Gold Standard
for the Global Goals

TEMPLATE

KEY PROJECT INFORMATION & PROJECT DESIGN DOCUMENT (PDD)

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VERSION **v. 1.2**

RELATED SUPPORT

- **TEMPLATE GUIDE Key Project Information & Project Design Document v.1.2**

This document contains the following Sections

KEY PROJECT INFORMATION

GS ID of Project	2510
Title of Project	Xe Namnoy 2 - Xe Katam 1 Hydropower project
Time of First Submission Date	30/09/2013
Date of Design Certification	20/08/2014
Version number of the PDD	01
Completion date of version	02/09/2022
Project Developer	SV Group Co., Ltd.
Project Representative	Swiss Carbon Assets Limited
Project Participants and any communities involved	SV Group Co., Ltd. Swiss Carbon Assets Limited
Host Country (ies)	Lao PDR
Activity Requirements applied	☐ Community Services Activities ☒ Renewable Energy Activities ☐ Land Use and Forestry Activities/Risks & Capacities ☐ N/A
Scale of the project activity	☐ Micro scale ☒ Small Scale ☐ Large Scale
Other Requirements applied	N/A
Methodology (ies) applied and version number	AMS-I.D.: Grid connected renewable electricity generation (Version 18.0)
Product Requirements applied	☒ GHG Emissions Reduction & Sequestration ☐ Renewable Energy Label ☐ N/A
Project Cycle:	☐ Regular ☒ Retroactive

Table 1 – Estimated Sustainable Development Contributions

Sustainable Development Goals Targeted	SDG Impact (defined in B.6.)	Estimated Annual Average	Units or Products
13 Climate Action (mandatory)	Emissions Reductions	46,802	tCO_2
7 Ensure access to affordable, reliable, sustainable and modern energy for all (Affordable and Clean Energy)	MWh of renewable energy generated	83,000	MWh
6 Ensure availability and sustainable management of water and sanitation for all	Number of the installed pumps on-site	8	/

SECTION A. DESCRIPTION OF PROJECT

A.1 Purpose and general description of project

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Xe Namnoy 2 - Xe Katam 1 Hydropower project (hereafter referred to as the "the project") is located on the Xe Nam Noy river and XeKatam River, Champasak Province in the southern part of Lao PDR, developed by SV Group Co., Ltd.

The installed capacity of the project is 15 MW, with the annually 83 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 (LPG). For Lao Power Grid (LPG) is connected with Thailand power grid (TPG), the electricity generated by the project is supplied to the regional grid consisting of Lao Power Grid (LPG) and Thailand Power Grid (TPG) (hereafter referred to as "LPG&TPG"). 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 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. By displacing part of the power generated by thermal power plants, the emission reductions are 46,438

tCO_2e/year during the first crediting period and the emission reductions in the second crediting period are 46,802 tCO_2e/year.

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 LPG&TPG, 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.

This project has been registered as a GS project with ID of 2510. The first crediting period of the project is from 01/01/2015 to 31/12/2021. The project is applying for crediting period renewal and the second crediting period is from 01/01/2022 to 31/12/2028. The starting date of the project is 14/10/2013 which is the date when the Construction Contract was signed. On 01/01/2015, the project started commercial operation.

A.1.1. Eligibility of the project under Gold Standard

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The project activity meets the eligibility criteria as per section 3.1.1 of GS4GG Principles & Requirements document as described below:

- Types of project:

The project type is power generation using a run-of-the-river hydropower station which is an eligible project type as it is in accordance with 2.1.2 a) and 2.1.2 b) of the Eligible Project Types & Scope under Renewable Energy Activity Requirements.

- Location of Project:

The project is located in Lao PDR. Therefore, the project is eligible.

- Project Area, Project Boundary and Scale:

The project is located in Pakse City, Champasak Province, Lao PDR . The project location is clearly defined in A.2. According to the methodology AMS-I.D. (Version 18.0), the spatial extent of the project boundary includes the project power plant and all power plants connected physically to the electricity system that the CDM project power plant is connected to.

The total installed capacity of the project is 15 MW, it satisfies the requirement that the capacity of the project should be at most 15 MW for a small-scale project. The estimated annual emission reductions of the project activity are 46,802 tCO_2e in the second crediting period, which is greater than 10,000 tCO_2eq, above microscale threshold, which is considered as Non microscale project.

The project has not and will not claim in any other voluntary or compliance standards programme except GS.

- Host Country Requirements

The project is in compliance with applicable Lao PDR's legal, environmental, ecological and social regulations.

- Contact details

Contact details is listed in Appendix 2.

- Legal ownership

The full and uncontested legal ownership is demonstrated and listed in A.1.2.

- Official Development Assistance (ODA) Declaration:

The project does not use ODA directly or indirectly.

A.1.2. Legal ownership of products generated by the project and legal rights to alter use of resources required to service the project

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The project owner (SV Group Co., Ltd.) has full and uncontested legal ownership of the emission reductions that are generated under this Gold Standard project, and has legal

rights concerning changes in use of resources required to service the project. The legal ownership of the project can be demonstrated via the following documents:

1. Project FSR approval by Ministry of Energy and Mines, Lao PDR
2. Initial Environmental Examination (IEE) approval by Ministry of Natural Resource and Environment, Lao PDR

A.2 Location of project

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The Project site is located on the main Stream of the Xe Nam Noy and Xe Katam River, southern part of Lao PDR. It takes about 1 hour by car from the project site to the Pakse City. The approximate coordinates of the project site is: 15.1217°N, 106.6067°E.

Figure A.1 shows 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 LPG&TPG. 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 15 MW. The construction of the project includes fixed weir, a sand flush, intake, headrace channel, head tank, penstock, powerhouse with 2 units of turbines (2*7,500 kW), and a tailrace.

The power generated will be delivered to EDL through 22kV transmission line.

A.4 Scale of the project

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The project is a small-scale project utilizing renewable water resources to generate electricity. The total installed capacity of the project is 15 MW, it satisfies the requirement that the capacity of the project should be at most 15 MW for a small-scale project.

A.5 Funding sources of project

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The project is financed by the project owner.

The project does not receive any public funding from Parties included in Annex I. The project does not use Official Development Assistance ODA directly or indirectly.

SECTION B. APPLICATION OF APPROVED GOLD STANDARD METHODOLOGY (IES) AND/OR DEMONSTRATION OF SDG CONTRIBUTIONS

B.1. Reference of approved methodology (ies)

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Approved methodology applied: AMS I.D. Grid connected renewable electricity generation (Version 18.0).

Reference:

https://cdm.unfccc.int/methodologies/DB/W3TINZ7KKWCK7L8WTXFQQOFQQH4SBK

Sectoral Scope: 01

The methodology was applied with the following tools:

- Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period (version 03.0.1)
- Tool to calculate the emission factor for an electricity system (version 07.0)

Further information pertaining to the methodology can be obtained at:

http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html

B.2. Applicability of methodology (ies)

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Justification for the choice of the selected methodology is given below in the table:

Criteria	Analysis	Applicable for the project?
This methodology is applicable to project activities that: (a) Install a Greenfield plant; (b) Involve a capacity addition in (an) existing plant(s); (c) Involve a retrofit of (an) existing plant(s); (d) Involve a rehabilitation of (an) existing plant(s)/unit(s); or (e) Involve a replacement of (an) existing plant(s).	The project is a greenfield grid-connected hydro power project.	Applicable
Hydro power plants with reservoirs that satisfy at least one of the following conditions are eligible to apply this	The project activity is a run-of-river small scale hydro power plant and	Not relevant

methodology: (a) The project activity is implemented in an existing reservoir with no change in the volume of reservoir; (b) The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the project emissions section, is greater than 4 W/m^2; (c) The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the project emissions section, is greater than 4 W/m^2.	does not involve the reservoir, therefore, this criterion is not relevant.	
If the new unit has both renewable and non-renewable components (e.g. a wind/diesel unit), the eligibility limit of 15 MW for a small-scale CDM project activity applies only to the renewable component. If the new unit co-fires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15 MW.	The project is a hydro power plant without non-renewable components (e.g. a wind/diesel unit). Therefore, this criterion is not relevant.	Not relevant
Combined heat and power (co-generation) systems are not eligible under this category.	The project is a hydro power plant and do not involve the combined heat and power (co-generation) systems. Therefore, this is not relevant.	Not relevant
In the case of project activities that involve the capacity addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be physically distinct1 from the existing units.	The project does not involve the capacity addition of renewable energy generation units at an existing renewable power generation facility, Therefore, this is not relevant.	Not relevant
In the case of retrofit, rehabilitation or replacement, to qualify as a small-scale project, the total output of the retrofitted, rehabilitated or replacement power plant/unit shall not exceed the limit of 15 MW.	The project is not retrofit, rehabilitation, replacement, or capacity addition project. Therefore, this item is not relevant.	Not relevant
In the case of landfill gas, waste gas, wastewater treatment and agro-industries projects, recovered methane emissions are eligible under a relevant	The project is a hydro power project. Therefore, this is not relevant.	Not relevant

Type III category. If the recovered methane is used for electricity generation for supply to a grid then the baseline for the electricity component shall be in accordance with procedure prescribed under this methodology. If the recovered methane is used for heat generation or cogeneration other applicable Type-I methodologies such as "AMS-I.C.: Thermal energy production with or without electricity" shall be explored.		
In case biomass is sourced from dedicated plantations, the applicability criteria in the tool "Project emissions from cultivation of biomass" shall apply.	The project is a hydro power project. Therefore, this is not relevant.	Not relevant

The criteria and assessment of "Tool to calculate the emission factor for an electricity system (version 07.0)" are in the following table B.1.

Table B.1. Applicability analysis of "*Tool to calculate the emission factor for an electricity system (version 07.0)*"

Criteria	Analysis
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 that is 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 project generates electricity to regional grid consisting of LPG&TPG. This tool is used to calculate the OM, BM and CM. This is applicable.
Under this tool, the emission factor for the project electricity system can be calculated either for grid power plants only or, as an option, can include off-grid power plants. In the latter case, two sub-options under the step 2 of the tool are available to the project participants, i.e. option IIa and option IIb. If option IIa is chosen, the conditions specified in "Appendix 1: Procedures related to off-grid power generation" should be met. Namely, the total	Since the project activity is grid connected, this condition is applicable and the emission factor has been calculated accordingly.

capacity of off-grid power plants (in MW) should be at least 10 per cent of the total capacity of grid power plants in the electricity system; or the total electricity generation by off-grid power plants (in MWh) should be at least 10 per cent of the total electricity generation by grid power plants in the electricity system; and that factors which negatively affect the reliability and stability of the grid are primarily due to constraints in generation and not to other aspects such as transmission capacity.	
In case of CDM projects the tool is not applicable if the project electricity system is located partially or totally in an Annex I country.	The project is not located in Annex I country. Therefore, the tool is applicable.
Under this tool, the value applied to the CO_2 emission factor of biofuels is zero.	The proposed project is a grid connected hydropower project/ unit and does not involve emission from biofuels. Therefore, this criterion is not relevant.

Applicability conditions of "*Assessment of the validity of the original/current baseline and update the baseline at the renewal of the crediting period (Version 03.0.1)*" is shown in table B.2.

Table B.2. Applicability analysis of "*Assessment of the validity of the original/current baseline and update the baseline at the renewal of the crediting period (Version 03.0.1)*"

Criteria	Analysis
This tool provides a stepwise procedure to assess the continued validity of the baseline and to update the baseline at the renewal of a crediting period.	Applicable. The baseline is assessed by the procedure of this tool.

B.3. Project boundary

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According to the methodology 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.

The project is located in Lao PDR. The DNA of Lao has published a delineation[1] of the proposed CDM project electricity system and connected electricity systems, therefore these delineations are applied. The proposed CDM project will supply power to LPG, which according to the delineation published by Lao DNA, is a part of the regional power grid consisted by LPG&TPG. Therefore, the relevant electricity system is the regional power grid including LPG&TPG. And the connected electricity system is Malaysia, China and Vietnam Power Grid[2].

Therefore, the electricity system of the proposed project is defined in accordance with the clarification of CDM-EB about the "regional" in its 28th meeting (Paragraph 14, meeting report) and the electricity system connected is identified according to the "Tool to calculate the emission factor for an electricity system" (Version 07.0). According to paragraph 17 of the Tool:

Project participants may delineate the project electricity system using any of the following options:

(a) ***Option 1.*** *A delineation of the project electricity system and connected electricity systems published by the DNA or the group of the DNAs of the host country(ies), In case a delineation is provided by a group of DNAs, the same delineation should be used by all the project participants applying the tool in these countries;*

(b) ***Option 2.*** *A delineation of the project electricity system defined by the dispatch area of the dispatch centre responsible for scheduling and dispatching electricity generated by the project activity. Where the dispatch area is controlled by more than one dispatch centre, i.e. layered dispatch area, the higher level area shall be used as a delineation of the project electricity system (e.g. where regional dispatch centres are required to comply with dispatch orders of the national dispatch centre then area controlled by the national dispatch centre shall be used);*

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

[2] EDL Electricity Statistic 2019, EGAT Annual Report 2019

(c) ***Option 3.*** *A delineation of the project electricity system defined by more than one independent dispatch areas, e.g. multi-national power pools.*

The power generated by the project will be supplied to the LPG, which is tightly connected with TPG through transmission lines. Thus (C) Option 3 is selected. According to the Tool, in case of option 3, transmission lines between dispatch areas included in the proposed delineation shall be checked for the existence or non-existence of transmission constraints following the paragraph 19 below:

There are no transmission constraints if any one of the following criteria is met:

(a) 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 at least during 90 per cent of the hours of the most recent year for which information is available (at least one year data is required); or

(b) The transmission line(s) is operated at 75 per cent or less of its rated capacity during 90 per cent or more of the hours of the most recent year for which information is available (at least one year data is required) using the algorithm below:

(i) For every hour of the year check whether the transmission line is operated at 75 per cent or less of its rated capacity;

(ii) Each hour of the year when the transmission line was operated at 75 per cent or less of its rated capacity should be counted as zero;

(iii) Each hour of the year when the transmission line was operated at 75 per cent or more of its rated capacity should be counted as one;

(iv) There is no transmission constraint if the total sum is less than ten per cent of the hours of the year (e.g. 876 for even year and 878 for leap year);

(v) The algorithm can be illustrated by the following equation:

$$\sum_{1}^{8760}\left[\frac{Hourly\ power\ transmission\ (MWh)}{[Maximum\ line's load\ capacity\ (MW)]} > 75\ per\ cent\right] < 876$$

(vi) The maximum line's load capacity should be based on official information (e.g. from the operator of the system);

(c) *The transmission capacity of the transmission line(s) that is connecting electricity systems is more than 10 per cent of the installed capacity either of the project*

electricity system or of the connected electricity system, whichever is smaller.

Criteria (C) is met with following description:

In 2019, the total transmission capacity that transferred from Lao PDR in Thailand is 5420.6 MW[3], which is 59.80% of total installed capacity of Lao PDR and 13.70% of total install capacity of Thailand[4], more than 10 per cent of the installed capacity either of the Lao or Thailand, the power grid of these two countries is tight connected. It is demonstrated that there are no transmission constraints between Lao and Thailand.

Besides, the DNA of Lao has published a delineation[5] of the project electricity system and connected electricity systems in 2010. The Project will supply power to LPG, which according to the delineation published by Lao DNA, is a part of the regional power grid consisted by TPG&LPG.

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)

	2019	2018	2017
Lao power export to Thailand[6]	25,407.09	26,386.04	24,196.64
Domestic demand in Lao[7]	8166.26	9386.77	7863.56
Lao power import from Thailand (EDL)[8]	1,316.51	253.86	365.27

[3] See Page 132, Annual Report, 2019, EGAT
[4] See ER spread sheet for calculation details.
[5] See Calculation for the emission factor for electricity generation in Lao PDR, 2010
[6] EGAT Annual Report 2019, page 134 & Annual Report 2018, page 132, Electricity Generating Authority of Thailand.
[7] EDL Electricity Statistic 2019, page 9-11, Electricity du Laos.
[8] EGAT Annual Report 2019, page 135 & Annual Report 2018, page 133, Electricity Generating Authority of Thailand.

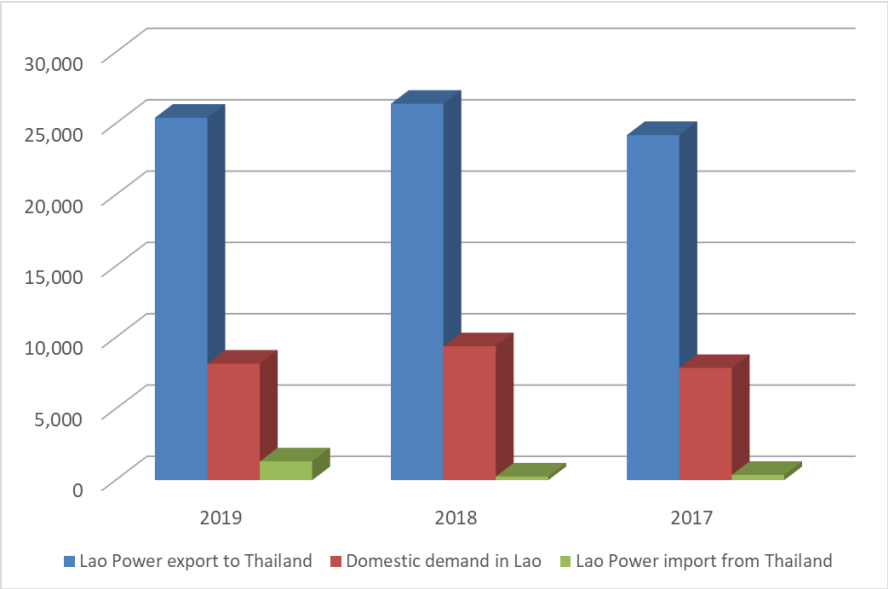

Figure B.1 Power exchange between Lao and Thailand (Unit GWh)

The data listed above indicates the close relationship between the power system of Lao and Thailand. According to the Memorandum of Understanding (MOU) signed between Lao government and Thailand government, that through the interconnection between the two countries, Lao power grid could sell the surplus energy to Thailand, and the deficits of Lao demand in rush hours can be covered by imports. Besides, Lao PDR will supply 7,000 MW to Thailand by 2020[9].

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 LPG&TPG.

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		CO_2	No	Minor emission source

[9] https://wle-mekong.cgiar.org/thailand-signals-plans-to-purchase-more-lao-electricity/

	For hydro power plants, emissions of CH_4 from the reservoir	CH_4	Yes	Main emission source. The project activity does not involve reservoir, the emission of CH_4 is 0
		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 LPG&TPG), and the GHG emissions.

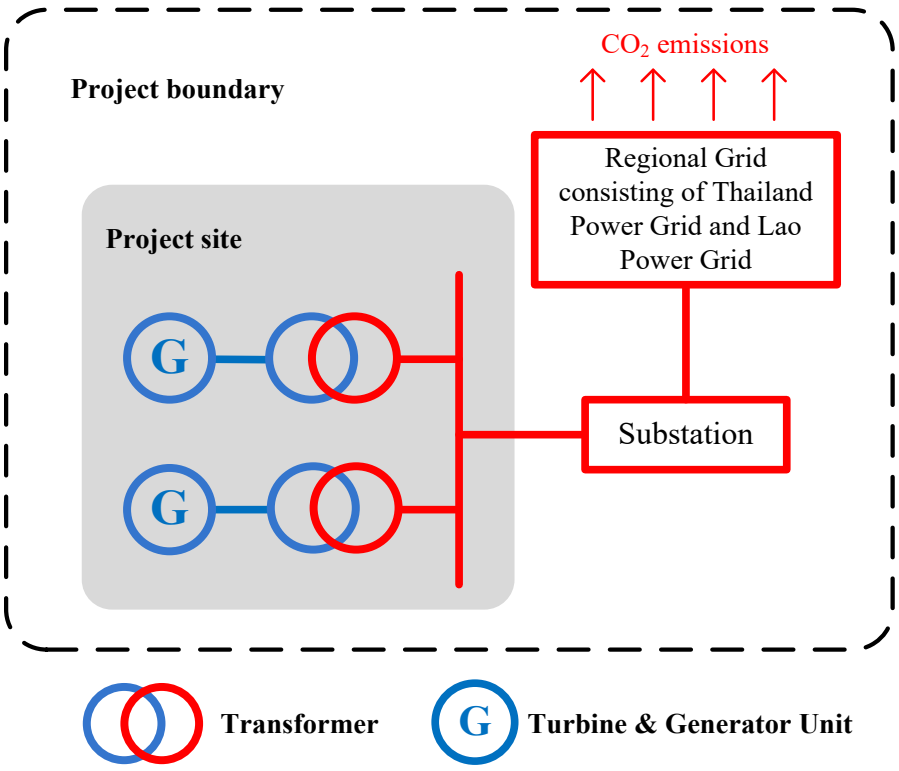

Figure B.2. Flow diagram of the project boundary

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.

For the second crediting period, the continued validity of the original baseline should be assessed.

According to the Methodological Tool "Assessment of the validity of the original/current baseline and update the baseline at the renewal of the crediting period" (version 03.0.1), the stepwise procedure as follows should be adopted to assess the continued validity of the baseline and to update the baseline:

Step 1: Assess the validity of the current baseline for the next crediting period

Step 1.1: Assess compliance of the current baseline with relevant mandatory national and/or sectoral policies

The project activity is a renewable hydropower project that supplies electricity to displace electricity from LPG&TPG. The project activity is claiming the emission reductions from the net exported quantity of electricity only. As the project displaces electricity generated in LPG&TPG, combined margin (CM) is used to determine baseline emission factor.

According to the latest data information available, thermal power generation is currently the dominant power supply option within LPG&TPG. By displacing thermal power generation in the LPG&TPG with clean and renewable energy, the project leads to the reduction of CO_2 emission into the atmosphere. Therefore, the baseline remains unchanged and it complies with all relevant mandatory national and/or sectoral policies. Thus, it can be concluded that the current baseline scenario is in compliance with relevant mandatory national and sectoral policies. Thus, go to Step 1.2.

Step 1.2: Assess the impact of circumstances

Firstly, the baseline scenario identified at the validation of the project activity was the continuation of the current practice without any investment;

Secondly, the market characteristics have no significant change which would impacts the current baseline. The current practice for the baseline emissions is still the GHG emitted by project: the equivalent electricity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources into the grid.

Step 1.3: Assess whether the continuation of the use of current baseline equipment(s) or an investment is the most likely scenario for the crediting period for which the renewal is requested.

The current baseline scenario is the continuation of the current practice. In the absence of the project, the electricity would have been supplied by power grid, and it will not request an investment by the project proponent or third party. So, this step is not applicable.

Step 1.4: Assessment of the validity of the data and parameters

Since there are some parameters, which were determined at the start of the first crediting period and not monitored during the first crediting period, are not valid anymore, therefore, the current baseline emissions need to be updated for the second crediting period according to this tool.

Before the time of requesting renewal of the crediting period, data source for calculating the emission factor has been updated, so the emission factor is updated for the second crediting period according to this Notice.

In summary, the emission factor and all values have been updated to the latest data for the second crediting period according to this Notice.

Application of Steps 1.1, 1.2, 1.3 and 1.4 confirmed that the current baseline is valid for the second crediting period but data and parameters need to be updated. Therefore step 2 is used.

Step 2: Update the current baseline and the data and parameters

Step 2.1: Update the current baseline

The baseline emissions for the second crediting period have been updated, without reassessing the baseline scenario, based on the latest approved version of the methodology ASM I.D. More details for the updated baseline emissions for the second crediting period can be seen in section B.6.

Step 2.2: Update the data and parameters

As mentioned in step 1.4 above, all parameters regarding the grid emission factor calculation have been updated for this second crediting period. More details can be seen in section B.6.

B.5. Demonstration of additionality

This section has been assessed and validated in the first crediting period. Not applicable for the second crediting period.

In accordance with "CDM project standard for project activities" (Version 03.0), "*For renewal of crediting period of a registered CDM project activity, the project participants are not required to reassess the additionality of the project activity nor update the section of the PDD relating to additionality*".

B.5.1 Prior Consideration

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N/A

B.5.2 Ongoing Financial Need

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Carbon revenues derived from Gold Standard certification have been playing a very important role in helping project owner to contribute to SDGs, e.g providing renewable electricity and 8 pumps has been installed in the villages, ensuring the access to water for 146 households with population more than 1000 persons.

B.6. Sustainable Development Goals (SDG) outcomes

Relevant Target/Indicator for each of the three SDGs

Sustainable Development Goals Targeted	Most relevant SDG Target	SDG Impact Indicator (Proposed or SDG Indicator)
13 Climate Action (mandatory)	Target 13.2: Integrate climate change measures into national policies, strategies and planning.	Emissions Reductions
7 Affordable and Clean Energy	Target 7.1: By 2030, ensure universal access to affordable, reliable and modern energy services.	7.1.1 Proportion of population with access to electricity

6 Clean water and sanitation	Target 6.1: By 2030, achieve universal and equitable access to safe and affordable drinking water for all.	6.1.1 Proportion of population using safely managed drinking water services.

B.6.1 Explanation of methodological choices/approaches for estimating the SDG Impact

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SDGs	Method
SDG 7 Affordable and Clean Energy	**Target 7.1:** By 2030, ensure universal access to affordable, reliable and modern energy services. **Indicator:** 7.1.1 Proportion of population with access to electricity **Monitoring Parameter:** $EG_{PJ,facility,y}$, Quantity of net electricity generation supplied by the project plant/unit to the grid in year y **Monitoring Method:** Calculated **Calculation Method:** $EG_{PJ,facility,y} = EG_{output,y} - EG_{input,y}$
SDG 6 Clean water and sanitation	**Target 6.1:** By 2030, achieve universal and equitable access to safe and affordable drinking water for all. **Indicator:** 6.1.1 Proportion of population using safely managed drinking water services. **Monitoring Parameter:** Number of the installed pumps on-site **Monitoring Method:** Site visit to the water supply program **Calculation Method:** N/A
SDG 13 Climate Action	**Indicator:** Emissions Reductions in tCO_2e from the project activity - **Monitoring Parameter:** ER_y, Emission reductions achieved in year y **Monitoring Method:** Calculated **Calculation Method:** Details as below - **Monitoring Parameter:** $EG_{output,y}$, Electricity supplied by the project to the grid in year y Monitoring Method: Measured Calculation Method: N/A - **Monitoring Parameter:** $EG_{input,y}$, The electricity used by the project and input from the grid in year y Monitoring Method: Measured Calculation Method: N/A - **Monitoring Parameter:** Cap_{PJ}, Installed capacity of the hydro power plant after the implementation of the project activity. Monitoring Method: Use the data in the FSR at start of the

	project. Measured by check the nameplate after operation. Calculation Method: N/A

For SDG 13, the applied methodology AMS I.D is applied in 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.**

1. 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_2e/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 $\boldsymbol{PE_{FF,y}}=0$, $\boldsymbol{PE_{GP,y}}=0$.

Calculate the Emissions from water reservoirs of hydro power plants ($PE_{HP,y}$)

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

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}} \quad \text{(Equation B.2)}$$

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 single or multiple reservoirs 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 single or multiple reservoirs 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

For hydro power project activities that result in new single or multiple reservoirs and hydro power project activities that result in the increase of single or multiple existing reservoirs, project proponents shall account for CH_4 and CO_2 emissions from the reservoirs, estimated as follows:

(a) For integrated hydro power project PD of the entire project is calculated as follows:

$$PD = \frac{\sum Cap_{PJ,i}}{\sum A_{PJ,j}} \quad \text{(Equation B.3)}$$

Where,

i = Individual power plants included in integrated hydro power project

j = Individual reservoirs included in integrated hydro power project

(b) if the power density of the project activity or in case of integrated hydro power project is greater than 4 W/m^2 and less than or equal to 10 W/m^2:

$$PE_{HP,y} = \frac{EF_{Res} \times TEG_y}{1000} \quad \text{(Equation B.4)}$$

Where,

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

EF_{Res} = Default emission factor for emissions from reservoirs of hydro power plants (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)

(c) If the power density of the project activity is greater than 10 W/m^2

$PE_{HP,y}=0$ (Equation B.5)

For this project, does not involve the reservoir, so $PE_{HP,y}$=0. Therefore, $PE_y=0$.

2. Calculate the baseline emissions (BE_y)

Baseline emissions include only CO_2 emissions from electricity generation in 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:

$BE_y=EG_{PJ,y} \times EF_{grid,CM,y}$ (Equation B.6)

Where:

BE_y	=	Baseline Emissions in year y (tCO_2)
$EG_{PJ,y}$	=	Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh)
$EF_{grid,CM,y}$	=	Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (t CO_2/MWh)

<u>Calculate the $EG_{PJ,y,}$</u>

The project activity is the installation of a Greenfield power plant, $EG_{PJ,y}$ is calculated as follows:

$EG_{PJ,y}=EG_{PJ,facility,y} = EG_{output,y} - EG_{input,y}$ (Equation B.7)

Where,

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

$EG_{input,y}$ = The electricity used by the project and input from the grid in year y (MWh)

Calculate the $EF_{grid,CM,y}$

The emission factor 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 07.0).

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 (optional);
STEP 3: Select a method to determine the operating margin (OM);
STEP 4: Calculate the operating margin emission factor according to the selected method;
STEP 5: Calculate the build margin (BM) emission factor;
STEP 6: Calculate the combined margin (CM) emissions factor.

STEP 1: Identify the relevant electricity system

As descripted in Section B.3., there are no transmission constraints between Lao and Thailand, the project electricity system is a regional grid consisting of TPG&LPG.

And as electricity imported from Malaysia, China and Vietnam Power Grid[10], these three Power Grids are considered as **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 07.0), there are two options to calculate the operating margin and build margin emission factor:

[10] According to Annual Report 2019, 2018, 2017, issued by EGAT, 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 2019 by the Lao Power Grid Electric du Lao (EDL).

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 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 07.0), 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 data of the most recent three historical years, which are 2019, 2018, 2017.

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" (Version 07.0) 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 07.0), 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.

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:

$$EF_{grid,OM\text{-}ave,y} = \frac{\sum_i (FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y})}{EG_y} \quad \text{(Equation B.8)}$$

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 07.0), electricity imports from the connected electricity systems $EG_{import,y}$ are included in the EG_y.

The calculation value of average OM emission factor is 0.5639 tCO_2/MWh and the detailed calculating procedures please refer to Appendix 3 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 07.0), 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" Version 07.0, 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.

The project located in Lao, which 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 follows:

$$EF_{grid,CM,y}=w_{OM}\times EF_{grid,OM,y}+w_{BM}\times EF_{grid,BM,y} \quad \text{(Equation B.9)}$$

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.

3. Calculate the project leakage (LE_y)

No leakage emissions are considered.

4. Calculate the emission reductions (ER_y)

Emission reductions are calculated as follows:

$$ER_y=BE_y-PE_y \quad \text{(Equation B.10)}$$

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

SDG13

Data/parameter	$EF_{CO2,grid,y}$
Unit	tCO_2e/MWh
Description	Combined margin CO_2 emission factor for grid connected power generation in year *y*
Source of data	Calculated
Value(s) applied	0.5639
Choice of data or Measurement methods and procedures	See Appendix 3 for the detailed data source and calculation
Purpose of data	Calculation of baseline emissions
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 site
Value(s) applied	0
Choice of data or Measurement methods and procedures	For new reservoirs, this value is zero.
Purpose of data	Calculation of project emissions

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 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	Calculation of project emissions
Additional comment	/

Data/parameter	EF_{Res}
Unit	$kgCO_2e/MWh$
Description	Default emission factor for emissions from reservoirs
Source of data	Decision at EB 23
Value(s) applied	90
Choice of data or Measurement methods and procedures	Decision by EB23
Purpose of data	Calculation of project emissions
Additional comment	/

B.6.3 Ex ante estimation of SDG Impact

>>

SDGs	Ex ante estimation of outcomes
SDG 6 Clean water and sanitation	Baseline outcomes: 0 Project outcomes: 8 pumps have been be installed in the villages, ensuring the access to water for 146 households with population more than 1000 persons.
SDG 7 Affordable and Clean Energy	Baseline outcomes: 0 Project outcomes: The net generation supplied by the project to the grid is estimated to be 83,000 MWh/yr, which could replace the equivalent electricity from fossil fuel based grid.
SDG 13 Climate Action	Baseline outcomes: 0 Project outcomes: The project will directly contribute by reducing 46,802 tons of CO_2 equivalent every year in the second crediting period. The estimation is as below.

1. Project emissions (PE_y)

As described in section B.6.1, the project activity does not involve reservoir, therefore, PE_y=0 tCO_2e.

2. Leakage emissions (LE_y)

Based on ACM0002, there is no need of leakage calculation or monitoring for this kind of activity, thus leakage is considered to be zero (0 tCO_2e). Thus, LE_y =0 tCO_2e.

3. Baseline emissions (BE_y)

According to section B.6.1, in second crediting period, the baseline emission factor ($EF_{grid,CM,y}$) of the project:

$$EF_{grid,CM,y}=w_{OM}\times EF_{grid,OM,y}+w_{BM}\times EF_{grid,BM,y} =0.5639\ tCO_2e/MWh.$$

The baseline emissions of the project:

$$BE_y= EG_{PJ,facility,y} \times EF_{grid,CM,y} = (EG_{output,y} - EG_{input,y}) \times EF_{grid,CM,y}$$

$$= (83{,}000 - 0)\ MWh\times 0.5639\ tCO_2e/MWh =46{,}802\ tCO_2e$$

4. Emission reductions (ER_y)

$$ER_y=BE_y-PE_y - LE_y = 46{,}802\ tCO_2e - 0\ tCO_2e - 0\ tCO_2e = 46{,}802\ tCO_2e$$

The result of emission reductions:

$EG_{BL,y}$	Quantity of net electricity supplied to the grid as a result of the implementation of the GS project activity in year y (MWh/yr)	83,000	MWh/year
$EF_{CO2,grid,y}$	Combined margin CO_2 emission factor for grid connected power generation in year y	0.5639	tCO_2e/MWh
ER_y	Emission reductions annually	46,802	tCO_2e/year

B.6.4 Summary of ex ante estimates of each SDG Impact

SDG13

Year	Baseline estimate	Project estimate	Net benefit
Year 1	0	46,802 tCO_2e	46,802 tCO_2e
Year 2	0	46,802 tCO_2e	46,802 tCO_2e
Year 2	0	46,802 tCO_2e	46,802 tCO_2e
Year 4	0	46,802 tCO_2e	46,802 tCO_2e
Year 5	0	46,802 tCO_2e	46,802 tCO_2e
Year 6	0	46,802 tCO_2e	46,802 tCO_2e
Year 7	0	46,802 tCO_2e	46,802 tCO_2e
Total	**0**	**327,614 tCO_2e**	**327,614 tCO_2e**
Total number of crediting years	7		
Annual average over the crediting period	0	46,802 tCO_2e	46,802 tCO_2e

SDG7

Year	Baseline estimate	Project estimate	Net benefit
Year 1	0	83,000 MWh	83,000 MWh
Year 2	0	83,000 MWh	83,000 MWh
Year 2	0	83,000 MWh	83,000 MWh
Year 4	0	83,000 MWh	83,000 MWh

Year 5	0	83,000 MWh	83,000 MWh
Year 6	0	83,000 MWh	83,000 MWh
Year 7	0	83,000 MWh	83,000 MWh
Total	**0**	**581,000 MWh**	**581,000 MWh**
Total number of crediting years		7	
Annual average over the crediting period	0	83,000 MWh	83,000 MWh

SDG6

Year	Baseline estimate	Project estimate	Net benefit
Year 1	0	8 pumps	8 pumps
Year 2	0	8 pumps	8 pumps
Year 2	0	8 pumps	8 pumps
Year 4	0	8 pumps	8 pumps
Year 5	0	8 pumps	8 pumps
Year 6	0	8 pumps	8 pumps
Year 7	0	8 pumps	8 pumps
Total	**0**	**8 pumps**	**8 pumps**
Total number of crediting years		7	
Annual average over the crediting period	0	8 pumps	8 pumps

B.7. Monitoring plan

B.7.1 Data and parameters to be monitored

SDG 13

Data / Parameter	ER_y
Unit	tCO_2/yr
Description	Emission reduction in year y

Source of data	Calculated
Value(s) applied	46,802
Measurement methods and procedures	Calculated
Monitoring frequency	Each verification
QA/QC procedures	/
Purpose of data	To monitor the SDG 13 Indicator
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	83,000
Measurement methods and procedures	Continuous measurement and monthly recording
Monitoring frequency	Monthly
QA/QC procedures	According to the recommendation by the manufacturer or the regulations of the grid company, meters are calibrated periodically. Data measured by meters will be cross-checked with the record document confirmed by EDL.
Purpose of data	Calculation of 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	Monthly
QA/QC procedures	According to the recommendation by the manufacturer or the regulations of the grid company, meters are calibrated periodically. Data measured by meters will be

	cross-checked with the record document confirmed by EDL.
Purpose of data	Calculation of 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	Equipment records and nameplates
Value(s) applied	15
Measurement methods and procedures	Checking the nameplate of water turbine generators
Monitoring frequency	Once at the beginning of each crediting period
QA/QC procedures	-
Purpose of data	Calculation of Project Emission
Additional comment	/

SDG 7

Data / Parameter	$\boldsymbol{EG_{PJ,facility,y}}$
Unit	MWh
Description	Quantity of net electricity supply of the project activity to the grid in year y.
Source of data	Calculated value
Value(s) applied	$EG_{PJ,facility,y} = EG_{output,y} - EG_{input,y}$
Measurement methods and procedures	Calculated
Monitoring frequency	Continuous measurement and monthly recording
QA/QC procedures	Please refer to the QA/QC procedures for meters and data of $\boldsymbol{EG_{output,y}}$ and $\boldsymbol{EG_{input,y}}$.
Purpose of data	Calculation of Baseline Emission
Additional comment	N/A

SDG 6

Data / Parameter	**Number of the installed pumps on-site**
Unit	/

Description	Number of the installed pumps on-site
Source of data	Survey
Value(s) applied	8
Measurement methods and procedures	Site visit to the water supply program.
Monitoring frequency	Each verification
QA/QC procedures	Site visit to the water supply program and interview with the local villager by simple random
Purpose of data	N/A
Additional comment	As confirmed by local village organization (Tayikseu village), 8 pumps are installed in the village in Nov. 2014 and the project also build temple and road to meet the local villagers' demand. According to the statistic by local EPB, over 146 households with population 1048 persons are benefits from the water supply program and temple. The PP has also placed Stakeholder Feedback and Complaint Form around the village and project site, no complaint has received yet.

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 are shown

below:

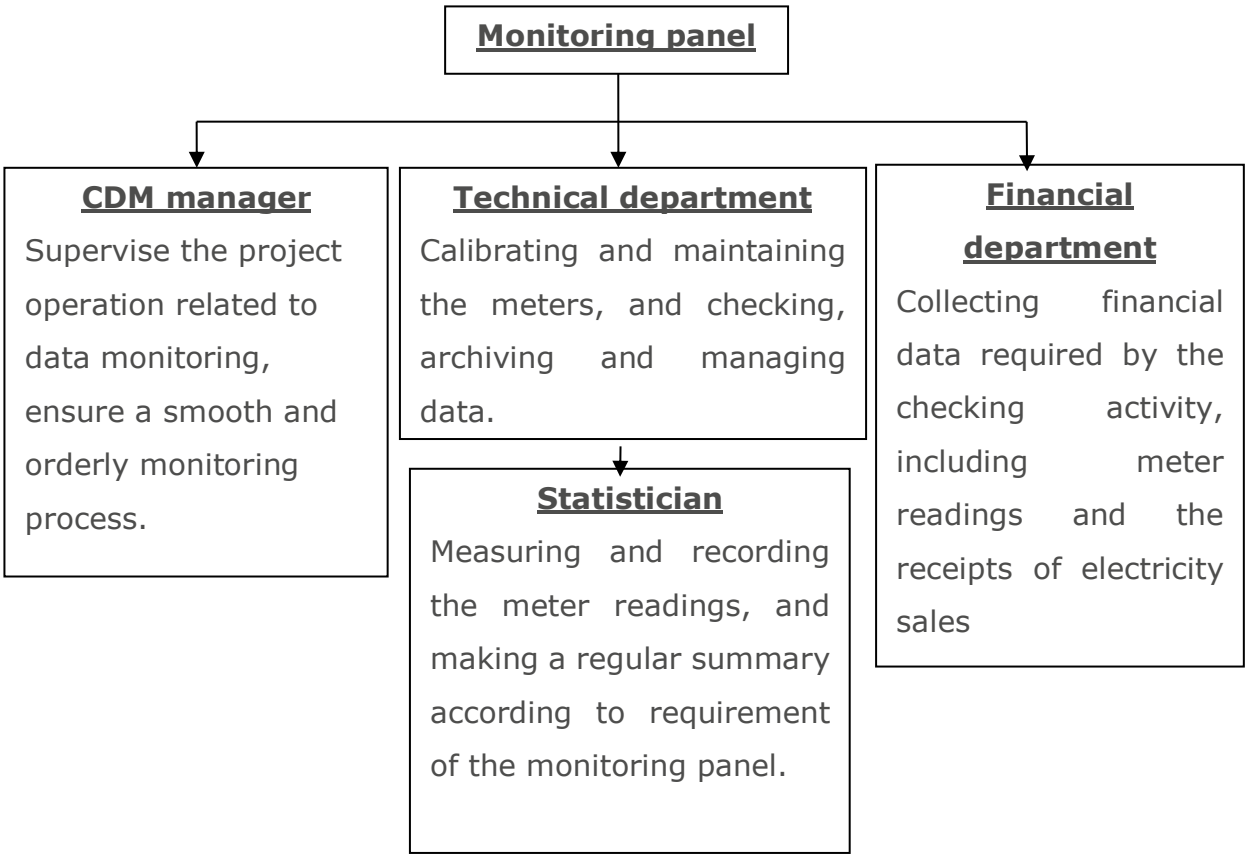

Figure B.4. Organization structure of the monitoring activity

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 22kV transmission line.

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 on the last day of every month.
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 operate 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 project participants. Once the final report is issued, it will be submitted to the DOE for verification.

SECTION C. DURATION AND CREDITING PERIOD

C.1. Duration of project

C.1.1 Start date of project

>>

14/10/2013 (the date when the Construction Contract was signed)

C.1.2 Expected operational lifetime of project

>>

25 years and 0 months

C.2. Crediting period of project

C.2.1 Start date of crediting period

>>

The start date of second crediting period is 01/01/2022. The first crediting period is from 01/01/2015 to 31/12/2021.

C.2.2 Total length of crediting period

>>

Seven years for the 2nd crediting period.

SECTION D. SUMMARY OF SAFEGUARDING PRINCIPLES AND GENDER SENSITIVE ASSESSMENT

D.1 Safeguarding Principles that will be monitored

A completed Safeguarding Principles Assessment is in Appendix 1, ongoing monitoring is summarised below.

Principles	Mitigation Measures added to the Monitoring Plan
N/A	N/A

D.2. Assessment that project complies with GS4GG Gender Sensitive requirements

Question 1 - Explain how the project reflects the key issues and requirements of Gender Sensitive design and implementation as outlined in the Gender Policy?	As per Gold Standard Gender Policy, para 4.2 (i) "Foundational gender-sensitive requirement - This strengthens Gold Standard's 'do no harm' approach and addresses safeguards to prevent or mitigate adverse impacts on women or men and girls and boys. Such action is mandatory for all projects seeking Gold Standard certification and includes compliance with the gender 'do no harm' safeguards, gender gap analysis and

	gender sensitive stakeholder consultations." The project being a renewable energy project is not gender sensitive project. The project does not adversely impact women or men.
Question 2 - Explain how the project aligns with existing country policies, strategies and best practices	Lao PDR is party to "Convention on the Elimination of All Forms of Discrimination against Women"[11] and the project has aligned its policies which does not discriminate on gender.
Question 3 - Is an Expert required for the Gender Safeguarding Principles & Requirements?	No. The project is a renewable energy project and it does not discriminate among gender.
Question 4 - Is an Expert required to assist with Gender issues at the Stakeholder Consultation?	No. The project is a renewable energy project and it does not discriminate among gender.

SECTION E. SUMMARY OF LOCAL STAKEHOLDER CONSULTATION

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.

In order to consult the public's opinions and suggestions about the project, 52 stakeholders were invited to carry out a consultation meeting through local government and bulletins, which including 18 female reprehensive.

The comments received from the stakeholders are summary as follows:

1) Is the water quantity affected by the project's implementation?
2) Does the project provide job opportunities to nearby village?

[11] https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=IV-8&chapter=4&lang=en

3) Some stakeholders expected the project owner could provide stable electricity to nearby village.
4) Is there Land occupied by the project?
5) Is the technology used in the project reliably?

E.1 Summary of stakeholder mitigation measures

>>
The project does not involve resettlements. Considerations on the comments by the stakeholders are listed as follow:
1) 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.
2) 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.
3) 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.
4) 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.
5) The project owner confirmed that they will choose reputable manufacturer to provide mature technology and equipment.

E.2 Final continuous input / grievance mechanism

Method	Include all details of Chosen Method (s) so that they may be understood and, where relevant, used by readers.

Continuous Input / Grievance Expression Process Book (mandatory)	A grievance expression process book was put in the power station to express their comments, suggestion and complaint.
GS Contact (mandatory)	help@goldstandard.org
Other	Telephone access + 00856-20-28190844 (for project manager) Phone and mobile are very common for local residential. Local stakeholders can call the working staff of the project owner to express their comments, suggestion and complaint. Internet/email access Yaodong.lu@gmail.com (for project manager) Local stakeholders can send email to the project owner to express their comments, suggestion and complaint.

APPENDIX 1 - SAFEGUARDING PRINCIPLES ASSESSMENT

Complete the Assessment below and copy all Mitigation Measures for each Principle into SECTION D above. Please refer to the instructions in the Guide to Completing this Form.

Assessment Questions/ Requirements	Justification of Relevance (Yes/potentially/no)	How Project will achieve Requirements through design, management or risk mitigation.	Mitigation Measures added to the Monitoring Plan (if required)
Principle 1. Human Rights			
1. The Project Developer and the Project shall respect internationally proclaimed human rights and shall not be complicit in violence or human rights abuses of any kind as defined in the Universal Declaration of Human Rights 2. The Project shall not discriminate with regards to participation and inclusion	No	The project does not involve any conflict with livelihood of local people and respect all human rights. Stakeholder consultation had been carried out to take their opinion. The host country prohibits discrimination on the basis of a person's race, sex, religion, place of birth, or social status. 1. The Project is not in conflict with the economic livelihood or other issue of the local community. Thus, the Project does not cause any human rights abuse and respects internationally proclaimed human rights issue.	N/A

		2. Project activities are not expected to cause any human rights abuse. As a member of United Nations and part of UN Agreement on Human Rights[12], it is ensured by law in Lao PDR that no action can be taken against human rights.	
Principle 2. Gender Equality			
1. The Project shall not directly or indirectly lead to/contribute to adverse impacts on gender equality and/or the situation of women. 2. Projects shall apply the principles of nondiscrimination, equal treatment, and equal pay for equal work. 3. The Project shall refer to the country's national gender strategy or equivalent national commitment to aid in assessing gender risks.	No	1. As a project combined of positive environmental, economic, and sustainable development benefits, the project is to generate clean electricity from the hydro power station to replace fossil fuel power. The project abides the rules of equality accordingly and does not involve and is not complicit in any form of discrimination. Specifically regarding the gender equality, detailed enforcement rules are regulated in 'Law on Development and Protection of Women'[13] to provide support and benefits to women. 2. Qualified local residents, both men and women, are recruited to work for the project. During stakeholders' consultation process, comments were collected from the	

[12] https://www.ilo.org/newdelhi/lang--en/index.htm
[13] http://www.na.gov.la/files/laws/105Development%20and%20Protection%20of%20Women%20Law.pdf

4. (where required) Summary of opinions and recommendations of an Expert Stakeholder(s)		local people, including both men and women. The details can be seen in registered passport. During previous monitoring periods, stakeholder interviews were conducted to collect comments about impacts of the project from the local people, including both men and women. The details can be seen in previous verification report. 3. The project abides the rules of equality accordingly. Regarding the gender equality, detailed enforcement rules are regulated in 'Labor Law'[14] and 'Law on Development and Protection of Women'[15] 4. No expert required.	
Principle 3. Community Health, Safety and Working Conditions			
1. The Project shall avoid community exposure to increased health risks and shall not adversely affect the health of the workers and the community	No	The project is renewable energy technology based power generation Technology) and does not have exposure to increased health risks and shall not adversely affect the health of the workers and the community. The project provides workers with a safe and healthy work environment and is not complicit in exposing workers to unsafe or unhealthy work environments.	N/A

[14] http://laoofficialgazette.gov.la/
[15] http://www.na.gov.la/files/laws/105Development%20and%20Protection%20of%20Women%20Law.pdf

		All the safety and hygiene measures are being ensured in order maintain a safe and healthy environment for the workers at site. In case of any emergency, the site incharge will ensure to take adequate action and preventive measures to avoid any miss happening. Necessary health and safety measures will be taken during construction and operation phase, relevant staff will be trained to be able to work with safety. The project is in compliance with all relevant local and national laws. The project proponent is committed to the employee's workplace health & safety during all phases of the project. All employees will attend health & safety trainings. This is issued in the Labour code on Occupational Safety, Health and Working Conditions and UN Agreement on Human Rights[16].	
Principle 4.1 Sites of Cultural and Historical Heritage			
Does the Project Area include sites, structures, or objects with historical, cultural, artistic, traditional or religious values or intangible forms of culture?	No	According to the IEE reports, the Project area does not include sites, structures, or objects with historical, cultural, artistic, traditional or religious values or intangible forms of culture.	N/A
>>			

[16] https://www.ohchr.org/EN/countries/AsiaRegion/Pages/LAIndex.aspx

Principle 4.2 Forced Eviction and Displacement			
Does the Project require or cause the physical or economic relocation of peoples (temporary or permanent, full or partial)?	No	As described in the IEE reports, the Project is constructed distanced to residential area, thus the Project does not require or cause the physical or economic relocation of peoples (temporary or permanent, full or partial).	No
>>			
Principle 4.3 Land Tenure and Other Rights			
Does the Project require any change, or have any uncertainties related to land tenure arrangements and/or access rights, usage rights or land ownership?	No	The project does not involve and is not complicit involuntary resettlement. As expected in the IEE report by the designer during the preparation stage. It does not require any change to land tenure arrangements and/or other rights.	N/A
>>			
Principle 4.4 Indigenous Peoples			
Are indigenous peoples present in or within the area of influence of the Project and/or is the Project located on land/territory claimed by indigenous peoples?	No	According to the IEE reports, no indigenous peoples present in or within the area of influence of the Project.	N/A
>>			
Principle 5. Corruption			

1. The Project shall not involve, be complicit in or inadvertently contribute to or reinforce corruption or corrupt Projects	No	The project does not condone or support corruption. Lao PDR has published relevant law[17] to against corruption. Furthermore, Lao PDR ratified the UN Convention against Corruption[18] on Sep. 25, 2009, Lao PDR will have the right to ask for assistance from other member countries in investigating and dealing with corruption cases with foreign elements. Besides, the stakeholder interviews were conducted during the first validation period, and confirmed that the Project Owner is not involving the corruption.	N/A
Principle 6.1 Labour Rights			
1. The Project Developer shall ensure that all employment is in compliance with national labour occupational health and safety laws and with the principles and standards embodied in the ILO fundamental conventions	No	1. The Project complies with national labour and occupational health and safety laws, obligations under international law, and the principles and standards embodied in the International Labour Organization (ILO) fundamental conventions. Labour rights are protected in the Labour Law[19]. The project fully respects the employees' rights in accordance with all labour related laws endorsed within Lao PDR. Law compliance is subject to government's inspection and ruling.	N/A

[17] http://www.na.gov.la/docs/eng/laws/pub_adm/Penal%20%282005%29%20Eng.pdf
[18] http://www.unlao.org/Blog/post/Lao-PDR-joins-international-fight-against-corruption.aspx
[19] http://laoofficialgazette.gov.la/

2. Workers shall be able to establish and join labour organisations 3. Working agreements with all individual workers shall be documented and implemented and include: a) Working hours (must not exceed 48 hours per week on a regular basis), AND b) Duties and tasks, AND c) Remuneration (must include provision for payment of overtime), AND d) Modalities on health insurance, AND e) Modalities on termination of the contract with provision for voluntary resignation by employee, AND		2. The rights to unionize, bargain collectively are highly protected by Labor Law[20]. The project fully respects the employees' rights in accordance with all labour related laws endorsed within Lao PDR. Law compliance is subject to government's inspection and ruling. 3. Working agreements between the company and individual workers are documented and implemented, including working hours, duties and tasks, remuneration, modalities on health insurance, modalities on termination of contract, provision for annual leave, etc. The employment model applied is locally and culturally appropriate. 4. Lao PDR has published Children's Rights Protection Law[21]. Employment regulations are described in this Law. The Project requires skilled employees to operate, maintain, and manage hydro power plant, as opposed to manufacturing industries, which may require abundant low-skilled labour. Therefore, the project does not employ and is not complicit in any form of child labour. 5. All equipment in the Project are operated properly according to the work procedures and safety regulation rules. The Project organizes	

[20] http://laoofficialgazette.gov.la/
[21] http://www.na.gov.la/files/laws/117.pdf

f) Provision for annual leave of not less than 10 days per year, not including sick and casual leave. 4. No child labour is allowed (Exceptions for children working on their families' property requires an Expert Stakeholder opinion) 5. The Project Developer shall ensure the use of appropriate equipment, training of workers, documentation and reporting of accidents and incidents, and emergency preparedness and response measures		employee training with topics on technical, environmental/safety code, and operational/maintenance procedures. The Project has established guard again and response procedure, which also regulates the documentation and reporting of accidents and incidents. Thus the Project owner ensures the use of appropriate equipment, training of workers, documentation and reporting of accidents and incidents, and emergency preparedness and response measures.	
Principle 6.2 Negative Economic Consequences			
1. Does the project cause negative economic consequences during and after project implementation?	No	The participants all recognized the positive socio-economic and environmental impacts of the proposed project, as follows: 1. Creating jobs for the local people 2. Economic benefit 3. Providing water	N/A
>>			

		There is no potential risks of the project to the local economy.	
Principle 7. Climate and Energy			
Principle 7.1 Emissions			
Will the Project increase greenhouse gas emissions over the Baseline Scenario? >>	No	The project is to generate clean electricity with the abundant resources and displace part of the electricity usage from the regional grid consisting of Laos and Thailand power grid, in which coal, oil and natural gas fired power plants are the dominated power sources. It will displace part of thermal power by making use of clean and renewable energy and the expected annual average GHG emission reductions are about 46,802 tCO_2e per year.	N/A
Principle 7.2 Energy Supply			
Will the Project use energy from a local grid or power supply (i.e., not connected to a national or regional grid) or fuel resource (such as wood, biomass) that provides for other local users? >>	No	The Project's does not use energy from a local grid or power supply or fuel resource that provides for other local users.	N/A
Principle 8. Water			
Principle 8.1 Impact on Natural Water Patterns/Flows			

Will the Project affect the natural or pre-existing pattern of watercourses, ground-water and/or the watershed(s) such as high seasonal flow variability, flooding potential, lack of aquatic connectivity or water scarcity? >>	No	The project activity would not have negative impact on the natural or pre-existing pattern of watercourses, ground-water and/or the watershed(s). The opinions and recommendations of experts, such as IEE indicators, stakeholder interview feedback, confirmed opinion from village organization and annual waterflow monitoring data was sought and demonstrated as being included in the Project design and Monitoring.	N/A
Principle 8.2 Erosion and/or Water Body Instability			
Could the Project directly or indirectly cause additional erosion and/or water body instability or disrupt the natural pattern of erosion? >>	No	The minimum flow will be released to maintain the eco-system and meet demand for irrigation in the downstream. The water quality and quantity will be examined by the environment monitoring department according to the relevant standards and regulations annually. The monitoring parameters are the flow rate of water released, relevant water quality indicators and competing uses of water resources at the project location. Therefore it would not cause additional erosion and/or water body instability or disrupt natural pattern of erosion. The project activity is only a hydropower project which not includes any planting, agriculture or similar activities.	N/A

		Therefore the project's area of influence is not susceptible to excessive erosion and/or water body instability.	
Principle 9. Environment, ecology and land use			
Principle 9.1 Landscape Modification and Soil			
Does the Project involve the use of land and soil for production of crops or other products?	No	The Project does not involve the use of land and soil for production of crops or other products.	N/A
>>			
Principle 9.2 Vulnerability to Natural Disaster			
Will the Project be susceptible to or lead to increased vulnerability to wind, earthquakes, subsidence, landslides, erosion, flooding, drought or other extreme climatic conditions?	No	The Project is not susceptible to and does not lead to increased vulnerability to wind, earthquakes, subsidence, landslides, erosion, flooding, drought or other extreme climatic conditions.	N/A
>>			
Principle 9.3 Genetic Resources			
Could the Project be negatively impacted by or involve genetically modified organisms or GMOs (e.g., contamination, collection and/or harvesting, commercial development, or	No	The project activity is only a hydropower project which not includes any planting, agriculture or similar activities. The project activity does not threaten human health or the environment. The project constructed and is operating in an environmental-friendly way. Therefore the Project	N/A

take place in facilities or farms that include GMOs in their processes and production)? >>		is not negatively impacted by the use of genetically modified organisms or GMOs.	
Principle 9.4 Release of pollutants			
Could the Project potentially result in the release of pollutants to the environment? >>	No	The project activity is only a hydropower project. The project activity does not threaten human health or the environment. The project constructed and is operating in an environmental-friendly way. Therefore the Project does not potentially result in release of pollutants to the environment.	N/A
Principle 9.5 Hazardous and Non-hazardous Waste			
Will the Project involve the manufacture, trade, release, and/ or use of hazardous and non-hazardous chemicals and/or materials? >>	No	The Project's purpose is to supply energy from the hydro power station. Therefore, the Project does not involve the manufacture, trade, release, and/or use of hazardous and non-hazardous chemicals and/or materials.	N/A
Principle 9.6 Pesticides & Fertilisers			
Will the Project involve the application of pesticides and/or fertilisers? >>	No	The project is a hyro power project, and the project area is deep in the mountain. Therefore, the Project does not involve the application of pesticides and/or fertilizers.	N/A

Principle 9.7 Harvesting of Forests			
Will the Project involve the harvesting of forests?	No	The project is a hyro power project, and the project area is deep in the mountain. It does not involve the harvesting of forests.	N/A
>>			
Principle 9.8 Food			
Does the Project modify the quantity or nutritional quality of food available such as through crop regime alteration or export or economic incentives?	No	The project activity is only a hydropower project which not includes any planting, agriculture or similar activities. Therefore the Project does not modify the quantity or nutritional quality of food available such as through crop regime alteration or export or economic incentives.	N/A
>>			
Principle 9.9 Animal husbandry			
Will the Project involve animal husbandry?	No	The project activity is only a hydropower project which not includes any planting, agriculture or similar activities. The Project does not involve animal husbandry.	N/A
>>			
Principle 9.10 High Conservation Value Areas and Critical Habitats			
Does the Project physically affect or alter largely intact or High Conservation Value (HCV) ecosystems, critical habitats, landscapes, key biodiversity areas or sites identified?	No	The project is a hydro power project. According to the IEE reports, it does not physically affect or alter largely intact or High Conservation Value (HCV) ecosystems, critical habitats, landscapes, key biodiversity areas or sites identified.	N/A
>>			

Principle 9.11 Endangered Species			
Are there any endangered species identified as potentially being present within the Project boundary (including those that may route through the area)? AND/OR Does the Project potentially impact other areas where endangered species may be present through transboundary affects?	No	According to the IEE report, there are no endangered species identified as potentially being present within the Project boundary (including those that may route through the area), and the project would not potentially impact other areas where endangered species may be present through transboundary affects.	N/A
>>			

APPENDIX 2- CONTACT INFORMATION OF PROJECT PARTICIPANTS

Organization name	**SV Group Co., Ltd**
Registration number with relevant authority	/
Street/P.O. Box	333 Anou Rd, Thakhek Kang Village, Thakhek District
Building	/
City	Khammouane Province
State/Region	/
Postcode	/
Country	Lao PDR
Telephone	856-51-214-129
E-mail	svgroupcoltd@yahoo.com
Website	/
Contact person	Xaysongkham VORACHITH
Title	/
Salutation	Mr.
Last name	VORACHITH
Middle name	/
First name	Xaysongkham
Department	/
Mobile	/
Direct tel.	/
Personal e-mail	/

Organization name	**Swiss Carbon Assets Limited**
Registration number with relevant authority	/
Street/P.O. Box	Technoparkstrasse 1
Building	/
City	Zürich
State/Region	/
Postcode	8005
Country	Switzerland
Telephone	+41 43 501 35 50
E-mail	r.heuberger@southpolecarbon.com
Website	/
Contact person	Renat Heuberger
Title	/
Salutation	Mr.
Last name	Heuberger
Middle name	/
First name	Renat
Department	/
Mobile	/
Direct tel.	+41 43 501 35 99
Personal e-mail	/

APPENDIX 3- FURTHER BACKGROUND INFORMATION ON EX ANTE CALCULATION OF EMISSION REDUCTIONS

Calculation of Operating Margin Emission Factor

Table 1 Electricity generated and delivered to Laos National Power Grid

Item	2019		2018		2017	
	EDL	IPP&SPP	EDL	IPP&SPP	EDL	IPP&SPP
	GWh	GWh	GWh	GWh	GWh	GWh
Lao domestic power consumption	2,713.81	5,452.45	3,181.77	6,205.00	2,848.61	5,014.95
Sum Up	**8166.26**		**9386.77**		**7863.56**	

Sources from:

Electricity Statistic (page 9-11, 2019), EDL

Table 2 Electricity generated and delivered to Thailand National Power Grid

Item	2019			2018			2017		
	EGAT	IPP	SPP	EGAT	IPP	SPP	EGAT	IPP	SPP
	GWh	GWh	GWh	GWh	GWh	GWh	GWh	GWh	GWh
Natural gas	38,828.25	39,265.45	43,023.09	37,903.77	38,397.08	39,339	38,916.80	48,453.64	32,644.34
Coal (bituminous & lignite)	16,074.20	15,816.72	2,028.78	15,903.31	15,887.85	2,150.58	16,925.69	15,112.63	1,695.51

Item	2019			2018			2017		
	EGAT	IPP	SPP	EGAT	IPP	SPP	EGAT	IPP	SPP
	GWh	GWh	GWh	GWh	GWh	GWh	GWh	GWh	GWh
Renewable energy (hydropower and others)	6,042.72	-	4,398.13	7,360.00	-	2,483	4,593.22	-	1,952.60
Hydropower	-	-	35.26	-	-	38	-	-	22.33
Solar power and wind power	-	-	4,362.87	-	-	2,445	-	-	1,930.27
Fuel oil and palm oil	932.07	-	207.16	28.67	-	245	93.33	98.91	201.26
Diesel oil	127.89	14.84	-	108.60	7.76	-	188.46	3.82	-
Biomass	-	-	5,276.95	-	-	4,847	-	-	3,620.41
Other	311.27	-	-	210.75	-	-	105.81	-	-
Sum up	62,316.40	55,097.01	54,934.11	61,515.10	54,292.69	49,064.33	60,823.31	63,669.00	40,114.12
Total	172,347.52			164,872.12			164,606.43		

Sourced from:

Annual Report (page 134, 2019; page 132, 2018), EGAT

Table 3 Electricity generated and delivered by Lao IPP directly supply to Thailand

Item	2019	2018	2017
	GWh	GWh	GWh
Thailand imports from Lao (Lao IPP directly supply to Thailand)	25407.09	26386.04	24196.64
Sum up	25,564.69	26,545.43	24,402.94

Sourced from:

Annual Report (page 134, 2019; page 132, 2018), EGAT

Table 4 Power import from the connected system

Item	2019	2018	2017
	GWh	GWh	GWh
Lao imports from Vietnam (1)	29.87	25.58	26.32
Lao imports from China (1)	9.35	14.24	48.08
Thailand imports from Malaysia (2)	118.39	119.57	131.9
Sum up	25,564.69	26,545.43	24,402.94

Sourced from:

(1) Electricity Statistic (page 11, 2019; page 11, 2018; page 11, 2017), EDL

(2) Annual Report (page 134, 2019; page 132, 2018), EGAT

Table 5 Calculation of CO_2 Emission within Lao PDR

There is only one thermal power generation plant in Lao (Hongsa power plant), and the power generated will be supplied to EDL (Lao grid) and EGAT (Thai grid) separately. Since the fuel consumption of the power station cannot be obtained, a conservative way (using power generation max efficiency of thermal power) is adopted to calculate the fuel consumption of the power station. Emission from Hongsa power plant calculated as follow:

Year		2017	2018	2019
Installed capacity (MW) (1)	A	1,878	1,878	1,878

Year		2017	2018	2019
Load Factor (2)	B	83.61%	89.65%	82.18%
Power generation of Hongsa (GWh)	C=A*B*8760/1000	13,754.92	14,748.57	13,519.66
Efficiency (3)	D	48%	48%	48%
Total calorific (GJ)	E=C/D*3600	103,161,864	110,614,294	101,397,464
Net Calorific Value (4) (GJ/t)	F	5.50	5.50	5.50
Fuel Consumption (t)	G=E/F	18,756,702.56	20,111,689.80	18,435,902.60
$EF_{CO2,lignite,y}$ (5) (tCO_2/TJ)	H	90.90	90.90	90.90
Emission (tCO_{2e})	I=E*H/1000	9,377,413	10,054,839	9,217,030

Sourced from:

(1) Electricity Statistic (page 6, 2019), EDL

(2) Sustainability Report 2019 of Banpu Power Public Company Limited (shareholder of Hongsa power plant), Page 61

(3) IPCC Technology-specific Cost and Performance Parameters, Table A.III.1, max value of plant efficiency for coal-PC, Page 1333

(4) IPCC 2006, Guidelines for National Greenhouse Gas Inventories, Volume 2 Chapter 1 Table 1.2, page 1.18

(5) *IPCC 2006, Guidelines for National Greenhouse Gas Inventories, Volume 2 Chapter 1 Table 1.4, page 1.23*

Table 6 Calculation of CO_2 Emission within Thailand

Fuel Type	Fuel Consumption		Fuel Specific EF	Net Calorific Value	GHG emission
	$FC_{i,y}$ (1)		$EF_{CO2,m,i,y}$ (2)	$NCV_{i,y}$ (3)	$FC_{i,y}$ x $EF_{CO2,m,i,y}$ x $NCV_{i,y}$
	Unit	FC/Unit	tCO_2/TJ	MJ/Unit	tCO_2
2019					
Natural Gas	ktoe	25,965	54.3	41.868	59,029,672
Lignite	ktoe	3,938	90.9	41.868	14,987,245
Bituminous	ktoe	3,098	89.5	41.868	11,608,782
Briquettes	ktoe	590	87.3	41.868	2,156,495
Diesel (HSD)	ktoe	38	72.6	41.868	115,505
Fuel oil	ktoe	26	75.5	41.868	82,187
Municipal wastes and biomass fraction	ktoe	6,682	46.2	41.868	12,925,003
Paddy husk	ktoe	837	-	-	-
Bagasse	ktoe	3,852	-	-	-
Agricultural waste	ktoe	1,957	-	-	-
MSW	ktoe	36	-	-	-
Biogas	ktoe	525	84.7	41.868	1,861,765
Sum (2019)					**102,766,656**
2018					
Natural Gas	ktoe	25,614	54.3	41.868	58,231,697

Fuel Type	Fuel Consumption		Fuel Specific EF	Net Calorific Value	GHG emission
	$FC_{i,y}$ (1)		$EF_{CO2,m,i,y}$ (2)	$NCV_{i,y}$ (3)	$FC_{i,y}$ x $EF_{CO2,m,i,y}$ x $NCV_{i,y}$
	Unit	FC/Unit	tCO_2/TJ	MJ/Unit	tCO_2
Lignite	ktoe	3,510	90.9	41.868	13,358,362
Bituminous	ktoe	3,329	89.5	41.868	12,474,382
Briquettes	ktoe	634	87.3	41.868	2,317,318
Diesel (HSD)	ktoe	35	72.6	41.868	106,387
Fuel oil	ktoe	15	75.5	41.868	47,416
Municipal wastes and biomass fraction	ktoe	7,457	46.2	41.868	14,424,087
Paddy husk	ktoe	691	-	-	-
Bagasse	ktoe	4,365	-	-	-
Agricultural waste	ktoe	2,334	-	-	-
MSW	ktoe	67	-	-	-
Biogas	ktoe	590	84.7	41.868	2,092,270
Sum					**103,051,919**
2017					
Natural Gas	ktoe	26,399	54.3	41.868	60,016,342
Lignite	ktoe	3,409	90.9	41.868	12,973,976
Bituminous	ktoe	3,190	89.5	41.868	11,953,523

Fuel Type	Fuel Consumption		Fuel Specific EF	Net Calorific Value	GHG emission
	$FC_{i,y}$ (1)		$EF_{CO2,m,i,y}$ (2)	$NCV_{i,y}$ (3)	$FC_{i,y}$ x $EF_{CO2,m,i,y}$ x $NCV_{i,y}$
	Unit	FC/Unit	tCO_2/TJ	MJ/Unit	tCO_2
Briquettes	ktoe	737	87.3	41.868	2,693,791
Diesel (HSD)	ktoe	35	72.6	41.868	106,387
Fuel oil	ktoe	24	75.5	41.868	75,865
Municipal wastes and biomass fraction	ktoe	8,192	46.2	41.868	15,845,799
Paddy husk	ktoe	717	-	-	-
Bagasse	ktoe	4,786	-	-	-
Agricultural waste	ktoe	2,587	-	-	-
MSW	ktoe	102	-	-	-
Biogas	ktoe	653	84.7	41.868	2,315,681
Sum					**105,981,364**

Sources from:

(1) Energy Balance of Thailand 2019, EGAT, table 43, Page 50

(2) IPCC 2006, Guidelines for National Greenhouse Gas Inventories, Volume 2 Chapter 1 Table 1.4, page 1.23 and 1.24

(3) Unit converter and glossary, International Energy Agency.

https://www.iea.org/reports/unit-converter-and-glossary

Table 7 Calculation of $EF_{grid,OM\text{-}ave,y}$

Year	Electricity generated and delivered to the power grid system (GWh)	Emission in the power grid system (tCO_2e)	OM Emission Factor (tCO_2/MWh)
2017	196,873	112,144,069	0.5696
2018	200,804	113,106,758	0.5633
2019	206,078	115,198,394	0.5590
Sum up	**603,756**	**340,449,221**	**0.5639**

Based on the equation and above data, the $EF_{grid,OM\text{-}ave,y}$ =0.5639 tCO_2/MWh

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

= 1×0.5639

= 0.5639 tCO_2e/MWh.

APPENDIX 4-SUMMARY OF APPROVED DESIGN CHANGES

No post registration design changes.

Revision History

Version	Date	Remarks
1.2	14 October 2020	Hyperlinked section summary to enable quick access to key sections Improved clarity on Key Project Information Inclusion criteria table added Gender sensitive requirements added Prior consideration (1 yr rule) and Ongoing Financial Need added Safeguard Principles Assessment as annex and a new section to include applicable safeguards for clarity Improved Clarity on SDG contribution/SDG Impact term used throughout Clarity on Stakeholder Consultation information required Provision of an accompanying Guide to help the user understand detailed rules and requirements
1.1	24 August 2017	Updated to include section A.8 on 'gender sensitive' requirements
1.0	10 July 2017	Initial adoption