	+856 (21) 451519
Fax	+856 (21) 453408
E-mail	vilaphorn05@gmail.com
Website	http://www.edl-laos.com
Contact person	-
Title	Managing Director
Salutation	Mr.
Last name	Thiravong
Middle name	-
First name	Sisavath
Department	-
Mobile	-
Direct fax	-
Direct tel.	-
Personal e-mail	-

Organization	Gazprom Marketing & Trading Limited
Street/P.O. Box	20 Triton Street,
City	London
State/Region	-
Postcode	NW1 3BF,
Country	United Kingdom
Telephone	+44 (0)20 7756 0056
Fax	+44 (0)20 7756 9744
E-mail	julia.elmgren@gazprom-mt.com
Website	http://www.gazprom-mt.com
Contact person	-
Title	Structured Carbon Trader
Salutation	Ms.
Last name	Julia
Middle name	-
First name	Elmgren
Department	-
Mobile	-
Direct fax	-
Direct tel.	-
Personal e-mail	-

Appendix 2: Affirmation regarding public funding

No public funding from Annex 1 countries is involved in the project.

Appendix 3: Applicability of selected methodology

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

The following emission factor calculation refers to the "Study of Emissions Factor for an Electricity System in Thailand 2009" which was published by the Thailand Greenhouse gas Office (TGO) in 2010. Further source data used was the Electricte du Laos Annual Reports from 2008, 2009 and 2010.

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 (2008, 2009 and 2010) 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.

The simple OM (Option A) is used where low-cost / must run resources constitute less than 50% of the total grid generation in: 1) average of the five most recent years or 2) based on long-term norms for hydroelectricity production. Over 60% of the total grid generation (including total grid generation of EGAT and Lao PDR Grid) is produced from natural gas which is not a low-cost must run power resource.

The combined margin emission factor ($EF_{grid,CM,y}$) is calculated as per methodological tool "Tool to calculate the emission factor an electricity system" version 04.0.0, consisting of the combination of operating margin (OM) and build margin (BM) emission factors as shown in the following steps:

Step 1: Calculate the Operating Margin emission factor(s) ($EF_{grid,OM,y}$)

The operating margin is based on the Simple OM emission factor ($EF_{grid,OMsimple,y}$), which is calculated as the generation-weighted average emissions per electricity unit (tCO_2/MWh) of all generating sources serving the system (option C), not including low-operating cost and must-run power plants as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_i FC_{i,y} \ x \ NCV_{i,y} \ x \ EF_{CO2,i,y}}{EG_y}$$

Where:

$EF_{grid,OMsimple,y}$	=	Simple operating margin CO_2 emission factor in year y (tCO_2/MWh)
$FC_{i,y}$	=	Amount of fossil fuel type *i* consumed in the project electricity system in year *y* (mass or volume unit)
$NCV_{i,y}$	=	Net calorific value (energy content) of fossil fuel type *i* in year (GJ/ mass or volume unit)
$EF_{CO2,i,y}$	=	CO_2 emission factor of fossil fuel *i* in year y (tCO_2/ GJ)
EG_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	=	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).

By using the default value from Revised 2006 IPCC Guideline for National Greenhouse Gas Inventories, the CO_2 emission coefficient of each fuel type is demonstrated in Table 3. The default oxidation factor is assumed to be one.

Fuel Type	**Net Calorific Value**		**CO2 emission coefficient**		
	MJ/Unit	**Unit**	**tCO2/TJ**	**kgCO2/Unit**	**Unit**
Natural gas	1.02	scf.	54.3	0.055	scf
Lignite	10,470.00	ton	90.9	951.723	ton
Bituminous	26,370.00	ton	89.5	2360.115	ton
Bunker	39.77	litre	75.5	3.002	litre
Diesel	36.42	litre	72.6	2.644	litre

Table 10 - CO2 Emission Co-efficients

Table 7 shows the CO_2 emission from each fuel type generated from the national grid system during 2008-2010. According to the methodological tool, imported electricity should be included in the calculation with zero tCO_2/MWh. The results in Table 2 show that the 3-year average OM emission factor is 0.5994 tCO_2/MWh

CO_2 emissions and OM emission factor of grid electricity generation, 2008 – 2010

Fuel Type	Fuel Consumption		CO² Emissions (kgCO²/Unit)	CO² Emission (kgCO²)
	Unit	Volume		
2010				
Total				88,452,088
Natural Gas	scf.	1,073,084,673,019	0.0554	59,433,868
Lignite	ton	16,043,174	951.7230	15,268,658
Bituminous	ton	5,502,160	2,360.1150	12,985,730
Bunker	litre	233,229,746	3.0026	700,304
Diesel	litre	24,026,558	2.6441	63,528
2009				
Total				82,178,673
Natural Gas	scf.	968,924,717,809	0.0554	53,664,864
Lignite	ton	15,818,265	951.7230	15,054,607
Bituminous	ton	5,486,248	2,360.1150	12,948,176
Bunker	litre	158,017,445	3.0026	474,469
Diesel	litre	13,825,937	2.6441	36,557
2008				
Total				84,083,369
Natural Gas	scf.	977,016,893,281	0.0554	54,113,058
Lignite	ton	16,407,465	951.7230	15,615,362
Bituminous	ton	5,578,567	2,360.1150	13,166,060
Bunker	litre	350,209,394	3.0026	1,051,551
Diesel	litre	51,941,958	2.6441	137,339

Table 11 - CO2 Emission Factors

OM Emissions Factor 2010

Year	CO² Emissions (tCO²)	Grid Consumption (GWh)	OM Factor (tCO² / MWh)
2010	88,452,088	152,603.73	0.5796
2009	82,178,673	136,193.80	0.6034
2008	84,083,369	136,116.14	0.6177
Summary	254,714,130	424,913.67	0.5994

Table 12 - 2010 OM Emission Factor

Step 2: Calculate the Build Margin emission factor ($EF_{grid,BM,y}$)

The build Margin emission factor is calculated as the generation-weighted average emission factor (tCO_2/MWh) of a sample of power plants *m*, as follows:

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

Where:

$EF_{grid,BM,y}$ = Buid margin CO_2 emission factor in year *y* (tCO_2/ MWh)

$EF_{EL,m,y}$ = CO_2 emission factor of powr unit *m* 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)

m = Power units in the build margin

List of five IPPs, comprise 20.56% of the total electricity generation, is used in the BM emission factor calculation shown in the table 3. The BM emission factor of the national grid system equals to 0.4231 tCO_2/MWh as shown in Table 4.

Quantity of Electricityy Delivered to Grid by Most Recently Built Power Plants.

Power Unit	Grid Generation (GWh)	COD
North Bangkok Power Plant (Unit 01)	1,584.22	19/11/2010
Bangpakong Power Plant (Unit 05)	4,643.22	16/9/2009
Phu Kieaw Bio Power Project 2	79.46	15/9/2009
Dan Chang Bio Power Project 2	76.75	15/9/2009
South Bangkok Power Plant (Unit 03)	4,431.92	1/3/2009
Chana Power Plant (Unit 01)	5,090.02	15/7/2008
Ratchaburi Power Company Limited (RPCL) (Unit 1 & 2)	7,124.72	1/7/2008
Gulf Power Generation Co., Ltd. (Unit 1 & 2)	9,903.93	1/3/2008
Summary	32,934.25	
Percentage as of 2010 Grid Generation (160,190.96 GWh)	20.56	

Table 13 Power Delivered to Grid by Most Recent Plants

BM emission factor 2010

Fuel Type	Fuel Consumption		CO² Emission (kgCO²/Unit)	CO² Emission (tCO²)
	Unit	Volume		
Total				
Natural Gas	scf.	251,512,881,819	0.0554	13,930,292
Lignite	ton	-	951.7230	-
Bituminous	ton	-	2,360.1150	-
Bunler	litre	-	3.0026	-
Diesel	litre	1,179,772	2.6441	3,119

Table 14 - BM Emission Factor 2010

Build Margin 0.4231 t CO2 / MWh

Step 3: Calculate the baseline emission factor

The Combined Margin emission factor is calculated as the weighted average of the Operating Margin emission factor ($EF_{grid,OM,y}$) and the Build Margin emission factor ($EF_{grid,BM,y}$) as follows:

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

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 default values of w_{OM} and w_{BM} for wind power generation project are 50% and 50% respectively as stated in the tool. The CM emission factor is calculated as shown in the equation above:

Table 5 demonstrates that the baseline emission factor of Thailand's national electricity system in 2010 is 0.5113 tCO_2/MWh.

Baseline emission factor of Thailand's national electricity system in 2009

	Weight	Emission Factor
Operating margin	0.50	0.5996
Build margin	0.50	0.4231
Baseline (Combined margin)		**0.5113**

Baseline emissions

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

Where:

BE_y = Baseline emission for year y, tCO_2/ year
$EF_{grid,CM,y}$ = Combined margin CO_2 emission factor for grid connected power generation in year *y* calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (tCO_2/MWh)
$EG_{PJ,y}$ = 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)

Baseline emission of the project

Combined margin emission factor (tCO_2/MWh)	0.5113
Electricity generation (MWh)	567,800
Baseline emission (tCO_2/ year)	290,316
Total baseline emission (tCO_2/ year)	**290,316**

Step 4: Emission Reductions

Since there are no anthropogenic emissions by sources of GHG due to the project activity, the emission reduction will be equal to the baseline emission.

ER_y = BEy- PEy

Where:
ER_y = Emission reductions generated in year y, tCO_2e/yr
BE_y = Baseline emissions in year y, tCO_2e/yr
PE_y = Project emissions in year y, tCO_2e yr

The Table below illustrates ex ante emission reduction and annual average of the estimated reductions over the crediting period.

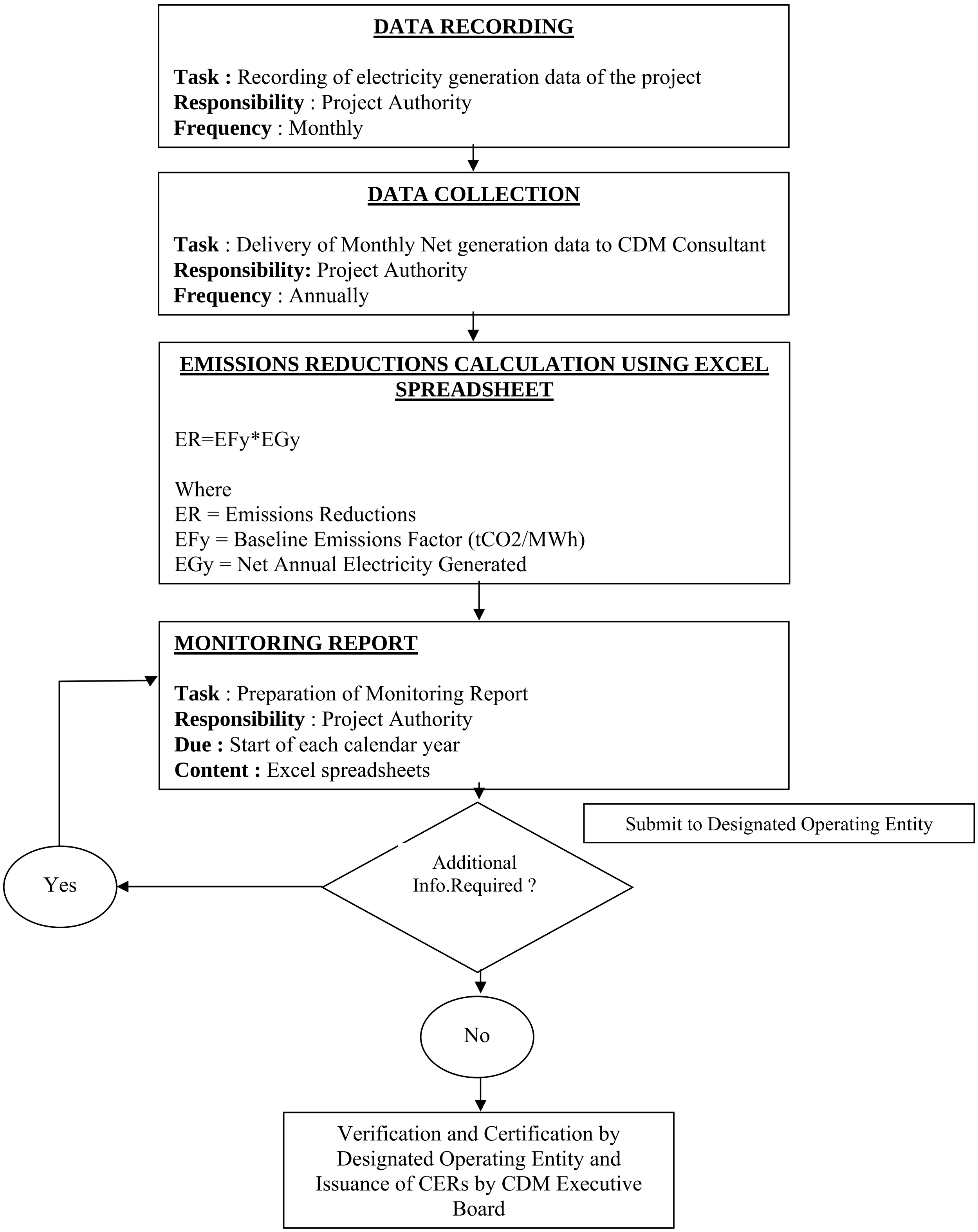
The ex ante estimation of emission reductions

Year	Estimation of annual emission reductions (tCO_2e)		
	Baseline Emissions	Project Emissions	Total
2015	290,316	51,102	239,214
2016	290,316	51,102	239,214
2017	290,316	51,102	239,214
2018	290,316	51,102	239,214
2019	290,316	51,102	239,214
2020	290,316	51,102	239,214
2021	290,316	51,102	239,214
Total number of crediting years	7		
Estimated reductions (tonnes of CO_2e)	**2,032,213**	**357,714**	**1,674,499**
Total estimated reductions (tCO_2e)	**1,674,499**		

Annual average of the estimated reductions over the crediting period (tCO_2e)	**239,214**

Table 14 - Ex-ante Emission Reductions

Appendix 5: Further background information on monitoring plan



Appendix 6: Summary of post registration changes

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History of the document

Version	Date	Nature of revision
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	EB 66 13 March 2012	Revision required to ensure consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Annex 8).
03	EB 25, Annex 15 26 July 2006	
02	EB 14, Annex 06b 14 June 2004	
01	EB 05, Paragraph 12 03 August 2002	Initial adoption.
Decision Class: Regulatory **Document Type:** Form **Business Function:** Registration		