CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
Version 03 - in effect as of: 22 December 2006

CONTENTS

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03	22 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

SECTION A. General description of small-scaleproject activity

A.1 Title of the small-scale project activity:

Nam Sim Hydropower Project, Huapanh Province, Lao PDR
Version – 10
Date – 27.9.2012

A.2. Description of the small-scale project activity:

Nam Sim is located in Huapanh Province in northern Lao PDR and forms part of the Nam Ma basin, which has its sources in Lao PDR and Vietnam. The project is located east of the province centre of XamNua, approximately 20 km southeast of the district capital of Viangxai. The project is located downstream of the village of Kangmuang village, about 1.5 km downstream of the confluence between the Nam Sim and Nam Vong rivers in Viengxai District. The catchment area for the Nam Sim is 197 km^2 with a mean annual runoff of 5.5 m^3/s.

The scheme is a run-of-the-river scheme with some daily regulation. This is a new power plant. Two conventional Francis turbines will generate up to 9.136 MW on the shaft which will be transferred to a 22 kV transmission line approximately 5 km in length connected to the Lao Grid. Electricite du Laos (EdL) will buy all power produced, with measurement of output at the plant.

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 17,995 tonnes per year.

The power supply in Huapanh Province is precarious, as it is in many other parts of this region, and electricity is today imported from Vietnam, but will later be connected to the EdL national grid.. There is currently no grid connected power generation within the province, and thus the Vietnam Emissions Factor should be used to calculate the emissions reductions.The province is facing a considerable shortage in supply in relation to demand, and load shedding is a frequent phenomenon. Only 25% of households in Huaphanh are connected to the grid, and many new customers are waiting for connections. The lack of stable supply of electricity has been a major factor in the slowing down socio-economic development in this part of Lao PDR.

The overall purpose of the project is the generation of electricity based on renewable energy sources. The electricity will be delivered to the grid in Huapanh Province. 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.3. Project participants:

Name of party involved	Private and/or public entity (ies) project participant	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Lao Peoples' Democratic Republic(host)	Nam Sim Power Company (Lao)	No
Sweden	Nordic Environment Finance Corporation NEFCO in its capacity as Fund Manager to the NEFCO Carbon Fund (NeCF)	No

The carbon purchaser is the Nordic Environment Finance Corporation NEFCO in its capacity as Fund Manager to the NEFCO Carbon Fund (NeCF)

NEFCO Carbon Fund (NeCF)

NEFCO, the Nordic Environment Finance Corporation, is a multilateral risk capital institution financing environmental projects in Central and Eastern Europe, with an emphasis on the Russian Federation and Ukraine. Its purpose is to facilitate the implementation of environmentally beneficial projects in the neighbouring region, with transboundary effects that also benefit the Nordic region. Today, NEFCO manages funds in an aggregate of approximately €400 million. NEFCO is located in Helsinki, in conjunction with the Nordic Investment Bank (NIB).

The NEFCO Carbon Fund (NeCF) was established as a Public Private Partnership in April 2008, to provide financial assistance to concrete projects by purchasing emission reduction credits from projects under the JI and CDM mechanisms. The NEFCO Carbon Fund (NeCF) has the Danish Energy Agency, DONG Energy, the Industrialisation Fund for Developing Countries (Denmark), Ministries of Environment and Foreign Affairs of Finland, Etelä-PohjanmaanVoimaOy (Finland), KymppivoimaOy (Finland), the Norwegian Finance Ministry, VapoOy (Finland) and NEFCO itself.

NEFCO is the Fund Manager of the NeCF, and has been authorised by the governments investing in the NeCF to participate on their behalf in actions leading to the generation, transfer and acquisition of CERs under Article 12 of the Kyoto Protocol.

A.4. Technical description of the small-scaleproject activity:

A.4.1. Location of the small-scaleproject activity:

Huapanh Province, Lao Peoples' Democratic Republic

Nam Sim River, Huapanh Province , 2-4 km upstream from Ban KhangMuang.

A.4.1.1. Host Party(ies):

Lao Peoples' Democratic Republic

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

Huapanh Province

A.4.1.3. City/Town/Community etc:

Nearest city: Sam Nua, approximately 20 km NW from the plant.

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scaleproject activity :

The location of Nam Sim project is remote.

Nam Sim is located in Huapanh Province in northern Lao PDR and forms part of the Nam Ma basin, which has its sources in Lao PDR and Vietnam. The project is located east of the province centre of XamNua, approximately 20 km southeast of the district capital of Viangxai. The project is located downstream of the village of Kangmuang village, about 1.5 km downstream of the confluence between the Nam Sim and Nam Vong rivers in Viengxai District.

The maps below show the location of the project site.

Figure 1

Figure 2

Using Degree, Minutes and Seconds as the measurement, the key locations are as follows :

Location	Co-ordinates
Main Dam Site	20.3459°N 104.3810°E
Power House	20.3585°N 104.3868°E

A.4.2. Type and category(ies) and technology/measure of the small-scaleproject activity:

The table below summarizes the main technical features of the project.[1]. The project will use the latest turbine technology from Europe thus resulting in a transfer of technology from Europe to Lao PDR.

Table 1

Project Main Data	**Feasibility Design**
Catchment and Hydrological data	
Catchment Area	196.2km²
Run-off Nam Sim and Bokay, Mean Annual	4.32 m³/s
Design Flood Estimation	300-800 m³/s
Dam and Reservoir Data	
Type of Dam	Concrete Gravity
Dam / Weir (L/H)	18m / 7m
Spillway Type	Free Overflow
Reservoir Area when full	30,000m²
Reservoir Storage (peak pond) including water tunnel	26.900 m³
Highest Regulated Water level (HRWL)	631 m.a.s.l.
Lowest Regulated Water Level (LRWL)	630 m.a.s.l.
Water Ways	
Headrace Tunnel (L/A)	1,100m / 18.7m²
Penstock (L/diameter)	1.4m
Diversion Pipe from Bokay	800m / Dia 0.40m
Power Plant Station Outlet (L/A)	12m / 5 m²
Power Plant	

[1] Feasibility Study Report and Annual Hydrological Updates

Gross Head	172.5 m
Net Head (Gross Head less Head Loss in Waterway)	170.5 m
Total Rated Discharge	5.4 m^3 / s
Type of Turbines	Francis, horizontal
Number of Units	2
Normal Capacity	4.568 MW
Access Road. Length (strengthening of existing dirt road)	5 km
New Access Road (from existing dirt road)	200 m
Transmission Line	
Voltage	22 kV
Alignment, length	4.70 km
Mean Energy Production	
Mean Annual Production	32.50GWh

A.4.3 Estimated amount of emission reductions over the chosen crediting period:

Year	Estimation of overall emission reductions
20/01/2013 - 19/01/2014	17,995 tCO2e
20/01/2014 - 19/01/2015	17,995 tCO2e
20/01/2015 - 19/01/2016	17,995 tCO2e
20/01/2016 - 19/01/2017	17,995 tCO2e
20/01/2017 - 19/01/2018	17,995 tCO2e
20/01/2018 - 19/01/2019	17,995 tCO2e
20/01/2019 - 19/01/2020	17,995 tCO2e
Total	125,965 tCO2e
Total number of crediting years	7

A.4.4. Public funding of the small-scaleproject activity:

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

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

The Nam Sim Project is not a debundled component of a large scale project. Please refer to Section B for a detailed discussion of this factor.

SECTION B. Application of a baseline and monitoring methodology

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

Project Type: I. Renewable energy project

Project Category:AMS I.D. Grid connected renewable electricity generation - Version 17 (I.D./Version17, Sectoral Scope: 01, EB 61)

Reference: Appendix B of the Simplified Modalities & Procedures for small scale CDM project activities (FCCC/KP/CMP/2005/8/Add.1)

B.2 Justification of the choice of the project category:

The details of how the proposed project is complied with the applicable requirements of AMS-I.D is presented in the Table below:

Table 2 Applicability of Small Scale Methodology AMS I.D.

	Applicability Criteria	Project Activity	Meet Criteria ?
1	This category comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal and renewable biomass, that supply electricity to a national or a regional grid. Project activities that displace electricity from an electricity distribution system that is or would have been supplied by at least one fossil fuel fired generated unit shall apply AMS I.F.	The proposed project is based on hydropower, a renewable energy generation source to generate electricity that is supplied to the Huapanh grid and then Lao National Power Grid..	Yes
2	This methodology is applicable to project activities that (a) install a new power plant at a site where there was no renewable energy power plant operating prior to the implementation of the project activity (Greenfield plant); (b) involve a capacity addition; (c) involve a retrofit of (an) existing plant(s); or (d) involve a replacement of (an) existing plant(s).	The proposed project involves the installation of a new hydropower plant at a site where there was no renewable energy power plant operating prior to the implementation of the project activity.	Yes
3	Hydropower plants with reservoirs that satisfy at least one of the following conditions are eligible to apply this methodology: • The project activity is implemented in an existing reservoir with no change in the	The project activity results in a new reservoir and the power density of the power plant, as per definitions given in the Project Emissions section, is 306 W/m2 which is greater than 4 W/m2.	Yes

	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 Emission section, is greater than 4W/m2 • The project activity results in new reservoirs and the power density of the project activity, as per definitions given in the Project Emission section, is greater than 4m²		
4	In the case of biomass power plants, no other biomass types than renewable biomass are to be used in the project plant	The project activity involves the construction of a hydropower plant. This criterion is thus not applicable.	Not Applicable
5	If the new unit has both renewable and nonrenewable components (e.g.,. a wind/diesel unit), the eligibility limit of 15 MW for a small-scale CDM project activity applies only to the renewable component. If the new unit co-fires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15 MW.	The project does not incorporate a mix of renewable and nonrenewable components. This criterion is therefore not applicable. The total installation capacity of the proposed project is 9.136 MW, which is within the limit of 15 MW stipulated for the chosen (small-scale) methodology.	Not Applicable
6	Combined heat and power (co-generation) systems are not eligible under this category.	There is no combined heat and power component in the project activity. This criterion is therefore not applicable.	Not Applicable
7	In the case of project activities that involve the addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be physically distinct from the existing units.	The project activity does not involve the addition of renewable energy generation units at an existing facility. This criterion is therefore not applicable.	Not Applicable
8	In case of retrofit or replacement, to qualify as a small-scale project, the total output of the retrofitted or replacement unit shall not exceed the limit of 15MW.	The project activity does not involve the retrofit or replacement of (an) existing unit(s). This criterion is therefore not applicable.	Not Applicable

The project is not a debundled part of a larger project for the following reasons :

- There is no registered small-scale CDM project activity or any application to register another CDM small-scale CDM project activity by the project participant, i.e. NEFCO or Nam Sim

Power Company (Lao) within the past two years in respect of the same project category and technology within 1 km of the project boundary of the project activity.

- The project is located in a remote rural region and there is also no hydropower plant within 1 km of the project area.
- This is the first hydropower project in which Nam Sim Power Company(Lao) has invested.

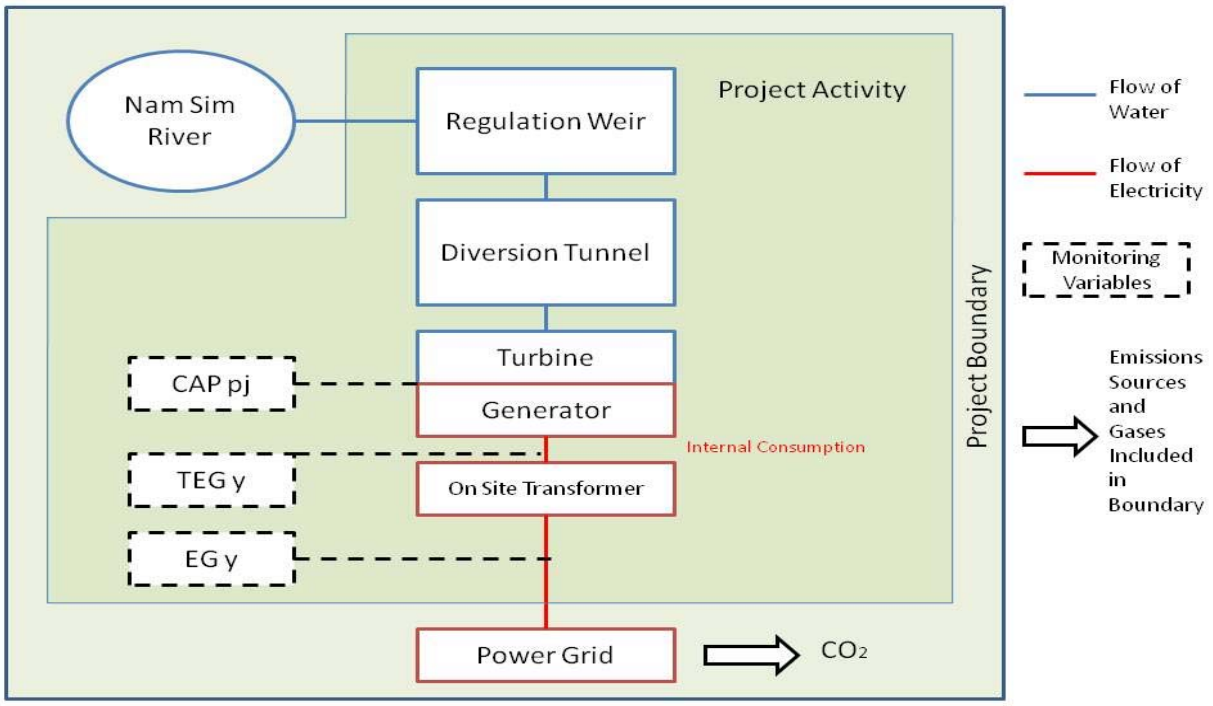
B.3. Description of the project boundary:

According to methodology AMS I.D, version 17 the boundary for this project type is delineated by:

• Geographical site: the area where the project is constructed which includes the dam, the reservoir, the tunnel, the power house and the sub-station.

• Physical boundary: This consists of all power plants connected physically to the electricity system, which is defined as the Huapanh Grid and the National Grid of Vietnam, to which the project is connected.

The Project Boundary is shown in the diagram below.



The GHGs and emission sources included in the project boundary are shown in the table below.

	Source	Gas	Included ?	Justification / Explanation
Baseline	CO_2 emissions from electricity generation in fossil duel fired power plants that is displaced due to the project activity	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
Project Activity	For hydro power plants, emissions of CH_4 from the Reservoir	CO_2	No	Minor emission source
		CH_4	No	Run of river power plant so there is no large reservoir created. The power density is 305 W/M² (Installed capacity of 9.136 MW divided by the surface area of the reservoir of 30,000M²). Because the power density is above 10W/m² these emissions can be disregarded.
		N_2O	No	Minor emission source
	CO2 emissions from back up power generation	CO_2	Yes	Main emission source. The volume of emission is estimated based on the operation hours of the backup system, and the volume and type of fossil fuel consumed by the backup system in year y. The accurate emission is monitored and calculated in year y.
		CH_4	No	Minor emission source
		N2O	No	Minor emission source

B.4. Description of baseline and its development:

Because the project activity is the installation of a new grid-connected renewable power plant/unit, thebaseline scenario is the electricity delivered to the grid by the project activity that otherwise would have
been generated by the operation of grid-connected power plants and by the addition of new generationsources.

The baseline emissions are the product of electrical energy baseline EGBL, y expressed in MWh ofelectricity produced by the renewable generating unit multiplied by the grid emission factor.

$$BEy = EGBL, y \times EFCO2,grid,y$$

Where:

BEy Baseline Emissions in year y;(tCO2)

EGBL, y Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year y (MWh)

EFCO2,grid,y CO2 emission factor of the grid in year y (tCO2/kWh)

The Emission Factor can be calculated in a transparent and conservative manner as follows:

(a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the 'Tool to calculate the emission factor or an electricity system'.

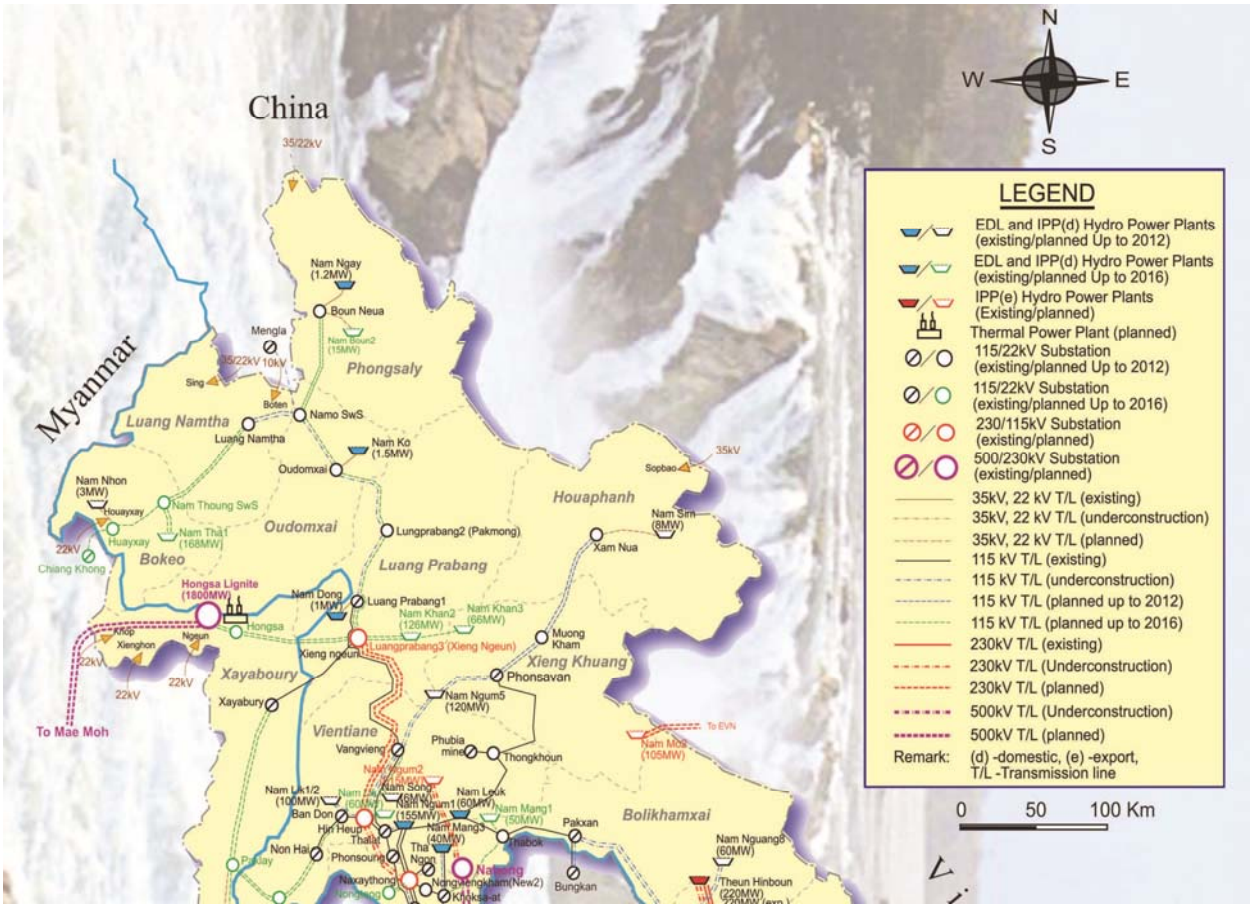
OR

(b) The weighted average emissions (in tCO2e/kWh) of the current generation mix. The data of the year in which project generation occurs must be used

Method (a) is used for calculation of the emission factor.

Huapanh Province is not connected to the main power grid in Lao PDR. The map below shows that the grid receives its power from the Vietnamese grid. Power is distributed in the province by Electricite du Laos.

The new plant will be connected to the Lao Power Grid.



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

Data from the Government of Laos on electricity consumption indicates a significant proportion of diesel generation which is distributed by Electricite du Laos.

Thus the baseline scenario of the proposed project is the delivery of equivalent amount of annual power output from the Vietnam national grid, to which the proposed project is also connected, and the balance of generation from local diesel generation. The database for calculating the baseline is provided by the EVN.

Following the EB guidance on the consideration of national and/or sectoral policies and circumstances in baseline scenarios (EB 22, annex 3), two types of policies E+ and E- have been examined.

(a) National and/or sectoral policies or regulations that give comparative advantages to more emissions intensive technologies or fuels over less emissions-intensive technologies or fuels. To date, the governments of Vietnam and Laos have not implemented any such E+ policies that are available and/or to be accessed publicly.

(b) National and/or sectoral policies or regulations that give comparative advantages to less emissions intensive technologies over more emissions-intensive technologies (e.g. public subsidies to promote the diffusion of renewable energy or to finance energy efficiency programs):

the latest relevant policy is the

–National Master Plan on national power development for the period 2006-2015 perspective to 2025 (Master plan VI) approved by the Prime Minister in 2007. According to EB 22, annex 3, it is not needed be taken into account in developing a baseline scenario as it is implemented after 11 November 2001. Furthermore, the main power capacity additions (new power plants) set out in the Master Plan are fossil fuel fired power plants. There are no special incentives for less emission intensive technologies.

So, the baseline scenario of this proposed project refers to a hypothetical situation or the delivery of equivalent amount of annual power output from the Vietnam national grid and power generated locally by means of diesel generators.

The development of the baseline will be described in Section B6.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scaleCDM project activity:

The Project Owner was aware of CDM incentives following the completion of the Feasibility Report.

The Nam Sim Project was included in the Project Catalogue of the Laos Power Development Plan in 2004. The report stated an Investor Hurdle Rate of 17% ROE.[2]

As the initial Feasibility Studies started to show that the Project had some potential, but would be marginal for investors, the Project Owner started to obtain quotations from CDM Consultants. The first such quotation was received in June 2007 and the first fees were paid in November 2007.

Major Milestones in the Development of the Investment Project and CDM Application

Detail	Date	Document
Feasibility Study Report Completed	July 2006	Feasibility Study
Feasibility Study Report Approved by GOL	11/12/2006	Letter from The Government of Laos (GOL)
Feasibility Study Amendment 1 (hydrological update) received	June 2007	Feasibility Study Amendment 1
CDM Consultant Proposal Received	14/6/2007	E-Mail with Proposal
DOE Approached	6/8/2007	E-Mail to CDM Consultants
Project Development Agreement (PDA) Signed	2/10/2007	Signed PDA
Feasibility Study Amendment 2 (hydrological update) received	August 2008	Feasibility Study Amendment 2

[2]Power System Development Plan for Lao PDR 2004. Main Report : Executive Summary Section 1.3.3 (Page 5)

Environmental Impact Assessment and Environmental Management Plan Completed	November 2008	EIA and EMP Report
Social Impact Assessment and Social Development Plan Reports Completed	November 2008	SIA and SDP Report
Tariff MOU Signed by EdL	01/12/2008	Tariff MOU
Shareholders Agreement Signed with ECI (Laos Partner)	20/01/2009	Shareholder Agreement
CDM Application made to Laos DNA	18/03/2009	Letter from WREA
Foreign Investment License Approved	21/04/2009	Foreign Investment License
Letter of Non Objection received from Laos DNA	13/05/2009	Letter from WREA
Articles of Association Approved	11/06/2009	Letter from GOL
Feasibility Study Amendment 3 (hydrological update) received	October 2009	Feasibility Study Amendment 3
LOI signed with CER Buyer	30/03/2010	Signed LOI
FSR Final Approved by the Ministry of Energy and Mines	20/01/2011	Final FSR approval by government
Termsheet signed with Lender (*Finnish Fund)*	02/02/2011	Signed Termsheet
Financial estimation with identified contractor	01/03/2011	Agreement letter
ERPA signed with CDM Buyer	10/03/2011	Signed ERPA
Signed validation service contract with TUV Rheinland DOE	11/04/2011	Signed validation contract
PDD publication on UNFCCC webpage	22/04/2011 to 21/05/2011	PDD GSP
Obtained letter of approval issued by the DNA	07/11/2011	LoA Laos
EPC Contract Signed (i.e. Project Starting Date)	29/11/11	Signed EPC Contract

According to the Guidelines for the Demonstration of Additionality of Small Scale Project Activities (Version 9, EB68), at least one barrier listed shall be identified due to which the project would not have occurred any way.

The main barrier identified by the project owner at the date of decision making was the financial barrier and the project owner hence made the decision to implement the project as a CDM project activity. The existence of the investment barrier is demonstrated in the following by benchmark analysis.

As the project generates financial benefits other than CDM related income, investment comparison analysis or benchmark analysis needs to be used to demonstrate additionality. As there are no other credible and realistic baseline scenario alternatives other than electricity supply from the grid, benchmark analysis is chosen to prove additionality.

In the following, pre tax project IRR is used to demonstrate the Additionality of the project.

The Guidelines on the assessment of Investment Analysis Version 05, EB 62, Report Annex 05 stated "local commercial lending rates…are appropriate benchmarks for a project IRR". Prime Lending Rates in Laos are summarized in the table below.[3]

Date	Commercial Lending Rate
31/12/2006	14.50%
31/12/2007	13.00%
31/12/2008	11.50%
31/12/2009	7.00%
31/12/2010	7.00%

As the trend in lending rates has been downward, and given the competitive international finance market, a rate of 6.25% has been used which is a conservative approach.

The Thai Minimum Lending Rates of 6.25%[4] were used to calculated the WACC as it is not realistic to assume that the debt financing would be sourced from a Lao Bank. This is partly because the rates are higher than those available elsewhere, and partly because Thai banks have an appetite for lending on a Project Finance. As a Project Company, Nam Sim Power Company does not have a S&P or Moody's Credit Rating, which limits sources of finance. Banks in Lao PDR will generally only lend on a long term basis to AAA Rated companies, and at higher interest rates[5].

A further measure to estimate the Benchmark Return was included by the UNFCCC was given in Annex 5 to EB 62 "Guidelines on the Assessment of Investment Analysis". For the power generating sector in Lao PDR, the default value for the cost of equity in nominal terms is 13.25%. In order to take the most conservative approach, inflation has not been taken into account and on this basis the WACC is 8.35%. The lower of the two figures has been adopted and the applied benchmark is therefore 8.35%

The Pre-Tax WACC was calculated using the following parameters :

Cost of Equity	13.25%
Cost of Debt	6.25%
% Equity	30%[6]
% Debt	70%
Tax Rate	0%[7]
WACC	8.35000%

The equation used for the above is shown below.

[3] Source – The World Bank - http://siteresources.worldbank.org/INTEAPHALFYEARLYUPDATE/Resources/550192-1287417391641/EAP_Update_Oct2010_lao.pdf

[4] Source – Bank Of Thailand : http://www2.bot.or.th/statistics/BOTWEBSTAT.aspx?reportID=223&language=ENG

[5] Source - http://www.bcel.com.la/en/InterestRate.aspx?InterestRateDeptID=1

[6] Source – Foreign Investment Law 2005

[7] For the purposes of the WACC calculation

$$WACC = K_d \times (1-T) \times D/(D+E) + K_e \times E/(D+E)$$

Where

Kd = Cost of Debt
Ke = Cost of Equity
D = Debt
E= Equity
T = Tax

The key assumptions financial assumptions in this report were as follows:

Assumption	**Actual / Feasibility Study**
Installed Capacity	9.136MW[9]
Total Capital Cost	USD 18,228,000[10]
Total Capital Cost Excluding Financial Cost	USD 17,494,000
Annual Output	Maximum of 32.5GWh[11]
Tariff	USD 0.0625 Levelized[12]
	Actual Tariff included in spreadsheet
Annual O&M Costs	USD 310,354[13]
Annual Depreciation Rate	25 Year in accordance with Project Lifetime[14]
Project IRR Before Tax	7.27%
Tax	10% (with 8 year tax "holiday")[15]

This table shows that the project IRR was lower than the benchmark of 8.35%.

Sensitivity analysis

A sensitivity analysis of the project activity has been conducted to test the robustness of the above calculations. Although the O&M cost accounted less than 20% of total investment cost, it is still included in the project sensitivity analysis for more detail about the financial analysis. The other items in the analysis – Total Capital Cost Excluding Financial Cost (CAPEX), Tariff and Annual Output – all

[9] Source : EPC Contract

[10] Source : Agreed EPC Contract, budgeted letter, Bank Due Diligence etc

[11] Source : Concession Agreement Annex C

[12] Source : Power Purchase Agreement

[13] Source : Electricite du Laos

[14] Source : Concession Agreement and PPA

[15]Source – Concession Agreement Page 7 (Clause 3). However, tax has been disregarded for the purposes of calculating the Benchmark Returns.

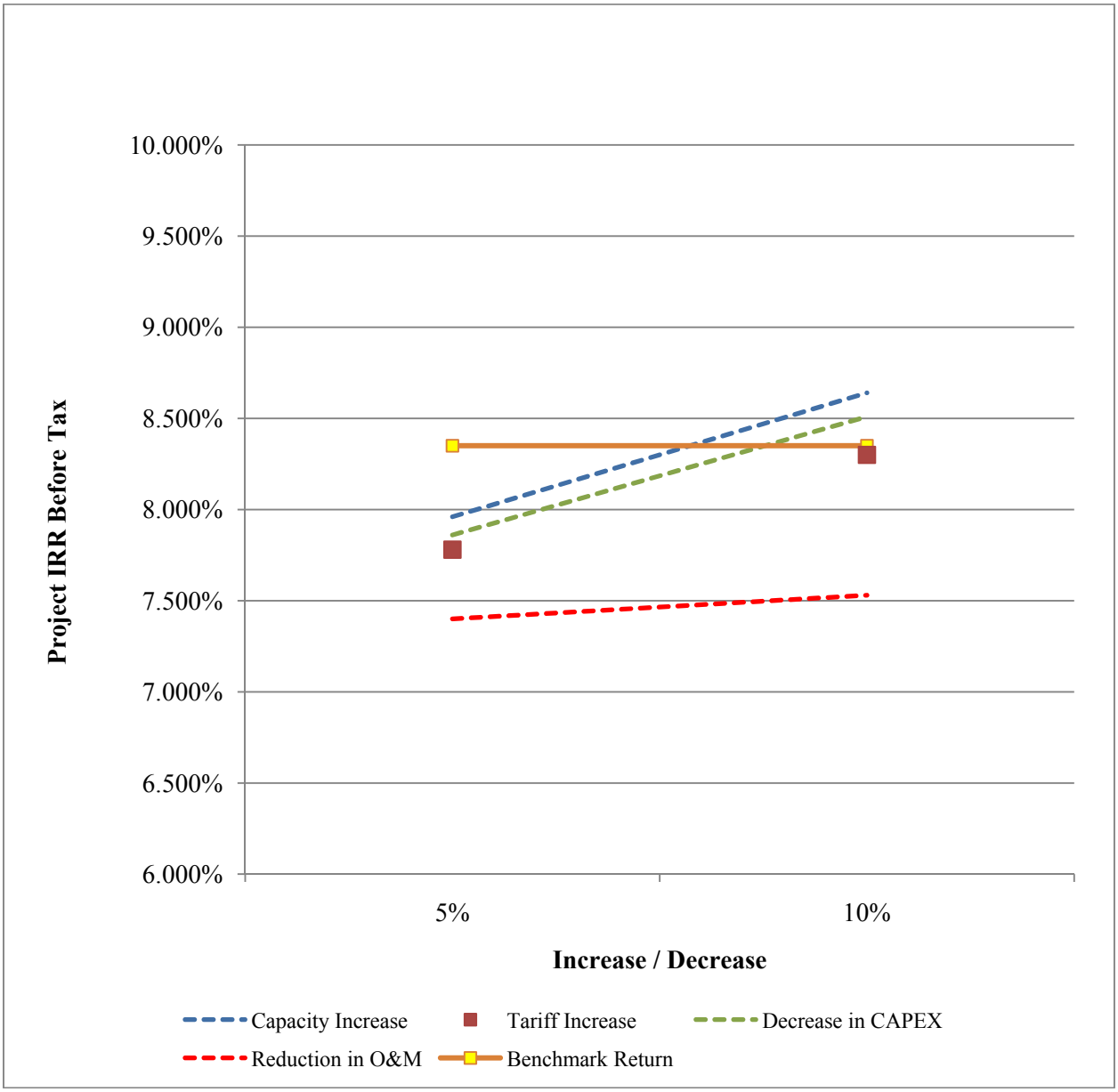
represent more than 20% of the Project Cost, so these parameters are used in the sensitivity analysis of the project activity:

- Annual Output exported to the national grid
- O&M costs
- Total Capital Cost
- Tariff
-

Table 7 shows the impact of variations in key factors on the project IRR considering a ±10% variation in the parameters.

	Increase / Decrease	
	5.000%	10.000%
Capacity Increase	7.960%	8.640%
Tariff Increase	7.780%	8.300%
Decrease in CAPEX	7.860%	8.510%
Reduction in O&M	7.400%	7.530%

This is shown graphically in the chart below.



Further analysis below shows the levels of increase / reduction which are required to achieve the Benchmark Return of 8.35%.These parameters are summarized in the table below.

Capacity / Output Increase	
Output Required	35,050,000
IRR	8.35%
Increased Output	7.85%

Tariff Increase		
Current Levelized Tariff	$	0.06210
Tariff Required	$	0.06710
IRR		8.35%
Tariff Increase		8.05%

Reduction in CAPEX		
Current CAPEX	$	17,494,000
CAPEX Required	$	15,920,000
IRR		8.35%
CAPEX Reduction		9.00%

Reduction in O&M		
Current O&M	$	310,354
O&M Required	$	177,000
IRR		8.35%
O&M Reduction		42.97%

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

1) The output is estimated based on the hydrological measurements at the site. Four 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 7.85%to 35.05GWh may achieve 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. For the purposes of the estimated power output in the Concession Agreement, a figure of 32.50GWh was used[16]. The hydrology consultants calculated an estimated output of 31.40GWh which was based on the hydrology readings from 2005 to 2009.[17] The estimated output is already an optimistic estimate and if an estimate of 35.05GWh were used, this would represent an increase of 11.62% over the figure from the specialist consultant.
2) The Project Owner does not have a choice of offtaker – all power has to be sold to the state owned utility, EdL. The tariff cannot be increased because Huapanh is one of the poorest provinces of Laos and the local population cannot afford a higher tariff. Similarly, if local businesses were faced with a higher tariff it would be cheaper to install generators powered by

[16]Concession Agreement Annex C

[17]E-Mail message from Multiconsult dated 26.4.2010

fossil fuels. The tariff is already the maximum available as agreed in the PPA and an increase of 8.05%, which is needed to exceed the benchmark return, is simply not possible. Furthemore, this is compounded by the conservative estimate of the output referred to above.

3) The CAPEX is already at a minimum level. Prices for both civil and electrical mechanical contracts have been stable over a number of years. However, currencies have not been stable and the most competitive bid for the civil works (a large proportion of the cost) was received from a Thai contractor. That contractor bid in USD and the value of the USD compared to the Thai Baht is much lower than it was at the time of bidding. The most competitive bidder is already earning less than expected because the contract is in USD and will not lower the price. There were numerous bidding round and any further reduction in CAPEX, which would be needed to exceed the benchmark, are not possible. It should also be noted that the CAPEX items are the acual items from contracts, and that where an estimate has been included (for example contingencies) this is lower than the industry norm for such projects.
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. Given that a reduction of 60% would be required to achieve the benchmark return, this would at best threaten project operation, efficiency and safety, and in a worst case scenario mean that the projects would not operate at all. Furthermore the figure is very conservative as there has been no allowance for inflation. According to the IMF the average rate of inflation in Lao PR for the period 2000 – 2010 was 9.07%[18].

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

B.6. Emissions reductions

B.6.1. Explanation of methodological choices:

The baseline scenario is that electricity delivered to the national grid by the project would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation based mainly on coal and oil resources.

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:

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

$PE_{FF,y}$ backup power emissions
$PE_{HP,y}$ the emissions from the reservoir

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

[18] http://www.indexmundi.com/laos/inflation_rate_(consumer_prices).html

This is a Run of River project and there is no large reservoir There is a small reservoir for seasonal regulation.

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:

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

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 02.2.1 of "Tool to calculate the emission factor for an electricity system" determines the CO_2 emission factor for the displacement of electricity generated by power plants in an electricity system, by calculating the "operating margin" (OM) and "build margin" (BM) as well as the "combined margin" (CM), including 6 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 Huapanh Province, Lao PDR, which is operated by EdL. This Provincial Grid is connected to the National Power Grid of Vietnam which is owned and operated by EVN. This electricity grid is the unique transmission and distribution line, to which all power plants in Vietnam are physically connected. Hence the interconnected grid of Huapanh Province 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 regionalgrid definition should be used.

According to above requirements, the regional grid (Huapanh Province Grid and Vietnamese 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 (2006, 2007 and 2008) that is the most recent data available at the time of submission of the CDM-PDD to the DOE for validation, without requirement to monitor and recalculate the emissions factor during the crediting period.

Step 4 – Calculate the 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:

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

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)

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

$$EF_{EL,m,y} = \frac{\sum_{m} FC_{i,y^y} \quad X \quad NCV_{i,y} \quad X \quad EF_{CO\ i,y}}{EG_{m,y}}$$

Where:

$EF_{EL,m,y}$ is the CO_2 emission factor of power unit *m* in year *y* (tCO_2/GWh)
$FC_{i,m,y}$ Amount of fossil fuel type *i* consumed by power plant/unit *m* in year *y* (mass or volume unit)
$NCV_{i,y}$ Net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ/mass or volume unit)
$EF_{CO2,i,y}$ CO_2 emission factor of fossil fuel type *i* in year *y* (tCO_2/GJ)
$EG_{m,y}$ Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost/must-run power plants/units, in year *y* (MWh)
i All fossil fuel types combusted in power sources in the project electricity system in year *y*
y The relevant year as per the data vintage chosen in Step 3

Table 3 Operating Margin emission factor of the most recent 3 years (2006, 2007 and 2008)[19][20]

Year	Total Output (MWh)	Total Emissions (tCO2e)	OM 2008 (tCO2e/MWh)
	A	B	(∑B / ∑A)
2006	37,618,199.00	24,591,823.95	
2007	43,921,501.00	27,295,017.33	
2008	48,719,874.00	28,672,019.54	
Total	**130,259,574**	**80,558,861**	**0.6184**

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

$$EF_{grid,OM,y} = 0.6184 \text{ tCO2 / MWh}$$

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

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

Option 1: For the first crediting period, calculate the build margin emission factor *ex ante* based on the most recent information available on units already built for sample group *m* at the time of CDM-PDD submission to the DOE for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period, or

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

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

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

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

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

[19] EVN Annual Report

[20] EdL Statistical Report

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

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

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

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \quad X \quad EF_{EL,m,y}}{\sum EG_{m,y}}$$

Where:

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

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

$\boldsymbol{EF_{grid,BM,y} = 0.4889\ tCO_2/MWh}$

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

The CM emissions factor is calculated as follows:

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

Where:

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

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

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

$$EF_{grid,CM,y} = 0.5 \times 0.6184 + 0.5 \times 0.4889 = 0.5537 \text{ tCO}_2\text{/MWh}$$

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

III. Leakage *(LE_y)*

As the energy generating equipment used is not transferred from another activity, leakage calculation is not required, therefore $LE_y = 0$

IV. Emission reductions *(ER_y)*

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y$$

Where:

ER_y Emission reductions in year y (tCO_2e/y).

BE_y Baseline emissions in year y (tCO_2e/y)

PE_y Project emissions in year y (tCO_2e /y).

LE_y Leakage emissions in year y (tCO_2e /y).

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

Data / Parameter:	**Cap_{BL}**
Data unit:	MW
Description:	Installed capacity of hydropower plant before the implementation of the project activity.
Source of data used:	This is a newly constructed power plant. This value does not exist prior to the implementation of the project activity
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	The project activity constructs a new hydropower plant, so $Cap_{BL}$is considered to be zero.
Any comment:	

Data / Parameter:	**A_{BL}**
Data unit:	m^2
Description:	Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full. For new reservoirs, this value is zero.

Source of data used:	This is a newly constructed power plant. This value does not exist prior to the implementation of the project activity
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	The project activity does not result in the creation of a reservoir, so A_{BL} is considered by zero.
Any comment:	

Data / Parameter:	**Heat Rate**
Data unit:	Kcal / KWh
Description:	Heat rate of each power plant or the energy conversion
Source of data used:	EVN
Value applied:	Value Applied in Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	Dispatch data is not disclosed by the Government of Vietnam. EVN provides the most actually updated data relevant to the power generation in Vietnam that could be accessed by public.
Any comment:	

Data / Parameter:	**$EG_{m,y}$**
Data unit:	MWh
Description:	Net electricity generated and delivered to the grid by power plant/unit m in year *y*
Source of data used:	Data supplied by EVN and EdL
Value applied:	Value Applied in Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	Dispatch data is not disclosed by the Government of Vietnam. EVN provides the most actually updated data relevant to the power generation in Vietnam that could be accessed by public.
Any comment:	

Data / Parameter:	**$EF_{CO2,i,y}$**
Data unit:	tCO_2/GJ
Description:	CO_2 emission factor of fossil fuel type *i* in year *y*
Source of data used:	Default value of the IPCC 2006 Guidelines
Value applied:	Value applied in Annex 3
Justification of the choice of data or description of measurement methods and procedures actually	With reference to Version 1.1 of "Tool to calculate the emission factor for an electricity system"

applied :	
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

Baseline emissions

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

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

Where:

EG_y= Electricity supplied by the Nam Sim Hydropower Plant to the grid

$EG_{BL,y}$ = 32,500,000 KWh = 32,500 MWh

$EF_{grid,CM,y}$ = 0.5537 tCO2/MWh

Therefore,

therefore:

BEy = 32,500 x 0.5537 = 17,995 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:

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

$PE_{FF,y}$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 9.136 MW which is a Run of River design and only requires a small reservoir. The dam has a free overflow spillway design and the maximum reservoir area is 3 hectares. The calculation of power density is the installed capacity in watts per square metre which is 9,136,000W / 30,000m² or 304.53. Therefore Project Emissions from the Reservoir can be disregarded from the Emissions Reductions Calculations as the power density is above 10W/M².

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 ($L_y = 0$)

Reduction emissions

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - L_y = 17{,}995 \text{ tCO2/y}$$

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

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

Table 4

Year	Estimation of project activity emissions	Estimation of baseline emissions	Estimation of leakage	Estimation of overall emission reductions
20/01/2013 - 19/01/2014	0 tCO2/y	17,995 tCO2/y	0 tCO2/y	17,995 tCO2/y
20/01/2014 - 19/01/2015	0 tCO2/y	17,995 tCO2/y	0 tCO2/y	17,995 tCO2/y
20/01/2015 - 19/01/2016	0 tCO2/y	17,995 tCO2/y	0 tCO2/y	17,995 tCO2/y
20/01/2016 - 19/01/2017	0 tCO2/y	17,995 tCO2/y	0 tCO2/y	17,995 tCO2/y
20/01/2017 - 19/01/2018	0 tCO2/y	17,995 tCO2/y	0 tCO2/y	17,995 tCO2/y
20/01/2018 - 19/01/2019	0 tCO2/y	17,995 tCO2/y	0 tCO2/y	17,995 tCO2/y
20/01/2019 - 19/01/2020	0 tCO2/y	17,995 tCO2/y	0 tCO2/y	17,995 tCO2/y
Total	0 tCO2/y	125,965 tCO2/y	0 tCO2/y	125,965 tCO2/y

Parameter	Unit	Value
1. Capacity	MW	9.136
2. Baseline Emissions		
- The OM	tCO2 / MWh	0.61840
- The BM	tCO2 / MWh	0.40000
- The Baseline Emission Factor	tCO2 / MWh	0.55370
3. Total baseline CO2 emissions over the chosen crediting period	tCO2	125,965
4. Total project CO2emissions over the chosen crediting period	tCO2	0
5. Total leakage CO2emissions over the chosen crediting period	tCO2	0
6. Total CO2 emission reductions over the chosen crediting period	**tCO2**	**125,965**

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

B.7.1 Data and parameters monitored

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	32,500
Description of measurement methods and procedures to be applied:	Two 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:	$EG_{y, import}$
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 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:	Monitored by the Measured Valuesas the difference between $EG_{y,export}$ and $EG_{y,import}$
Value of data	32,500
Description of measurement methods and procedures to be applied:	Calculating by subtracting $EG_{y,import}$ from $EG_{y,export}$. Double checking by the joint balance sheet issued by EVN and project owner to ensure the consistency. Data will be archived within the crediting period and 2 years after the end of the crediting period.
Monitoring Frequency	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	9,136,000
Description of measurement methods and procedures to be applied:	Manufacturer's Nameplate
Monitoring Frequency	Yearly
QA/QC procedures to be applied:	No National Standard for the checking of installed capacity in Laos, thus only the manufacturer's nameplate will be checked during monitoring.
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 Description of the 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 under a long-term PPA with EdL.

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.

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

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.

More specifically, in addition to the provisions of the Power Purchase Agreement (Clause 6 regarding meter calibration[21] and recording)[22], the project participant shall:

(a) Electronically archive all data collected as part of monitoring for a period of two years from the end of the crediting period;

[21] Calibration shall be in the presence of both Buyer and Seller – Power Purchase Agreement Clause 6.3,6.5 and 6.7

[22] Power Purchase Agreement Clause 6.5 – meter accuracy shall be within 1%.

(b) Data variables that are most directly related to the emission reductions (i.e.. quantity of the fuel inputs, the amount of electricity produced) will be measured continuously. Data elements that are generally constant and indirectly related to the emission reductions (i.e. emission factors, and reservoir area, system efficiencies) shall be measured or calculated at least once a year

(c) Measuring equipment should be certified to national or IEC standards and calibrated according to the national standards and reference points or IEC standards and recalibrated at appropriate intervals according to manufacturer specifications, but at least once in three years;

(d) The measured data with high levels of uncertainty or without adequate calibration should be compared with location/national data and commercial data to ensure consistency; and this is addressed in the regulations of the Power Purchase Agreement

There will be installed two bi-directional power meters in the electrical panels produced by Mecamidi. The power measurement is after all transformers, and is effectively the power transmitted from the plant itself. One meter shall be sent to certified institution for checking regularly. So, the relevant emergency procedure is the double metering, i.e. one main and one backup, meaning there is always a certified meter in use.

The Power Purchase Agreement is very explicit on these procedures and states

6.1 The Meters will be located at the agreed Metering Point. The Seller shall provide a lockable, weatherproof cubical for the Meters to the Buyer's satisfaction. The Meters shall at all times remain the property of the Seller.

6.2 The Meters must have been calibrated before they are put into service. Thereafter the Meters shall be tested and calibrated at least once every twelve (12) months at the Seller's expense. The Buyer shall be notified prior to testing and calibration and has the right to be present at such testing and calibration.

6.3 The Seller shall, at its expense, install secondary meters for the propose of providing a backup measure of Energy Output. The secondary Meters must be tested and calibrated before being put into service and at least once every twelve (12) months thereafter.

6.4 At any reasonable time, either Party may request a test of the accuracy of any metering equipment. Each Party shall have the right to be present for the breaking of the seals, testing, calibration and sealing of meters. The result of the meter calibrations and tests shall be available for examination by the Parties at all reasonable times. If, at any times, any metering equipment including the Meters is found to be inaccurate by more than one (1%) percent, that metering equipment shall be made accurate or replace as soon as possible.

6.5 If either Parties believes that there has been meter failure or stoppage, it shall immediately notify the other Party and request a test pursuant to the Clause 6.5

The meters are running simultaneously. The PPA refers to seals and calibration. If one meter fails, or is suspected to have failed, the other meter should be functioning properly.

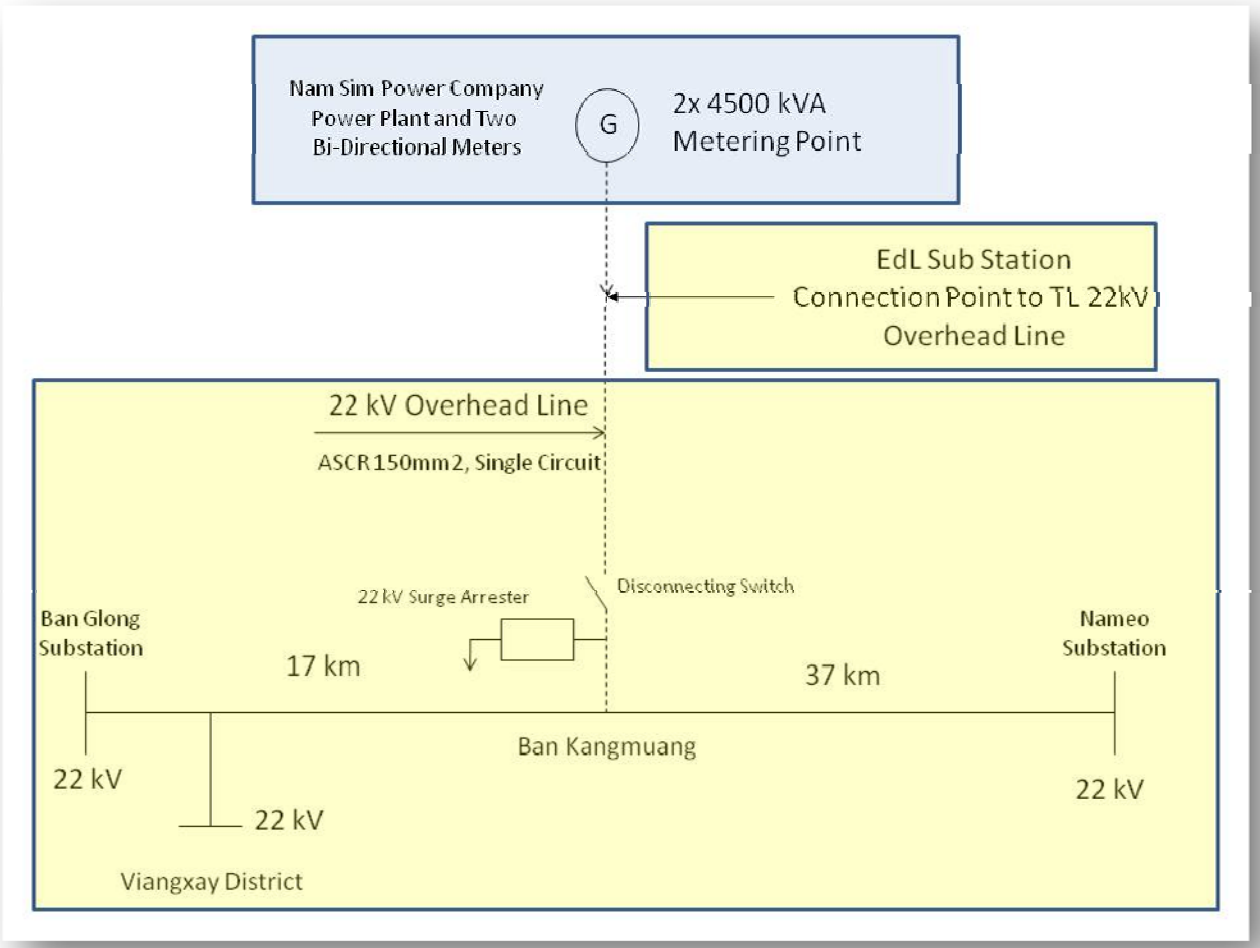


Figure 3 – Single Line Diagram

CDM Training will take the form of CDM Workshop to be held in Lao PDR in both English and Lao language. 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. ECI, the Lao Shareholder, has the expertise and technical resources to provide this training.

With regard to CDM training, the key calibration regulations are contained within the PPA and the CA. 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 which will follow the regulations set out in the PPA and the CA.

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

Date: 31/03/ 2011

Mr. Philip Britton
Asianet Services,
18th Floor, Central City Tower 1,
BangnaTrad Road (KM3)
Bangkok 10260
Thailand

Asianet Services is not a "project participant" listed in Annex 1.

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

The CDM Glossary of Terms (Version 7) defines the Starting Date of the Project Activity as follows :

In light of the above definition, the start date shall be considered to be the date on which the project participant has committed to expenditures related to the implementation or related to the construction of the project activity. This, for example, can be the date on which contracts have been signed for equipment or construction/operation services required for the project activity. Minor pre-project expenses, e.g. the contracting of services /payment of fees for feasibility studies or preliminary surveys, should not be considered in the determination of the start date as they do not necessarily indicate the commencement of implementation of the project. For those project activities which do not require construction or significant pre-project implementation (e.g. light bulb replacement) the start date is to be considered the date when real action occurs. In the context of the above definition, pre-project planning is not considered "real action".

Based on this definition, the Starting Date of the Project is 29th**November 2011** which is the date that the Project Participant and the EPC Contractor committed to the obligations in the EPC Contract.

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

25 years

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

C.2.1. Renewable crediting period

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

20/01/2013

C.2.1.2. Length of the first crediting period:

7 Years

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not applicable

C.2.2.2. Length:

Not applicable

SECTION D. Environmental impacts

D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

The National Policy on the Environment and Social Sustainability of the Hydropower Sector in Lao PDR was approved by the Prime Minister's office on 7 June 2005. This policy acknowledges the importance of hydropower for the future development of the country and summarises a number of key aspects based on the environmental considerations and social sustainability of such projects.

It states the conditions for EIA Reports and EMP according to the Environmental Protection Law, provides definitions and rights of project-affected people, the need for watershed management and conservation, the need for consultations and disclosure, compliance with existing laws and regulations, and monitoring arrangements and reporting.

The Environmental Impact Assessment (EIA) and Environmental management Plan (EMP) report has been developed in accordance with the Environmental Management Standard for Electricity Projects and the legislation referred to above. A separate Social Impact Assessment (SIA) and Social Development Plan (SDM) have been prepared for the project. All of these documents have been approved as it is not possible to obtain a Concession Agreement unless all of the necessary approvals have been obtained from the different government ministries. The EIA and EMP were approved by the relevant ministry on 30th January 2009. The Concession Agreement, which states that the project is consistent with all relevant laws and regulations, was signed on 13th June 2011.

Furthermore, based on the impact assessments of the proposed project, the EIA report proposes that the mitigation measures shall be conducted during the construction and operation phases in order to minimize the negative impacts and ensure the long-term benefits from this project.

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

The summary of the Environmental Impacts is detailed below.

Cumulative Impacts

Cumulative impacts are the combined impacts of the Nam Sim project and other projects and activities.

Water Use

Below the planned intake there are some fish ponds and agricultural fields in HuayNokay. It is believed that this diversion will not impact this area, nor deprive it of water in the dry season when it is needed for fish ponds and agricultural production. However in the unlikely case of a lack of flow, a small amount of water can be released from the intake.

These are shallow streams with only small aquatic life. Any impact on the flow will be negligible and the pond / reservoir will actually increase aquatic life.

Flooding

Nam Sim is a run of river scheme with some daily regulation and will not affect the wet season flow significantly. The impact on flooding is assumed to be minimal.

Biodiversity

It is expected that pressure on natural resources and biodiversity caused by a combination of development projects, population growth and unsustainable forest and land utilisation will increase substantially.

Agriculture

No large or significant impacts on agriculture systems and practices are foreseen for upstream or downstream areas in the near future. Agricultural development in the villages will ,mainly be affected by development initiatives and by general development trends such as population increase, both of which will probably result in a more intensified use of agricultural land.

Increased market opportunities for agricultural products will arise from hydropower construction activities, improved infrastructure and population influx. More market oriented and commercialised production of fruit and vegetables to supply the workforce will arise in the villages in the vicinity of the construction sites and camps.

Hydropower

In Lao PDR a number of hydropower projects are slated to be built and commissioned before 2020. No new hydropower developments in this catchment area are foreseen in this period.

Roads

The transportation sector is identified as one of the four key sectors for reducing poverty in the National Growth and Poverty Reduction Strategy for Lao PDR. Hence, the transportation sector is expected to continue to receive considerable resources for road and other transportation infrastructure improvements in the future both in Lao PDR and the region. No new roads are known to be planned for the Nam Sim Area.

SECTION E. Stakeholders' comments

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

Consultations have been carried on site at the two impacted villages on April 3, 2006.

The site is extremely remote and communications were even more difficult at the time of the consultations. The meetings were arranged by local and national representatives of the project owner.

The invitations were co-ordinated by word of mouth and telephone because the postal and address system in that remote province of Lao PDR was not reliable.

The Project Owner contacted EdL, the state owned utility, in Vientiane. The Project Owner was then able to contact the EdL office in XamNuea, the Provincial Capital.

The XamNuea office then travelled to the site because there were no phone lines or mobile phone signals there, and they briefed the people about the forthcoming meetings.

The villages affected by the project are very small and sparsely populated, and all interested parties were in attendance

Stakeholder Consultation on April 3rd 2006

There are two villages directly affected by project works, including the intake (incl. inundated area), power station, access roads and other areas affected by construction work on the ground (quarries, borrow pits, tips etc.). The Table below shows number of people in the Directly Affected villages. The Tai

Daeng is the only ethnic groups residing in these villages and is fully integrated socially and economically and not considered as an ethnic minority since they are one of the largest groups in the Province. Therefore an 'Ethnic Minority Development Plan' is not required for this project.

The following villages are defined as Directly Affected Villages:

#	Village name	# of people
2	Kangmuang	383
4	DonphaoNua	251

The programme for the April 3rd 2006 consultations was as follows :

Location: Donphao and Kangmuang Villages

Date: April 3, 2006 Time: 9:00-17:30

Agenda

Donphao Village

9:00 Welcome and Opening of the Consultations by Provincial Officials
9:15 Introductions of Nam Sim Team and Objectives of the Consultations by NORPLAN/Energy Development
9:30 Overview of the Nam Sim Project and Technical Design by NORPLAN/Energy Development
10:00 Questions and comments
10:30 Social and Environmental – Impacts on Danphao village and vicinity
11:00 Questions and comments
11:30 Summarising and closing of the meeting by Provincial Officials
12:00 Approximate end of Consultations

Lunch

Kangmuang Village

14:30 Welcome and Opening of the Consultations by Provincial Officials
14:45 Introductions of Nam Sim Team and Objectives of the Consultations by NORPLAN/Energy Development
15:00 Overview of the Nam Sim Project and Technical Design by NORPLAN/Energy Development
15:30 Questions and comments
16:00 Social and Environmental – Impacts on Danphao village and vicinity
16:30 Questions and comments
17:00 Summarising and closing of the meeting by Provincial Officials
17:30 Approximate end of Consultations

Participants

GOL Representatives
Representative from the Office of the Head of Province

Dept. of Industry and Handicraft, XamNeua Office
STEO Representatives, XamNeua Office
Dept. of Electricity, EdL, XamNeua Office
Representative from the Office of the Head of Viengxay District
District Agriculture and Forestry Office Representative, Viengxay

Village Representatives

Village headmen or deputies and Lao Women's Union Representatives from DonphaoNeua, Donphao Tai and Bo villages (first consultation), and Kangmuang, Kangthat and Sompoy villages (second consultation).

Consultants and Developers:

Mr. Ove Bugge, Energy Development, Norway
Mr. Bounnom Khounsamnane, ED Representative, Lao PDR
Mr. BounnamKhaosaath, ED Project Coordinator, Lao PDR
Mr. Jan Høiseth, Project Team Leader, NORPLAN, Norway
Mr. KåreMidtun, Electrical Engineer, NORPLAN, Norway
Dr. Stephen Sparkes, Senior Social Scientist, EIA Team Leader, NORPLAN, Vientiane
Mr. SingkhamBoulivanh, Field Assistant, NORPLAN, Vientiane

Meetings with district and provincial authorities have occurred on a regular basis and efforts have been made to involve various agencies in the planning, especially the Provincial Office of Science, Technology and Environment (STEA, now called the Water Resources and Environment Administration [WREA]) and the District Agriculture and Forestry Office (DAFO). A national workshop was held on April 7, 2006 that was open to the public and attended by many government officials and interested parties.

E.2. Summary of the comments received:

There were two meetings with villagers and village authorities at Donphao and Kangmeuang on April 3, 2006

Since this was the first formal, village-level consultation, most of the meeting consisted of the project developers and consultants presenting the main aspects of the project, including legal requirements, impacts and possible mitigations and benefits. There were only a few inquiries and clarifications:

DanphaoVillage:

- Small garden and fishponds along HuayBokai (Near Powerhouse location)? What Solution is the solution? – Answer: no impacts are expected.
- Could Project support water supply connected with pipeline from near small rivers near village? – Answer: possible as part of the disturbance allowance/community development arrangements.

KangmuangVillage:

- How we can make tunnel through mountain? Answer: short description of techniques to be employed

- Declaration of support for the project

Meetings with District and Provincial Authorities

Meetings have been held with various GOL authorities at the Provincial and District levels throughout the project development, including:

- Office of the Provincial Governor
- Electricite de Laos
- Provincial Office of Industry and Handicraft
- PAFO and DAFO
- Provincial STEA Office
- Provincial Office of Social Welfare

STEA Workshop in Vientiane

A workshop was held for the public in Vientiane on April 7. This workshop was chaired by Mr. Soukata of STEA Vientiane and attended by many government officials, hydropower developers and other interested parties. Some issues raised concerning the EIA included:

- Clarification on Ethnic Minority in the project area - Only Tai Deng? More information is required in the EIA
- How is the Nam Simdifferent from Nam Nua Project? Answer: the latter project was deemed too small in terms of generation and too many environmental impacts as well as tourist potential.
- More information on Fisheries in downstream and mitigation measures required. Comments: more information will be given but impacts are expected to be very small.
- Careful attention should be paid to land compensation. Comment: detailed assessment to be provided in the EMP.

In addition, it may be necessary to call on other experts in certain fields to assist the Team Leader or GOL in implementation arrangements for resettlement and compensation, consultations, land-use planning, fisheries, etc. The budget for these experts is listed as part of the Social and Environmental Management Team budget.

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

Social and Environmental Management Team

For project implementation, a Social and Environmental Management Team is required. This will consist of one full-time member, or Team Leader, and the intermittent assistance of a range of experts and

stakeholders. This arrangement is proposed since the impacts are not expected require extensive manpower.

Social and Environmental Team Leader

It is proposed that the Team Leader be a qualified Local Consultant. This consultant should be based on site for a period of two years over a three year period, being full time during the first year of construction and gradually turning to intermittent supervision of activities after this period. This consultant should be experienced with implementation Environmental Management Plans and Social Development Plans. It is proposed that this expert be recruited nationally prior to the start of construction.
The main tasks of the Team Leaders in relation to social issues will include:

- Overall supervision of the EMP/SDP and budget
- Development of detailed implementation arrangements based on those outlined in this SDP
- Supervision of ongoing consultations with local stakeholders
- Coordination with GOL organisations and other experts as required for implementation
- Monitoring of compensation issues together with DAFO and other organisations
- Coordination with contractors and supervising engineers regarding environmental regulations and contracting of local labour
- Participate as a member of the Grievance Committee to resolve issues as they arise

Local Experts

Intermittent interventions and a pool of local experts will be needed at various times during project implementation. These experts are mentioned in the sections that follow in relation to the different mitigation measures to be carried out and the personnel, organisations and costs are outlined in these sections. The following areas will require expertise:

In addition, it may be necessary to call on other experts in certain fields to assist the Team Leader or GOL in implementation arrangements for resettlement and compensation, consultations, land-use planning, fisheries, etc. The budget for these experts is listed as part of the Social and Environmental Management Team budget.

Role of GOL Organisationsand CapacityBuilding

An important part of the SDP is the role of the Government of Lao organisations and agencies in a number of key fields. Several GOL organisations have been involved in the planning of this project and their role will continue, but more specifically, the following organisations will require support:

- Provincial Offices of the Science, Technology and Environment Agency (STEO) based in HouaPhan for the supervision of environmental and social issues – STEO officers will conduct regular field visits with the Team Leader during construction
- Viengxai District Agriculture and Forestry Office (DAFO)

- Land-use planning for impacted villages (detailing of existing land-use planning maps developed under the Poverty Fund)
- Agricultural studies regarding the identification of new areas and the enhancement of existing paddy production and irrigation systems
- Alternative livelihood strategies that will be developed as part of the compensation package and in relation to ongoing consultations with affected villagers
- Monitoring of livelihood interventions to ensure that incomes have been restored by mitigation measures

- DistrictLand Registration and Taxation Office to provide documents for new land parcels and oversee the estimation of land and production losses
- District and Provincial Health Offices for health issues, STD awareness programmes and safety issues
- District Social Welfare Office for the supervision of the recruitment of local labour and agreements with contractors
- District and Provincial Lao Women's Union (LWU) for consultations at the village level, monitoring and health issues

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Nam Sim Power Company (Lao).
Street/P.O.Box:	N. 592, Unit 1 Ban Phonphanao,
Building:	NA
City:	Saysettha District, Vientiane Capital
State/Region:	NA
Postfix/ZIP:	NA
Country:	Lao PDR
Telephone:	+4766802412
FAX:	+47 66801568
E-Mail:	energy.development@online.no
URL:	NA
Represented by:	NA
Title:	Managing Director
Salutation:	Mr.
Last Name:	Bugge
Middle Name:	Chr.
First Name:	Ove
Department:	NA
Mobile:	NA
Direct FAX:	NA
Direct tel:	NA
Personal E-Mail:	NA

Organisation:	Nordic Environment Finance Corporation NEFCO in its capacity as Fund Manager to the NEFCO Carbon Fund (NeCF)
Street/P.O.Box:	Fabianinkatu 34, P.O. Box 249
Building:	34
City:	Helsinki
State/Region:	NA
Postal code:	FI-00171
Country:	Finland
Phone:	+358 10 618 003
Fax:	+358 9 630 976
E-mail:	NA
URL:	NA
Represented by:	Ash Sharma
Title:	Vice President, Head of Carbon Finance and Funds
Salutation:	Mr.
Last name:	Sharma
Middle name:	NA
First name:	Ash
Department:	NA
Direct tel.	+358 10 6180 644
Fax (direct):	+358 9 630 976
Mobile:	+358 40 081 1327
Personal e-mail:	ash.sharma@nefco.fi

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public funding involved in this project.

Annex 3

BASELINE INFORMATION

Baseline information released by the Vietnamese DNA was used to calculate baseline emissions.

The main data used in this report to calculate the emissions factor of the Vietnamese National Grid are given below.

Type of fuel	Default carbon oxidation factor	Emission factor (tCO2/TJ)		
		default value	95% confidence interval	
			Lower	Uper
Diesel Oil	1	74.1	72.6	74.8
Fuel Oil	1	77.4	75.5	78.8
Anthracite coal	1	98.3	94.6	101
Bituminous coal	1	94.6	89.5	99.7
Natural gas	1	56.1	54.3	58.3

	2004	2005	2006	2007	2008
Hydro	17,859	16,365	19,508	22,385	25,934
Coal	6,500	7,872	8,989	9,836	10,055
Gas	19,053	24,017	26,543	29,475	33,857
Oil	1,379	1,612	1,044	1,834	1,482
FO	68	50	80	105	90
Diesel Oil	43	16	25	42	15
Bagasse	34	26	34	42	36
Import	39	373	937	2,629	3,220
Total Power Generation	44,936	49,958	56,223	63,719	71,469
Total Power Generation (including imported electricity)	**44,975**	**50,331**	**57,160**	**66,348**	**74,689**
low cost/must run	39.71%	32.52%	34.13%	33.74%	34.72%

Data source: Viet Nam DNA

Fuel Type	Fuel consumption (1000t or 1000m3)	Power Generation (MWh)	Emission factor (tCO2/TJ)	NCV (TJ/t or TJ/Nm3)	Oxidation Rate	GHG Emission (tCO2)
Year 2006						
Bituminous coal	5,645.86	8,989,230	89.5	0.022137514	1	11,186,185
Gas		26,542,978				12,079,164
Natural Gas	5,743,235.28	18,838,764	54.3	3.80038E-05	1	11,851,774
Natural Gas	70.14	233,582	54.3	0.059704121	1	227,389
Tail gas	-	7,470,632			1	-
Bituminous coal	397.65	1,043,991	89.5	0.03529172	1	1,256,021
Fuel Oil	16.60	80,000	75.5	0.040193331	1	50,374
Diesel Oil	6.39	25,000	72.6	0.043284146	1	20,080
Eelctricity imported		937,000			1	-
Total		**37,618,199**				**24,591,824**
Year 2007						
Bituminous coal	6,386.09	9,836,548	89.5	0.02197048	1	12,557,339
Gas		29,474,918				12,695,227
Natural Gas	5,910,941.84	20,023,591	54.3	3.79087E-05	1	12,167,332
Natural Gas	163.27	557,880	54.3	0.059544424	1	527,895
Tail gas	-	8,893,447			1	-
Bituminous coal	614.06	1,834,409	89.5	0.035227497	1	1,936,046
Fuel Oil	25.15	104,626	75.5	0.041028763	1	77,906
Diesel Oil	9.16	42,000	72.6	0.04285487	1	28,499
Eelctricity imported		2,629,000			1	-
Total		**43,921,501**				**27,295,017**
Year 2008						
Bituminous coal	6,483.99	10,055,394	89.5	0.021811425	1	12,657,543
Gas		33,857,135				14,244,602
Natural Gas	6,839,114.84	22,396,231	54.3	3.78844E-05	1	14,068,894
Natural Gas	54.35	183,088	54.3	0.059537854	1	175,708
Tail gas	-	11,277,816				-
Bituminous coal	534.59	1,481,880	89.5	0.035292602	1	1,688,603
Fuel Oil	22.48	90,465	75.5	0.041026994	1	69,633
Diesel Oil	3.73	15,000	72.6	0.042978657	1	11,639
Eelctricity imported		3,220,000			1	-
Total		**48,719,874**				**28,672,020**

Year	Total electricity generation (MWh)	Total Emissions (tCO2)
2006	37,618,199.00	24,591,823.95
2007	43,921,501.00	27,295,017.33
2008	48,719,874.00	28,672,019.54
EFgrid,OM,y	**0.6184**	

Power Plan	Year	Type	Fuel consumption (1000 ton or 1000m3)	Power Generation in 2008 (MWh)	Emission factor (tCO2/TJ)	NCV (TJ/t or TJ/Nm3)	Oxidation Rate	GHG Emission (tCO2)
A Vuong	2008	Hydro		168,104				
Tuyen Quang	2008	Hydro		1,136,112				
Dai Ninh	2008	Hydro		1,145,109				
Nhon	2008	Natural Gas	166.38	544,809	54.3	0.040499927	1	365,894
Ca Mau 1&2	2007	Natural Gas	647.24	2,106,807	54.3	0.039411775	1	1,385,132
				2,728,872				
Total				**7,829,812**				
A Vuong	2008	Hydro		168,104				
SROC Phu Mieng IDICO	2006	Hydro		241,556				
SE SAN	2006	Hydro		394,896				
Tuyen Quang	2008	Hydro		1,136,112				
Dai Ninh	2008	Hydro		1,145,109				
SE SAN 3	2006	Hydro		1,131,614				
Quang Tri	2007	Hydro		250,804				
Uong Bi 2	2007	Anthracite	281.759	532,000	94.6	0.020977706	1	559,148
Na Duong	2005	Anthracite	532	627,930	94.6	0.01690097	1	850,579
Cao Ngan	2007	Anthracite	526	708,693	94.6	0.020909566	1	1,040,452
Formosa	2004	Anthracite	495	560,295	94.6	0.026538076	1	1,242,698
Nhon	2008	Natural Gas	166.38	544,809	54.3	0.040499935	1	365,894
Ca Mau 1&2	2007	Natural Gas	647.24	2,106,807	54.3	0.039411764	1	1,385,132
		Tail gas		2,728,872				
Phu My	2004	Natural Gas	1159.75	4,141,980	54.3	0.038590146	1	2,430,192
Dam Phu	2006	Natural Gas	56.15	4,716	54.3	0.042497728	1	129,573
CAI LAN-VINASHI	2007	Fuel Oil	22.48	90,465	75.5	0.041026988	1	69,633
Total				**16,514,761**				**8,073,301**
Total Power Generation in 2008						74,689,636		
20% of Total Power Generation in 2008						14,937,927		
EFrid,BM,y						0.4889		

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

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 a hydropower generation project are 50% and 50% respectively as stated in the tool. The CM emission factor is calculated as shown in the equation above:

The table below demonstrates that the baseline emission factor of Vietnam's national electricity system in 2008 is 0.5537 tCO_2/MWh.

$EF_{grid,OM,y}$	0.6184	ω_{OM}	0.5
$EF_{grid,BM,y}$	0.4889	ω_{BM}	0.5
$EF_{grid,CM,y}$	0.5537		

Annex 4

MONITORING INFORMATION