15 MW Nam Hinboun Downstream Hydropower Project

Document Prepared by Kosher Climate India Private Limited

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1 PROJECT DETAILS

1.1 Summary Description of the Project

Nam Hinboun Downstream Hydropower Project (hereafter referred to as the "the project") is developed by Rasita Power Co., Ltd. in Songhong village, Hinboun District, Khammouane province, Lao PDR. The primary purpose of the project is to generate electricity to the Lao Power Grid.

Total installed capacity of the project is 15MW, provided by two (2) bulb turbine and the unit capacity is 7.5MW. Project is commissioned on 01/02/2021 with an average annual output of 79,740 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 44,615 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.

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	Rasita Power Co. Ltd.
Contact person	Mr. Outdone Somphone
Title	General Manager
Address	Songhong Village, Hinboun District, Khammouane Province, Lao PDR
Telephone	+856 20 55511731
Email	rasita@live.cn

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

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

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

The project owner is Rasita Power Co., Ltd. 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

01/02/2021 (Commercial Operation Date)

1.9 Project Crediting Period

Project Owner has chosen the renewable crediting period with first crediting of 7 Years which starts from 01/02/2021 to 31/01/2028 with an option of two times of renewable up to 21 years.

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	X
Large project	

Year	**Estimated GHG emission reductions or removals (tCO_2e)**
Year 1	44,615
Year 2	44,615
Year 3	44,615
Year 4	44,615

Year 5	44,615
Year 6	44,615
Year 7	44,615
Total estimated ERs	312,302
Total number of crediting years	7
Average annual ERs	44,615

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 provided by two (2) bulb turbine with unit capacity is 7.5MW each. The project is promoted by Rasita 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 44,615 tCO_2e per year, thereon displacing 79,740 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.

Table.1: Main Technical Parameters of the project

Turbine		
Item	Value	Unit
Number of units	2	set
Rated Capacity	7.8	MW
Normal Pool level	144	m
Rated Head	5	m

Generator		
Item	Value	Unit
Number of Units	2	set
Rated Capacity	7.5	MW
Generator Rated Power Factor	0.85	-

1.12 Project Location

The project is located in the Hinboun District, Khammouane province, Lao PDR.

Table.2: Project Location

Project Location	Latitude	Longitude
Songhong and Samakhixai Villages, Hinboun District, Khammouane, Lao PDR	17°43′38″ N	104°34′19″ E

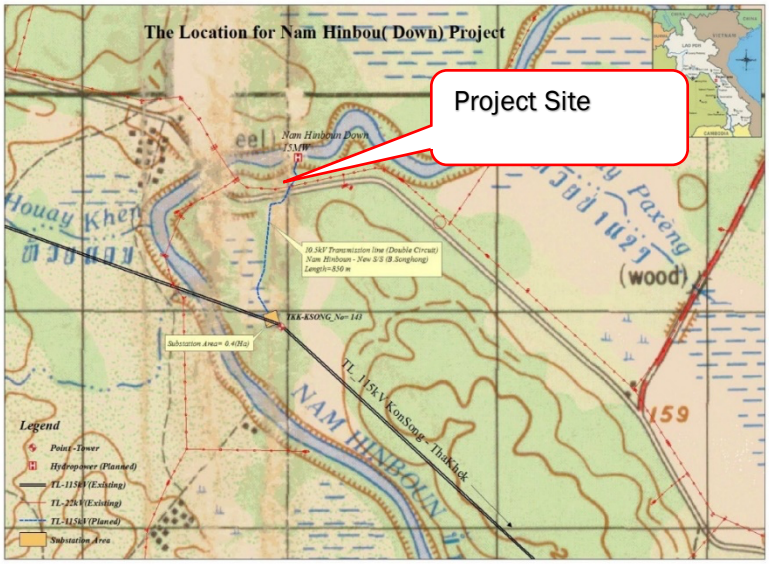

Fig.1 Project Location

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 practise 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.

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 programs.

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 SOx, NOx, 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 79,740 MWh/year to the national grid and thus expected to increase the share of renewable energy by 19,93,500 MWh to the national grid for its lifetime	In the absence of the project activity 79,740 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.

4)	13.0	13.2 Integrate climate change measures into national policies, strategies, and planning	Implemented activities to decrease	Project target to reduce 44,615 tCO2 emissions per year in the host country and expected to reduce 1,115,363 tCO2 emission reductions to in the host country for its lifetime	In the absence of the project activity 44,615 tCO2/year emission 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

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: According to the Initial Environment Examination (IEE) report during the preparation stage, a number of houses and associated built household assets within the dam site on the left-hand side in Ban Khamkeo may require relocation due to their too close proximity to the dam. While the exact extent of this impact remains to be further ascertained in consultation with the concerned homeowners, it is necessary that attention is paid to the possible relocation of those homes and their assets.

Mitigation Measures: If relocation is to take place, the following should be undertaken to mitigate the impact to resolve the situation.

• Carry out a closer examination of the few houses and associated household assets (only those that will be made partially or entirely unusable) which will need to be relocated, especially if so, wished by the homeowners.

• The Developer in consultation with the village authority, homeowners, concerned district offices and authority works out appropriate compensation measures to be discussed and agreed upon with the owners.

• Compensation can either be in-kind (land for land, house for house) or monetary compensation as will be agreed to with the owners34. If land for land is the preferred option to the affected persons, the Developer will need to locate alternative sites (possibly within the village) for the relocation subject to consensus of the affected people. The principle is that financial compensation should be made on the full replacement cost basis.

• Informing affected households of the detailed schedule of construction activities well in advance of the construction. This will allow the residents to plan their land use activities and be

prepared for relocation if so necessary. All costs associated with the removal and transportation of the household assets, items and materials to the new site or the cost of new building materials will be borne by the Project

2.2 Local Stakeholder Consultation

The details of stakeholder meetings are as follows:

Date of meeting: 12/07/2017

Location: Khamkeo village, meeting room, Hinboun district, Kanmouane province, Lao PDR

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

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

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

Finally, 43 stakeholders participated in the meeting. The meeting was opened by the introduction of the project developers and the representative from the project owner company. The objective of the meeting was based on the non-technical summary, Environmental Management Plan and draft Passport Report of the project. Also, how the project might have some environmental effects, how these issues will be mitigated by the investor and also climate change and how the project will help the fight against climate change were discussed.

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

The question raised by the villagers are summarised in the table below:

Table.3: Stakeholder Comments

Stakeholder Comment	Explanation (Why? How?)
Is the air in local context polluted?	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 dust emission while the mitigation measure would be adopted.
How is the air in local context before and during the construction?	The sources of air emission and fugitive dust will likely be from the drilling, crushing, and hauling associated with the construction activities. However, the dam construction is not directly linked to industrial processes, and thus the impact of emission from specific contaminants, organic chemical compounds and particulate matters will be minimized except where the work involves welding and aerosol spraying. Furthermore, the representative mentioned that a series of mitigation measure would be prepared for the local people to improve their local air.
Does this project affect the quality and quantity of water?	Water quality issue in this stretch of the Nam Hinboun is complex as it involves many factors. The NHDHP will concern with ensuring that its activities will not lead to worsening the water quality of the river through applying the following measures: Strictly control the use of fuel and other hydrocarbon products such as grease, oils and lubricants to prevent leachate or run-off that can cause soil and water contamination. Fuel and hydrocarbon products should be stored in specially built containers in bounded areas with an impermeable base. Washing of vehicles or equipment will be required to designated wash down areas. Wastewater treatment systems need to be installed at each site to collect and treat raw sewage from various sources. These systems need to be maintained throughout the operation phase to enable the treatment of wastewater from all permanent site facilities. Long term monitoring would be essential for the successful management and mitigation of the impacts relating to waterborne disease in the local communities, both upstream and

	downstream of the sites. Therefore, there would be in or impact on the water utilization for nearby villages.
Does this project affect the protection of biodiversity?	The project area is of predominantly secondary and disturbed forestland and patches of remnant woodland. There is no presence of primary forest nor are there any NPAs, PPAs or DPAs located within or nearby the Project area. These village conservation forests will, among other uses, provide habitats for wildlife and healthy forest ecosystem services. It is important for the project to make sure that threats to species will not be resulted from the presence of the construction workforce. At the same time, presence of the workforce should not result in increased pressures on the local harvest and use of NTFPs. For this reason, direct project impact on sensitive forest areas and resources will be minimal during the construction phase and negligible during operation.
Do the project conditions affect the soil situation?	According to the IEE, to prevent soil erosion, the following measures will be undertaken, for example: (1) Schedule construction activities during the dry season (low flows), where possible; (2) Implement appropriate erosion control and drainage management measures to minimize the potential impacts associated with land clearance; (3) Minimize cleared areas and revegetate exposed sites with grass or plants to reduce sediment run-off, etc. Thus, status of soil erosion will be mitigated.
Does the pollution from the project include sound or light pollution?	For this, main resources of noise are dam construction blasting, drilling, dredging, operation of heavy machinery and equipment, transport operation. The mitigation's as follows: All construction equipment and machinery shall comply with noise emission standard. Avoid night shift work and work on Sundays unless special permit is granted. Use of PPE among workers and on-site personnel exposed to noisy work. The project doesn't exist light pollution. Therefore, this project will not cause light pollution and significant noise pollution.
Will the implementation of the project help improve the working environment and quality of the workers?	The working environment of the workers will strictly implement as following measures: Promotion of preventive measures, eg, use of condoms. Regular site clean-ups, draining water bodies that can harbor

	disease vector (mosquito). Conduct hygiene and sanitation awareness programmed. Support local initiatives on disease prevention campaigns. Siting fuel depot away from the living buildings and residential areas.
Will the project provide jobs and generate incomes?	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.

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].

[2] https://cdm.unfccc.int/filestorage/2/P/7/2P7FS6ZQAR84LG3NMKYUH50WI9ODBC/EB81_repan24_AMS-I.D_ver18.pdf?t=anp8cmdlajJhfDAMZLHwYM9O1ArKakJg8B5Y

[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-v1.pdf

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
1. 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"
(a) 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).
4. 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	As the project activity is a run-off river type hydro power plant, this criterion is not relevant for the project activity.

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/m2	
5. 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 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 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	The project activity is a greenfield hydro power generation plant and hence, according to the 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

have been provided by the grid (e.g.: demand-side energy efficiency projects).	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 small-scale project activities- Version 13.1	
The use of the methodological tool "Demonstration of additionality of small-scale project activities" is not mandatory for project participants when proposing new methodologies. Project participants and coordinating/managing entities may propose	Since the applied technology is not a new methodology project proponent has applied this tool for the demonstration additionality in compliance with the tool. Refer to section 3.5, for the detailed applicability of this tool and additionality assessment.

alternative methods to demonstrate additionality for consideration by the Executive Board	Hence this tool is 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 project power 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 in table 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.

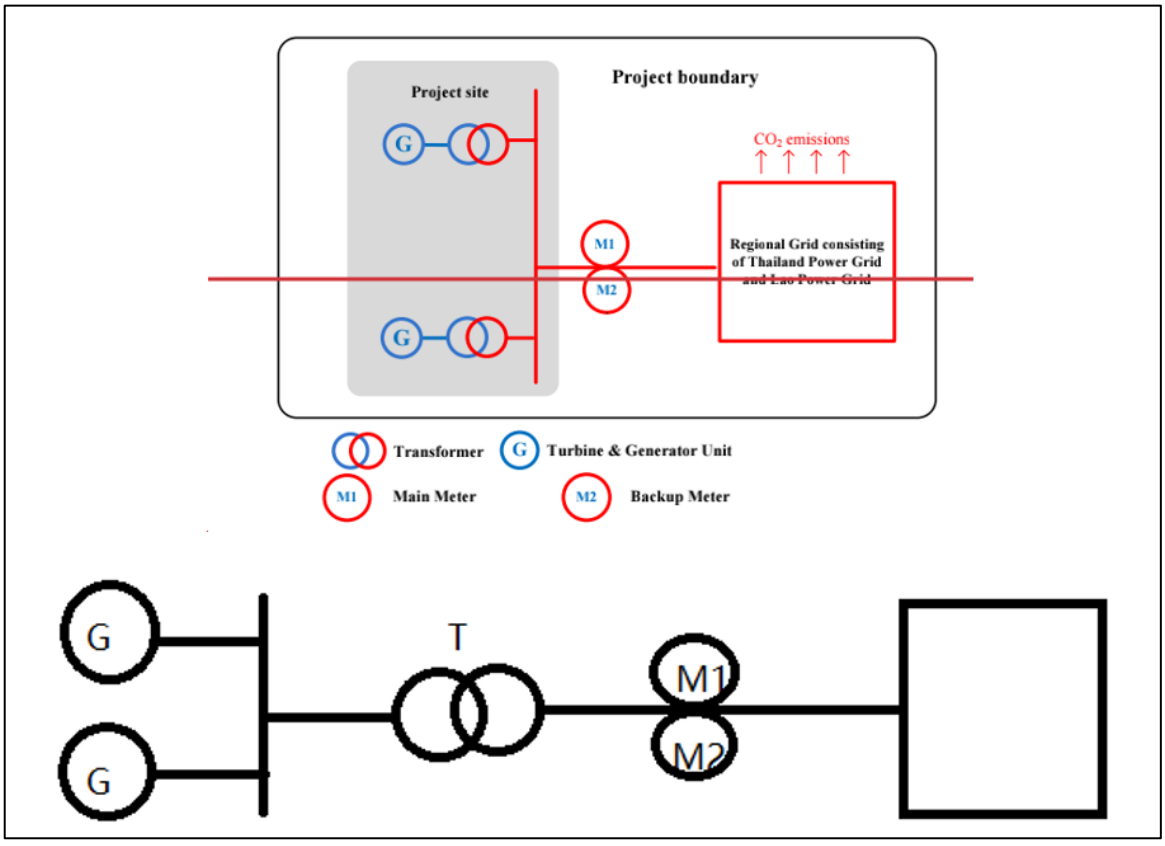

Fig. 2 Project Boundary

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
		Other	No	Project activity does not emit CO_2
Project	Source 1	CO_2	No	Project activity does not emit CH_4
		CH_4	No	Project activity does not emit N_2O
		N_2O	No	Main Emission Source
		Other	No	Minor Emission Source

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	Source
$EF_{grid,CM,y}$	0.5595 tCO_2/MWh	Combined margin CO_2 emission factor for the project	Calculated as the weighted average of the operating margin & build margin values, sourced from the document published by

		electricity system in year y	the Institute for Global Environmental Strategies based on the data from Electricity Generation Authority of Thailand.
$EF_{grid,OM,y}$	0.5595 tCO_2/MWh	Operating margin CO_2emission factor for the project electricity system in year y	Calculated as the 2-year (2009 & 2010) generation-weighted average, sourced from the document published by the Institute for Global Environmental Strategies based on the data from Electricity Generation Authority of Thailand.
$EF_{grid,BM,y}$	0 tCO_2/MWh	Build margin CO_2emission factor for the project electricity system in year y	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.

3.5 Additionality

The table below is only applicable if the proposed project activity is a type of project activity which is deemed automatically additional, as defined by the applied approved methodology, tool, standardized baseline or specific renewable technologies/measures conferring automatic additional microscale CDM project activities proposed by a DNA and approved by the Board.

Specify the methodology, tool, standardized baseline or specific renewable technologies/measures conferring automatic additional microscale CDM project activities proposed by DNAs and approved by the Board, that establish automatic additionality for the proposed project activity (including the version number and the specific paragraph, if applicable).	Not Applicable, as the project is a hydro power project and not auto additional
Describe how the proposed project activity meets the criteria for automatic additionality in the relevant methodology, tool, standardized baselines or specific renewable technologies/measures conferring automatic additional microscale CDM project activities proposed by a DNA and approved by the Board.	Not Applicable, as the project is a hydro power project and not auto additional.

According to "Demonstration of additionality of small-scale project activities (Version 13.1, EB 105)", project participants shall provide an explanation to show that the project activity would not have occurred anyway due to at least one of the following barriers:

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

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

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

(d) Other barriers: without the project activity, for another specific reason identifies 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 insurmountable barrier for the implementation of the project is investment barrier.

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

Determine appropriate analysis method

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

(OptionI) Simple cost analysis;

(OptionII) Investment comparison analysis;

(Option III) Benchmark analysis;

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

Option III. Apply benchmark analysis

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

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

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

c) A company internal benchmark (weighted average capital cost of the company), only in the particular case referred to above in paragraph 5. The project developers shall demonstrate that this benchmark has been consistently used in the past, i.e., that project activities under similar conditions developed by the same company used the same benchmark;

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

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

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

The average value of the 3-Month US Treasury Constant Maturity Rate[5] at the recent 20 years before the starting date (Sep 29th 1997- Sep 25th 2017)2% will be introduced to represents the risk-free rate (nominal rate, consistent with the calculation of cash flow) for the following reasons:

i. There is no systematic government bond issue structure in Lao PDR;

ii. The project was accounted in U.S. dollar, and the 3-month U.S Treasury rate is a widely accepted risk-free rate[6];

iii. The average value in the recent 20 years before the starting date was applied since the long- term average value reduces the short term uncertainly and violation of and the market.

Regarding the value of national risk premium. The data "Risk premium on lending (prime rate minus Treasury bill rate; %)" provided by world bank [7] was applied. Risk premium on lending is the interest rate charged by banks on loans to prime private sector customers minus the "risk free" Treasury bill interest rate which short-term government securities are issued or traded in the market. The data is proper to illustrate the "suitable risk premium to reflect private

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

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

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

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

investment" in the host country stated in the "Tool for the Demonstration and Assessment of Additionality (Version 7.0.0)". To reduce the short term uncertainly, the average risk premium of Lao PDR in the latest 5 year 12.68% was adopted (the risk premium of Lao PDR from 2006 to 2010 are 11.70, 10.10, 11.70, 15.30 and 14.60resperctively).

So, the benchmark adopted equals the maturity rate of the 3-month US Treasury bill plus the Risk premium on lending in Lao PDR, the value is 14.68% (post-tax).

Calculation and comparison of financial indicators

Basic parameters for calculation of financial indicators

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

Basic parameters	Unit	Value	Source
Installed capacity	MW	15	FSR
Static investment Cost	10^3USD	34,781	FSR
Fluid Capacity	10^3USD	683	FSR
Electricity Tariff	USD/kWh	0.0625	FSR
Average O&M cost	10^3USD	753	Calculated based on FSR
The annual average energy	GWh	79	FSR

The analysis shows that without the revenue of CERs, the IRR of the project will be 9.92%. Much lower than the benchmark 14.68%. The project is not financial attractive. However, the CDM revenues will help to improve the financial index (IRR with CDM revenue=12.24%).

Sensitivity analysis

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

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

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

Table B.5 Sensitive analysis of the project

Item	Variation range				
Static investment Cost	-10%	-5%	0%	5%	10%
	10.07%	10.00%	9.92%	9.85%	9.78%
Annual O&M cost	-10%	-5%	0%	5%	10%
	10.14%	10.03%	9.92%	9.82%	9.71%
Electricity tariff	-10%	-5%	0%	5%	10%
	8.49%	9.22%	9.92%	10.61%	11.28%
Power supplied	-10%	-5%	0%	5%	10%
	8.49%	9.22%	9.92%	10.61%	11.28%

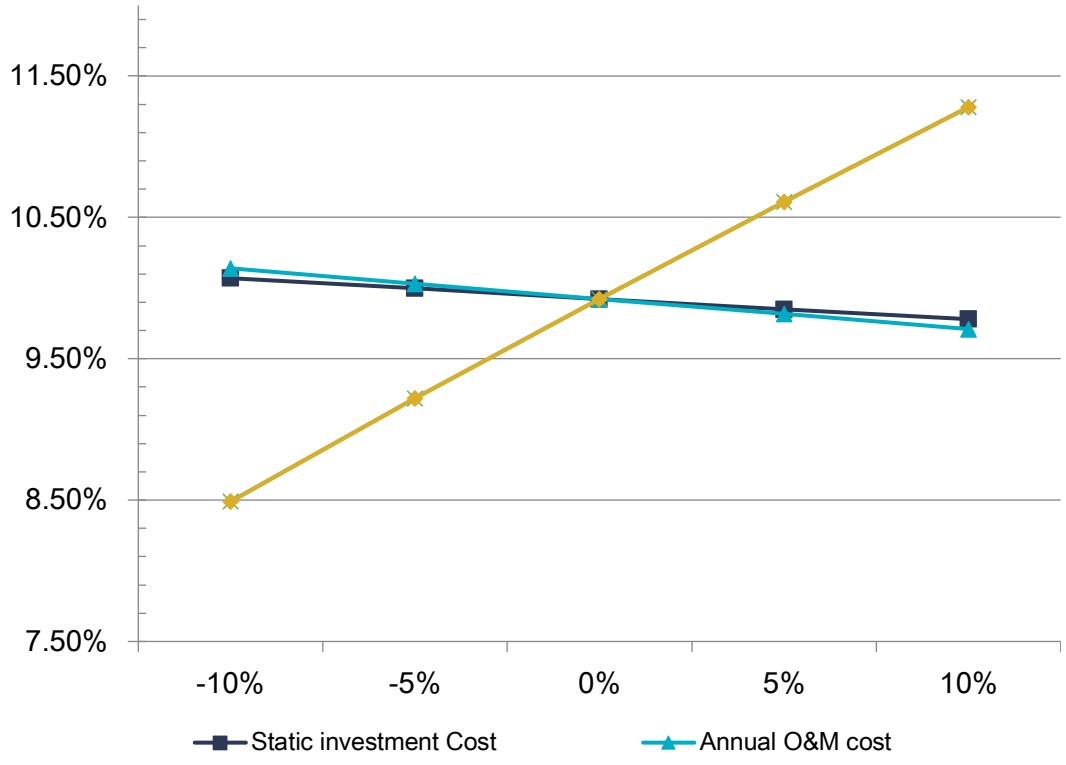

Figure B.3 Sensitive analysis

Based on the relationship shown above, we can find out that the project IRR that will decline accompany with the rise of the fixed assets investment and the annual O&M cost; and the IRR will rise accompany with the rise of the electricity tariff and the electricity supply. We can conclude from the above analysis that, even if ±10% variation range of the four parameters, the IRR of the

project still can't surpass the benchmark. However, the revenue from the CERs will greatly improve the financial feasibility of the project.

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

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

Item	Critical Point
Static investment Cost	-350.00%
Annual O&M cost	-240.00%
Electricity tariff	36.80%
Power supplied	36.80%

The results show that when the project IRR is equal to the benchmark value, the fixed assets investment or annual O&M costs need to be decreased by 350%, and 240% respectively, or electricity tariff or power supplied to the grid need to be increased by 36.8%. These are cases that are unlikely to occur.

1) **Regarding the fixed assets investment**

The parameters adopted from the FSR that finalized by the third party with abundant experiences in hydropower projects. The fixed assets investment estimated in the FSR is in line with local standards on engineering, construction and equipments. In fact, through comparing with the actual signed EPC contracts, the static investment estimated in FSR has already accomplished, the EPC price is 31,200,077.76USD, which is 90% of the static investment estimated in the FSR, thus it is unlikely to decrease the investment as much as 350%.

2) **Regarding to the annual O&M cost**

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

3) **Regarding the electricity tariff**

The Tariff adopted in the analysis is sourced from the FSR that finalized by the third party. The value is the same with the Power Purchase Agreement signed between the Project Owner and the power grid company (EDL) for all the operation period, thus it is reasonable to apply in the IRR calculation and it is unlikely to increase it by such a high percentage.

4) **Regarding the power supplied**

The power supply is determined by the FSR author according to a relative long-term local hydrological data. There may exist fluctuations and uncertainty among the practical situation in each operational year regarding to the precipitation and runoff of the river, but the space of fluctuation would be limited, it is unlikely to deviate from the long-term hydrological data as much as 36.8% annually.

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

3.6 Methodology Deviations

There is no methodology deviation

4 ESTIMATED 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 CO2)

$EG_{PJ,y}$ = 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 CO2 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 CO2/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)

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.20.0", paragraph 37

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

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/m2)

$CapPJ$ = Installed capacity of the hydro power plant after the implementation of the project activity (W)

$CapBL$ = Installed capacity of the hydro power plant before the implementation of the project activity (W). For new hydro power plants, this value is zero

APJ = 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 (m2)

ABL = 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 (m2). For new reservoirs, this value is zero

According to the FSR, the PD is greater than 10W/m2, thus PEHP, y= 0. Then PEy= 0 tCO2.

4.3 Leakage

No leakage emissions are considered.

4.4 Estimated Net GHG Emission Reductions and Removals

The ex-ante emission reductions (ERy) 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	44,615	0	0	44,615
Year 2	44,615	0	0	44,615
Year 3	44,615	0	0	44,615
Year 4	44,615	0	0	44,615
Year 5	44,615	0	0	44,615
Year 6	44,615	0	0	44,615
Year 7	44,615	0	0	44,615
Total	312,302	0	0	312,302
Total number of crediting years	7			
Annual average over the crediting period	44,615	0	0	44,615

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	The document published by Institute for Global Environmental Strategies based on the data from Electricity Authority of Cambodia[8]
Value applied:	0.5595
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 2010, 2011 & 2012. The data are obtained from electricity authority of Cambodia.
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	Build Margin CO2 emission factor in year y
Source of data	The document published by Institute for Global Environmental Strategies based on the data from Electricity Authority of Cambodia
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" as per the latest data available for the most recent year 2012.
Purpose of Data	Baseline Emission calculation
Comments	This parameter is fixed ex-ante for the entire crediting period

[8] https://portal.gms-eoc.org/uploads/resources/1904/attachment/GEF-Cambodia_2010-2012.pdf

Data / Parameter	$EF_{grid,CM,y}$
Data unit	tCO_2/MWh
Description	Combined Margin CO2 emission factor in year y
Source of data	The document published by Institute for Global Environmental Strategies based on the data from Electricity Authority of Cambodia
Value applied:	0.5595
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 CO2 emission factor in year y (tCO2/MWh) $EF_{grid,OM,y}$= Operating margin CO2 emission factor in year y (tCO2/MWh) WOM = Weighting of operating margin emissions factor (%) = 50% WBM= Weighting of build margin emissions factor (%) = 50%
Purpose of Data	Baseline Emission calculation
Comments	This parameter is fixed ex-ante for the entire crediting period

Data / Parameter	Cap_{PJ}
Data unit	MW
Description	Installed capacity of the hydro power plant after the implementation of the project activity
Source of data	Project site

Value applied:	15
Justification of choice of data or description of measurement methods and procedures applied	Use the data in the FSR at start of the project. Measure by check the nameplate after operation
Purpose of Data	Project emission
Comments	-

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	Monthly joint meter reading reports
Description of measurement methods and procedures 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 measurement & Monthly recording
Value applied:	79,740
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 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 is shown below:

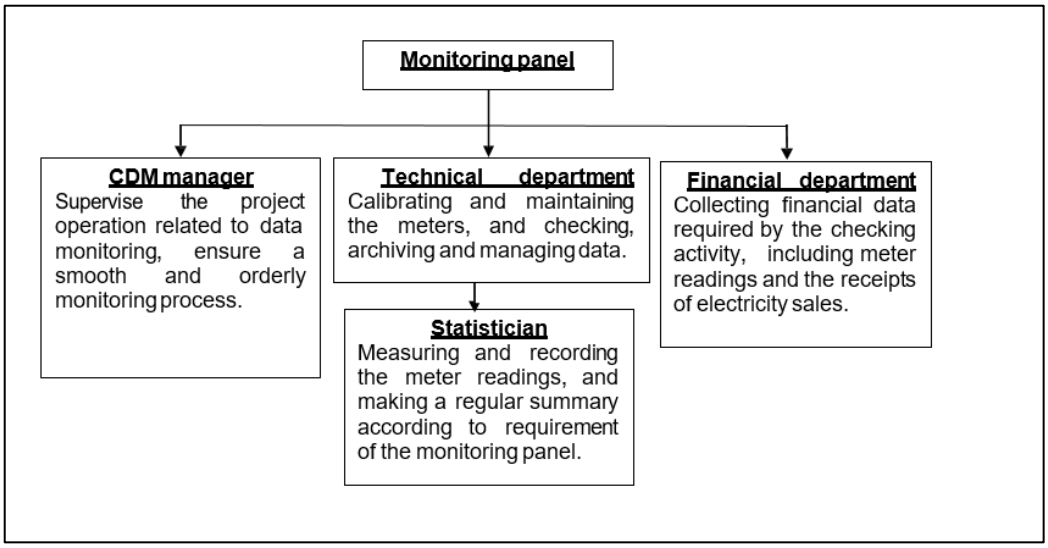

Fig. 3 Organization structure of the monitoring activity

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. Calibration

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

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

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

2) The repair of all or part of meter caused by the failure of one or more parts to 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.

6 ACHIEVED GHG EMISSION REDUCTIONS AND REMOVALS

6.1 Data and Parameters Monitored

Data / Parameter	$EG_{PG,y}$
Data unit	MWh/y
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y in MWh.
Value applied:	98,737
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. Monitoring period: 01/02/2021 to 31/07/2022

6.2 Baseline Emissions

$$BEy = EG_{PJ,\,y} * EF_{grid,CM,y}$$

Where:

BEy: Baseline emissions in year y (tCO_2e/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 VCS project activity in year y (MWh/yr)

$EF_{grid,CM,y}$: Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (tCO_2e/MWh).

	$EG_{PJ,y}$ (MWh)	**$EF_{grid,CM,y}$**	**Bey (tCO_2)**
1-Jan-2021 to 31-Dec-2021	63,389	0.5595	35,466

1-Jan-2022 to 31-July-2022	35,348	0.55953	19,777
Total	**98,737**	**0.5595**	**55,243**

6.3 Project Emissions

Not Applicable, since emissions from the project activity is zero.

6.4 Leakage

Not Applicable, since leakage emissions are zero.

6.5 Net GHG Emission Reductions and Removals

Year	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)
2021	35,466	0	0	35,466
2022	19,777	0	0	19,777
Total	**55,243**	**0**	0	**55,243**

It is to be noted here that as per the estimated emission reduction to be achieved from the project activity for the current monitoring period is 70,528 tCO2e, whereas actual emission reductions achieved are 55,243 tCO2e, which is approximately 22% lower than the estimated emission