Project design document form for small-scale CDM project activities

(Version 08.0)

Complete this form in accordance with the Attachment "Instructions for filling out the project design document form for small-scale CDM project activities" at the end of this form.

PROJECT DESIGN DOCUMENT (PDD)	
Title of the project activity	Nam Sor Hydropower Project
Version number of the PDD	2.0
Completion date of the PDD	11/05/2017
Project participant(s)	Vientiane Techno Co., Ltd. Swiss Carbon Assets Ltd.
Host Party	Lao PDR
Applied methodology(ies) and, where applicable, applied standardized baseline(s)	AMS-I.D. Grid connected renewable electricity generation (Version 18.0, EB 81)
Sectoral scope(s) linked to the applied methodology(ies)	Sectoral Scope 1: Energy Industries.
Estimated amount of annual average GHG emission reductions	10,630 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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Nam Sor Hydropower Project (hereafter referred to as the “the project”) is located about 17km away from Viengthong District, Vientiane Capital of Lao PDR., and developed by Vientiane Techno Co., Ltd..

The project is a run-of-river hydropower station. The installed capacity is 4.2MW (2×2.1MW), with annually 19 GWh power supplied to the power grid.

The project is expected to constantly contribute clean energy to the Lao Power Grid. For the Lao Power Grid is connected with the power grid in Thailand, the power supplied by the project will not only meet domestic electricity demand, but also increase the net power export to Thailand and decrease the net power import from Thailand, where the power grid is dominated by thermal power plants. The baseline scenario of the project is continuation of the present situation, i.e. electricity supplied from the power grid. By displacing part of the power generated by thermal power plants, the project is therefore expected to reduction of CO_2 emissions by an estimated 10,630 t CO_2e per year during the first crediting period.

As a renewable energy project, the project will produce positive environmental and economic benefits and contribute to the local sustainable development in following aspects:

- During the construction period, plenty of job opportunities were provided to local residents, and the newcomers surged in the area will bring local people lots of employment opportunities thus bring more revenue for the local residents;
- Reduce the local use of firewood displacing by electricity, reduce the damage to the local vegetation;
- Power supplied to the regional grid consisting of Thailand Power Grid and the Lao Power Grid, will provide clean & cheap electricity power in this region, promote the sustainable development in this region and slow down the increasing trend of GHG emissions.

A.2. Location of project activity

A.2.1. Host Party

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Lao PDR

A.2.2. Region/State/Province etc.

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Vientiane Capital

A.2.3. City/Town/Community etc.

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Viengthong District

A.2.4. Physical/Geographical location

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The Project site is located about 17km away from Viengthong District, Vientiane Capital of Lao PDR. The approximate coordinates of the project site is: 18°33′58″ to18°41′35″N, 104°24′48″ to 104°35′02″E.

Figure A.1 Show the location of the project:

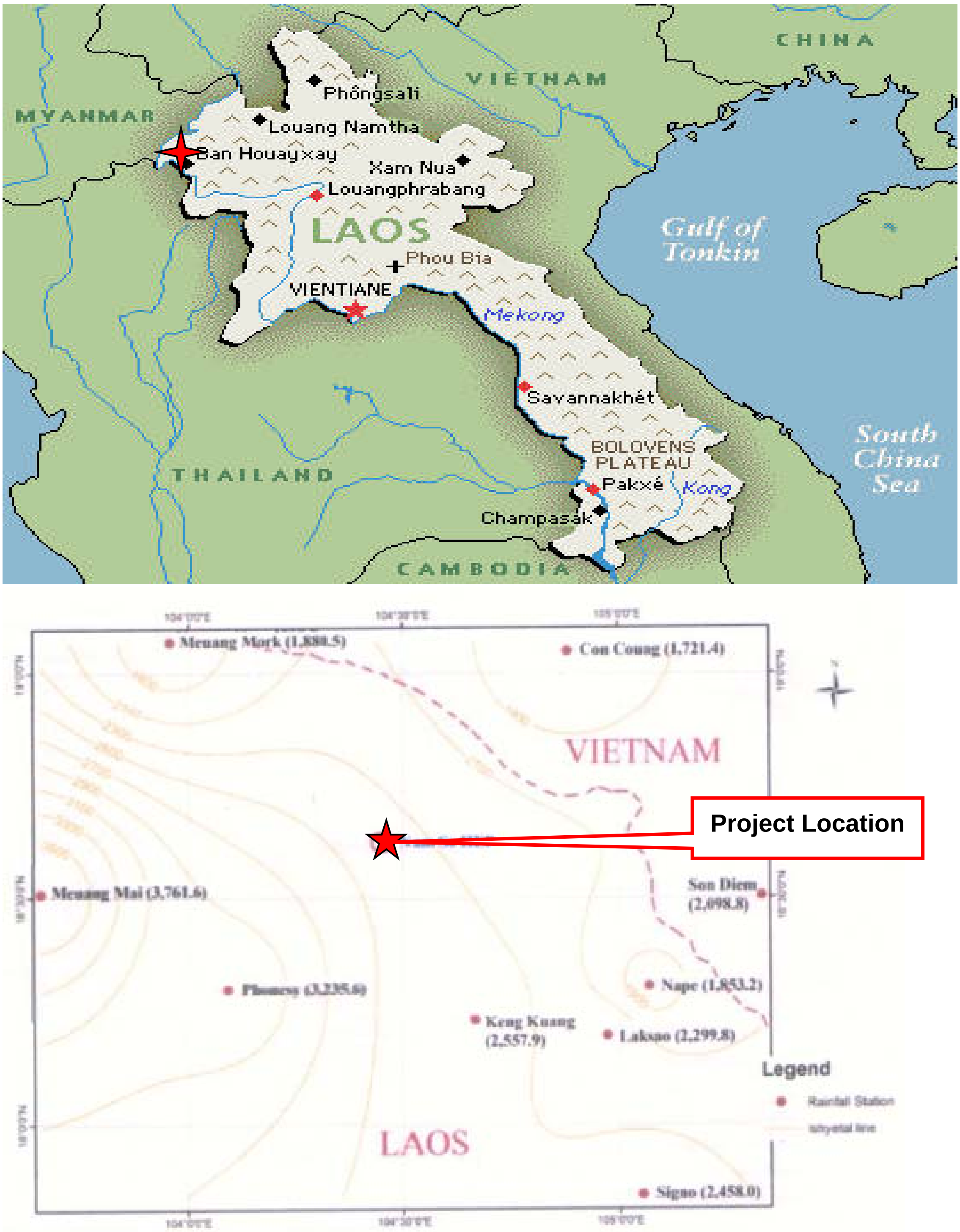

Figure A.1 Location of the project

A.3. Technologies and/or measures

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After completion of the project, the newly built plant will provide clean electric power to the regional grid consisting of Thailand Power Grid and the Lao Power Grid. The scenario prior to the start of implementation of the project activity is provision of the equivalent amount of electricity generated by the power plants connected with the regional grid, which is dominated by thermal power plants, thus leads to mass of GHG emissions. The baseline scenario is the same as the scenario prior to the start of implementation of the project activity.

The Project is a run-of-river hydropower project. The total install capacity of the project is 4.2MW (2×2.1MW). The construction of the project includes fixed weir, a sand trap, intake, headrace canal, headrace tunnel, forebay, penstock, powerhouse and a tailrace. The annual net electricity supply for the project will be 19GWh. The power generated will be delivered to EDL.

The main parameters of the equipment as follows:

Table A.1 main parameters of the equipment[1]

Parameter		Unit	Value
Turbine	Type	-	Horizontal Francis
	Rated discharge per unit	m^3/s	1.75-2.10
	Rated output per unit	MW	2,1
	Rated net head	m	120.43
	Speed	r/min	750
Generator	Type	-	Horizontal synchronous
	Output	KVA	2200
	Frequency	Hz	50
	Voltage	kV	606
	Power Factor	-	0.9

A.4. Parties and project participants

Party involved (host) indicates 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 (host)	Vientiane Techno Co., Ltd. (Project owner)	No
Switzerland	Swiss Carbon Assets Limited	No

A.5. Public funding of project activity

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The project does not receive any public funding from Parties included in Annex I of the UNFCCC. The project does not use ODA directly or indirectly.

A.6. Debundling for project activity

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According to the Guidelines on Assessment of Debundling for SSC Project Activities (Version 03, EB54, Annex13), a proposed small-scale project activity shall be deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or an application to register another small-scale CDM project activity:

(a) With the same project participants;
(b) In the same project category and technology/measure;
(c) Registered within the previous 2 years; And
(d) Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.

[1] Due to the Equipment's Parameter Technical Protocol was not obtained, the parameters were derived from Project's FSR.

The project owner indicates that there is not a registered small-scale CDM project activity or an application to register another small-scale CDM project activity in accordance with any condition mentioned above, therefore the project is not a de-bundled component of a large project activity.

SECTION B. Application of selected approved baseline and monitoring methodology and standardized baseline

B.1. Reference of methodology and standardized baseline

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Baseline methodology:
I.D. Grid connected renewable electricity generation (Version 18.0, EB 81).

This methodology draws upon the following tools:
Demonstration of additionality of microscale project activities” (Version 07.1, EB 86), and
Tool to calculate the emission factor for an electricity system (Version 5.0, EB 87)

Please click following link for more information about the methodology and tool:
http://cdm.unfccc.int/methodologies/SSCmethodologies/approved

B.2. Project activity eligibility

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The Project is a grid connected renewable electricity generation project which meets all the applicability criteria stated in methodology ASM-I.D (Version 18.0):

- The project makes use of renewable water resources to generate electricity to the regional grid consisting of Thailand Power Grid and the Lao Power Grid;
- The project will install new power plant at the site where there was no renewable energy power plant operating prior to the implementation of the project activity (Greenfield plant);
- Power density of the project is greater than 4 W/m^2;
- The total installed capacity of the project is 4.2MW, it satisfies the requirement that the capacity of the project should be at most 15 MW for a small-scale CDM project.
- The other criteria stated in the AMS-I.D are not applicable to the project;

Therefore, the methodology AMS-I.D.-Grid Connected Renewable Electricity Generation is applicable to the Project.

“Tool to calculate the emission factor for an electricity system” (Version 5.0) was adopted to estimate the emission factor of the project. According to the “Tool to calculate the emission factor for an electricity system”:

This tool may be applied to estimate the OM, BM and/or CM when calculating baseline emissions for a project activity that substitutes grid electricity, i.e. where a project activity supplies electricity to a grid or a project activity that results in savings of electricity that would have been provided by the grid (e.g. demand-side energy efficiency projects).

The power generated by the project will be supplied to the regional grid consisting of Thailand Power Grid and the Lao Power Grid, and result in saving of electricity that would have been provided by the grid. Therefore, the “Tool to calculate the emission factor for an electricity system” is applicable for this project.

B.3. Project boundary

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Spatial boundary

The power generated by the project will be supplied to the Lao Power Grid, which connected with Thailand Power Grid through transmission lines. According to the “*Calculation for the emission factor for electricity generation in Lao PDR, 2010*” published by the Lao DNA, the regional grid consisting of Thailand Power Grid and the Lao Power Grid is adopted as the project boundary.

According to AMS-I.D., 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.

According to "*Tool to calculate the emission factor for an electricity system*", the project electricity system is defined as the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity (i.e. the renewable power plant location) and that can be dispatched without significant transmission constraints. A connected electricity system 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.

According to the tool mentioned above, there are no transmission constraints if any one of the following criteria is met:

i. *In case of electricity systems with spot markets for electricity: there are differences in electricity prices (without transmission and distribution costs) of less than five per cent between the two electricity systems during 60 per cent or more of the hours of the year; or*

ii. *The transmission line is operated at 90 per cent or less of its rated capacity at least during 90 per cent of the hours of the year.*

As demonstrated by the official document by Lao DNA mentioned above, for transmission lines between Thailand and Lao Power Grid, there is no spot market exists, so the criteria i. list above is not applicable. Furthermore the load of the transmission lines between Lao Power Grid and Thailand Power Grid is far below 50% of its rated capacity during all the year[2]. So, the electricity system does not have significant transmission constrain.

According to the "*Tool to calculate the emission factor for an electricity system*":
In addition, in cases involving international interconnection (i.e. transmission line is between different countries and the project electricity system covers national grids of interconnected countries) it should be further verified that there are no legal restrictions for international electricity exchange.

The grid between Lao and Thailand kept enormous power exchange, and the power comparison of Laos export, import and domestic demand are listed below:

Table B.1 Power exchange between Lao and Thailand (Unit: GWh)

	2010	**2009**	**2008**
Lao power export to Thailand[3]	6,938.45	2,385.84	2,315.43
Domestic demand in Lao[4]	2,228.15	1,901.29	1,577.86
Lao power import from Thailand (EDL)[5]	1,042.12	1,081.19	772.8

[2] Information provided by EDL, regarding to the power load of the transmission lines between Laos and Thailand.

[3] EGAT Annual Report 2010, page 101 & Annual Report 2009, page 88, Electricity Generating Authority of Thailand.

[4] EDL Annual Report 2009, page 17, Electricite du Laos.

[5] EGAT Annual Report 2010, page 102 & Annual Report 2009, page 89, Electricity Generating Authority of Thailand.

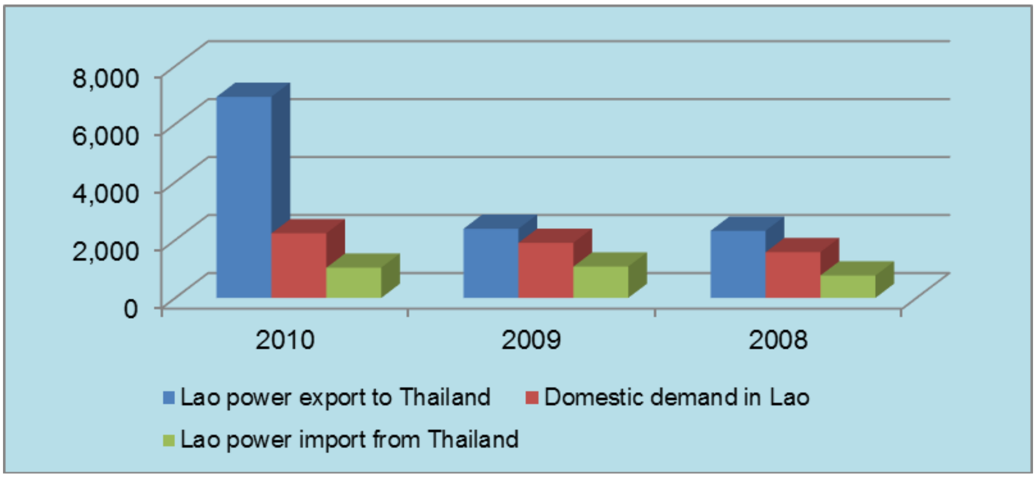

Figure B.1 Power exchange between Lao and Thailand (Unit: GWh)

The data listed above indicates the close relationship between the power system of Lao and Thailand. The Thai and Lao power system have kept intimately cooperation, and Thailand government promised that 7,000 MWh power will be imported from Lao PDR during 2010 to 2015[6]. According to the MOU signed between Lao government and Thailand government, through the interconnection between the two countries, Lao power grid could sold the surplus energy to Thailand, and the deficits of Lao demand in rush hours can be covered by imports. Based on the above information, it could be concluded that there are no legal restrictions for international electricity exchange.

Based on the reasons listed above, it is shown that the most appropriate definition of the spatial extension of the project electricity system is a regional grid consisting of Thailand Power Grid and the Lao Power Grid.

Emission sources and gases

The greenhouse gases and emission sources included in or excluded from the project boundary are shown in the table below.

Table B.2 GHG emissions in Project boundary

Source		GHGs	Included?	Justification/Explanation
Baseline scenario	CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
Project scenario	For geothermal power plants, fugitive emissions of CH_4 and CO_2 from non condensable gases contained in geothermal steam.	CO_2	No	Not applicable to hydro power Project
		CH_4	No	
		N_2O	No	
	CO_2 emissions from combustion of fossil fuels for electricity generation in solar thermal power plants and geothermal power plants.	CO_2	No	Not applicable to hydro power Project
		CH_4	No	
		N_2O	No	
	For hydro power plants, emissions of CH_4 from the reservoir.	CO_2	No	Minor emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source

A flow diagram of the project boundary is presented in Figure B.2 below. The flow diagram physically delineates the project boundary, includes the flow of electricity and the project electricity system (the regional grid consisting of Thailand Power Grid and the Lao Power Grid), and the GHG emissions.

[6] http://uk.reuters.com/article/idUKBKK15938520071018

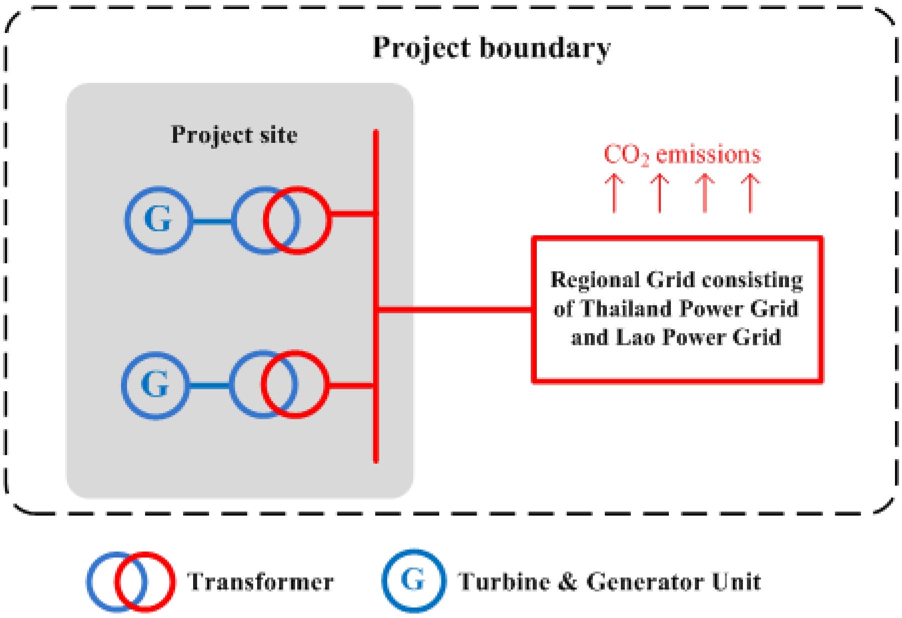

Figure B.2 Flow diagram of the project boundary

B.4. Establishment and description of baseline scenario

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According to AMS-I.D., as a Greenfield hydropower Project, the baseline scenario is that the 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 into the grid.

B.5. Demonstration of additionality

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Prior consideration of CDM

To overcome financial weakness, and unfavourable conditions that the project encounters, the project owner decided to seek CDM assistance after the project Feasibility Study Report has been completed by independent design institute.

In the 06/01/2015, the prior consideration form was submitted to both the DNA and UNFCCC within 6 months of the start date.

The main Milestones in the Project implementation and CDM application summarized in the below table:

Table B.3 Basic parameters of the project

Milestone	Data
IEE finished	01/2014
FSR finished	01/2014
IEE Approval	24/1/2014
FSR Approval	29/1/2014
ERPA with buyer	30/6/2014
Submitted the Prior CDM consideration to Lao DNA	6/1/2015
The Prior CDM consideration to EB confirmed by UNFCCC secretariat	6/1/2015
PDD Global Stakeholder Consulting (GSC)	14/4/2015~13/5/2015
Signed the Civil Work Agreement (Start date)	15/5/2015
Signed the EPC agreement	15/07/2015
LoA from Switzerland	22/1/2016

LoA from Lao PDR	19/10/2016
Commissioning and operation (estimated)	01/01/2018

As shown in above table, the CDM was seriously considered during the project implementation.

Assessment and demonstration of additionality

The additionality of the Project could be assessed according to the UNFCCC-approved additionality demonstration criteria of "Microscale Project Activity" per "Demonstration of additionality of microscale project activities" (Version 07.1, EB 86).

According to Paragraph 8(a), Project activities up to five megawatts that employ renewable energy technology are additional if the geographic location of the project activity is in one of the least developed countries or the small island developing States (LDCs/SIDS) or in a special underdeveloped zone (SUZ) of the host country, which can be summarized as follow in accordance with the Project situation:

(i) The installed capacity of the project is up to 5 MW
The actual installed capacity of the project is 4.2 MW, which is no more than 5 MW.

(ii) The project activity is located in LDCs/SIDs
Lao PDR is one of the 49 least developed countries[7] published by Committee for Development Policy (CDP).

Therefore, the condition 8(a) is satisfied. Thus, the project is deemed to be additional.

B.6. Emission reductions

B.6.1. Explanation of methodological choices

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The Methodology AMS-I.D. is applied in the context of the project in the following four steps:

- **Step 1, calculate the project emissions;**
- **Step 2, calculate the baseline emissions;**
- **Step 3, calculate the project leakage;**
- **Step 4, calculate the emission reductions.**

Calculate the project emissions

According to Methodology, the project emissions shall be calculated by the following equation:

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y} \qquad \text{(Equation B.1)}$$

Where:

PE_y	Project emissions in year y (tCO_2e/y);
$PE_{FF,y}$	Project emissions from fossil fuel consumption in year y (tCO_2/y);
$PE_{GP,y}$	Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in year y (tCO_2e/y);
$PE_{HP,y}$	Project emissions from water reservoirs of hydro power plants in year y (tCO_2e/y);

For this project, does not involve the fossil fuel consumption and geothermal power, so $PE_{FF,y}$=0, $PE_{GP,y}$=0. For hydro power project activities that result in new reservoirs and hydro power project activities that result in the increase of existing reservoirs, project proponents shall account for project emissions, estimated as follows:

a) If the power density (PD) of power plant is greater than 4 W/m^2 and less than or equal to 10 W/m^2:

$$PE_{HP,y} = \frac{EF_{Res} \cdot TEG_y}{1000} \qquad \text{(Equation B.2)}$$

[7] http://www.unohrlls.org/en/ldc/25/

Where:

$PE_{HP,y}$	Project emissions from water reservoirs (tCO_2e/y);
EF_{Res}	Default emission factor for emissions from reservoirs, and the default value as per EB 23 is 90 kg CO_2e /MWh;
TEG_y	Total electricity produced by the project activity, including the electricity supplied to the grid and the electricity supplied to internal loads, in year *y* (MWh);

b) If the power density (*PD*) of the power plant is greater than 10 W/ m^2

$$PE_{HP,y}=0 \qquad \text{(Equation B.3)}$$

The PD of the project activity is calculated as follows:

$$PD=\frac{Cap_{PJ}-Cap_{BL}}{A_{PJ}-A_{BL}} \qquad \text{(Equation B.4)}$$

Where:

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

According to the FSR, there is no reservoir for the project, thus $PE_{HP,y}$= 0. Then PE_y= 0 tCO_2.

Calculate the baseline emissions

Baseline emissions include only CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity. The methodology assumes that all project electricity generation above baseline levels would have been generated by existing grid-connected power plants and the addition of new grid-connected power plants. The baseline emissions are to be calculated as follows:

$$BE_y=EG_{PJ,y}\times EF_{grid,CM,y} \qquad \text{(Equation B.5)}$$

Where:

BE_y	=	Baseline Emissions in year *y* (tCO_2/yr)
$EG_{PJ,y}$	=	Quantity of net electricity supplied 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 for grid connected power generation in year *y*

According to Methodology, if the project activity is the installation of a new grid-connected renewable power plant/unit at a site where no renewable power plant was operated prior to the implementation of the project activity, then:

$$EG_{PJ,y}=EG_{facility,y} \qquad \text{(Equation B.6)}$$

<u>Calculate the Combined margin CO_2 emission factor</u>

The emission coefficient (measured in tCO_2e/MWh) should be calculated in a transparent and conservative manner according to the procedures prescribed in the "*Tool to calculate the emission factor for an electricity system*" (Version 05.0).

The data used for calculation are from an official source (where available) and publicly available. The calculation processes are as follows:

STEP 1: Identify the relevant electricity system.

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

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

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

STEP 5: Calculate the build margin (BM) emission factor;

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

STEP 1: Identify the relevant electricity system

The DNA of Lao has published a delineation[8] of the project electricity system and connected electricity systems, therefore these delineations are applied. The Project will supply power to Lao Power Grid, which according to the delineation published by Lao DNA, is a part of the regional power grid consisted by Lao and Thailand power grid. Therefore, the relevant electricity system is the regional power grid including Lao Power Grid and Thailand Power Grid. And the **connected electricity system** is Malaysia, China and Vietnam Power Grid[9].

For the purpose of determining the operating margin emission factor, 0 tCO_2/MWh was applied as the emission factor(s) for net electricity imports from a connected electricity system.

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

According to "*Tool to calculate the emission factor for an electricity system*" (Version 05.0), there are two options to calculate the operating margin and build margin emission factor:
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.

Option I is chosen for operating margin and build margin emission factor calculation.

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

According to "*Tool to calculate the emission factor for an electricity system*" (Version 05.0), there are four methods for calculating the $EF_{grid, OM, y}$:
(a) Simple OM, or
(b) Simple adjusted OM, or
(c) Dispatch Data Analysis OM, or
(d) Average OM

The method (d) average OM is selected.

$EF_{grid,OM\text{-}ave,y}$ is calculated using ex ante option: a 3-year generation-weighted average in 2010, 2009, 2008, 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 average OM emission factor is calculated as the average emission rate of all power plants serving the grid, using the methodological guidance as described under Step 4 in the "Tool to calculate the emission factor for an electricity system" for the simple OM, but also including the low-cost / must-run power plants in all equations.

According to *Tool to calculate the emission factor for an electricity system*, there are two options based on different data for calculating average OM:

Option A: Based on the net electricity generation and a CO_2 emission factor of each power unit; or

Option B: Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system.

The necessary data for Option A is not available, so Option B can be used.

Under this option, the average OM emission factor is calculated based on the net electricity supplied to the grid by all power plants serving the system, including low-cost/must-run power plants/units, and based on the fuel type(s) and total fuel consumption of the project electricity system, as follows:

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[8] See Calculation for the emission factor for electricity generation in Lao PDR, 2010, Lao DNA

[9] According to Electrical Power in Thailand 2008, 2009, 2010, Thailand DEDE, the Thailand import power from Lao PDR and Malaysia. Lao is considered as part of the project electricity system, and Malaysia is considered as the connected electricity system. Vietnam and China are also considered as connected electricity system for the power supply to Lao according to the Annual Repot 2012 by the Lao Power Grid Electric du Lao (EDL).

$$EF_{grid,OM-ave,y} = \frac{\sum_{i}(FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y})}{EG_y}$$ (Equation B.7)

Where:

$EF_{grid,OM\text{-}ave,y}$	Average 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 *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_y	Net electricity generated and delivered to the grid by all power sources serving the system, including low-cost/must-run power plants/units, in year *y* (MWh)
i	All fossil fuel types combusted in power sources in project electricity system in year *y*
y	The data available in the most recent 3 years

According to the *Tool to calculate the emission factor for an electricity system*, electricity imports from the connected electricity systems $EG_{import,y}$ are included in the EG_y.

The detailed calculating procedures please refer to Appendix 4 of the PDD.

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

To calculate the build margin (BM) emission factor, the data for determine the sample group of power units *m* about the most recently units in the electricity system is needed. However, as an international project system, it's difficult to obtain the information for all the units in both Lao and Thailand (power generation data, commissioning date, and the fuel consumption). The data requirements for the application for calculate the build margin (BM) emission factor cannot be met.

As the Simplified CM is adopted in the step 6, the weighting of build margin emissions factor is 0.

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

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

(a) Weighted average CM; or
(b) Simplified CM.

According to *Tool to calculate the emission factor for an electricity system*, the simplified CM can be used if:

(a) The project activity is located in: (i) a Least Developed Country (LDC); or in (ii) a country with less than 10 registered CDM projects at the starting date of validation; or (iii) a Small Island Developing States (SIDS); and
(b) The data requirements for the application of Step 5 above cannot be met.

Lao is a Least Developed Country, therefore the criteria (a) is met; and also as mentioned in step 5, the data requirements for the application for calculate the build margin (BM) emission factor is not available, therefore the criteria (b) is also met.

The Simplified CM method is calculated as follow:

$$EF_{grid,CM,y} = w_{OM} \times EF_{grid,OM,y} + w_{BM} \times EF_{grid,BM,y}$$ (Equation B.8)

Where:

$EF_{grid,CM,y}$	Combined margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EF_{grid,BM,y}$	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 emission factor;
w_{BM}	Weighting of build margin emission factor.

Where, w_{BM}= 0, w_{OM}= 1.

Thus $EF_{CO2, grid, y}$ = $EF_{grid, CM, y}$ =0.5595 tCO_2/MWh.

Calculate the project leakage

No leakage emissions are considered.

Calculate the emission reductions

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \quad \text{(Equation B.9)}$$

Where:
ER_y Emission reduction in year *y* (t CO_2e/y);
BE_y Baseline emission in year *y* (t CO_2e/y);
PE_y Project emission in year *y* (t CO_2e/y).

B.6.2. Data and parameters fixed ex ante

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Data / Parameter	$FC_{i, y}$
Unit	mass or volume unit of the fuel *i*
Description	Amount of fossil fuel type *i* consumed in the project electricity system in year *y* (mass or volume unit)
Source of data	*Calculation for the emission factor for electricity generation in Lao PDR, 2010*
Value(s) applied	Refer to Appendix 4 for details.
Choice of data or Measurement methods and procedures	Data used are from Thailand DNA.
Purpose of data	Baseline Emission Calculation
Additional comment	-

Data / Parameter	$NCV_{i,y}$
Unit	kJ/kg or kJ/m^3
Description	The net calorific value (energy content) per mass or volume unit of fuel *i* in year *y.*
Source of data	*Electric Power in Thailand 2010*
Value(s) applied	Refer to Appendix 4 for details.
Choice of data or Measurement methods and procedures	Data used are from Thailand authorities, DEDE.
Purpose of data	Baseline Emission Calculation
Additional comment	-

Data / Parameter	$EF_{CO2, i, y}$
Unit	tCO_2/TJ
Description	The CO_2 emission factor per unit of fuel i in year y
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2 Chapter 1 Table 1.4
Value(s) applied	Refer to Appendix 4 for details.
Choice of data or Measurement methods and procedures	No specific local value available, the value form IPCC 2006, Guidelines for National Greenhouse Gas Inventories was adopted.
Purpose of data	Baseline Emission Calculation

Additional comment	-

Data / Parameter	EG_y
Unit	GWh
Description	Net electricity generated and delivered to the grid by all power sources serving the system, including low-cost/must-run power plants/units, in year y.
Source of data	Calculation for the emission factor for electricity generation in Lao PDR, 2010
Value(s) applied	130
Choice of data or Measurement methods and procedures	Data used are from Thailand DNA, TGO.
Purpose of data	Baseline Emission Calculation
Additional comment	-

Data / Parameter	$EG_{import,y}$
Unit	MWh
Description	The electricity(MWh) imported from Malaysia, China and Vietnam Power Grid in year y.
Source of data	Electricity report by EGAT (2010, 2009, 2008) EDL Annual Report 2012
Value(s) applied	Refer to Appendix 4 for details.
Choice of data or Measurement methods and procedures	Data used are from Thailand authorities, EGAT.
Purpose of data	Baseline Emission Calculation
Additional comment	-

B.6.3. Ex ante calculation of emission reductions

>>

Project emission

PE_y=0 tCO_2e

Baseline emission

According to section B.6.1, in first crediting period, the baseline emission factor of the project:

$EF_{grid,CM,y} = w_{OM} \times EF_{grid,OM,y} + w_{BM} \times EF_{grid,BM,y}$ =0.5595 tCO_2e/MWh.

The baseline emission of the project:

$BE_y = EG_{PJ,y} \times EF_{grid,CM,y} = EG_{facility,y} \times EF_{grid,CM,y}$ = 19,000 ×0.5595=10,630 tCO_2e

Project leakage

No leakage emissions are considered.

Emission reductions

$ER_y = BE_y - PE_y$ = 10,630 – 0 = 10,630 tCO_2e

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

>>

Year	Baseline emissions ($t\ CO_2e$)	Project emissions ($t\ CO_2e$)	Leakage ($t\ CO_2e$)	Emission reductions ($t\ CO_2e$)
2018	10,630	0	0	10,630
2019	10,630	0	0	10,630
2020	10,630	0	0	10,630
2021	10,630	0	0	10,630
2022	10,630	0	0	10,630
2023	10,630	0	0	10,630
2024	10,630	0	0	10,630
Total	74,410	0	0	74,410
Total number of crediting years	7			
Annual average over the crediting period	10,630	0	0	10,630

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

>>

Data / Parameter	$EG_{facility,y}$
Unit	MWh
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y
Source of data	Calculated value
Value(s) applied	$EG_{facility,y} = EG_{output,y} - EG_{input,y}$
Measurement methods and procedures	Calculated
Monitoring frequency	Continuously
QA/QC procedures	Please refer to $EG_{output,y}$ and $EG_{input,y}$
Purpose of data	Baseline Emission Calculation
Additional comment	-

Data / Parameter	$EG_{output,y}$
Unit	MWh
Description	Electricity supplied by the project to the grid in year y
Source of data	Measured by meters
Value(s) applied	19,000
Measurement methods and procedures	Continuous measurement and monthly recording, Refer to Section B.7.3 for details.
Monitoring frequency	Continuously
QA/QC procedures	According to the recommendation by the manufacturer or the regulations of the grid company, meters will be calibrated periodically. Data measured by meters will be cross-checked with the record document confirmed by EdL.
Purpose of data	Baseline Emission Calculation
Additional comment	-

Data / Parameter	$EG_{input,y}$
Unit	MWh
Description	The electricity used by the project and input from the grid in year y
Source of data	Measured by meters
Value(s) applied	0 MWh for ex-ante calculation

Measurement methods and procedures	Continuous measurement and monthly recording. Refer to Section B.7.3 for details.
Monitoring frequency	Continuously
QA/QC procedures	According to the recommendation by the manufacturer or the regulations by the grid company, meters will be calibrated periodically. Data measured by meters will be cross-checked with the record document confirmed by EDL.
Purpose of data	Baseline Emission Calculation
Additional comment	-

B.7.2. Sampling plan

>>
NA.

B.7.3. Other elements of monitoring plan

>>
The purpose of the monitoring plan is to ensure that the monitoring and calculation of emission reductions of the project within the crediting period is complete, consistent, clear and accurate. The plan will be implemented by the project owner with the support of the grid corporation.

1. Monitoring organization

The monitoring process will be carried out and responsibility by the project owner. A monitoring panel will be established by the plant managers to be in charge of monitoring the data and information relating to the calculation of emission reductions with the cooperation of the Technical and Financial Department. A CDM manager will be assigned full charge the monitoring works. The operation and management structure is shown below:

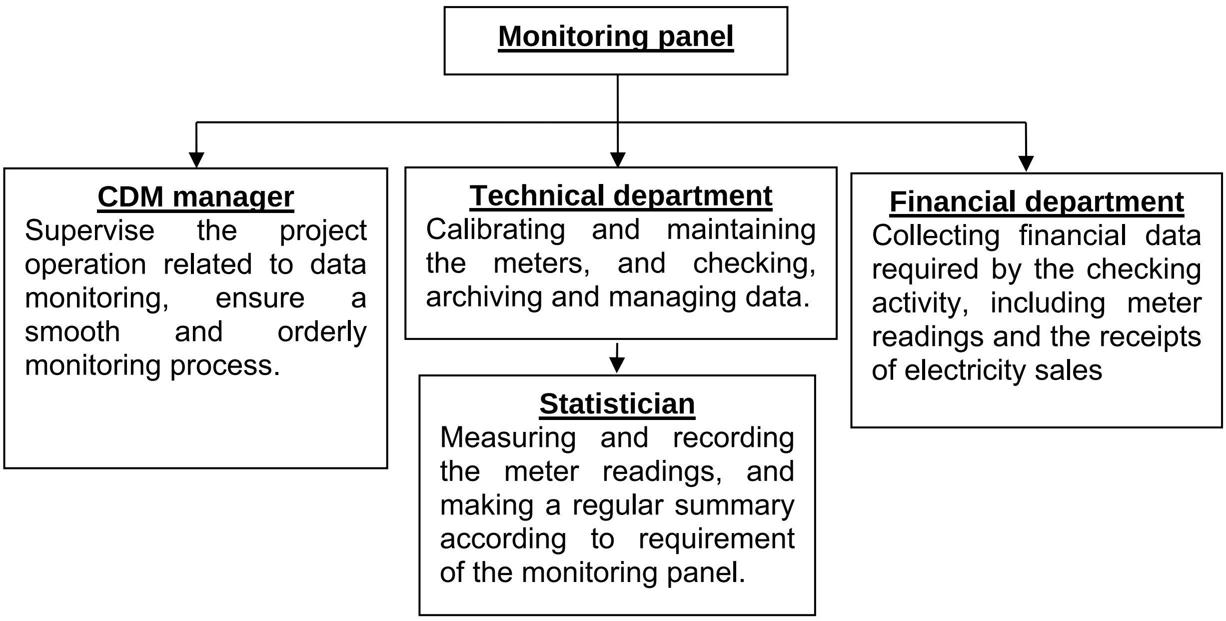

Figure B.4 Organization structure of the monitoring activity

2. Monitoring apparatus and installation:

The meters will be installed in accordance with relevant national or international standard. Before the operation of the project, the metering equipments will be clarified and examined by the project owner and the power grid company according to the above regulation. The power generated will be delivered to EDL through transmission lines.

3. Data collection:

The specific steps for data collection and reporting are listed below:

a) During the crediting period, both the grid company and the project owner will record the values displayed by the main meter.
b) Simultaneously to step a), the project owner will both record the values displayed by the backup meters.
c) The meters will be calibrated according to the relevant regulation and request of EDL.
d) The main meter's readings will be cross-checked with record document confirmed by EDL.
e) The project owner and the grid company will record both output and input power readings from the main meter. These data will be used to calculate the amount of net electricity delivered to the grid.
f) The project owner will be responsible of providing copies of record document confirmed by EDL to the DOE for verification.

If the reading of the main meter in a certain month is inaccurate and beyond the allowable error or the meter doesn't work normally, the grid-connected power generation shall be determined by following measures:

g) Read the data of the backup meters.
h) If the backup meter's data is not so accurate as to be accepted, or the practice is not standardized, the project owner and the grid corporation should jointly make a reasonable and conservative estimation method which can be supported by sufficient evidence and proved to be reasonable and conservative when verified by DOE.
i) If the project owner and the grid corporation don't agree on an estimated method, arbitration will be conducted according the procedures set by the agreement to work out an estimation method.

4. Calibration

Calibration of Meters should be implemented according to relevant standards and rules accepted by the grid company EDL. After the examination, the meters should be sealed. The lift of the seals requires the presence of both the project owner and the grid company. One party must not lift the seals or fiddle with the meters without the presence of the other party.

All the meters installed shall be tested by a qualified metering verification institution commissioned jointly by the project owner and the grid company within 10 days after:

1) Detection of a difference larger than the allowable error in the readings of both meters;
2) The repair of all or part of meter caused by the failure of one or more parts to operated in accordance with the specifications.

5. Data management system

Physical document such as the plant electrical wiring diagram will be gathered with this monitoring plan in a single place. In order to facilitate auditors' access to project documents, the project materials and monitoring results will be indexed. All paper-based information will be stored by the technical department of the project owner and all the material will have a copy for backup. All data, including calibration records, will be kept until 2 years after the end of the total crediting period.

6. Monitoring Report

During the crediting period, at the end of each year, the monitoring officer shall produce a monitoring report covering the past monitoring period. The report shall be transmitted to the General Manager who will check the data and issue a final monitoring report in the name of the projects participants. Once the final report is issued, it will be submitted to the DOE for verification.

B.8. Date of completion of application of methodology and standardized baseline and contact information of responsible persons/ entities

>>
Date of completion of application of methodology and standardized baseline:
11/05/2017

Responsible persons/ entities:
Mr. Lu Yaodong

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

>>
15/5/2015 (Civil Work Agreement)

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

>>
Renewable crediting period

C.2.2. Start date of crediting period

>>
01/01/2018

C.2.3. Length of crediting period

>>
7 years of the first crediting period

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>>
The Initial Environmental Examination (IEE) with Environmental Management Plan for Nam Sor Hydropower Project was compiled by qualified institute. According to this report, environmental impacts caused by the project and the corresponding measures adopted by the project owner for mitigation are as following:

<u>Construction Phase</u>

Wastewater

The waste water is not allowed to be discharged into River directly in order to protect the water quality. The wastewater generated from disturbed, erosion prone land (i.e. construction camps, quarries, borrow pits and spoil dumps) will be treated employing the following mitigation measures according to the IEE report:

- Dirty water from erosion-prone land will be collected in interception channels and, if necessary, directed to sedimentation ponds, prior to being released to the environment;
- Septic sanitation facilities will be provided to construction and camp areas. No untreated human waste is allowed to enter any watercourse to affect water quality, aquatic environments and human health.
- All hydrocarbons (e.g. fuels and lubricants) and chemical reagents will be stored in safe places, fully bundled areas constructed and managed in accordance with relevant International Standards and Material Safety Data Sheets. Oil, fuel and lubricant storage areas should be located well away from any water courses. Project Developer will ensure that containers of reagents and drums of used oil or

grease are stored under cover at all times;
- Potentially oil runoff from areas such as vehicle maintenance bays, equipment lay down areas, or refuelling stations will be contained by perimeter bundling or interception drains. Oil runoff will be directed through oil/water separators prior to discharge to the environment. Oil/water separators will be regularly cleaned and maintained.

Exhaust gases and dust

Exhaust gases resulting from vehicles, construction equipments and the dust generating from the construction activities is the greatest threaten of air quality. Dustproof measures are employed including watering and dust collecting, wet construction method will be used to minimize the negative impact and those construction equipment and vehicles in compliance with relevant sanitary regulations will be selected and properly conserved. Furthermore, dustproof respirator will be applied to protect the respiratory tract of the workers on site who are granted to be the main casualties. Attribute to the methods mentioned above, the negative impact on air quality is confined into the construction site during the construction period and can be neglected.

Solid and Liquid Waste

Waste management procedures will be based on the following hierarchy (in decreasing order of preference): (i) Minimize the waste production and maximize waste recycling and reuse; and (ii) Promote safe waste disposal.
To minimize waste production, a lot of mitigation measures will be taken including maximizing the efficiency of all on-site activities, supplying products with less waste produced and using no-hazardous materials. Project owner will educate staff, contractors to minimize litter generation and procedures will be established for segregating different types of waste at the location where they are generated to maximize the recovery of recyclables.

Noise and vibration

The area of construction, including quarries should have restricted working hours, including restricted times for above ground blasting. Construction workers exposed to noise levels of 70-80 dB or more than will be provided with adequate hearing protection, in accordance with the requirements of the health and safety plan. The exhaust and radiator silencers will be fitted to construction equipment, in particular, trucks and loaders. Construction activities and use of heavy vehicles will be minimized during night time. Emissions from reversing alarms may be regulated to reduce intrusiveness, particularly at night.

Impacts on ecosystem

Soil and water erosion might be induced attribute to slope exploration, earth-and-rock excavation, and the utilization of dumpsites. Rehabilitation of vegetation and other technique methods will be conducted to minimize the negative impact once the construction activities completed.

There seems to be no land acquisition involved with the project and no resettlement either, the soil is poor with low coverage rate of vegetation. Therefore, the induced ecosystem loss is minimum.

No cultural relic, mineral or protected plant were identified during the environment survey, and no extinction of plant will be induced. Hence, the impact to local ecosystem attribute to the transformation of land use is insignificant.

As the construction site is far away from nearest village, the proposed project will not result in any displacement of residents and inundation of houses.

Operation Phase

Waste water

The wastewater mainly generated from the permanent staffs during the operation phase is not allowed to be fed into the river directly. It is designed that the domestic sewage should be disposed using the advanced integrated treatment equipment to minimize the impacts on local environment.

Water quality and quantity

Clearance of head pond is one of the procedures that the project developer will be taken before head pond being filled in order to secure the operating safety that might be influenced by the trees, waste and etc. to be submerged. The project owner will closely coordinate with Provincial Agriculture and Forestry Office (PAFO) and District Agriculture and Forestry Office (DAFO) to undertake the head pond clearance.

And attribute to the river-type characteristics, the hydrological feature such as the precipitation, temperature and etc. will not alter obviously. Furthermore, the minimum water release will be not less than the natural flow in the dry season to maintain the eco-system.

In conclusion, environmental impacts arising from the Project are considered insignificant.

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

>>

During the Initial Environmental Examination (IEE) compiled period, stakeholder comments are collected in a series of ground survey, village profile and household survey with the use of questionnaires and interviews.

The participants of the surveys and interviews were from different groups including: all the stakeholders who concerns about the project, representative of Lao Women's Union at village level, Lao national Old People Union at the village level, and head of village and head of household.

The stakeholders took part in the workshops, and stated their concerns on the issues on land use, water supply, infrastructure construction, and local cultures. The workshops discussed such topics and put forward corresponding mitigation measures.

E.2. Summary of comments received

>>

The comments received from the stakeholders are summary as follows:

1) Hope the project owner could assist the villager erect water supply system.
2) Hope the construction of the dam not impact the water use of the downstream residents.
3) Hope the project owner could introduce advanced agricultural technologies to the local villagers and improve their living standard.
4) Hope the construction of the project could improve local power supply situation.
5) Local transportation condition is poor, hope the project could help improve the road construction.
6) Hope the project construction could provide working chance to local residents.

E.3. Report on consideration of comments received

>>

The project does not involve resettlements. Considerations on the comments by the stakeholders are listed as follow:

1) Water supply program will be implemented for the villagers. The project owner will dig well and provide water pump to the local residents.
2) The minimum flow will be released to maintain the eco-system and meet demand for irrigation in the downstream.
3) The project owner will donate money to the appointed Agricultural Development Fund, professional staff will introduce agricultural technologies to the villagers.
4) The construction of the project will improve local electricity transmission system, promote the electrification progress. Furthermore, the project owner will cooperate with the telecommunication company, provide electricity power to the communication station and thus promote local communication system development.
5) During the project construction period, the project owner will improve local road condition to transport the equipments. The project owner will also donate money to government for the national road construction alone the project site, which will greatly improve local transportation condition.
6) During the project construction period, plenty of working chances will provided to local residents. And during the operation period, some long-term position will provided to local people.

SECTION F. Approval and authorization

>>

The Letters of approval from the Lao PDR and Switzerland were obtained.

Appendix 1. Contact information of project participants and responsible persons/ entities

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	Vientiane Techno Co., Ltd.
Street/P.O. Box	Dongsavath Village, Sisattanak District
Building	
City	Vientiane Capital
State/Region	
Postcode	
Country	Lao PDR
Telephone	+856-21-330309
Fax	
E-mail	
Website	
Contact person	Sisouvanh Keomany
Title	Director
Salutation	Mr.
Last name	Sisouvanh
Middle name	
First name	Keomany
Department	
Mobile	+856-20-55505351
Direct fax	
Direct tel.	
Personal e-mail	vtc_330309@yahoo.com

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	Swiss Carbon Assets Limited
Street/P.O. Box	Technoparkstr 1
Building	-
City	Zürich
State/Region	-
Postcode	8005
Country	Switzerland
Telephone	+41 43 501 35 50
Fax	+41 43 501 35 99
E-mail	registration@southpolecarbon.com
Website	-
Contact person	Renat Heuberger
Title	-
Salutation	Mr.
Last name	Heuberger
Middle name	-
First name	Renat
Department	-
Mobile	-
Direct fax	+41 43 501 35 99
Direct tel.	+41 43 501 35 50
Personal e-mail	

Appendix 2. Affirmation regarding public funding

No public funding from parties included in UNFCCC Annex I is available to the project activity.

Appendix 3. Applicability of methodology and standardized baseline

Please refer to the Section B.1 of the PDD.

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

Table 1 Net electricity generated and delivered to the grid by all power sources serving the system (GWh)

Year	2010	2009	2008
Power generation by EdL owned power plants	1,552.73	1,655.91	1,777.57
Power generation by IPP located in Laos	7,329.69	2,135.32	1,938.01
Power generation in Thailand	152,913.56	142,697.75	142,330.52
Sum up	**161,795.98**	**146,488.98**	**146,046.10**

Sources from:

- EDL Annual Report 2012, 2010, 2009, Electricite du Laos;
- Electric Power in Thailand 2010, 2009, 2008, Department of Alternative Energy Development and Efficiency, Ministry of Energy, Thailand;
- Electricity Statistic Annual Report 2010, Electricity Generating Authority of Thailand.

Table 2 Power import from the connected system (GWh)

Year	2010	2009	2008
Malaysia	160.31	92.68	470.67
Vietnam	31.81	25.39	22.59
China	77.02	21.58	17.78
Sum up	**269.14**	139.65	**511.04**

Sources from:

- Electricity Statistic Annual Report 2010, 2009, 2008, Electricity Generating Authority of Thailand.
- EDL Annual Report 2012, Electricite du Laos.

Table 3 Quantity of GHG emission by all power sources serving the system

Fuel Type	Fuel Consumption		Fuel Specific EF	Net Calorific Value	GHG emission
	$FC_{i,y}$		$EF_{CO2,m,i,y}$	$NCV_{i,y}$	$FC_{i,y}$x$EF_{CO2,m,i,y}$x $NCV_{i,y}$/1000000
	Unit	FC/Unit	tCO_2/TJ	MJ/Unit	tCO_2
2010					
Natural Gas	scf.	1,073,084,673,019	54.3	1.02	59,433,868
Lignite	ton	16,043,174	90.9	10470	15,268,658
Bituminous	ton	5,502,160	89.5	26370	12,985,730

Bunker	liter	233,229,746	75.5	39.77	700,304
Diesel	liter	24,026,558	72.6	36.42	63,528
2009					
Natural Gas	scf.	968,924,717,809	54.3	1.02	53,664,864
Lignite	ton	15,818,265	90.9	10470	15,054,607
Bituminous	ton	5,486,248	89.5	26370	12,948,176
Bunker	liter	158,017,445	75.5	39.77	474,469
Diesel	liter	13,825,937	72.6	36.42	36,557
2008					
Natural Gas	scf.	977,016,893,281	54.3	1.02	54,113,058
Lignite	ton	16,407,465	90.9	10470	15,615,362
Bituminous	ton	5,578,567	89.5	26370	13,166,060
Bunker	liter	350,209,394	75.5	39.77	1,051,551
Diesel	liter	51,941,958	72.6	36.42	137,339

Sources from:

- Electricity Statistic Annual Report 2010, Electricity Generating Authority of Thailand.
- IPCC 2006, Guidelines for National Greenhouse Gas Inventories, Volume 2 Chapter 1 Table 1.4.
- Electric Power in Thailand 2010, Energy Content of Fuel, Department of Alternative Energy Development and Efficiency, Ministry of Energy, Thailand.

$EF_{grid,CM,y} = w_{OM} \times EF_{grid,OM,y} + w_{BM} \times EF_{grid,BM,y}$ = 1×0.5595 = 0.5595 tCO_2e/MWh.

Based on the equation and above data, the $EF_{grid,OM\text{-}ave,y}$ =0.5595 tCO_2/MWh

Appendix 5. Further background information on monitoring plan

Please refer to the Section B.7 of the PDD.

Appendix 6. Summary of post registration changes

NA.

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Document information

Version	Date	Description
08.0	22 July 2016	EB 90, Annex 2 Revision to include provisions related to automatically additional project activities.
07.0	15 April 2016	Revision to ensure consistency with the “Standard: Applicability of sectoral scopes” (CDM-EB88-A04-STAN) (version 01.0).
06.0	9 March 2015	Revisions to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Editorial improvement.
05.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the project design document form for small-scale CDM project activities (these instructions supersede the "Guidelines for completing the project design document form for small-scale CDM project activities" (Version 01.1)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and 错误!未找到引用源。; • Change the reference number from *F-CDM-SSC-PDD* to *CDM-SSC-PDD-FORM*; • Editorial improvement.
04.1	11 April 2012	Editorial revision to change history box by adding EB meeting and annex numbers in the Date column.
04.0	13 March 2012	EB 66, Annex 9 Revision required to ensure consistency with the “Guidelines for completing the project design document form for small-scale CDM project activities”
03.0	15 December 2006	EB 28, Annex 34 • 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.

Version	Date	Description
02.0	08 July 2005	EB 20, Annex 14 • 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>.
01.0	21 January 2003	EB 07, Annex 05 Initial adoption.

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Document Type: Form
Business Function: Registration
Keywords: project design document, SSC project activities