NAM HOUNG - 1 HYDRO POWER PROJECT

Document Prepared by Kosher Climate India Private Limited

carbon@kosherclimate.com

Project Title	Nam Houng - 1 Hydro Power Project
Version	01
Date of Issue	11-September-2023
Prepared By	Kosher Climate India Private Limited
Contact	Zee Plaza, No.1678, 27th Main Rd, Near KLM Mall, Sector 2, HSR Layout, Bengaluru, Karnataka 560102 India Email: vamsi@kosherclimate.com; narendra@kosherclimate.com

CONTENTS

1 PROJECT DETAILS

1.1 Summary Description of the Project

Nam Houng - 1 Hydro Power Project (hereafter referred to as the "the project") is developed by Nam Houng - 1 Hydro Power Co., Ltd in Xayabouly province, Lao PDR. The primary purpose of the project is to generate electricity to the Lao Power Grid.

The project activity is a run-off river hydro power project with a total installed capacity of 15 MW. The project is promoted by Nam Houng - 1 Hydro Power Co., Ltd. Project is commissioned on 01-September-2023 with a net annual generation of 87,280 MWh.

The project is expected to constantly contribute clean energy to the Lao Power Grid. It not only conforms to the present situation, but also can adapt to future changes in the electricity market. The baseline scenario of the project is continuation of the present situation, i.e electricity supplied from the power grid. By displacing part of the power generated by thermal power plants, the project is therefore expected to reduce CO_2 emissions by an estimation of 40,515 tCO_2e per year during the first crediting period.

The project is not only supplying renewable electricity to grid, but also producing positive environmental and economic benefits and also, promotes the local sustainable development in the following aspects:

- During the construction period, plenty of job opportunities were provided to local residents,
- The infrastructure has been greatly improved. The enhancement of the transportation and electricity system brings substantial benefits to local villagers;
- The use of firewood will be reduced because of displacement by electricity, this reduces the damage to the local vegetation;
- Provide clean & cheap electricity in this region, promote the sustainable development in this region and slowing down the increasing trend of GHG emissions.

The Nam Houng - 1 Hydro Power development project is a part of the power development strategy by the Xayabouly Provincial Government Lao PDR to achieve the following important objectives:

- Augmenting foreign exchange earnings for Lao PDR through the sale to Thailand of electrical energy surplus to consumption in the northern grid.
- Assisting in the displacement of imported kerosene and diesel fuels by indigenous hydropower and thereby reducing the outflow of foreign exchange.
- Assisting in the reduction of imported power from neighbor countries.
- Assisting in the reduction of Energy losses and stability on the EDL grid.
- Facilitating development of agro-based and other industries.
- Improving the general standard of living of the population of Lao PDR.

- One part in Xayabouly Province has to be purchased energy by Lao Government Policy in year 2020 on 90% electrified whole country.

1.2 Sectoral Scope and Project Type

Sectoral Scope : 01 – Energy Industries (Renewable/non-renewable sources)
Project Type : Renewable Energy Project

The project is not AFOLU project and is not a grouped project.

1.3 Project Eligibility

The project is a 15 MW small-scale grid connected electricity generation project using hydro power in Lao PDR which is a Least developed Country (LDC)[1] as per the UN. As per VCS standard V-4.3, section 2.1 – Table 1, the small-scale hydro power project activity in LDC does not fall under excluded project activities. Hence, the project activity is eligible under VCS.

1.4 Project Design

☒ The project includes a single location or installation only

☐ The project includes multiple locations or project activity instances, but is not being developed as a grouped project

☐ The project is a grouped project

The project has been designed to include a single installation of an activity.

Eligibility Criteria

The project is not a grouped project. Thus, this section is not applicable.

1.5 Project Proponent

Organization name	Nam Houng - 1 Hydro Power Co., Ltd
Contact person	Phapithack Ekaphanh
Title	Director
Address	Khampheng Mueang Road (T4), Phonthan Nuea Village, Sayysathar District, Vientiane Capital

[1] https://unctad.org/topic/least-developed-countries/list

Telephone	+85 621 922777
Email	smgroad@yahoo.com info@smgroup.com.la

1.6 Other Entities Involved in the Project

Organization name	Kosher Climate India Private Limited
Role in the project	Project Representative
Contact person	Vamsi Krishna M
Title	Director
Address	Zee Plaza, No.1678, 27th Main Rd, Near KLM Mall, Sector 2, HSR Layout, Bengaluru, Karnataka 560102, India
Telephone	+91 99453 43475
Email	vamsi@kosherclimate.com narendra@kosherclimate.com

1.7 Ownership

Nam Houng - 1 Hydro Power Co., Ltd. is a SPV of Simoung Group Co., Ltd. Simoung Group Co., Ltd. is the legal owner of Nam Houng – 1 Hydro Power Project (Nam Houng - 1 Hydro Power Co., Ltd.). They have the legal right to control and operate the project activities.

The business license of the project owner are the evidences for legislative right. Besides, the project allotment license, the equipment purchasing contract and the power purchase agreement are the evidences for the ownership of the plant equipment and power generating.

1.8 Project Start Date

01-September-2023

1.9 Project Crediting Period

Project Owner has chosen the renewable crediting period with first crediting of 7 Years which starts from 01-September-2023 to 31-August-2030 with an option of two times of renewable up to 21 years.

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

The estimated annual GHG emission reductions/removals of the project are:

☐ <20,000 tCO_2e/year

☒ 20,000 – 100,000 tCO_2e/year

☐ 100,001 – 1,000,000 tCO_2e/year

☐ >1,000,000 tCO_2e/year

Project Scale	
Project	X
Large project	

Year	Estimated GHG emission reductions or removals (tCO_2e)
Year 1	40,515
Year 2	40,515
Year 3	40,515
Year 4	40,515
Year 5	40,515
Year 6	40,515
Year 7	40,515
Total estimated ERs	283,608
Total number of crediting years	7
Average annual ERs	40,515

1.11 Description of the Project Activity

The project activity is a run-of-river Hydro power project with a total installed capacity of 15 MW. The project is promoted by Nam Houng - 1 Hydro Power Co., Ltd. The Project activity is a new facility (Greenfield) and the electricity generated by the project will be exported to the electricity grid. The project will therefore displace an equivalent amount of electricity which would have otherwise been generated by fossil fuel dominant electricity grid. The Project Proponent plans to avail the VCS benefits for the project. In the Pre- project scenario, the entire electricity delivered to the grid by the project activity, would have otherwise been generated by the operation of grid-connected power plant. The scenario prior to the start of implementation of the project activity is generation of electricity, dominated by thermal power plants, thus leading to GHG emissions. The

baseline scenario is the same as the scenario prior to the start of implementation of the project activity. The project shall result in replacing anthropogenic emissions of greenhouse gases (GHG's) estimated to be approximately 40,515 tCO_2e per year, thereon displacing 87,280 MWh/year amount of electricity from the gird over the 7 years crediting period. The hydro project structure consists of release sluice, main powerhouse, and right-bank non overflow dam, etc.

1.12 Project Location

The project is located in the Xayabouly Province, Lao PDR.

Table 2: Project Location

Project Location	Latitude	Longitude
Xayabouly Province, Lao PDR	19°11'19.7"N	101°48'17.8"E

Fig.1 Project Location

1.13 Conditions Prior to Project Initiation

The project is a Greenfield hydro power project and does not involve generation of GHG emissions for the purpose of their subsequent reduction, removal or destruction. Thus prior to project initiation, there was nothing at site.

In the absence of project activity, the continuation of current practice i.e., generation of equivalent amount of electricity would have been generated from grid connected fossil fuel dominated power plants. Thus, for project activity baseline scenario is 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.

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

The project has received all the necessary approvals for the development and commissioning of the proposed 15MW hydro power project from the respective nodal agencies and is in compliance to the local laws and regulations. The list of applicable laws & regulations and the project compliance against it are given below:

1.15 Participation under Other GHG Programs

1.15.1 Projects Registered (or seeking registration) under Other GHG Program(s)

The project is not registered under any other GHG programs. The project is seeking registration only in VCS program.

1.15.2 Projects Rejected by Other GHG Programs

The project is not rejected by any other GHG program.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

Does the project reduce GHG emissions from activities that are included in an emissions trading program or any other mechanism that includes GHG allowance trading?

☐ Yes ☒ No

1.16.2 Other Forms of Environmental Credit

Has the project sought or received another form of GHG-related credit, including renewable energy certificates?

☐ Yes ☒ No

1.17 Sustainable Development Contributions

1.17.1 Sustainable Development Contributions Activity Description

Social well-being: The project would help in generating employment opportunities during the construction and operation phases. The project activity will lead to development in infrastructure in the region like development of roads and also may promote business with improved power generation.

Economic well-being: The project is a clean technology investment in the region, which would not have been taken place in the absence of the VCS benefits the project activity will also help to reduce the demand supply gap in the state.

The project activity will generate power using hydro energy-based power generation which helps to reduce GHG emissions and specific pollutants like SO_x, NO_x, and SPM associated with the conventional thermal power generation facilities.

Technological well-being: The successful operation of project activity would lead to promotion of hydro power generation and would encourage other entrepreneurs to participate in similar projects.

Environmental well-being: Hydro energy being a renewable source of energy, it reduces the dependence on fossil fuels and conserves natural resources which are on the verge of depletion. Due to its zero emission the Project activity also helps in avoiding significant amount of GHG emissions.

1.17.2 Sustainable Development Contributions Activity Monitoring

The project supplies clean electricity from the hydro power plant to the National grid hence displacing the electricity generated from grid connected fossil fuel power plants and thereby avoiding the equivalent Carbon dioxide which is a greenhouse gas. In the absence of the project activity, there won't be any avoidance of carbon dioxide.

During the construction, operation and maintenance of the hydro power plant, the project created many direct and indirect new job opportunities mostly to the local people in the project region. In the absence of the project activity, there would be no new jobs created in the project area.

As a part of regional development efforts associated with the project, PP has supported many education, health & infrastructure related needs for local people. These are funded from the revenue generated from the operation of the project activity. In the absence of project activity, there would be no revenue generated from the project and hence the activity would have not occurred in the absence of the project activity.

Table 1: Sustainable Development Contributions

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions over project lifetime
Sequential row number	SDG Target number	Number and text of SDG indicator or, if no official SDG indicator is applicable, user-defined indicator	Indicate the project's contribution to the SDG Indicator (implemented activities to increase or decrease)	Brief description of the quantifiable impact of the project's activities related to the SDG indicator, during the monitoring period.	Brief description of the cumulative quantifiable impact of the project's activities related to the SDG indicator, over the project lifetime.
1)	7	7.2 By 2030, increase substantially the share of renewable energy in the global energy mix	Implemented activities to increase	Project target to generate and feed 87,280 MWh/year to the national grid and thus expected to increase the share of renewable energy by 2,182,000 MWh to the national grid for its lifetime	In the absence of the project activity 87,280 MWh/year of electricity would have been generated by the fossil fuel dominated grid.
2)	8	8.5 By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value.	Implemented activities to increase	Project creates employment to the people	Project creates new employment and generates income for the people during the project lifetime.
3)	13.0	13.2 Integrate climate change measures into national policies, strategies, and planning	Implemented activities to increase	Project target to reduce 40,515 tCO_2 emissions per year in the host	In the absence of the project activity 40,515 tCO_2/year emission

				country and expected to reduce 1,012,875tCO_2 emission reductions to in the host country for its lifetime	reductions would have been generated from the fossil fuel dominated power plants in the host country.

1.18 Additional Information Relevant to the Project

Leakage Management

Not Applicable as no leakage emission is involved in this project.

Commercially Sensitive Information

No commercially sensitive information has been excluded from the public version of the project description.

Further Information

Not Applicable.

2 SAFEGUARDS

2.1 No Net Harm

The project activity involves major construction activity and primarily requires the installation of the turbines, interfacing the generators with the State Electricity Board by setting up HT transmission lines and installation of other accessories. Hydro Power project activity operations do not result in direct air pollution, noise pollution. Thus, there is no any significant impact due to implementation of project activity on air, water, soil quality and ambience are envisaged due to the project activity.

Safe-guarding Principles: The project does not involve and is not complicit in involuntary resettlement.

Relevance to the Project Activity: As per the final project design, there is no relocation involved. The project being a run off river project, there is no considerable change in the water storage area. Hence, no negative impact due to the project.

2.2 Local Stakeholder Consultation

Public consultation was carried out at different levels including the Government Authorities from National, Provincial, District, Village authorities and institutions, as well as international organizations. At village level the consultation focused on the proposed effected villages which are located in upstream, downstream and project construction sites in order to provide basic information about the project. The content of public consultation includes provision of basic information about the project, its objectives and the expected potential project impacts and mitigation measures. The representative of each village group attended the meeting was asked

to introduce the project to the other members of each village. The public consultation at village level was conducted informally during the time of social economic survey in each impact village. The participants were from the different groups as in following:

- Representative of government official of the concerned districts;
- Representative of Lao women's union, at village level, Lao National Front and the Lao Youth organization at village level;
- Head of village and head of household;
- The socio-economic survey teams.

Summary of the consultation meeting

Nam Houng - 1 Hydro Power project received support from all the villages around the project area. The main positive impacts of the project are as follows:

- Opportunity for employment by the Project during the construction and the operation phases;
- Opportunity to sell small goods and/or provide food for the workers at the camp;
- Benefits from an improved road-increased and all-year access;
- Availability of electricity and the opportunity to expand into small home-run businesses as well as improving everyday life; and
- Access to training and technical programs delivered by District Government (Improved access to agricultural extension services).

Post the stakeholder meeting, all the concerns raised during the meeting was properly addressed along with mitigation measures to minimise any impacts.

2.3 Environmental Impact

The project activity has no significant impact on the environment.

2.4 Public Comments

Comments to be provided after the project is listed.

2.5 AFOLU-Specific Safeguards

Not Applicable.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

Title: "Small-scale methodology for grid-connected renewable electricity generation" – AMS I.D[2]

Version: 18.0

Type I: Energy industries (Renewable/ non-renewable sources)

Tools used along with the above methodology are mentioned below:

- Tool to calculate the emission factor for an electricity system - Version 07.0[3]
- Demonstration of additionality of small-scale project activities – Version 13.1[4]
- Investment analysis, version 12.0[5]

3.2 Applicability of Methodology

The project activity involves generation of grid connected electricity from hydro energy. The project activity has a proposed capacity of 15 MW which will qualify for a small scale CDM project activity under Type-I of the small-scale methodologies. The project status is corresponding to the methodology AMS I.D version 18.0 and applicability of methodology is discussed below.

Applicability Criteria	Applicability Status
This methodology comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal and renewable biomass: (a) Supplying electricity to a national or a regional grid; or (b) Supplying electricity to an identified consumer facility via national/regional grid through a contractual arrangement such as wheeling.	The project activity involves setting up of a renewable energy (hydro) generation plant that exports electricity to the fossil fuel dominated electricity grid. Thus, the project meets this applicability conditions "a"

[2] https://cdm.unfccc.int/UserManagement/FileStorage/2P7FS6ZQAR84LG3NMKYUH50WI9ODBC

[3] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v7.0.pdf

[4] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-21-v13.1.pdf

[5] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-27-v12.pdf

Illustration of respective situations under which each of the methodology (i.e., AMS-I. D: Grid connected renewable electricity generation", AMS-I.F: Renewable electricity generation for captive use and mini-grid" and AMS-I.A: Electricity generation by the user) applies is included in Table 2	According to the point 1 of the Table 2 in the methodology – "Project supplies electricity to a national/ regional grid" is applicable under AMS I.D. As the project activity supplies the electricity to Lao PDR Grid system grid which is a regional grid, the methodology AMS-I.D. is applicable.
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); or (e) Involve a replacement of (an) existing plant(s)	The Project activity involves the installation of new power plant at a site where there was no renewable energy power plant operating prior to the implementation of the project activity. Thus, Project activity is a Greenfield plant and satisfies this applicability condition (a).
Hydro power plants with reservoirs that satisfy at least one of the following conditions are eligible to apply this methodology: (a) The project activity is implemented in existing reservoir, with no change in the volume of the reservoir; or (b) The project activity is implemented in existing reservoir, where the volume of the reservoir(s) is increased and the power density 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	As the project activity is a run-off river type hydro power plant, this criterion is not relevant for the project activity.
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 rated capacity of the project activity is 15 MW with no provision of Co-firing fossil fuel. Hence, meeting with this criterion.

Combined heat and power (co-generation) systems are not eligible under this category.	This is not relevant to the project activity as the project involves only hydro power generating units.
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 distinct from the existing units.	There is no other existing renewable energy power generation facility at the project site. Therefore, this criterion is not applicable.
In the case of retrofit or replacement, to qualify as a small-scale project, the total output of the retrofitted or replacement power plant/unit shall not exceed the limit of 15 MW.	The project activity is a new installation, it does not involve any retrofit measures nor any replacement and hence is not applicable for the project activity.
In the case of landfill gas, waste gas, wastewater treatment and agro-industries projects, recovered methane emissions are eligible under a 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	This project is a hydro power project activity and hence this criterion is not applicable.
In case biomass is sourced from dedicated plantations, the applicability criteria in the tool "Project emissions from cultivation of biomass" shall apply.	This project is a hydro power project activity and hence this criterion is not applicable.
In addition, the above applicability conditions, the applicability conditions of tool referred in the methodology AMS I.D, version 18.0 has been referred here under:	
Tool 07: Tool to calculate the emission factor for an electricity system version 7.0	
This tool may be applied to estimate the OM, BM and/or CM when calculating baseline	The project activity is a greenfield hydro power generation plant and hence, according to the

emissions for a project activity that substitutes of 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).	applied methodology, the baseline scenario is electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in "TOOL07: Tool to calculate the emission factor for an electricity system".
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, the conditions specified in "Appendix 2: Procedures related to off-grid power generation" should be met. Namely, the total 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.	Since the project activity is grid connected, this condition is applicable and the emission factor has been calculated accordingly.
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 activity is located in Lao PDR, a non-Annex I country. Therefore, this criterion is not applicable for the project activity.
Under this tool, the value applied to the CO_2 emission factor of bio fuels is zero.	The project activity is a grid connected hydro power project and therefore, this criterion is not applicable for the project activity
Tool 21: Demonstration of additionality of a small-scale project activity – version 13.1	
The use of the methodological tool "Demonstration of additionality of small-scale project activities" is not mandatory for project	Since the applied technology is not a new methodology project proponent has applied this tool for the demonstration additionality in

participants when proposing new methodologies. Project participants and coordinating/managing entities may propose alternative methods to demonstrate additionality for consideration by the Executive Board	compliance with the tool. Refer to section 3.5, for the detailed applicability of this tool and additionality assessment. Hence this tool is applicable.
Tool 27: Investment Analysis – version 12	
This methodological tool is applicable to project activities that apply the methodological tool "Tool for the demonstration and assessment of additionality", the methodological tool "Combined tool to identify the baseline scenario and demonstrate additionality", the guidelines "Non-binding best practice examples to demonstrate additionality for SSC project activities", or baseline and monitoring methodologies that use the investment analysis for the demonstration of additionality and/or the identification of the baseline scenario.	PP used "demonstration of additionality of small-scale project activities" (formerly named as "non-binding best practice examples to demonstrate additionality for SSC project activities" to demonstrate additionality of the project. Hence, using Tool 27 for conducting investment analysis is appropriate.
In case the applied approved baseline and monitoring methodology contains requirements for the investment analysis that are different from those described in this methodological tool, the requirements contained in the methodology shall prevail.	The applied methodology AMS I.D does not contain requirement for the investment analysis. Hence this criterion is not applicable

3.3 Project Boundary

As per applicable methodology AMS-I.D. Version 18, "The spatial extent of the project boundary includes the project power plant and all power plants connected physically to the electricity system that the projectpower plant is connected to."

Thus, the project boundary includes the Hydro Turbine Generators and the Lao grid system.

The project does not involve any other emissions sources not foreseen by the methodologies. The greenhouse gases and emission sources included in or excluded from the project boundary are shown intable below.

The table below provides an overview of the emissions sources included or excluded from the project boundary for determination of baseline and project emissions.

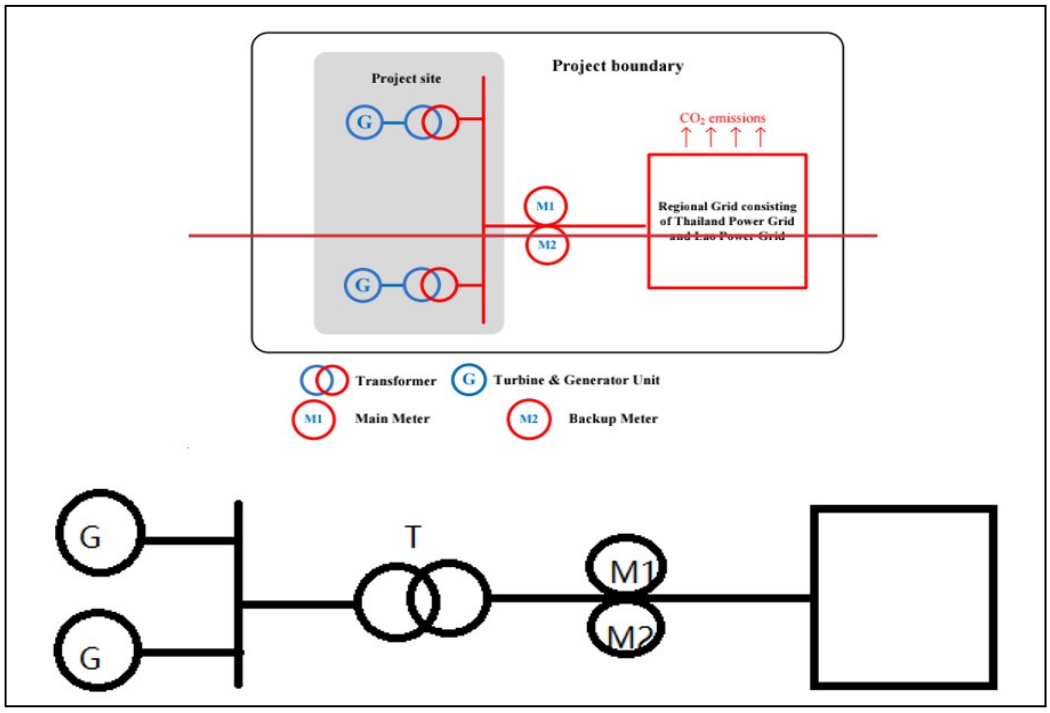

Fig. 2 Project Boundary

Source		Gas	Included?	Justification/Explanation
Baseline	Source 1	CO_2	Yes	Main Emission Source
		CH_4	No	Minor Emission Source
		N_2O	No	Minor Emission Source
Project	Source 1	CO_2	No	Project activity does not emit CO_2
		CH_4	No	Project activity does not emit CH_4
		N_2O	No	Project activity does not emit N_2O

3.4 Baseline Scenario

As per the approved consolidated Methodology AMS I.D (Version 18.0) para 19: "If the project activity is the installation of a Greenfield power plant, the baseline scenario is electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the "Tool to calculate the emission factor for an electricity system".

The project activity involves setting up of hydro project to harness the power of hydro energy to produce electricity and supply to the grid. In the absence of the project activity, the equivalent amount of power would have been supplied by the national grid, which is fed mainly by fossil fuel fired plants.

The project is run-of-river hydropower project. As described in Section B.3 of the PDD, the project electricity system is a regional grid consisting of Thailand Power Grid and the Lao Power Grid. In the absence of the project, the local was/will be supplied by the above-mentioned regional grid. Thus, the baseline scenario of the project is continuation of the present situation, i.e., electricity supplied from the regional power grid.

The combined margin of the grid used for the project activity is as follows:

Parameter	Value	Nomenclature
$EF_{grid,CM,y}$	0.5542 tCO_2/MWh	Combined margin CO2 emission factor for the project electricitysystem in year y
$EF_{grid,OM,y}$	0.5542 tCO_2/MWh	Operating margin CO2emission factor for the project electricitysystem in year y
$EF_{grid,BM,y}$	0 tCO_2/MWh	Build margin CO2emission factor for the project electricity systemin year y

3.5 Additionality

The additionality of a VCS Project shall be demonstrated by applying the following approach having two components:

(i) A Legal Requirement Test; and

(ii) An Additionality Test

The project activity is a Type A project and hence requires undergoing a Legal Requirement Test. However, the projects as in the project activity are not mandated by law or regulations and are entirely a voluntary action. The project activity does not fulfil the criteria of positive list as provided in CDM Tool 32: "Methodological Tool – Positive List of Technologies" and hence additionality of the project activity is demonstrated through a project specific additionality test. For the demonstration and assessment of additionality, Tool 21 "demonstration of additionality of small-scale project activities", Version 13.1 has been applied. As per the para 10 of the tool, project owner shall provide an explanation to show that the project activity would not have occurred anyway due to at least one of the following barriers:

Investment Barrier: a financially more viable alternative to the project activity would have led to higher emissions

Technological barrier: a less technologically advanced alternative to the project activity involves lower risks due to the performance uncertainty or low market share of the new technology adopted for the project activity as so would have led to higher emissions:

Barrier due to prevailing practice: or existing regulatory or policy requirements would have led to implementation of a technology with higher emissions.

Other barriers: without the project activity, for another specific reason identified by the project participant, such as institutional barriers or limited information, managerial resources, organizational capacity, financial resources, or capacity to absorb new technologies, emissions would have been higher.

The project investor has selected Investment barrier to demonstrate in a conservative and transparent manner that the project activity is financially unattractive.

To conduct the investment analysis, Methodological tool: Investment analysis, version 12, EB 116 Annex 2[6] has been referred.

Considering the fact that the alternative to the project is the supply of electricity from the grid & the choice of the developer is to invest or not to invest, benchmark analysis has been considered appropriate for demonstration of additionality, which is in conformity with "Investment Analysis" Annex 2 EB 116.

Apply benchmark analysis

As per para 15 of Tool 27: Investment analysis, Version 12 states that Required/expected returns on equity are appropriate benchmarks for equity IRR. The project participant has chosen benchmark analysis to demonstrate the additionality of the project. The project is promoted by private limited company and hence the return on equity and the risks associated with the investments for their shareholder is of primary concern. Hence, in order to analyze the financial viability of the project activity, the prime financial indicator that has been used is the post-tax equity IRR of the project activity.

Selection of Appropriate Benchmark

The benchmark has been considered in accordance with Guidance 19 of EB 116 Annex 2, "The values in the table in the Appendix may also be used, as a simple default option".

Methodology deployed for arriving at a suitable value of Benchmark using Default Value has been described below:

- As the proposed project activity generates power utilizing hydro energy, Group 1 as per para 5a of Appendix of EB 116 Annex 2 has been identified as a suitable category.
- The investment analysis has been carried out in Nominal terms. Accordingly, Default value as given in table under the Appendix, Tool 27 has been adjusted by adding suitable forecasted inflation rate taken from IMF world Economic database as no inflation forecast or inflation target published by Lao PDR
- Average forecasted inflation rate for the host country (Lao PDR) published by the IMF (International Monetary Fund) World Economic Outlook for the next five years has been considered.

[6] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-27-v12.pdf

Hence applicable inflation rate has been chosen from the IMF databases accordingly for the estimation of resultant benchmark.

The benchmark has been computed in the following manner:

Default Value Benchmark:

The cost of equity is determined by selecting the values provided in the table of the Appendix, i.e., Default values for cost of equity (expected return on equity) in the 'Methodological tool: Investment analysis.

The Required return on equity (benchmark) was computed in the following manner:

Nominal Benchmark[7] = {(1+Real Benchmark) * (1+Inflation rate)}-1

Where:

Default value for Real Benchmark = 20.68% (CDM Tool 27: Investment Analysis, version 12)

Inflation Rate forecast for by (International Monetary Fund) World Economic Outlook database for Lao PDR.

Benchmark Estimation:

The Cost of Equity has been considered using the "Methodological tool: Investment analysis" available at the time of decision making as well as the latest available value. As a conservative approach, the minimum value of benchmark has been considered as calculated using these 2 approaches.

Table under Appendix in EB116, Annex 2 specifies default value of expected return on equity in real terms for Energy Industries in Lao PDR = **20.68%**[8]

Thus, minimum cost of equity considered for calculation of Benchmark = 20.68%

5-year inflation Forecast for Lao PDR as IMF World Economic Outlook available at the time of investment decision and corresponding benchmark values is

Inflation forecast for 5 years	Source
3.30%	World Economic Outlook database: April 2017[9]

Corresponding benchmark values applicable at the time of investment decision time:
Nominal Benchmark = {(1+20.68%) * (1+3.30%)} - 1 = 24.66%

Calculation and comparison of financial indicators

The period considered for Post Tax Equity IRR calculations is 30 years, which corresponds to the operational lifetime of the project activity.

[7] As per Pg.320 of Corporate Finance, Second Edition of Aswath Damodaran

[8] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-27-v11.0.pdf

[9] https://www.imf.org/en/Publications/WEO/weo-database/2017/April/weo-report?c=544,&s=PCPI,PCPIPCH,PCPIE,PCPIEPCH,&sy=2017&ey=2022&ssm=0&scsm=1&scc=0&ssd=1&ssc=0&sic=0&sort=country&ds=.&b

Depreciation, and other non-cash items related to the project activity, which have been deducted in estimating gross profits on which tax is calculated, is added back to net profits for the purpose of calculating the financial indicator.

IRR for total project capacity

Project proponent also calculated the Post tax Equity IRR by integrating the total cash flows of all three projects to check the viability of the project against the benchmark value. Still, it is evident that the combined project is also not financially viable as the equity IRR is still less below the benchmark

Post Tax Equity IRR for the project activities against the benchmark values are shown in table below. Thus, it is evident that the project is not financially attractive as the equity IRR is less below the benchmark value.

Post Tax Equity IRR	13.73 %
Benchmark	24.66%

Sensitivity Analysis

The robustness of the conclusion drawn above, namely that the project is not financially attractive, has been tested by subjecting critical assumptions to reasonable variation. As required by Annex 2 of EB 116, only variables, including the initial investment cost, that constitute more than 20% of either total project costs or total project revenues should be subjected to reasonable variation. Project owner has identified the total revenue from the project activity is dependent on the Tariff, Plant Load Factor, Project Cost and O&M Costs constitute more than 20% of the project costs. These factors have been subjected to a 10% variation on either side and the results of the sensitivity analysis indicate that even after applying such variation the EIRR does not cross the benchmark.

Variation %	-10%	Normal	10%	Variation required to reach benchmark
Tariff	11.63%	13.73%	15.84%	51.80%
PLF	11.63%	13.73%	15.84%	51.70%
Project cost	16.06%	13.73%	11.83%	-34.20%
O&M cost	13.73%	13.73%	13.72%	NA

Conclusion

Even with the changes of +/- 10% of the variation, the IRR is still less than the benchmark. Hence, the project is additional.

3.6 Methodology Deviations

There is no methodology deviation.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

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:

$$BE_y = EG_{PJ,y} \times EF_{grid,y} \quad \text{(Equation 1)}$$

Where,

BE_y = Baseline emissions in year y (t CO_2/yr)

$EG_{PJ,y}$= 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)

$EF_{grid,y}$ = 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)

If the project activity is the installation of a greenfield power plant, then:

$$EG_{PJ,y} = EG_{PJ,facility,y} \quad \text{(Equation 2)}$$

Where,

$EG_{PJ,facility,y}$ = Quantity of net electricity generation supplied by the project plant/unit to the grid in year y (MWh)

Calculate the $EF_{grid,y}$

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:

STEP1: Identify the relevant electricity system;

STEP2: Choose whether to include off-grid power plants in the project electricity system (optional);
STEP3: Select a method to determine the operating margin (OM);
STEP4: Calculate the operating margin emission factor according to the selected method;
STEP5: Calculate the build margin (BM) emission factor;
STEP6: 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 Thailand Power Grid and Lao Power Grid. And as electricity imported from Malaysia, China and Vietnam Power Grid10, 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:

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 ex ante option: a 3-year generation-weighted average in 2020, 2019, 2018 without requirement to monitor and recalculate the emissions factor during the crediting period.

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

The average OM emission factor is calculated as the average emission rate of all power plants serving the grid, using the methodological guidance as described under Step 4 in the "Tool to calculate the emission factor for an electricity system" (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:

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

$EF_{grid,OM\text{-}ave,y\ FCi,\ y}$ = 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 0.5542 tCO_2/MWh and the detailed calculating procedures please refer to ER calculation sheet.

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

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.
Hence calculation value of CM emission factor is 0.5542 tCO_2/MWh

Hence the baseline emission factor is calculated as below:

BE_y= 87,280 × 0.5542 = 48,371 tCO_2

4.2 Project Emissions

The project activity is a hydro power project activity and as per the para 39 of the applied methodology the Emissions from water reservoirs of hydro power plants shall be determined considered following the procedure described in the most recent version of "ACM0002: Grid-connected electricity generation from renewable sources". As per ACM0002: Grid-connected electricity generation from renewable sources V.21.0", paragraph 35

$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y}$ (Equation 1)

For this project activity, the emissions from water reservoirs of hydro power plants ($PE_{HP,y}$) are applicable. The power density (PD) of the project activity is calculated as follows:

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

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) (ie, 15,000,000 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) (ie, as per the satellite map it is 1520,000 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

PD = (15,000,000-0)/(1,520,000-0) = 9.87 W/m^2

As per ACM002, version 21.0 methodology, If the power density of the project activity is greater than 4 W/m2 and less than or equal to 10 W/m^2, $PE_{HP,y}$ is calculated

$$PE_{HP,y} = \frac{EF_{Res} \times TEG_y}{1000}$$

Where:

$PE_{HP,y}$ = Project emissions from water reservoirs (t CO_{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)

Hence, PE_y = (90x87280)/1000 = 7855.2 t CO_{2e}/yr

4.3 Leakage

No leakage emissions are considered.

4.4 Net GHG Emission Reductions and Removals

The ex-ante emission reductions (ER_y) for the project activity are calculated as follows

$$ER_y = BE_y - PE_y - LE_y$$

Where,
ER_y = Emission Reduction in year y (tCO_2)
BE_y = Baseline emission in year y (tCO_2)
PE_y = Project emissions in year y (tCO_2)
LE_y = Leakage Emissions in year y (tCO_2)

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
Year 1	48,371	7,855.2	0	40,515
Year 2	48,371	7,855.2	0	40,515
Year 3	48,371	7,855.2	0	40,515
Year 4	48,371	7,855.2	0	40,515
Year 5	48,371	7,855.2	0	40,515
Year 6	48,371	7,855.2	0	40,515
Year 7	48,371	7,855.2	0	40,515
Total	338,594	54,986	0	283,608
Total number of crediting years	7			
Annual average over the crediting period	40,515			

5 MONITORING

5.1 Data and Parameters Available at Validation

Data / Parameter	$EF_{grid,OM,y}$
Data unit	tCO_2/MWh
Description	Operating Margin CO2 emission factor in year y
Source of data	Calculated
Value applied	0.5542
Justification of choice of data or description of measurement methods and procedures applied	Calculated as per "Tool to calculate the emission factor for an electricity system, version 07" as 3-year generation weighted average using data for the years 2018, 2019 & 2020
Purpose of Data	Baseline emission calculation

Comments	This parameter is fixed ex-ante for the entire crediting period

Data / Parameter	$EF_{grid,BM,y}$
Data unit	tCO_2/MWh
Description	Built Margin CO2 emission factor in year y
Source of data	Calculated
Value applied	0
Justification of choice of data or description of measurement methods and procedures applied	Calculated as per "Tool to calculate the emission factor for an electricity system, version 07"
Purpose of Data	Baseline emission calculation
Comments	This parameter is fixed ex-ante for the entire crediting period

Data / Parameter	$EF_{grid,CM,y}$
Data unit	tCO_2/MWh
Description	Combined margin CO_2 emission factor for the project electricity system in year y
Source of data	Calculated
Value applied	0.5542
Justification of choice of data or description of measurement methods and procedures applied	The combined margin emissions factor is calculated as follows: $EF_{grid,CM,y} = EF_{grid,OM,y} * WOM + EF_{grid,BM,y} * WBM$ Where: $EF_{grid,BM,y}$= Build margin CO_2 emission factor in year y (tCO_2/MWh) $EF_{grid,OM,y}$= Operating margin CO_2 emission factor in year y (tCO_2/MWh) WOM = Weighting of operating margin emissions factor (%) = 100% (for simplified CM)

	WBM= Weighting of build margin emissions factor (%) = 0% (for simplified CM)
Purpose of Data	Baseline emission calculation
Comments	This parameter is fixed ex-ante for the entire crediting period

5.2 Data and Parameters Monitored

Data / Parameter	$EG_{PJ,y}$
Data unit	MWh/y
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y in MWh
Source of data	Electricity meter readings
Description of measurement methods and procedures to be applied	The difference of final value of export and import is used for monthly values of net electricity supplied to the grid by the project activity and same value will be considered for ER calculations.
Frequency of monitoring/recording	Continuous and monthly measurement
Value applied	87,280 MWh
Monitoring equipment	The electricity exported / supplied by the plant to pooling substation and further to substation. This meter also measures electricity imported by the plant from the grid.
QA/QC procedures to be applied	The meters are approved, tested & sealed by the State Utility. The meters are in the custody of State Utility. The frequency of calibration is once in 5 years. The monthly electricity supplied/exported by the project activity in the JMR report is cross checked with the monthly invoices of sale. In the absence or delay in the meter calibration appropriate Guidelines will be applied appropriately to confirm the conservativeness of metering. The metering arrangement, accuracy class of meters, calibration frequency is under control of state electricity board and PP does not have any control on it. PP is getting value of net electricity supplied to grid and the same is considered the monitoring parameter. The billing is raised based on substation meters.
Purpose of data	Calculation of baseline emissions
Calculation method	Net electricity supplied to the grid by the project plant in a given month = Export(kWh)– Import (kWh)

Comments	Data will be archived in paper & electronic form for two years after the end of crediting period or of the last issuance of VERs for this project activity, whichever occurs later.

5.3 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:

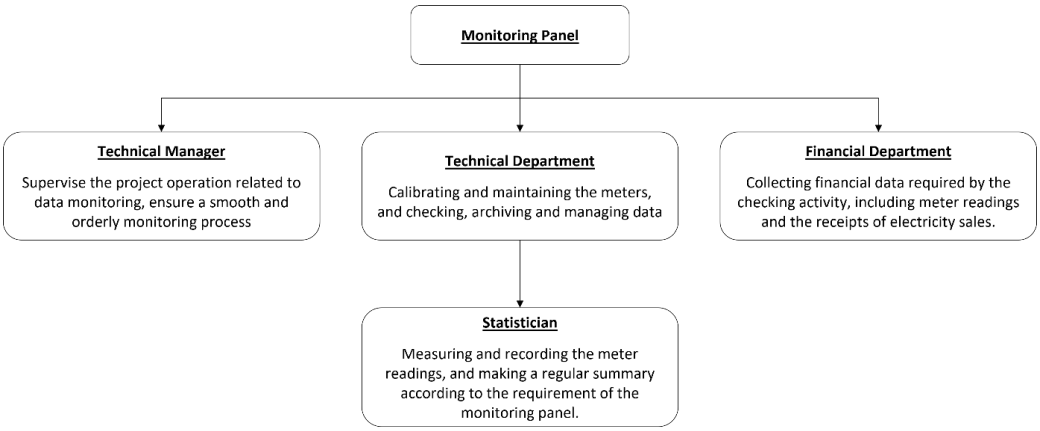

Fig. 3 Organization structure of the monitoring activity

2. **Monitoring apparatus and installation**

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

3. **Data Collection:**

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

a) During the crediting period, both the grid company and the project owner will record the values displayed by the main meter.

b) Simultaneously to step a), the project owner will both record the values displayed by the backup meters.

c) The meters will be calibrated according to the relevant regulation and request of EDL

d) The main meter's readings will be cross-checked with record document confirmed by EDL.

e) The project owner and the grid company will record both output and input power readings from the main meter. These data will be used to calculate the amount of net electricity delivered to the grid.

f) The project owner will be responsible of providing copies of record document confirmed by EDL to the DOE for verification.

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

g) Read the data of the backup meters.

h) If the backup meter's data is not so accurate as to be accepted, or the practice is not standardized, the project owner and the grid corporation should jointly make a reasonable and conservative estimation method which can be supported by sufficient evidence and proved to be reasonable and conservative when verified by DOE.

i) If the project owner and the grid corporation don't agree on an estimated method, arbitration will be conducted according the procedures set by the agreement to work out an estimation method.

4. Data Collection:

The calibration frequency of the monitoring meters will be annually. The accuracy of the monitoring meters will not less than 0.5. Calibration of Meters should be implemented according to relevant standards and rules accepted by the grid company EDL. After the examination, the meters should be sealed. The lift of the seals requires the presence of both the project owner and the grid company. One party must not lift the seals or fiddle with the meters without the presence of the other party.

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

1) Detection of a difference larger than the allowable error in the readings of both meters;

2) The repair of all or part of meter caused by the failure of one or more parts to operate in accordance with the specifications.

5. Data Collection:

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.