



**Verified Carbon
Standard**

YUNNAN MANGLI HYDROPOWER PROJECT

Document Prepared by Climate Bridge(Shanghai) Ltd.

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Project Title	Yunnan Mangli Hydropower Project
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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

Yunnan Mangli Hydropower Project (hereafter referred as the project) is located on Mangshi River in Luxi City, Yunnan Province, P. R. China. The project is developed and operated by Datang Mangli Hydropower Development Company Limited. The project is to generate hydro power and deliver it to China Southern Power Grid (CSPG).

Totally 2 sets of 18MW hydro turbines have been installed, providing a total capacity of 36MW. It is estimated that the power supplied to the grid would be 143,652MWh annually.

During the first crediting period, this project would achieve an amount of 113,189 tCO₂e emission reductions every year, and during the second crediting period this project would achieve 51,887 tCO₂e every year.

The Project started construction on 30/06/2008. The first turbine of the Project started commissioning on 13/01/2010. And this project was registered as a VCS project (VCS ID 928) on 14/11/2012. This project started operation on 13/01/2010. In the beginning period of the operation, the monitoring data of the project was not complete. Since 25/01/2010, the data have been monitored and collected following the monitoring procedure in Section 4.3. Therefore, starting date of the crediting period is 25/01/2010. The project is registered under VCS standard Version 3.2 and completed validation before 19/03/2020. Thus, it remains eligible to apply the crediting period requirements under VCS standard Version 3.2 which shall be a maximum of ten years and may be renewed at most twice, so the first renewable crediting period of the project should be updated from 25/01/2010 ~ 06/10/2011 to 25/01/2010 ~ 24/01/2020, and the second crediting period would be 25/01/2020 ~ 24/01/2030. Also, the project was registered as a CDM project (UNFCCC Ref.4821) on 07/10/2011.

During the period from 01/05/2018 to 24/01/2020 attributed to the first crediting period, the project has supplied electricity of 191,602.457 MWh and achieved 150,962 tCO₂e emission reductions. And during the period from 25/01/2020 to 31/07/2021 attributed to the second crediting period, the project has supplied electricity of 141,103.455 MWh and achieved 50,966 tCO₂e emission reductions. In sum, during the monitoring period (01/05/2018–31/07/2021), the project has supplied electricity of 332,705.912 MWh and achieved 201,928 tCO₂e emission reductions by replacing electricity generated by fossil fuel fired power plants connected to CSPG.

1.2 Sectoral Scope and Project Type

Sectoral Scope: 1. Energy (renewable/non-renewable);

Project type: Hydropower generation project;

The project is not a grouped project.

1.3 Project Proponent

Organization name	Datang Mangli Hydropower Development Company Limited
Contact person	Luo Xianjun
Title	Project Manager
Address	Fenghua Road, Mangli City, Dehong District, Yunnan Province
Telephone	+86-21-23019950
Email	3542346576.qq.com

1.4 Other Entities Involved in the Project

Organization name	Climate Bridge (shanghai) Ltd.
Role in the Project	Consultancy
Contact person	Zhiwen Gao
Title	General Manager
Address	Block B, Level 24, Jiangong Mansion, 33 Fushan Road, Pudong New Area, Shanghai, China 200120
Telephone	+86-2162462036
Email	gao.zhiwen@climatebridge.com ; projects@climatebridge.com

1.5 Project Start Date

13/01/2010 the date on which the Project started commissioning.

1.6 Project Crediting Period

There is a deviation for the crediting period. The project is registered under VCS standard Version 3.2 and completed validation before 19/03/2020. Thus, it remains eligible to apply the crediting period requirements under VCS Version 3 which shall be a maximum of ten years and may be renewed at most twice, so the first renewable crediting period of the project should be updated from 25/01/2010 ¹~ 06/10/2011 to 25/01/2010 ~ 24/01/2020. However, as the project is

¹ According to the registered PD, in the beginning period of the operation, the monitoring data of the project was not complete. Since 25/01/2010, the data have been monitored and collected following the monitoring procedure in the VCS-PD. Therefore, starting date of the crediting period is 25/01/2010.

also registered as a CDM project with a seven-year twice renewable project crediting period and the total CDM crediting period is from 07/10/2011 to 06/10/2032. Therefore, the total length of VCS crediting period should be no more than 21 years which is from 25/01/2010 to 24/01/2031. And the second crediting period under VCS is from 25/01/2020 to 24/01/2030.

1.7 Project Location

The centre of the project site is located on Mangshi River, in Luxi City of Yunnan Province, P.R.China. The exact geographical coordinates of the blocking dam are 98.3145° East longitude and 24.3083° North latitude. The project is 38 km away from Mangshi City (capital of Dehong Prefecture).

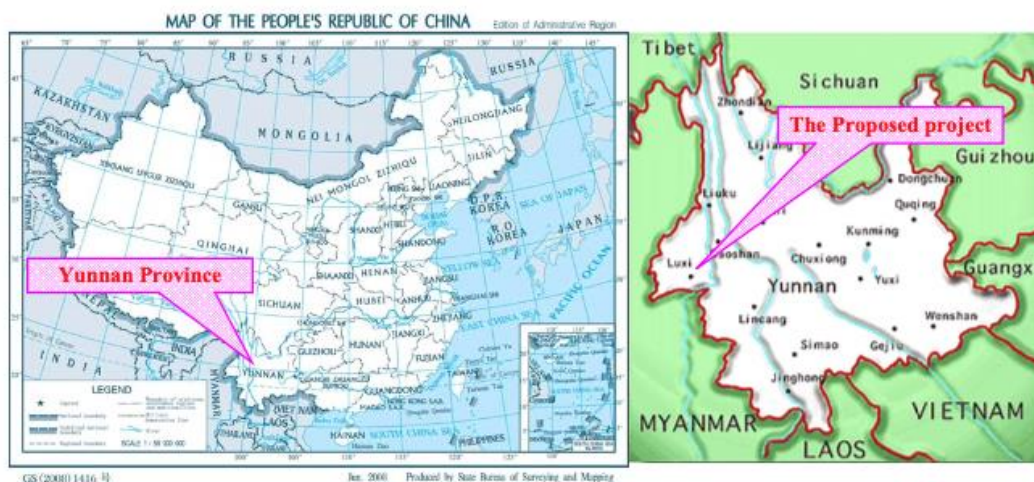


Figure 1 Location of the Project in Provincial Map

1.8 Title and Reference of Methodology

Following approved baseline & monitoring methodology is applied.

Methodology:

Approved consolidated baseline and monitoring methodology ACM0002: “Consolidated baseline methodology for grid-connected electricity generation from renewable sources” (Version 12.1.0 and version 20.0²).

Reference:

<https://cdm.unfccc.int/methodologies/DB/XP2LKUSA61DKUQC0PIWPGWDN8ED5PG>

Tools applied:

² The ACM0002 version 12.1.0 and 20.0 are respectively applied in the first and second crediting period.

“Tool to calculate the emission factor for an electricity system” (Version 02.1 and version 07.0³)

Reference:

<https://cdm.unfccc.int/methodologies/PAmethodologies/approved>

<https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v7.0.pdf>

1.9 Participation under other GHG Programs

The project was registered as a CDM project (UNFCCC Ref.4821) on 07/10/2011, and the starting date of the credit period of CDM project was same as the registration date.

Total GHG emission reductions of 102,673 tCO₂e generated from 07/10/2011 to 31/10/2013 (both first and last days included) by the project has been issued as CER under CDM program.

Please refer to the following link for details:

<https://cdm.unfccc.int/Projects/DB/DNV-CUK1305694841.24/view>.

Except for CDM, the project did not register under any other GHG program.

1.10 Other Forms of Credit

Emission Trading Programs and Other Binding Limits

China has a national emissions trading scheme only cover the high-emission industries, such as thermal power generation, petrochemical, chemical, building materials, iron and steel, non-ferrous, paper, aviation and other key emission industries that emitted at least 26,000 tons of CO₂e/year, not including renewable project⁴. And the project activity is not included the mandatory emission control scheme and there is no emission cap enforced for the project owner according to the enforced company list⁵ in public information. Hence, it is confirmed that the emission reductions will not be double counted.

The project does not reduce GHG emissions from activities that are included in an emissions trading program or any other mechanism that includes GHG allowance trading.

Other Forms of Environmental Credit

The project has not sought or received another form of GHG-related environmental credit, including renewable energy certificates.

³ The tool Version 02.1 and version 07.0 are respectively applied in the first and second crediting period.

⁴ http://www.mee.gov.cn/xxgk2018/xxgk/xxgk05/202103/t20210330_826728.html

⁵ <http://mee.gov.cn/xxgk2018/xxgk/xxgk03/202012/W020201230736907682380.pdf>

1.11 Sustainable Development

The proposed project will contribute to the sustainable development in the following ways:



332,705.912 MWh of electricity from renewable sources were supplied to the power grid. Thus, the project achieved SDG 7 Affordable and Clean Energy⁶.



The project achieved 201,928 tCO₂e emission reduction during this monitoring period. Thus, the project achieved SDG 13 Climate Action⁷.



Create employment opportunities during the project operation and construction, providing local residents with full and productive employment and decent work. Thus, the project achieved SDG 8 Decent Work and Economic Growth⁸.

2 SAFEGUARDS

2.1 No Net Harm

According to the EIA (Environmental Impact Assessment) conducted by a third party, Yunnan University, the environmental impact of the proposed project was reduced to the minimum level. Thus, there are no negative environmental and/or socio-economic impacts due to the project. In fact, the project as a clean renewable energy project can reduce greenhouse gas emissions and the environmental pollution caused by fossil fuels consumption. Meanwhile, the implementation of the project improves local socio-economic development through creating career opportunities and paying taxes.

⁶ <https://sdgs.un.org/goals/goal7>

⁷ <https://sdgs.un.org/goals/goal13>

⁸ <https://sdgs.un.org/goals/goal8>

2.2 Local Stakeholder Consultation

Local Stakeholder Consultation during the project preparation stage:

In order to get the comments and suggestions from local stakeholders, the project owner visited local residents and coherent organizations for stakeholder consultation in June 2009. 100 questionnaires were sent to the stakeholders by the project developer.

The survey showed that the proposed project receives strong support from local people, which is closely linked to the fact that the majority of local residents have some understandings with hydro power projects. All the respondents believed that the Project would have overall positive impacts on their livelihoods with increase of job opportunities, increase of income and others. The concern about the environmental impacts has been clarified in EIA. All the impacts would be reduced by mitigating measures.

100% of the investigated people are supportive to the project construction.

Local Stakeholder Consultation during the project implementation stage:

Communications with local stakeholders are being carried out at periodic intervals. In the previous monitoring period, the project owner carried out questionnaire survey for the local stakeholder to collect the relevant comments and suggestions in April 2014, August 2016 and March 2018. And there are no negative comments received for the project. In this monitoring period, the project owner also carried out questionnaire survey for the local stakeholder to collect the relevant comments and suggestions in May 2019, August 2020 and April 2021. And there are no negative comments received for the project. In line with VCS requirements all the processes have been implemented to receive comments from local stakeholders as well as communicate with them at periodic intervals.

2.3 AFOLU-Specific Safeguards

There is not applicable due to the project is non-AFOLU project.

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

The project is a hydropower station with the total installed capacity of 36MW. The hydro-junction essentially consists of the water retaining structure (barrage), the sluice works, as well as the water intake and power generation system. The sluice works include free overflow spillway, flood discharging tunnel and desalting tunnel.

Two turbines and two generators have been installed. It is expected that the annual electricity delivered to the grid is 143,652MWh to CSPG and replace the same amount of electricity generated by fossil fuel fired power plants connected to CSPG. The construction of the Project was started on 30/06/2008. The turbine and generator started operation on 13/01/2010. The key events of its implementation are summarized in the Table 1.

Table 1 Key events of the project implementation

Key events	Date
The date on the contract of construction signed	30/06/2008
The date on which the turbines and Generators started operation	13/01/2010
The Project registered under CDM	07/10/2011
1 st monitoring period under CDM	07/10/2011~30/04/2012 (Both days included)
2 nd monitoring period under CDM	01/05/2012~31/10/2013 (Both days included)
The Project registered under VCS	14/11/2012
1 st monitoring period under VCS	25/01/2010~06/10/2011 (Both days included)
2 nd monitoring period under VCS	01/11/2013~30/04/2018 (Both days included)
3 rd monitoring period under VCS	01/05/2018 ~ 31/07/2021 (Both days included)

The project has been registered as a Clean Development Mechanism (CDM) project in UNFCCC on 07/10/2011 (UNFCCC Ref. 4821), with the renewable 3*7 crediting period started from 07/10/2011. The project also has registered as a VCS project on 14/11/2012 (VCS ID 928), issued 172,001 tCO₂e during the VCS first monitoring period from 25/01/2010 to 06/10/2011 and 342,023tCO₂e during the second monitoring period from 01/11/2013~30/04/2018.

The electricity for the project is generated by two units of HLA551c-LJ-262 turbines and two units of SF-J18-30/5050 generators. The expected operational lifetime is 25 years. Key technical specifications are listed in Table 2 below.

Table 2 Key technical parameters of the project

Generator		Turbine	
Model	SF-J18-30/5050	Model	HLA551c-LJ-262
Quantity	2	Quantity	2
Rated Power	18 MW	Rated Power	18.66 MW
Rated Voltage	10.5 kV	Rated Water Head	37m
Rated Current	1100 A	Rated Flux	55.42 m ³ /s
Rated Speed	200 r/min	Rated Speed	200 r/min

The power is delivered to the CSPG via 110kV lines to a designated transformer station. The technical process is indicated in the Figure 2⁹.

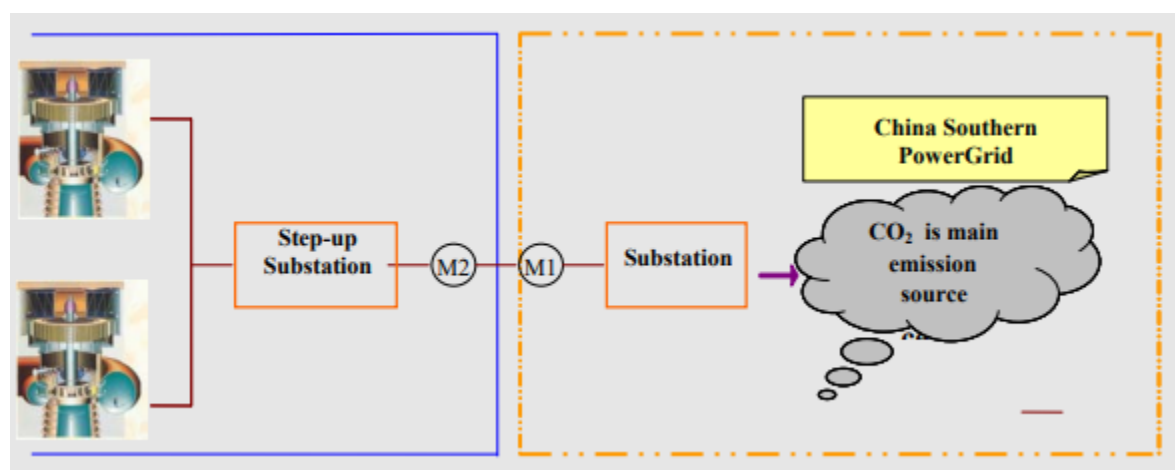


Figure2 The flow diagram of the project

During this monitoring period, there was a change in monitoring meters, more information refers to section 4.3. Besides, the project is normal operation, no special event occurred which may impact the applicability of the methodology, the GHG emission reductions or removals and monitoring. And the project is implemented in accordance with the registered PD and renewed PD.

⁹ During the construction period, there is a back-up line at the project site was used as a power resource and used for emergency. After construction was finished the back-up line has stopped. The back-up line will not be used anymore and no potential emission can be considered.

3.2 Deviations

3.2.1 Methodology Deviations

There is no deviation applied to this monitoring period.

3.2.2 Project Description Deviations

There is a deviation for the crediting period. The project is registered under VCS standard Version 3.2 and completed validation before 19/03/2020. Thus, it remains eligible to apply the crediting period requirements under VCS Version 3 which shall be a maximum of ten years and may be renewed at most twice, so the first renewable crediting period of the project should be updated from 25/01/2010 ~ 06/10/2011 to 25/01/2010 ~ 24/01/2020. However, as the project is also registered as a CDM project with a seven-year twice renewable project crediting period and the total CDM crediting period is from 07/10/2011 to 06/10/2032. Therefore, the total length of VCS crediting period should be no more than 21 years which is from 25/01/2010 to 24/01/2031.

3.3 Grouped Projects

The Project is not a grouped project.

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

In the 1st crediting period, the parameter ($FC_{i,y}$, $NCV_{i,y}$, $EF_{c,i,y}$, GEN_y , $CAP_{j,y}$, electricity imports to CSPG, electricity self-consumption ratio) used for calculation of the baseline grid emission factor $EF_{grid,CM,y}$ available at validation in the registered PDD are replaced by the parameter of $EF_{grid,CM,y}$ directly here. In the 2nd crediting period, $EF_{grid,CM,y}$ is obtained directly from the official source Notification on Determining Baseline Emission Factor of China's Grid by China's DNA. With consideration of the fact of the Project, data and parameters that are available at validation are summarized in below table.

Data / Parameter	$EF_{grid,CM,y}$ (1 st and 2 nd crediting period) ¹⁰
Data unit	tCO ₂ e/MWh
Description	Emission factor of the Grid (1 st crediting period) The baseline grid emission factor (2 nd crediting period)

¹⁰ Applicable for both first and second crediting period.

Source of data	Registered CDM PDD (1 st crediting period) 2019 Baseline Emission Factors for Regional Power Grids (2 nd crediting period)
Value applied	0.7879 (1 st crediting period) 0.3612 (2 nd crediting period)
Justification of choice of data or description of measurement methods and procedures applied	As per the registered PD (1 st crediting period) Calculated ss per “Tool to calculate the emission factor for an electricity system version 07.0” (2 nd crediting period)
Purpose of Data	Calculation of baseline emissions
Comments	The value of $EF_{grid,CM,y}$ calculated is determined ex-ante and fixed during the 1 st and 2 nd crediting period.

Data / Parameter	CAP_{BL} (1 st and 2 nd crediting period)
Data unit	W
Description	Installed capacity of the hydro power plant before the implementation of the project activity. For new hydro power plants, this value is zero. (1 st and 2 nd crediting period)
Source of data	ACM0002 version 12.1.0 and registered PDD (1 st crediting period) ACM0002 version 20.0 and renewed PD (2 nd crediting period)
Value applied	0
Justification of choice of data or description of measurement methods and	-

procedures applied	
Purpose of Data	Calculation of project emissions.
Comments	Determined ex-ante and fixed for the first crediting period; Determined ex-ante and fixed for the second crediting period.

Data / Parameter	A_{BL} (1 st and 2 nd crediting period)
Data unit	m ²
Description	Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full . For new reservoirs, this value is zero. (1 st and 2 nd crediting period)
Source of data	ACM0002 version 12.1.0 and registered PDD (1 st crediting period) ACM0002 version 20.0 and renewed PD (2 nd crediting period)
Value applied	0
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of project emissions or actual net GHG removals by sinks
Comments	Determined ex-ante and fixed for the first crediting period; Determined ex-ante and fixed for the second crediting period.

4.2 Data and Parameters Monitored

Data / Parameter	$EG_{\text{export},y}$ (1 st and 2 nd crediting period)
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Data unit	MWh														
Description	Electricity supplied by the project activity to the grid in year y (1 st and 2 nd crediting period)														
Source of data	Project site														
Description of measurement methods and procedures to be applied	Data type: Continuously measured. Archiving procedure: Electronic. Responsibility: The electricity meter was calibrated by a qualified third party regularly. Calibration Frequency: Annually.														
Frequency of monitoring/recording	Continuously measured, and monthly recorded														
Value monitored	Please refer to section 5.1 for the monthly data. <table><tr><th>Year</th><th>Value</th></tr><tr><td>01/05/2018~31/12/2018</td><td>104,626.720</td></tr><tr><td>01/01/2019~31/12/2019</td><td>85,157.600</td></tr><tr><td>01/01/2020~24/01/2020</td><td>2,101.781</td></tr><tr><td>25/01/2020~31/12/2020</td><td>104,124.691</td></tr><tr><td>01/01/2021~31/07/2021</td><td>37,295.280</td></tr><tr><td>Total</td><td>333,306.072</td></tr></table>	Year	Value	01/05/2018~31/12/2018	104,626.720	01/01/2019~31/12/2019	85,157.600	01/01/2020~24/01/2020	2,101.781	25/01/2020~31/12/2020	104,124.691	01/01/2021~31/07/2021	37,295.280	Total	333,306.072
Year	Value														
01/05/2018~31/12/2018	104,626.720														
01/01/2019~31/12/2019	85,157.600														
01/01/2020~24/01/2020	2,101.781														
25/01/2020~31/12/2020	104,124.691														
01/01/2021~31/07/2021	37,295.280														
Total	333,306.072														
Monitoring equipment	The bidirectional meters (M₁, M₂) with measurement accuracy of 0.2s are calibrated annually by the qualified third party. When M₁ is out of order, the readings from M₂ will be used for reference. On 25/11/2020, M₁ was replaced by a new bidirectional DTSD718 meter whose serial number is 05131SG000002015AD701411 and accuracy level is 0.5s; M₂ was replaced by a bidirectional DTSD5 meter whose serial number is 02299816 and accuracy level is 0.2s. The accuracy of these new meters is in line with the requirements of the registered PD and renewed PD. Before 25/11/2020, the information of monitoring meters is listed below: <table><tr><th>No.</th><th>Type</th><th>Serial number</th><th>Accuracy class</th><th>Date of calibration</th><th>Validity</th></tr><tr><td>M₁</td><td>DTS5</td><td>02299816</td><td>0.2S</td><td>04/04/2018 24/03/2019</td><td>03/04/2019 23/03/2020</td></tr></table>	No.	Type	Serial number	Accuracy class	Date of calibration	Validity	M ₁	DTS5	02299816	0.2S	04/04/2018 24/03/2019	03/04/2019 23/03/2020		
No.	Type	Serial number	Accuracy class	Date of calibration	Validity										
M ₁	DTS5	02299816	0.2S	04/04/2018 24/03/2019	03/04/2019 23/03/2020										

				19/03/2020	18/03/2021	
	M ₂	DTSD341	200811670 20135	0.2S	03/04/2018 24/03/2019 19/03/2020	02/04/2019 23/03/2020 18/03/2021
	From 25/11/2020 onwards, the information of monitoring meters is listed below:					
	No.	Type	Serial number	Accuracy class	Date of calibration	Validity
	M ₁	DTSD718	05131SG000 0020015AD7 01411	0.5S ¹¹	23/11/2020	22/11/2021
	M ₂	DTSD5	02299816	0.2S	23/11/2020	22/11/2021
	During this monitoring period, M ₂ was never being used.					
QA/QC procedures to be applied	The meters are calibrated annually according to the sectoral requirement. Data measured by the meter is cross checked by Electricity Transaction Notes (ETNs), the conservative data between the measured data and data from ETNs are used to calculate VCUs during the verification.					
Purpose of the data	Calculation of baseline emissions					
Calculation method	-					
Comments	-					

Data / Parameter	EG _{import,y} (1 st and 2 nd crediting period)
Data unit	MWh
Description	Electricity imported by the project activity from the grid in year y (1 st and 2 nd crediting period)
Source of data	Project site
Description of measurement methods and procedures to be applied	Data type: Continuously measured. Archiving procedure: Electronic. Responsibility: The electricity meter was calibrated by a qualified third party regularly. Calibration Frequency: Annually.

¹¹ According to the revised registered PD, the net electricity delivered to the grid should be measured by electronic meters with accuracy of 0.5 or higher. Hence, the new electricity meter with accuracy of 0.5S does impact the electricity monitored and emission reduction calculation.

Frequency of monitoring/recording	Continuously measured, and monthly recorded.					
Value monitored	Please refer to section 5.1 for the monthly data.					
	Year		Value			
	01/05/2018~31/12/2018		75.680			
	01/01/2019~31/12/2019		184.800			
	01/01/2020~24/01/2020		23.164			
	25/01/2020~31/12/2020		180.996			
	01/01/2021~31/07/2021		135.520			
	Total		600.160			
Monitoring equipment	The bidirectional meters (M ₁ , M ₂) with measurement accuracy of 0.2s are calibrated annually by the qualified third party. When M ₁ is out of order, the readings from M ₂ will be used for reference.					
	On 25/11/2020, M ₁ was replaced by a new bidirectional DTSD718 meter whose serial number is 05131SG000002015AD701411 and accuracy level is 0.5s; M ₂ was replaced by a bidirectional DTSD5 meter whose serial number is 02299816 and accuracy level is 0.2s. The accuracy of these new meters is in line with the requirements of the registered PD and renewed PD.					
	Before 25/11/2020, the information of monitoring meters is down below:					
	No.	Type	Serial number	Accuracy class	Date of calibration	Validity
	M ₁	DTS5	02299816	0.2S	04/04/2018 24/03/2019 19/03/2020	03/04/2019 23/03/2020 18/03/2021
M ₂	DTSD341	2008116702 0135	0.2S	03/04/2018 24/03/2019 19/03/2020	02/04/2019 23/03/2020 18/03/2021	
From 25/11/2020 onwards, the information of monitoring meters is down below:						
No.	Type	Serial number	Accuracy class	Date of calibration	Validity	
M ₁	DTSD718	05131SG000 0020015AD7 01411	0.5S	23/11/2020	22/11/2021	
M ₂	DTSD5	02299816	0.2S	23/11/2020	22/11/2021	
During this monitoring period, M ₂ was never being used.						

QA/QC procedures to be applied	The meters are calibrated annually according to the sectoral requirement. Data measured by the meter is cross checked by purchased receipts, the conservative data between the measured data and data from receipts are used to calculate VCU's during the verification.
Purpose of the data	Calculation of baseline emissions
Calculation method	-
Comments	-

Data / Parameter	EG _{backup,y} (1 st and 2 nd crediting period)					
Data unit	MWh					
Description	Electricity imported through backup line from the grid in year y (1 st and 2 nd crediting period)					
Source of data	Project site					
Description of measurement methods and procedures to be applied	Data type: Continuously measured. Archiving procedure: Electronic. Responsibility: The electricity meter was calibrated by a qualified third party regularly. Calibration Frequency: Annually.					
Frequency of monitoring/recording	Continuous measurement and monthly recording.					
Value monitored	0					
Monitoring equipment	The meter (M _{backup}) with measurement accuracy of 1.0 is calibrated annually by the qualified third party.					
	On 25/11/2020, M _{backup} was replaced by a WFET-1000F meter whose serial number is 050013100020205200008947 and accuracy level is 1.0. The accuracy of the new meter is in line with the requirements of the registered PD and renewed PD.					
	Before 25/11/2020, the information of monitoring meters is down below:					
	No.	Type	Serial number	Accuracy class	Date of calibration	Validity
	M _{backup}	HX3000	060001004134	1.0	26/03/2018 24/03/2019	25/03/2019 23/03/2020

				19/03/2020	18/03/2021
	From 25/11/2020 onwards, the information of monitoring meters is down below:				
	No.	Type	Serial number	Accuracy class	Date of calibration
	M _{backup}	WFET-1000F	050013100 020205200 008947	1.0	23/11/2020
	Validity				
	22/11/2021				
	During this monitoring period, backup line has never been used.				
QA/QC procedures to be applied	-				
Purpose of the data	Calculation of baseline emissions				
Calculation method	-				
Comments	-				

Data / Parameter	Cap _{PJ} (1 st and 2 nd crediting period)
Data unit	MW
Description	Installed capacity of the hydro power plant after the implementation of the project activity (1 st and 2 nd crediting period)
Source of data	Project site
Description of measurement methods and procedures to be applied	Measured. Determine the installed capacity based on recognized standards yearly, i.e. nameplates of the turbines and generators installed at the project site and the equipment purchase contract.
Frequency of monitoring/recording	Yearly as per registered PD for 1st crediting period Once at the beginning of each crediting period as per renewed PD for 2 nd crediting period
Value monitored	36
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of the data	Calculation of baseline emissions

Calculation method	-
Comments	-

Data / Parameter	A _{PJ} (1 st and 2 nd crediting period)											
Data unit	m ²											
Description	Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m ²) (1 st and 2 nd crediting period)											
Source of data	Project site											
Description of measurement methods and procedures to be applied	The data is measured by professional design institute annually											
Frequency of monitoring/recording	Annually as per registered PD for 1 st crediting period Once at the beginning of each crediting period as per renewed PD for 2 nd crediting period											
Value monitored	<table><tr><td>Year</td><td>Value</td></tr><tr><td>2018</td><td>2,732,380</td></tr><tr><td>2019</td><td>2,732,305</td></tr><tr><td>2020</td><td>2,732,380</td></tr><tr><td>2021</td><td>2,732,305</td></tr></table>		Year	Value	2018	2,732,380	2019	2,732,305	2020	2,732,380	2021	2,732,305
Year	Value											
2018	2,732,380											
2019	2,732,305											
2020	2,732,380											
2021	2,732,305											
Monitoring equipment	-											
QA/QC procedures to be applied	-											
Purpose of the data	Calculation of baseline emissions											
Calculation method	-											
Comments	-											

4.3 Monitoring Plan

1. Organizational and monitoring structure

A Monitoring Team has been established consisting of three units, which are data recording, data management and QA/QC. The staffs of the team have been selected from different departments of the project company. The Team Leader holds the overall responsibilities to the monitoring of the project. His/her role is to ensure that the data monitored are accurately recorded, properly archived, QA/QC procedure is timely carried out and the entire monitoring process is strictly in line with the CDM requirements. He/she also acts as a liaison with the project manager of the consultancy company on a needy basis.

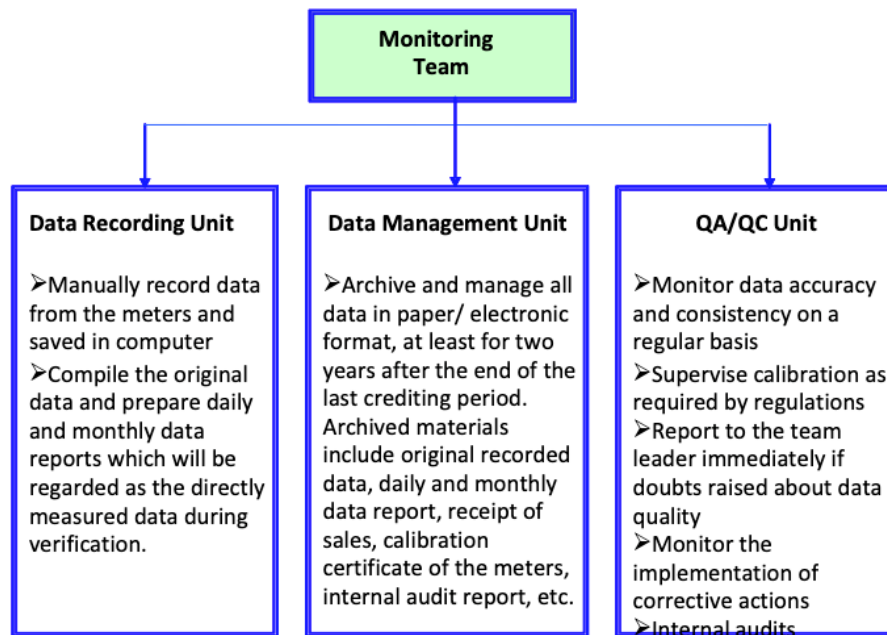


Figure 3 Structure of the monitoring team

2. Monitoring system and data collection

Bidirectional metering equipment with the rated precision of 0.2s installed at the substation of Grid Company and project site. The meter at the substation of Grid Company (M_1) has been used to monitor the supplied and imported electricity. If the metering equipment of the Grid Company failed to monitor the electricity, the metering equipment at the project site (M_2) has been used to report the data. During this monitoring period, the relevant data was from M_1 and M_2 was never being used.

The electricity imported through backup line from the grid could be measured by the meter (M_{Backup}) installed on the back-up line with accuracy of 1.0. Figure 4 illustrates the positioning of monitoring equipment.

Furthermore, on 25/11/2020, M_1 was replaced by a new bidirectional DTSD718 meter whose serial number is 05131SG000002015AD701411 and accuracy level is 0.5s; M_2 was replaced by a bidirectional DTSD5 meter whose serial number is 02299816 and accuracy level is 0.2s; M_{backup} was replaced by a WFET-1000F meter whose serial number is

050013100020205200008947 and accuracy level is 1.0. The accuracy of these meters is in line with the requirements of the registered PD and renewed PD.

The above-mentioned monitoring parameters $EG_{export,y}$, $EG_{import,y}$ and EG_{backup} have been measured continuously. The implementation of the monitoring system has been strictly in line with the Power Purchase Agreement signed between the project company and the grid company.

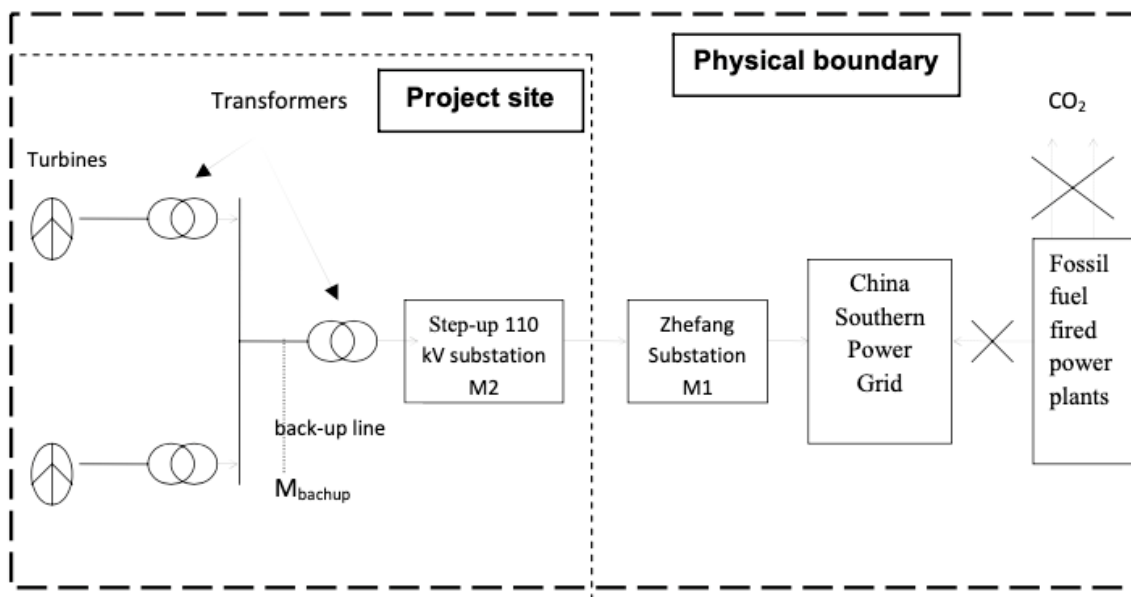


Figure 4 Positioning of monitoring equipment

The installed capacity of the hydro power plant after the implementation of the project activity (CapPJ) is yearly determined based on recognized standards i.e. by nameplates of the turbines and generators installed at the project site and the equipment purchase contract.

The area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (A_{PJ}) is measured by professional design institute annually.

Data recording: In this monitoring period, the grid company and the plant operation staff read and record the meters at 24:00 of the last day of each month. These electricity data is approved by the local grid company. All data including calibration records are kept until 2 years after the end of the total credit time of the VCS project.

Data aggregation: The net electricity supplied to the grid is summed over the monitoring period. Physical document such as paper - based maps, diagrams and environmental assessments have been collected in a central place, together with this monitoring plan. All paper-based information and the electronic records are stored by the technology department of the project owner and will be kept until 2 years after the end of the crediting period of the VCS project.

Calculation: Electricity supplied by the project activity to the grid ($EG_{export,y}$) and electricity imported by the project activity from the grid ($EG_{import,y}$) are monitored by the bi-directional meter (M_1). The electricity imported through backup line ($EG_{backup,y}$) is monitored by M_{backup} . Quantity of net electricity generation supplied by the project plant/unit to the grid ($EG_{facility,y}$) can be calculated by $EG_{import,y}$ and $EG_{export,y}$ and $EG_{backup,y}$.

$$EG_{facility,y} = EG_{export,y} - EG_{import,y} - EG_{backup,y}.$$

See section 5 for calculations of emission reductions.

Reporting: The recordings of electricity are collected in an Excel sheet and reported in the VCS - MR. All the events or situations that occurred during the monitoring period, which may impact the accuracy of data, have been detailed recorded by the project owner in the run log and summarized in VCS-MR.

3. Quality Assurance and Quality Control

QA/QC is to ensure the accuracy of data collected through measures including periodic calibration of monitoring meters, corrective actions, and internal audits.

3.1 Data quality monitoring

QA/QC unit is responsible for comparing monthly data reports from Grid company with on - site original data, crosschecking receipts with data reports to ensure data consistency and accuracy before transferring data to the data management unit. If problems occur, QA/QC unit manager will report to the team leader immediately.

3.2 Calibration

Procedure about calibration is consistent with what is stipulated in the Power Purchase Agreement. The metering equipments are calibrated by an accredited calibration agency according to the sectoral requirement. Calibration Certificates and relevant documents are collected by the QA/QC unit and transferred to data management unit for archiving.

3.3 Corrective actions

If the metering equipment of the Grid Company (M_1) failed to monitor the electricity, the metering equipment at the project site (M_2) will be used to report the data and the QA/QC unit manager will initiate and supervise the implementation of corrective actions. For instance, metering equipment installed shall be inspected by an accredited inspection agency after the repair of all or part of meter caused by the failure of one or more parts to operate in accordance with the specifications.

3.4 Internal audits

Internal audit procedure will be initiated under any of the below circumstances:

- a. modification of the monitoring system
- b. two months prior to verification

Firstly, the monitoring system will be checked on if the system functions properly and if the monitored results are correct. Secondly, spot check of daily/monthly data report will be undertaken. Internal audit report will be submitted upon completion of the procedure.

4. emergency procedures

If problems which can affect the quality of data occur, the QA/QC unit manager will initiate and supervise the implementation of corrective actions. For instance, metering equipment installed shall be inspected by an accredited inspection agency after the repair of all or part of meter caused by the failure of one or more parts to operate in accordance with the specifications. Should the metering equipment (M_1 , M_2) fail, no emission reductions shall be counted.

During this monitoring period, the metering equipment worked very well, and there was no emergency occurred.

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

According to the renewed PDD and renewed PD, the same equation can be applied in both 1st and 2nd crediting period. So, the baseline emission BE_y during the monitoring period results from:

$$BE_y = EG_{PJ,y} \times EF_{grid,CM,y} = (EG_{export,y} - EG_{import,y} - EG_{backup,y}) \times EF_{grid,CM,y}$$

Where:

BE_y = Baseline emissions in year y (tCO₂e)

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

$EG_{export,y}$ = Electricity supplied by the project activity to the grid in year y

$EG_{import,y}$ = Electricity supplied to the project activity from the Grid in year(y)

$EG_{backup,y}$ = Electricity imported through backup line from the grid in year y

$EF_{grid,CM,y}$ = 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”.

During the first crediting period, the $EF_{grid,CM,y}$ is equal to 0.7879 tCO₂e/MWh.

During the second crediting period, the $EF_{grid,CM,y}$ is equal to 0.3612 tCO₂e/MWh.

For the period from 01/05/2018 to 24/01/2020 attributed to 1st crediting period,

$EG_{export,y}$ = 191,886.101 MWh,

$EG_{import,y}$ = 283.644 MWh,

$EG_{backup,y}$ = 0 MWh,

$EF_{grid,CM,y}$ = 0.7879 tCO₂e/MWh

So, **BE₁** = (191,886.101 MWh - 283.644 MWh) × 0.7879 tCO₂e/MWh = **150,962 tCO₂e**

For the period from 25/01/2020 to 31/07/2021 attributed to 2nd crediting period,

$EG_{export,y}$ = 141,419.971 MWh,

$EG_{import,y}$ = 316.516 MWh,

$EG_{backup,y}$ = 0 MWh,

$EF_{grid,CM,y}$ = 0.3612 tCO₂e/MWh,

So, **BE₂** = (141,419.971 MWh - 316.516 MWh) × 0.3612 tCO₂e/MWh = **50,966 tCO₂e**

Therefore, in this monitoring period,

BE_y = 150,962 tCO₂e + 50,966 tCO₂e = **201,928 tCO₂e**

Please refer to the ER spreadsheet for the monthly monitored data.

Period	Electricity supplied by the project activity to the grid (MWh)	Electricity Imported from the Grid (MWh)	Electricity Imported by the project activity from the Backup	Quantity of net electricity generation supplied by the project plant/unit to the grid (MWh)	$EF_{grid,CM,y}$ (tCO ₂ e/MWh)	Baseline Emissions (tCO ₂ e)
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			Line (MWh)			
01/05/2018~31/12/2018	104,626.720	75.680	0.000	104,551.040	0.7879	82,375
01/01/2019~31/12/2019	85,157.600	184.800	0.000	84,972.800	0.7879	66,950
01/01/2020~24/01/2020 ¹²	2,101.781	23.164	0.000	2,078.617	0.7879	1,637
25/01/2020~31/12/2020	104,124.691	180.996	0.000	103,952.495	0.3612	37,544
01/01/2021~31/07/2021	37,295.280	135.520	0.000	37,159.760	0.3612	13,422
Total	333,306.072	600.160	0.000	332,705.912	/	201,928

In summary, the baseline emissions BE_y during this monitoring period is 201,928 tCO₂e.

5.2 Project Emissions

In April 2018, area of the reservoir measured in the surface of the water of the project is 2,732,380 m², Installed capacity of the project is 36,000,000W, the power density of the project = $(Cap_{PJ} - Cap_{BL}) / (A_{PJ} - A_{BL}) = 13.175 \text{ W/ m}^2$, greater than 10W/m².

In April 2019, area of the reservoir measured in the surface of the water of the project is 2,732,305 m², installed capacity of the project is 36,000,000W, the power density of the project = $(Cap_{PJ} - Cap_{BL}) / (A_{PJ} - A_{BL}) = 13.176 \text{ W/ m}^2$, greater than 10W/m².

In May 2020, area of the reservoir measured in the surface of the water of the project is 2,732,380 m², installed capacity of the project is 36,000,000W, the power density of the project = $(Cap_{PJ} - Cap_{BL}) / (A_{PJ} - A_{BL}) = 13.175 \text{ W/ m}^2$, greater than 10W/m².

In April 2021, area of the reservoir measured in the surface of the water of the project is 2,732,305 m², installed capacity of the project is 36,000,000W, the power density of the project = $(Cap_{PJ} - Cap_{BL}) / (A_{PJ} - A_{BL}) = 13.176 \text{ W/ m}^2$, greater than 10W/m².

According to ACM0002 version 20.0, in this monitoring period, the Power Density of the power plant is greater than 10 W/ m², the project emissions is zero.

5.3 Leakage

According to the ACM0002, Leakage (L_y) is not considered.

¹² The electricity from 01/01/2020 to 31/01/2020 was divided into two periods including the period from 01/01/2020 to 24/01/2020 and the other period from 25/01/2020 to 31/01/2020 based on the meter daily reading record and the total electricity in January 2020 was not change. Additionally, these data have been approved by the local grid company.

5.4 Net GHG Emission Reductions and Removals

According to the Section 5.1, 5.2 and 5.3 above,

$$BE_y = 201,928 \text{ tCO}_2\text{e};$$

$$PE_y = 0 \text{ tCO}_2\text{e};$$

$$LE_y = 0 \text{ tCO}_2\text{e};$$

$$\text{Therefore, } ER_y = BE_y - PE_y - LE_y = 201,928 \text{ tCO}_2\text{e}$$

This monitoring period includes the period from 01/05/2018 to 24/01/2020 attributed to the 1st crediting period and the other period from 25/01/2020 to 31/07/2021 attributed to the 2nd crediting period, with totally 1,188 days. Based on the annual estimated emission reductions from the registered VCS PD and renewed VCS PD, the amount of emission reductions for this monitoring period would be $113,189 \text{ tCO}_2\text{e} / 365 \text{ days} \times 634 \text{ days} + 51,887 \text{ tCO}_2\text{e} / 365 \text{ days} \times 554 \text{ days} = 275,362 \text{ tCO}_2\text{e}$. The actual emission reductions in this monitoring period (1,188 days) are 201,928 tCO₂e, which is 26.67% less than the estimated value. It is because the water flow caused by the abundant rainfall for the monitoring period is lower than other seasons in previous year. So, it is reasonable that during this monitoring period, the actual emission reduction is less than the estimated value.

Year	Baseline emissions or removals (tCO ₂ e)	Project emissions or removals (tCO ₂ e)	Leakage emissions (tCO ₂ e)	Net GHG emission reductions or removals (tCO ₂ e)
01/05/2018~31/12/2018	82,375	0	0	82,375
01/01/2019~31/12/2019	66,950	0	0	66,950
01/01/2020~24/01/2020	1,637	0	0	1,637
25/01/2020~31/12/2020	37,544	0	0	37,544
01/01/2021~31/07/2021	13,422	0	0	13,422
Total	201,928	0	0	201,928