Project design document form for small-scale CDM project activities

(Version 06.0)

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 Nga 2 Hydropower Project
Version number of the PDD	2.1
Completion date of the PDD	05/11/2015
Project participant(s)	Nam Nga 2 Hydropower Co., Ltd. Swiss Carbon Assets Limited
Host Party	Lao PDR Switzerland
Sectoral scope and selected methodology(ies), and where applicable, selected standardized baseline(s)	Sectoral Scope 1: Energy Industries. Baseline methodology: AMS I.D. - Grid Connected Renewable Electricity Generation
Estimated amount of annual average GHG emission reductions	35,019 t CO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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Nam Nga 2 Hydropower project (hereafter referred to as the "the project") is located on main stream of Nam Nga River, about 80 km from powerhouse and dam zone to M. Xai City, Oudom Xai Province, Lao PDR, developed by Nam Nga 2 Hydropower Co., Ltd. The installed capacity of the project is 14.5 MW, with the annually 62.59 GWh power supplied to the power grid.

Following the Lao PDR's electrification policy, the electricity supply falls in short compared to the increased electricity demand. 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 35,019 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;
- The infrastructures were greatly improved. The implementation of water supply program, transportation and electricity system enhancement will bring substantial benefits to local villagers;
- 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 slowing 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.

>>

Oudom Xai Province

A.2.3. City/Town/Community etc.

>>

Nga District

A.2.4. Physical/Geographical location

>>

The Project site is located at the Nam Nga River, 70 km from the Muang Sai City, Oudom Xai Province, North part of Lao PDR. The approximate coordinates of the project site (overflow weir) is: 20.40°N, 102.017°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 total install capacity of the project is 14.5 MW. The construction of the project includes intake, headrace channel, head tank, penstock, powerhouse with 2 units of turbines (2*7,250 kW). Refer to the following table for the main equipment's parameters.

Table A.1 main parameters of the equipment

Item		Unit	Value[1]
Turbine	Type	-	HL275-LJ-220
	Unit Capacity	MW	7.25
	Number of unites	-	2
	Rated head	m	26.5
	Rated discharge	m^3/s	31.97
	Rated speed	r/min	187.5
	Rated capacity	-	≥92%
Generator	Type	-	SF7.25-16/4000
	Rated output	MW	7.25
	Rated voltage	kV	6.3
	Power factor	-	0.8
	Rated speed	r/min	187.5
	Rated frequency	Hz	50

The power generated will be delivered to EDL through transmission lines.

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)	Nam Nga 2 Hydropower 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 "*Assessment of Debundling for SSC Project Activities" (Version 04.0, EB 83, Annex 13)*, 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;

[1] The final equipment purchase contract has not signed, the parameters' value are derived from the FSR. The actual parameter value should be depended on the equipment purchase contracts.

(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.

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:

AMS I.D. Grid connected renewable electricity generation (Version 18, EB 81).

This methodology draws upon the following tools:
Tool for the demonstration and assessment of additionality (Version 7.0.0, EB 70), and
Tool to calculate the emission factor for an electricity system (Version 4.0.0, EB 75)

And the Approved consolidated baseline and monitoring methodology ACM0002 (Version 16, EB 81): Grid-connected electricity generation from renewable sources is also a reference according to AMS I.D.

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

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):

- 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 14.5 MW, 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.

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 the 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.

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 don 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.

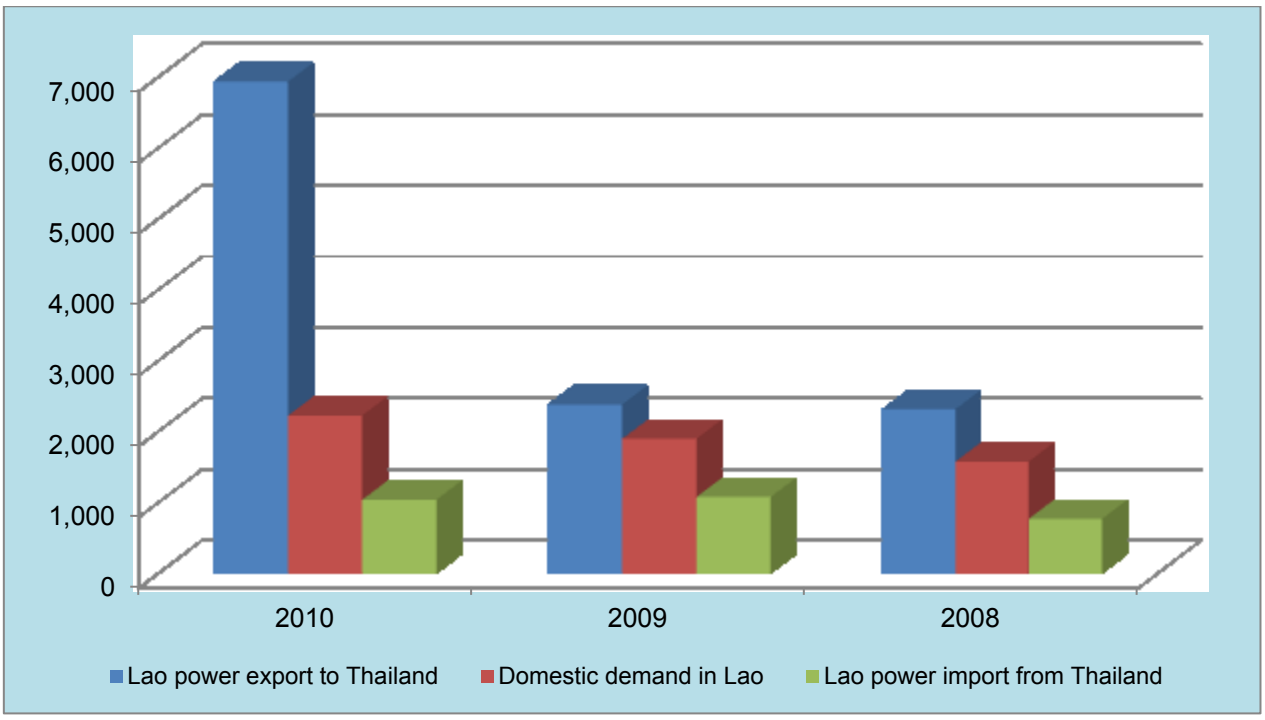

Figure B.1 Power exchange between Lao and Thailand (Unit GWh)

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 MW 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	Gas	Included?	Justification/Explanation
Baseline	CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
Project Activity	For 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	

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

	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	No reservoir in the project
		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.

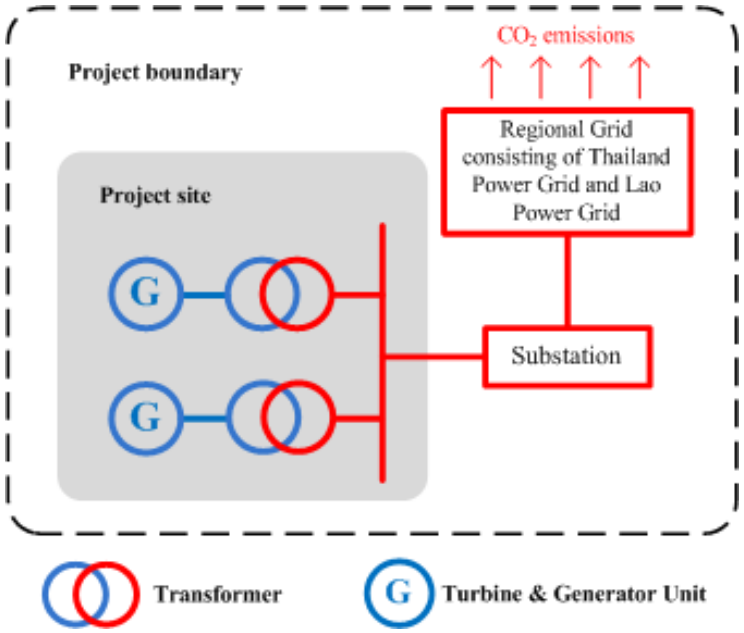

Figure B.2 Flow diagram of the project boundary

B.4. Establishment and description of baseline scenario

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According to ASM I.D, 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.

The project is run-of-river hydropower project. As described in Section B.3 of the PDD, the project electricity system is a regional grid consisting of Thailand Power Grid and the Lao Power Grid. In the absence of the project, the local was/will be supplied by the above mentioned regional grid. Thus, the baseline scenario of the project is continuation of the present situation, i.e. electricity supplied from the regional power 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 carbon revenue assistance after the project Feasibility Study Report has been completed by independent design institute. In 18/02/2014, the prior consideration form was submitted to UNFCCC. The prior consideration form was submitted within 6 months after the

project starting date, the CDM was seriously considered in the decision to implement the project activity.

Table B.3 Major Milestone in the development of the project implementation and CDM application

Date	Milestone
Dec. 2012	FSR completed
Feb. 2013	EIA completed
Mar. 11 2013	FSR approved by Government of Lao PDR
Mar. 19 2013	EIA approved by Government of Lao PDR
Sep. 11 2013	Board meeting decided to carry out the project with CDM assistance
Dec. 31 2013	Submitted the CDM Prior Consideration to Lao DNA
Feb. 18 2014	Submitted the CDM Prior Consideration to UNFCCC secretary
Jul. 22 2014	Signed the Emission Reduction Purchase Agreement (ERPA) with buyer
Jul. 24 2014	Civil work agreement (**Starting date**)
Aug. 07 2014	Uploaded PDD for Global Stakeholder Consulting
Dec. 23 2014	Got the Lao PDR LoA
Jul. 21 2015	Got the Switzerland LoA

Assessment and demonstration of additionality

According to Attachment A to Appendix B of the Simplified Modalities and Procedures for Small-scale CDM Project Activities, Project participants shall provide an explanation to show that the project activity would not have occurred anyway due to at least one of the following barriers:

a) Investment barrier: a financially more viable alternative to the project activity would have led to higher emissions;
b) Technological barrier: a less technologically advanced alternative to the project activity involves lower risks due to the performance uncertainty or low market share of the new technology adopted for the project activity and so would have led to higher emissions;
c) Barrier due to prevailing practice: prevailing practice or existing regulatory or policy requirements would have led to implementation of a technology with higher emissions;
d) Other barriers: without the project activity, for another specific reason identified by the project participant, such as institutional barriers or limited information, managerial resources, organizational capacity, financial resources, or capacity to absorb new technologies, emissions would have been higher.

The additionality assessment is based on the proposition that the project faces an investment barrier would prevents its implementation. As a small hydropower project located in poor mountainous area, the project faces many implementation complexities, which make it hardly financial attractive. The investment barrier represents the most prohibitive factor in implementing the project. Detailed analysis is shown as follow:

The insurmountable barrier for the implementation of the project is investment barrier. According to the “Tool for the demonstration and assessment of additionality” (Version 7.0.0) approved by EB, the additionality of the project is demonstrated and assessed through the following steps.

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

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

Plausible and credible alternatives available to the project that provide outputs or services comparable to the proposed CDM project activity include:

Alternative a): The project activity not undertaken as a CDM project activity;

Alternative b): Construction of a thermal power plant with equivalent installed capacity or annual electricity generation;

Alternative c): Construction of a power plant using other sources of renewable energy with equivalent amount of annual electricity generation;

Alternative d): Provision of an equivalent amount of annual power output by the grid into which the project is connected.

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

Alternative b) is not a realistic alternative. Lao is lack in oil and natural gas resources, only coal could be produced domestically. According to the Power System Development Plan for Lao PDR, there isn't an existing thermal power plant with the similar or larger power generation capacity with Nam Nga 2 project in Lao yet, due to the less developed mining industry and transportation system, the condition is limited for thermal power generation development in Lao, till now, the first coal-fired power plant is still under planning, the alternative b) is not a realistic alternative.

Alternative c), other kinds of renewable energy technologies, such as wind, solar PV, geothermal, and biomass are possible grid-connected sources. However, according to the *Country Paper Rural Energy Development and Utilization*[7], these projects face varies barriers in awareness, finance, law and institution and technologies, etc. The other kinds of renewable energy technologies in Lao are not mature currently and lack of financial attractive to construct power plants with the similar power generation capacity with Nam Nga 2 project.

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

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

Sub-step 1b. Consistency with mandatory laws and regulations:

All the alternatives identified above are in compliance with applicable rules and regulations in Lao PDR.

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

Step 2. Investment analysis

The purpose of this step is to determine whether the project activity is economically or financially less attractive than other alternatives without the revenue from the sale of certified emission reductions (CERs). The investment analysis was conducted in the following steps:

Sub-step 2a. Determine appropriate analysis method

The "*Tool for the Demonstration and Assessment of Additionality (Version 7.0.0)"* proposal three analysis methods which are:

(Option I) Simple cost analysis;

(Option II) Investment comparison analysis;

[7] Prepared by Renewable Energy Technology Center, Technology Research Institute of Lao PDR,

(Option III) Benchmark analysis;

Since the project will earn revenues not only from the CERs sales but also from electricity sales, the simple cost analysis method is not appropriate. Investment comparison analysis method is only applicable to projects whose alternatives are similar investment projects. The Alternative d) of the project is supply electricity by the regional grid rather than newly invested projects. Therefore Option II is not appropriate. The project will use benchmark analysis method (Option III) based on the consideration that benchmark IRR of the power sector is available.

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

According to the "*Tool for the Demonstration and Assessment of Additionality (Version 7.0.0)*", there are five options for discount rates and benchmarks determine:

a) Government bond rates, increased by a suitable risk premium to reflect private investment and/or the project type, as substantiated by an independent (financial) expert or documented by official publicly available financial data;

b) Estimates of the cost of financing and required return on capital (e.g. commercial lending rates and guarantees required for the country and the type of project activity concerned), based on bankers views and private equity investors/funds' required return on comparable projects;

c) A company internal benchmark (weighted average capital cost of the company), only in the particular case where the project activity can be implemented by the project participant, the specific financial/economic situation of the company undertaking the project activity can be considered. The project developers shall demonstrate that this benchmark has been consistently used in the past i.e. that project activities under similar conditions developed by the same company used the same benchmark;

d) Government/official approved benchmark where such benchmarks are used for investment decisions;

e) Any other indicators, if the project participants can demonstrate that the above Options are not applicable and their indicator is appropriately justified.

For this project, option a) was applied. The project adopted US dollar as the currency accounted and invested in Lao PDR, thus the benchmark is combined by the maturity rate of the 3-month US Treasury bill and the risk premium on lending of Laos which could respectively reflect the risk-free return of the currency adopted and the risk premium of the host country.

The average value of the 3-Month US Treasury Constant Maturity Rate[8] at the recent 20 years before the prior consideration date (Feb 19th 1994 ~ Feb 18th 2014) 2.88% will be introduced to represents the risk free rate (nominal rate, consistent with the calculation of cash flow) for the following reasons:

i. There is no systematic government bond issue structure in Lao PDR;
ii. The project was accounted in U.S. dollar, and the 3-month U.S. Treasury rate is a widely accepted risk-free rate[9];
iii. The average value in the recent 20 years before the starting date was applied since the long term average value reduces the short term uncertainty and violation of the market.

Regarding the value of national risk premium. The data "Risk premium on lending (prime rate minus Treasury bill rate; %)" provided by World Bank[10] was applied. Risk premium on lending is the interest rate charged by banks on loans to prime private sector customers minus the "risk free" Treasury bill interest rate at which short-term government securities are issued or traded in the

[8] Website of the Federal Reserve Bank of St. Louis

http://research.stlouisfed.org/fred2/series/DGS3MO?cid=47

[9] http://www.investopedia.com/terms/r/risk-freerate.asp#axzz1V9mGhc6k

[10] http://data.worldbank.org/indicator/FR.INR.RISK

market. The data is proper to illustrate the "suitable risk premium to reflect private investment" in the host country stated in the *"Tool for the Demonstration and Assessment of Additionality (Version 7.0.0)"*. To reduce the short term uncertainty, the average risk premium of Lao PDR in the latest 5 years 12.68% was adopted (the risk premium of Lao PDR from 2006 to 2010 are 11.70, 10.10, 11.70, 15.30 and 14.60 respectively).

So, the benchmark adopted equals the maturity rate of the 3-month US Treasury bill plus the Risk premium on lending in Lao PDR, the value is 15.56% (post-tax).

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

1) Basic parameters for calculation of financial indicators

Based on the Feasibility Study Report (FSR) accomplished by the third party, the main assumptions for the investment analysis are shown in Table below.

Table B.4 Basic parameters of the project

Basic parameters	Unit	Value	Source
Installed capacity	MW	14.5	FSR
Annual net power supplied	GWh	62.59	FSR
Operation period	year	25	FSR
Construction period	year	2	FSR
Statistic Investment	Million USD	27.41	FSR
Bankloan	Million USD	19.2	FSR
Interest rate	-	7.7%	FSR
Annual O&M cost	10^3USD		
Employee fee	10^3USD	150	FSR
Material fee	USD/kW	0.5	FSR
Maintenance fee	-	1.5%	FSR
Resource utilization fee	-	1%	FSR
Other fee	USD/kW	1	FSR
Electricity tariff(including VAT)	Cents/kWh	6.5	FSR
Income tax rate	-	15%	FSR
Business Turnover tax	-	5%	FSR
Minimum tax rate	-	0.25%	FSR
Residual value	Million USD	0	FSR
Depreciation Period			
Building	Years	20	FSR
Equipment	Years	5	FSR
CERs price	USD/tCO_2	10	

The analysis shows that without the revenue of CERs, the IRR of the project will be 9.39%. Much lower than the benchmark 15.56%. The project is not financial attractive. However, the CDM revenues will help to improve the financial index (IRR with CDM revenue=10.70%).

Sub-step 2d. Sensitivity analysis

The sensitivity analysis shows whether the conclusion regarding financial attractiveness is robust to reasonable variations in the critical assumptions. For the project, the most important parameters impacting the project IRR are:

- Fixed assets investment
- Annual O&M cost
- Electricity tariff
- Power supplied to the grid

In case of the ±10% variation range of the four parameters, the fluctuations of the IRR (without CER revenue) are showing below:

Table B.5 Sensitive analysis of the project

Variation range / IRR / Parameters	-10%	-5%	0%	+5%	+10%
Fixed assets investment	10.86%	10.10%	9.39%	8.74%	8.14%
Annual O&M cost	9.62%	9.51%	9.39%	9.28%	9.17%
Electricity tariff	7.97%	8.69%	9.39%	10.08%	10.74%
Power supplied to the grid	7.97%	8.69%	9.39%	10.08%	10.74%

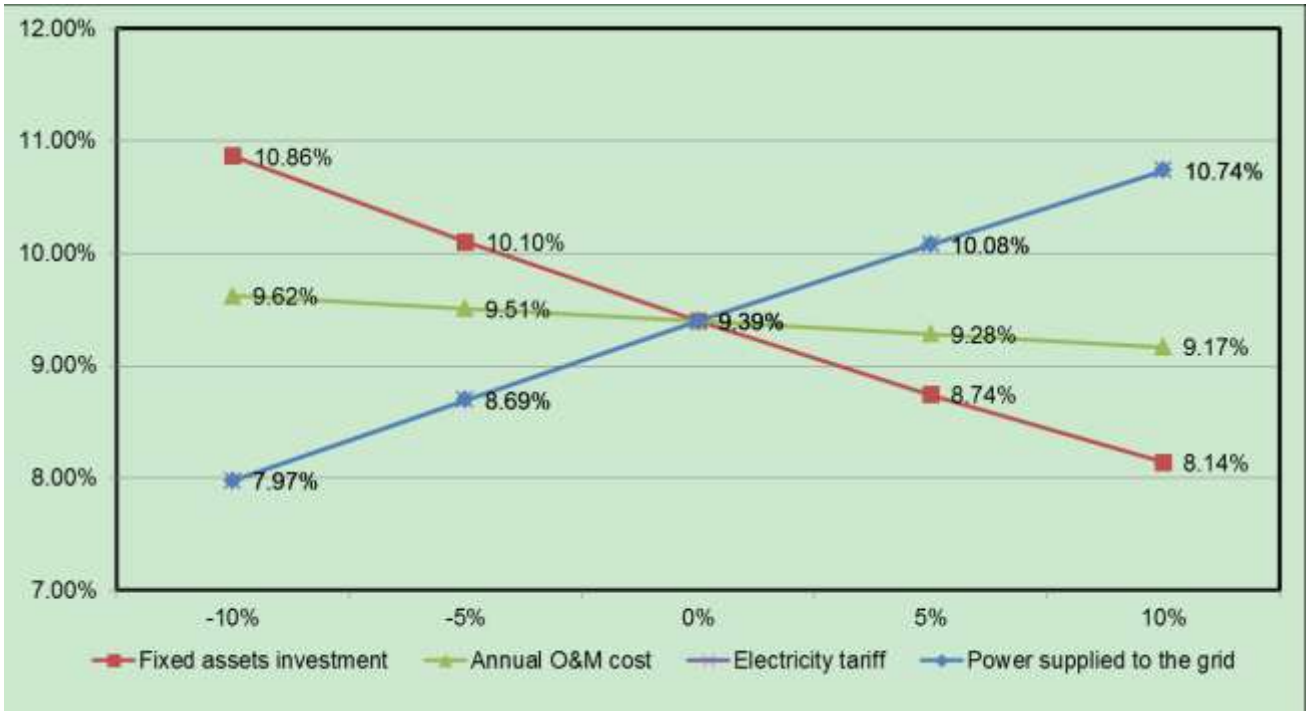

Figure B.3 Sensitive analysis

Based on the relationship shown above, we can find out that the project IRR that will decline accompany with the rise of the fixed assets investment and the annual O&M cost; and the IRR will rise accompany with the rise of the electricity tariff and the electricity supply. We can conclude from the above analysis that, even if ±10% variation range of the four parameters, the IRR of the project still can't surpass the benchmark. However, the revenue from the CERs will greatly improve the financial feasibility of the project.

The table below shows the critical point of the four parameters when the adjusted project IRR is equal to the benchmark.

Table B.6 Parameter changes when project IRR is equal to the benchmark

Change of Parameters	Fixed assets investment	Annual O&M cost	Electricity tariff	Power supplied to the grid
Project IRR=Benchmark	-33.40%	-313.50%	+51.25%	+51.25%

The results show that when the project IRR is equal to the benchmark value, the fixed assets investment or annual O&M costs need to be decreased by 33.40%, and 313.50% respectively, or electricity tariff or power supplied to the grid need to be increased by 51.25%. These are cases that are unlikely to occur.

- **Regarding to fixed assets investment**

The case of a decrease in fixed assets investment by 33.40% is unlikely to occur. The total investment of main contracts is over 28 million USD accounted for 102% of the total static investment estimated in the FSR, thus it is not impossible for the statistic investment to decrease by 33.40%.

- **Regarding to the annual O&M cost**

It can be seen that even the annual O&M cost decreased to 0, the project IRR is still below the benchmark.

- **Regarding to the electricity tariff**

As for the electricity tariff, if it increased by 51.25% the project IRR would be equal to the benchmark. The electricity tariff (6.5 Cents/kWh) used at the time of investment decision is derived from FSR. According to '*Power Purchase Agreement*' signed with EdL, the fixed electricity tariff is 6.5 Cents/kWh, electricity tariff increased by 51.25% is unlikely to occur.

- **Regarding to the power supplied to the grid**

When the power supplied to the grid is increased by 51.25%, the project IRR can reach the benchmark. According to the FSR, the annual electricity was estimated and calculated by the chartered specialists of Hydrochina Kunming Engineering Corporation based on a long series hydrology data and its value will be relatively stable. Therefore the annual electricity output will not be changed so much. Thus the project is always lack of financial attractiveness within the reasonable range of annual electricity output.

In conclusion, without the consideration of the revenue from CERs, the conclusion of the project activities lacks of commercial attraction is evidenced, so the specific project is in shortage of commercial attraction.

B.6. Emission reductions

B.6.1. Explanation of methodological choices

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The Methodology AMS I.D (version 18) 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:

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

Where:

PE_y = Project emissions in year y (tCO_2e/yr);

$PE_{FF,y}$ = Project emissions from fossil fuel consumption in year y (tCO_2/yr);

$PE_{GP,y}$ = Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in year y (tCO_2e/yr);

$PE_{HP,y}$ = Project emissions from water reservoirs of hydro power plants in year y (tCO_2e/yr);

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:

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

Where:

$PE_{HP,y}$ = Project emissions from water reservoirs (tCO_2e/yr);

EF_{Res} = Default emission factor for emissions from reservoirs, and the default value as per EB23 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

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

The PD of the project activity is calculated as follows:

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

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 project IEE, the project does not involve the reservoir, so $PE_{HP,y}=0$.

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:

$$BE_y = EG_{BL,y} * EF_{CO2,grid,y} \quad \text{(Equation B.5)}$$

Where:

BE_y = Baseline Emissions in year *y* (tCO_2/yr);

EG_{BLy} = Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year *y* (MWh/yr);

$EF_{CO2,grid,y}$ = Combined margin CO_2 emission factor for grid connected power generation in year *y*(tCO_2/MWh);

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:

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

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 4.0.0).

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[11] 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[12].

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 4.0.0), 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.

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

[12] 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).

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 4.0.0), 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*" (Version 4.0.0), there are two options based on different data for calculating average OM:

Option A: Based on the net electricity generation and a CO2 emission factor of each power unit; or

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

For the project, the necessary data for Option A is not available, so **Option B** was 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:

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

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, not 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*" (Version 4.0.0), 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

According to "*Tool to calculate the emission factor for an electricity system*" (Version 4.0.0), 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; 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:

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

Where:
w_{OM} = Weighting of operating margin emission factor (%);
w_{BM} = Weighting of build margin emission factor (%);

The weighs w_{OM} and $w_{BM,}$ for simplified CM by default, are w_{OM}=1 and w_{BM}= 0.

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/yr);
BE_y = Baseline emission in year *y* (t CO_2e/yr);

PE_y = Project emission in year *y* (t CO_2e/yr).

B.6.2. Data and parameters fixed ex ante

>>

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	See Appendix 4 for details.
Choice of data or Measurement methods and procedures	Data used are from Lao DNA.
Purpose of data	Baseline emission
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	See Appendix 4 for details.
Choice of data or Measurement methods and procedures	Data used are from Thailand authorities, DEDE.
Purpose of data	Baseline emission
Additional comment	-

Data / Parameter	$EF_{CO2,i,y}$
Unit	tCO2/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	See 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
Additional comment	-

Data / Parameter	EG_y
Unit	MWh

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	See Appendix 4 for details.
Choice of data or Measurement methods and procedures	Data used are from Lao DNA.
Purpose of data	Baseline emission
Additional comment	-

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

Data / Parameter	A_{BL}
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
Source of data	Project on-site
Value(s) applied	0
Choice of data or Measurement methods and procedures	For new reservoirs, this value is zero.
Purpose of data	Project emission
Additional comment	

Data / Parameter	CAP_{BL}
Unit	MW
Description	Installed capacity of the hydro power plant before the implementation of the project activity.
Source of data	Project on-site
Value(s) applied	0

Choice of data or Measurement methods and procedures	For new hydro power plants, this value is zero
Purpose of data	Project emission
Additional comment	

Data / Parameter	EF_{Res}
Unit	$kgCO_2e/MWh$
Description	Default emission factor for emissions from reservoirs
Source of data	*Methodology ACM0002 (Version 16)*
Value(s) applied	90
Choice of data or Measurement methods and procedures	-
Purpose of data	Project emission
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:

$EF_{CO2,grid,y} = EF_{grid,CM,y} = w_{OM} \times EF_{grid,OM,y} + w_{BM} \times EF_{grid,BM,y}$ =0.5595 tCO_2e/MWh.

The baseline emission of the project:

$BE_y = EG_{BL,y} \times EF_{CO2,grid,y}$ = 62,590 ×0.5595=35,019 tCO_2e

Project leakage

No leakage emissions are considered.

Emission reductions

$ER_y = BE_y - PE_y$ =35,019 – 0 = 35,019 tCO_2e

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

>>

Year	Baseline emissions (tCO_2 e)	Project emissions (tCO_2 e)	Leakage (tCO_2 e)	Emission reductions (tCO_2 e)
Year 1	35,019	0	0	35,019

Year 2	35,019	0	0	35,019
Year 3	35,019	0	0	35,019
Year 4	35,019	0	0	35,019
Year 5	35,019	0	0	35,019
Year 6	35,019	0	0	35,019
Year 7	35,019	0	0	35,019
Total	245,133	0	0	245,133
Total number of crediting years	7			
Annual average over the crediting period	35,019	0	0	35,019

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	
QA/QC procedures	Please refer to $EG_{output,y}$ and $EG_{input,y}$
Purpose of data	Baseline emission
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	62,590
Measurement methods and procedures	Continuous measurement and monthly recording
Monitoring frequency	Continuous measurement and at least monthly recording
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
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	Estimated to be 0 MWh for ex-ante calculation
Measurement methods and procedures	Continuous measurement and monthly recording
Monitoring frequency	Continuous measurement and at least monthly recording
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
Additional comment	

Data / Parameter	Cap_{PJ}
Unit	MW
Description	Installed capacity of the hydro power plant after the implementation of the project activity.
Source of data	Project site
Value(s) applied	14.5
Measurement methods and procedures	Use the data in the FSR at start of the project. Measure by check the nameplate after operation.
Monitoring frequency	Once at the beginning of each crediting period
QA/QC procedures	-
Purpose of data	Project emission
Additional comment	-

B.7.2. Sampling plan

>>

The data and parameters monitored in section B.7.1 above are not determined by a sampling approach.

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:

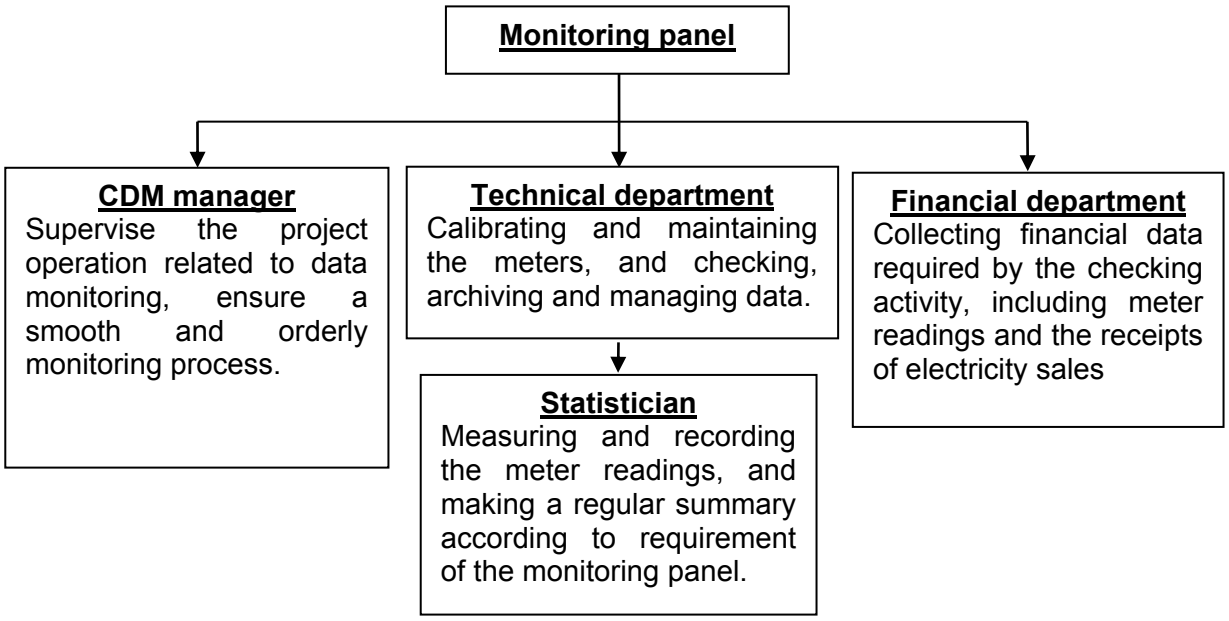

Figure B.4 Organization structure of the monitoring activity

2. Monitoring apparatus and installation:

The meter(s) will be installed at the project site, to monitoring the input/output electricity at the grid side. The meter(s) will be installed in accordance with relevant national or international standard. As the project is still under construction, the monitoring meters have not been installed yet, therefore the serial numbers of meters are not available. Before the operation of the project, the metering equipment(s) will be clarified and examined by the project owner and the power grid company according to the above regulation.

The diagram for the monitoring meter(s) is shown below:

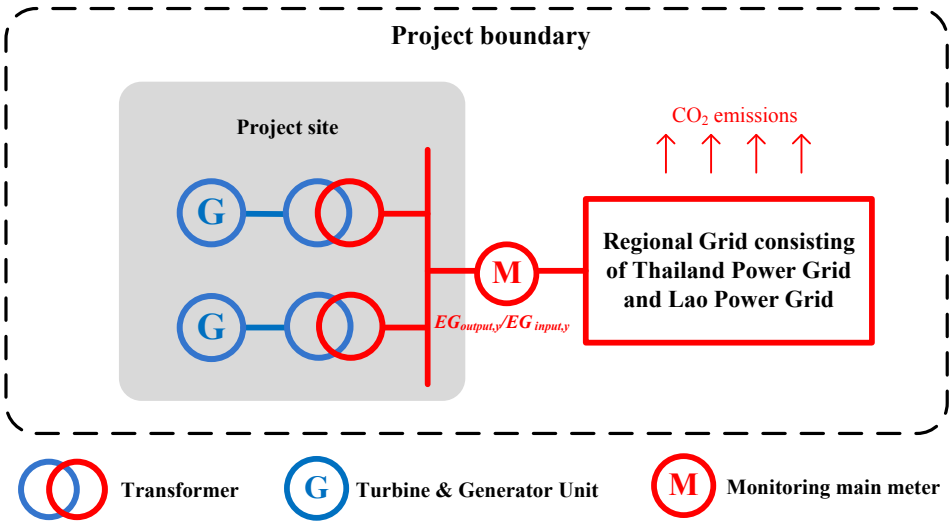

Figure B.5 Diagram of the monitoring meter(s)

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

The calibration frequency of the monitoring meters will be annually. The accuracy of the monitoring meters will not less than 0.5. 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:
23/10/2015

Responsible persons/ entities:
Mr. Lu Yaodong
Beijing Karbon Energy Consulting Co., Ltd.

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

>>
Jul. 24 2014 (Signed the "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

>>
First period of renewable crediting period

C.2.2. Start date of crediting period

>>
01/01/2016 or the date of registration whichever is later.

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) for the 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:

Construction Phase

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:

- 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.

Lands will be occupied permanently due to the construction of water retaining dam, access road, dumpsites and livelihood areas, however, due to the severe vegetation deterioration, 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

Water quality and quantity

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.

The proposed project will discharge all of the water that is used for generate the electricity. The minimum flow will be released to maintain the eco-system and meet demand for irrigation in the downstream.

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

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

>>

In order to develop the project as a Gold Standard CDM project a Local Stakeholder Consultation Meeting which is in line with Gold Standard Requirements was held in May 2014, before the construction started.

Stakeholders were invited to attend the meeting through different means including:

- Personal face to face invitations to government officer
- E-mail correspondence
- Invitation letter posted on the village Bulletin Board

Local people were invited to the meeting via personal face to face invitations and posters. Local government officers were invited to the meeting via face to face invitations and invitation letter. In addition, NGOs were invited to the meeting via e-mails sent.

Finally, 53 stakeholders participated in the meeting. The meeting was opened by the introduction of the project developers and the representative from the project owner company. The objective of the meeting was based on the non-technical summary, Environmental Management Plan and draft Passport Report of the project. In addition, a presentation was provided for addressing the issues about project specifications. Also, how the project might have some environmental effects, how these issues will be mitigated by the investor and also climate change and how the project will help the fight against climate change were discussed.

During the invitation process and the stakeholder meeting, the evaluation forms were handed out and the stakeholder were asked for their comments and requests about the project. The questions of the stakeholders were responded during the consultation meeting and their requests were assessed.

The detailed information can be found in LSC Report of the project.

E.2. Summary of comments received

>>

During the consultation meeting, stakeholders' comments were positive about the Project. Stakeholders had some comments about the project and asked for some contributions from the project owner. The main issues raised by the participants during the meeting were:

- Water quantity

- Job opportunities
- Electricity supply to nearby village
- Construct new temple
- Waste water
- Land occupy
- Technology reliable
- Lead to flood
- Affect the irrigation

(Please refer to the LSC Report of the project for the details of the Stakeholder assessments.)

E.3. Report on consideration of comments received

>>

The project does not involve resettlements. All comments from stakeholders were taken into account and promptly responded as given below.

- Water quantity: Project Owner's representative confirmed that there would be no negative permanent effect to locals during the project construction and operation phase, instead there might be only minor temporally impact due to waste water while the mitigation measure would be adopted. Only part of the water flow would be diverted for power generation and regarding to the river part from overflow dam to the power house, a minimum water flow would be guaranteed at no less than the average water flow in dry season thus there would be minor impact on the water utilization for nearby villages. Furthermore, the representative mentioned that a Water Supply Program would be prepared for the local people to improve their water supply system.
- Job opportunities: Project Owner's representative mentioned that all the construction works would be open for local construction company, and would request the company to recruit locally.
- Electricity supply to nearby village: The Project Owner's representative mentioned that it is not allowed to supply electricity directly from the plant to end user, but the project owner would keep the power line(s) for construction even after the project comes into operation, thus the surrounding village can use those power lines to connect to the grid.
- Construct new temple: The company had program to construct a new temple nearing the village to meet the villagers' demand.
- Waste water: Project Owner's representative mentioned that water is very important to the local residents, migration measures would be taken to avoid impacts on water quality, such as introduce sanitation facility to treat the human waste, collect dirty water from disturbed land and treat before release to the river.
- Land occupy: Project Owner's representative confirmed that none village would be directly affected by the intake weir, access road and powerhouse construction, due to the project site is far away from villages.
- Technology reliable: The project owner confirmed that they will choose reputable manufacturer to provide mature technology and equipment.
- Lead to flood: The project is run-of-river hydropower project, and there is no dam to reserve water which not leads to the flood occur. Furthermore, afforestation will be taken to prevent soil erosion.
- Affect the irrigation: The project owner explained that there's no reservoir for the project to regulate the run off of the river, thus will not affect the water for irrigation. Actually project is far away from nearby village and there is no farmland nearby.

SECTION F. Approval and authorization

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The Letter of approval from the Parties 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	Nam Nga 2 Hydropower Co., Ltd.
Street/P.O. Box	Bannawannoi, Xay District, Udomxay Province, Lao PDR
Building	
City	Vientiane Capital
State/Region	
Postcode	
Country	Lao PDR
Telephone	856-20-2312 8898
Fax	
E-mail	
Website	
Contact person	Houmphan RATTANA
Title	Advisor
Salutation	Mr.
Last name	RATTANA
Middle name	
First name	Houmphan
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	

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	Swiss Carbon Assets Ltd.
Street/P.O. Box	Technoparkstrasse 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

Calculation of Operating Margin Emission Factor

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
	$FC_{i,y}$		$EF_{CO2,m,i,y}$	$NCV_{i,y}$	$FC_{i,v}$ x $EF_{CO2,m,i,v}$ 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.*

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

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

= 1×0.5595

= 0.5595 tCO_2e/MWh.

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

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Document information

Version	*Date*	*Description*
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.
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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