82 MW LAU RENUN HYDRO POWER PLANT NORTH SUMATRA

Document Prepared by South Pole Carbon Asset Management Ltd.

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Monitoring Period	01-May-2017 to 31-December-2020 (both dates included)
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CONTENTS

1PROJECT DETAILS 3
1.1 Summary Description of the Implementation Status of the Project 3
1.2 Sectoral Scope and Project Type 4
1.3 Project Proponent 4
1.4 Other Entities Involved in the Project 4
1.5 Project Start Date 5
1.6 Project Crediting Period 5
1.7 Project Location 5
1.8 Title and Reference of Methodology 5
1.9 Participation under other GHG Programs 6
1.10 Other Forms of Credit 6
1.11 Sustainable Development 7
2 SAFEGUARDS 9
2.1 No Net Harm 9
2.2 Local Stakeholder Consultation 11
2.3 AFOLU-Specific Safeguards 11
3 IMPLEMENTATION STATUS 12
3.1 Implementation Status of the Project Activity 12
3.2 Deviations 14
3.2.1 Methodology Deviations 14
3.2.2 Project Description Deviations 14
3.3 Grouped Projects 14
4 DATA AND PARAMETERS 15
4.1 Data and Parameters Available at Validation 15
4.2 Data and Parameters Monitored 15
4.3 Monitoring Plan 18
5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS 22
5.1 Baseline Emissions 22
5.2 Project Emissions 22
5.3 Leakage 24
5.4 Net GHG Emission Reductions and Removals 24

1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

The 82 MW Lau Renun Hydro Power Plant (hereinafter refer to as 'project activity') is a new type of run-of-river hydropower plant with a daily regulating pond and five hours of peak power generation, diverting from the Renun river mainstream and eleven tributaries into Lake Toba. The project start date was 14/08/2006. The regulating pond has a storage capacity of 500,000 m^3 and a power density of 820 W/m^2. The total actual installed capacity of the project is 82 megawatts (MW), consisting of two 41 MW generators and an expected annual power generation (effective supply to the grid) of 313,500 megawatt hours (MWh). The project is owned and developed by PT. PLN (Persero), a state-owned electricity company. The project supplies electricity to the connected Sumatra grid. Below is the technical description of the turbines and generators.

The project activity is registered as a VCS project with ID Number 488. Further background on this project can be found in the Verified Carbon Standard Project Description (VCS-PD).

The project activity is located at 2.6500 north latitude and 98.4094 east longitude, in the northwestern part of Lake Toba, North Sumatera Province, which is about 100 kilometers(km) south of Medan City.

Prior to the implementation of the project activity there had been no existing power generation at the project location. The electricity in the grid was predominantly generated from fossil fuel sources and had been solely distributed to consumers via the electrical grid.

The estimated annual carbon dioxide (CO_2) emissions reduction of the project is 270,019[1] tons of carbon dioxide equivalent (tCO_2e). During the second monitoring period under second crediting period (01/05/2017 – 31/12/2020, both dates included) the total emissions reduction is 782,423 **tCO_2e** (see below):

Vintage year	Emissions reduction (tCO_2e)
01/05/2017 – 31/12/2017	149,409
01/01/2018 – 31/12/2018	218,237
01/01/2019 – 31/12/2019	228,769
01/01/2020 – 31/12/2020	186,008
Total	**782,423**

The project was validated under the VCS and was initially registered on 25/08/2010 (1st crediting period) and final validation report for renewal of 2nd crediting period was issued on 05/12/2017, with the registration for 2nd crediting period was completed on 21/12/2017[2]. This monitoring report has been prepared in accordance with the monitoring plan contained in the validated VCS-PD. The VCS-PD will serve as the basis for the verification, certification, and issuance of the emission reductions during the monitoring period.

[1] As per the annual ex-ante value of the registered PD, 21/12/2017. https://registry.verra.org/app/projectDetail/VCS/488
[2] Refer to the "Date Updated" VCS Registry (VCS Program), https://registry.verra.org/app/projectDetail/VCS/488.

1.2 Sectoral Scope and Project Type

Electricity generation:

Type I	Renewable energy projects
Methodology	ACM0002: Grid-connected electricity generation from renewable sources
Sectoral Scope 1	Energy industries (renewable/non-renewable sources)
Version	17.0

This project activity is not a grouped project and is not an AFOLU project.

1.3 Project Proponent

Project owner:

Organization name	PT. PLN (Persero)
Contact person	Mr. Komang Parmita
Title	Executive Vice President (EVP) of Health, Safety, Security and Environment (HSSE)
Address	Jl. Trunojoyo Blok M – I No 135, Kebayoran Baru, Jakarta 12160, Indonesia
Telephone	+62-21-725 1234
Email	komangparmita@pln.co.id

Carbon credit buyer:

Organization name	South Pole Carbon Asset Management Ltd.
Contact person	Renat Heuberger
Title	CEO
Address	Technoparkstrasse 1, Zurich, Switzerland, 8005
Telephone	+41 43 501 35 50
Email	registration@southpole.com

1.4 Other Entities Involved in the Project

No other entities are involved in this project.

1.5 Project Start Date

As per the VCS policy announcement on 10/09/2008, the project start date is the date from which the project activity began reducing or removing greenhouse gas (GHG) emissions.

The commissioning dates for both units are as follows:

- Lau Renun Hydro Power Plant Unit 1: 18/12/2006 (Certificate of Operation or *Sertifikat Laik Operasi*)
- Lau Renun Hydro Power Plant Unit 2: 14/08/2006 (Certificate of Operation or *Sertifikat Laik Operasi)*

Thus, the project start date is 14/08/2006, as the earliest project start date of the two units that make up the project activity.

1.6 Project Crediting Period

- First crediting period: 01/09/2006 – 31/08/2016 (both dates included, 10 years)
- Second crediting period: 01/09/2016 – 31/08/2026 (both dates included, 10 years).

1.7 Project Location

The project area of the Lau Renun Hydro Power Plant (HEPP) is situated in the northwestern part of Lake Toba in North Sumatra Province, which is about 100 km south of Medan city. The power station is located at the foot of the spur of Toba Escarpment, about 2 km southeast of Silalahi village, Silahi Sabungan sub-district, Dairi district, North Sumatera province, Indonesia.

The exact location is 2.6500 N and 98.4094 E. The location of the project site is shown in the map below:

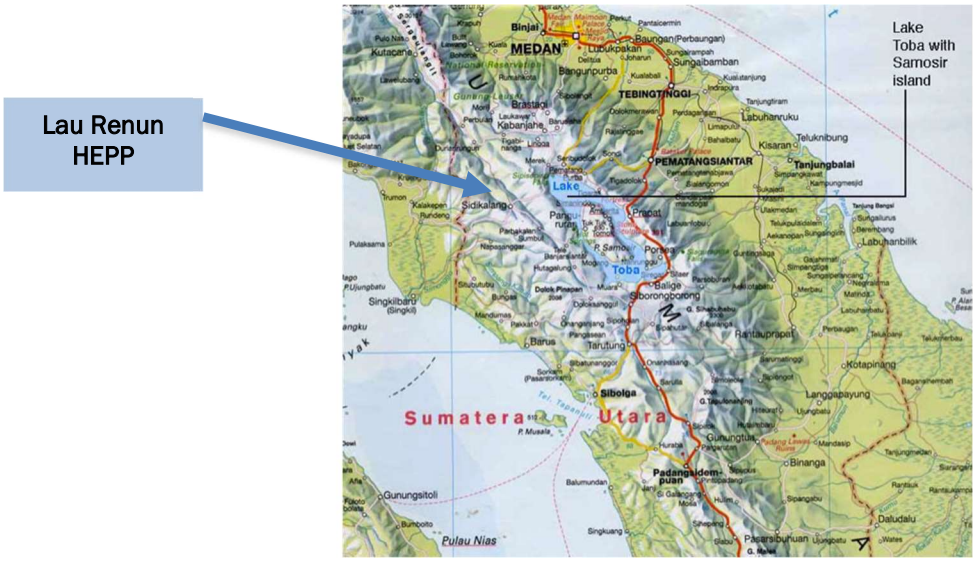

Figure 1: Location of Lau Renun HEPP

1.8 Title and Reference of Methodology

The baseline and monitoring methodology for the project activity is defined as:

- ACM0002 – "Grid-connected electricity generation from renewable sources", version 17.0

Tool referenced in the applied methodologies:

- TOOL07 – "Tool to calculate the emission factor for an electricity system", version 05.0

1.9 Participation under other GHG Programs

During the project verification, a new Indonesian Presidential Decree Number 98 2021[3], was announced on 29/10/2021. The decree includes the Implementation of Carbon Economic Value for The Achievement of The Target National Determined Contributions and Greenhouse Gas Emissions Inventory in National Development.

With the VCS Program Definition of GHG Program, the SRN would not be classified as a GHG Program as it does not lead to the GHG emission reductions.

Thus, it could be confirmed that the project activity is not registered under any other GHG program.

1.10 Other Forms of Credit

Emission trading programs and other binding limits:

Referring to Indonesian Presidential Decree Number 98 2021, Chapter 54 Clause 7 the newly signed Presidential Decree states that Carbon trading that occurs in a marketplace must be conducted in the Indonesian marketplace. To comply with such decree, the project is in a process of registering itself under this national inventory. During this verification, the project has completed first steps out of four; in receiving registration number under the National Registry System. The approval email for the achievement of first step was received on 4th October 2021, with the registration number as 005-X-2021-2372. With this ongoing process, it does not limit the project to be binding under such compliance programs yet. Furthermore, following chapters have been noted; Chapter 85 and Chapter 86 Clause 1 of the Presidential Decree, that business actors have one-year of grace period from the launch for adjusting their business to comply with the regulations, confirming that the project would not have credits be used for compliance under such programs.

Other forms of environment credit:

The project activity currently has not applied for any other type of environmental credit.

Projects may generate other forms of GHG-related environmental credits, such as renewable energy certificates (RECs), though GHG emission reductions and removals presented for VCU issuance shall not also be recognized as another form of GHG-related environmental credit.

If the project activity will be issued under any recognized program which creates GHG-related environmental credits (such as RECs), the GHG emission reductions or removals from one verification period can be split between the VCS program and another GHG program.

[3] Presidential Decree No. 98 Year 2021, available from: https://peraturan.bpk.go.id/Home/Details/187122/perpres-no-98-tahun-2021 [accessed 12 January 2022]

1.11 Sustainable Development

The project contributes to the sustainable development defined by the Government of Indonesia as follows:

Social well-being:

- The project contributes to the development of the region by increasing community development and the corporate social responsibility of PT. PLN (Persero), for example through infrastructure development (roads, bridges); providing funds for the building of a new school, church and mosque in the region; upgrading health care facilities (a small clinic); and providing free medicines in the vicinity of the project for the benefit of the community.
- During both construction and operation, various kinds of mechanical work are required, providing employment on a regular and permanent basis.

Economic well-being:

- The project activity generates direct and indirect employment for skilled and unskilled manpower during the construction phase as well as the operational stage, and thus helped in controlling migration from the region and the alleviation of poverty in the local area.
- The generated electricity is fed into regional grids through the local grid, thereby increasing the electricity supply and improving the availability of electricity to local consumers (villagers and suburban inhabitants). This creates new opportunities for industrial and economic activities, meaning an increase in local employment and better overall development.
- The project activity leads to the diversification of the national energy supply, which is dominated by conventional fuel-based generating units.
- The project activity contributes to economic sustainability around the plant site and encourages economic power decentralization.

Environmental well-being:

- The project utilizes hydropower to generate electricity, which otherwise would have been generated through fuel- (most likely fossil fuel) based power plants. In this way, it is contributing to a reduction in specific emissions (emissions of pollutant/unit of energy generated), including GHG emissions.
- As hydroelectric power projects produce no end-products in the form of solid waste (ash, etc.), they do not have to deal with the issue of solid waste disposal encountered by most other sources of power.
- Being a renewable energy source, hydro energy is used to generate electricity that contributes to resource conservation.
- Thus, the project causes no negative impact on the surrounding environment since it is a run- off-river type hydropower plant with daily regulating ponds; and ultimately contributes to environmental well-being. The low impact on the surrounding environment demonstrates the very high-power density of the regulating pond, calculated to be 820 W/m^2 (see section 2.2 of VCS PD).

Technological well-being:

- The project supports high quality equipment transfer from other regions and countries and contributes to capacity building of the labor force through training and practical work.
- The project promotes local products developed in the region (when replacement of spare parts is necessary), and supports renewable technology development, especially for hydroelectric power technology.

In light of the above, the project participants consider the project activity to profoundly contribute to sustainable development.

2 SAFEGUARDS

2.1 No Net Harm

According to the Decree of the Ministry of Environment No. 17/2001, all hydroelectric power plants with a dam height of ≥ 15 meters (m), or a flooded area of ≥ 200 hectares (ha), or an installed capacity of ≥ 50 MW need to undertake an Environmental Impact Assessment (EIA). The project activity has a total installed capacity of 82 MW electricity, and thus requires an EIA.

An EIA has been developed for this project and was completed on 02/06/1986 and approved by the Ministry of Energy and Mining in 1991. Where impacts of the project were identified, mitigation measures were suggested and defined. The EIA highlights the following impacts in connection with the project, as shown in the table below.

Identified environmental impacts	Measures taken
Pre-construction phase	
Social responsibility	
Community perception related to project consultation, publicizing, and resettlement	Perform discussion with local community, give proportional compensation on resettlement of village, monitor the issues that develop in the community
Construction phase	
Air and noise pollution	
Increase in air and noise pollution due to increased transportation and operation of heavy equipment	Restrict the operation of heavy equipment during the day, build a project fence to reduce noise pollution, spray water to avoid dust from construction, control vehicle emissions and noise, and use protective masks for employees
Water pollution	
Change in surface water flow due to land clearing and covering	Create a drainage system to the nearest water body, perform a gradual land covering based on project phase, and execute land clearing only on the project site
Solid waste	
Construction waste from the transportation of soil material	Perform continuous cleaning during the construction period to remove debris and deposit of it appropriately
Biodiversity and ecosystems	
Change in biodiversity due to alteration in land and water body conditions	Reforest and restore the green lands after the construction, and maintain the minimum river flow to preserve the natural biodiversity within the river
Employment impacts	

Identified environmental impacts	Measures taken
Utilization of local human resources	Give priority to local employment and hold special training to enhance the local community's skills
Operation phase	
Water pollution	
Decrease in the quality and quantity of water due to the wastewater from plant's activity and land erosion	Operate wastewater treatment plant and reforest the watershed area
Environmental	
Related to the project operation and its supporting facility, solid waste and wastewater from the surrounding settlement	Build a wastewater treatment facility, execute a solid waste temporary disposal system and create a waste transportation system
Spatial planning	
Change in spatial planning structure due to project activity	Control the development around project activity by enforcing the appropriate planning regulations
Regional image	
Change in regional image due to the development in the region	Planning controls will ensure sensitive development of the region
Traffic	
Increase in traffic activity due to the project's operational activity	Restore the trans-Sumatra main road and set up traffic signs
Health and Safety	
Human resources needed to operate the project and its facilities	Give employment opportunities to local human resources following high health and safety standards
Working opportunity and income	
Related to utilization of local human resources	Give priority to the admission of local human resources and hold special training sessions to enhance the local community's skills
Comfort	
Uncomfortable conditions due to vehicle's activity on the access road from and/or to the project	Maintain the road condition by setting up traffic signs and planting trees on the roadside
Social responsibility	
Community perception related to project operation	Give a donation to the community, build a kindergarten in the nearest village and reforestation

With mitigation controls planned as part of the project construction and EIA process, and the contribution made by the project to sustainable development in the local and national area, the project is expected to have an overall positive impact on the local and global environment. All negative environmental impacts are subject to mitigation measures as described above.

2.2 Local Stakeholder Consultation

To identify the project's positive and negative impacts on the region, and to understand stakeholder perceptions of the project, a meeting was conducted with relevant stakeholders, including the village chief, local leaders, local organizations, and local residents within the project boundary.

As documented, local stakeholders felt that the construction of the Lau Renun HEPP had increased their social and economic life due to road construction, additional earnings from temporary jobs, and especially due to the additional supply of electricity.

The stakeholder meeting was carried out on 24/08/2005 in the village hall of the Pegagan Julu IV village. The meeting was documented and recorded. The attendance list, pictures, and other relevant documentation will be made available to the DOE and sent separately.

Outcome: no negative comments were received from local stakeholders during the meeting. They did not object to the project activity because the project will not negatively impact the surrounding environment or people. The project also does not require any major displacement of the local population. The project activity has acquired land from the local population, who have been given compensation in return. The project activity has not received any adverse comments from their side.

Ongoing Communication

Project Proponent (PP) has been reporting on the implementation of environmental management and environmental monitoring (*Laporan Implementasi Pengelolaan Lingkungan dan Pemantuan Lingkungan*) on a regular basis as part of the EIA implementation. PP also conducted a survey of the local community regarding the benefits perceived during project operations. The local community is not disturbed by the operation of the Lau Renun Hepp. During this monitoring period, the surrounding community voiced their suggestions and expectations, for example that the Lau Renun HEPP would help to repair building fences, take care of street lights, and clean up plants/weeds around the building.

2.3 AFOLU-Specific Safeguards

For non-AFOLU projects, this section is not required.

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

The project was initially registered on 25/08/2010 and already completed renewal for the 2nd crediting period on 21/12/2017. The current monitoring period is from 01/05/2017 – 31/12/2020 (both dates included). The emission reductions for this period are 782,423 **tCO_2e** (VCUs). The implementation status of the project activity during this monitoring period was in-line with the registered PD of the 2nd Crediting Period.

Table 1: Technical data of the turbine/generator units (specifications are per unit)

Turbines 1 & 2	Brand	Kvaerner Boving Limited
	Model	Francis vertical shaft
	Rated output	42,000 kW
	Rated head	434.6 m
	Rated speed	750 rpm
	Rated flow	10.42^3/s
	Contract number	6028

Generators 1 & 2	Brand	Elin
	Model	SSV 290/8 – 176
	Rated output	46,000 kVA
	Rated voltage	11,000 +/- 10%
	Rated current	2,414 A
	Rated frequency	50 Hertz
	Rated speed	750
	Rated factor	0.89
	Serial Number	● 1.659260/UNIT 1 ● 1.659261/UNIT 2

Transformer 1 & 2	Brand	Pauwels
	Model	Generator transformer
	Rated Power	46 MVA
	Rated voltage	11 kV/150kV
	Rated frequency	50 hertz
	Serial Number	● 98P0046/UNIT 1 ● 98P0047/UNIT 2

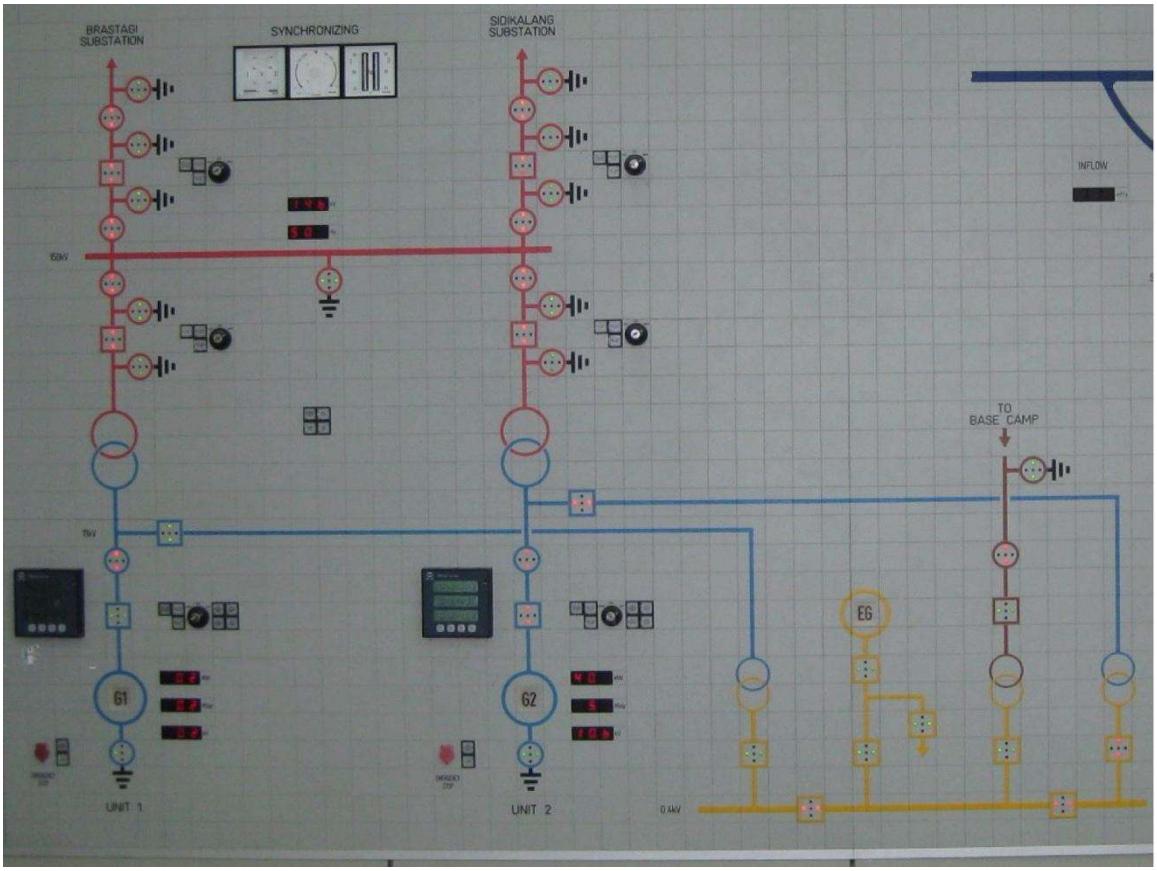

Figure 2. Single Line Electrical Diagram

The operation of the project activity during this monitoring period (01/05/2017 to 31/12/2020, both dates included) was under normal conditions, where all the monitoring parameters were conducted as per the registered monitoring plan. There was no change in the project activity as per the registered Project Description (PD). The equipment/machine was also maintained according to the registered PD. In case of any calibration delay, the maximum error was applied to the relevant monitoring data and conservative values were used for the calculation of emission reductions. The events that may impact the GHG emission reductions were provided in Table 2.

Table 2: The implementation status of the project activity

Date	Events
14/08/2006	Project Start Date
01/09/2006	First crediting period start date
25/08/2010	Initial Registration with VCS
01/09/2016 – 30/04/2017 (both dates included)	First Monitoring Period under second crediting period

21/12/2017	Renewal of second crediting period date as shown on VERRA Registry (VCS program)[4]
12/10/2018 – 02/12/2018	Planned Outage (PO): General Inspection Plus (GI+)
17/10/2020 – 09/01/2021	Planned Outage (PO): Major overhaul + (MO+) in Unit 1
14/11/2020 – 17/12/2020	Planned Outage (PO): Main Inlet Valve (MIV) maintenance in Unit 2
18/11/2020 – 31/12/2020	Forced Outage (FO): Puddle of water in the turbine and MIV area in Unit 2
01/05/2017 – 31/12/2020 (both dates included)	Second monitoring period under second crediting period; refer to this report

3.2 Deviations

3.2.1 Methodology Deviations

Not applicable as the project activity does not need any deviations of the methodology.

3.2.2 Project Description Deviations

Not applicable as the project activity does not need any deviations of the Project Description.

3.3 Grouped Projects

The project activity is not a grouped project.

[4] Refer to the "Date Updated" VCS Registry (VCS Program), https://registry.verra.org/app/projectDetail/VCS/488.

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Data/Parameter	$EF_{grid,CM,y}$
Data unit	tCO_2/MWh
Description	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' As per the UNFCCC 'Methodological tool: Tool to calculate the emission factor for an electricity system' v05.0, the following default values should be used for w_{OM} and w_{BM} (for all projects except for wind and solar power generation project activities): w_{OM} = 0.5 and w_{BM} = 0.5 for the first crediting period, and w_{OM} = 0.25 and w_{BM} = 0.75 for the second and third crediting period, unless otherwise specified in the approved methodology which refers to this tool.
Source of data	Calculation[5]
Value applied	0.869
Justification of choice of data or description of measurement methods and procedures applied	No measurement required. Data is obtained based on analysis of MEMR published information following the 'Tool to calculate the emission factor for an electricity system'.
Purpose of data	Calculation of baseline emissions
Comments	-

4.2 Data and Parameters Monitored

Data/Parameter	$EG_{PJ,y}$
Data unit	MWh per year
Description	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
Source of data	kWh meter at project activity site (switchyard) The electricity generation data used for monitoring is the Monthly Electricity Transfer Protocol Report (METPR) delivered to the grid

[5] Source of data for EFgrid,OM,y (0.676 tCO2e/MWh) and EFgrid,BM,y (0.933 tCO2e/MWh) are from Indonesian government under the Directorate General of Electricity - Ministry of Energy and Mineral Resources (MEMR), based on notification letter number 1515/03/DLT.3/2017 dated on May 30th, 2017.

<table>
<tr><td></td><td>signed by both parties of generation division and transmission division.</td></tr>
<tr><td>Description of measurement methods and procedures to be applied</td><td>Electricity supplied to the grid will be measured by a watt-hour meter (connected to a digital control system and continuously monitored and recorded), which can measure export and import electricity data separately. Therefore, net electricity delivered to the grid would be the difference between export and import electricity.

The measurement of electricity supplied to the grid (Joint Meter Reading/JMR) has been conducted and taken at the transaction point on a regular basis and is continuously monitored (recorded on a monthly basis in the METPR).</td></tr>
<tr><td>Frequency of monitoring/recording</td><td>Monitoring is continuous with the monthly recording of data.</td></tr>
<tr><td>Value monitored</td><td><table><tr><th>Monitoring period</th><th>Applied value</th></tr><tr><td>01/05/2017 – 31/12/2017</td><td>171,933.10</td></tr><tr><td>01/01/2018 – 31/12/2018</td><td>251,136.00</td></tr><tr><td>01/01/2019 – 31/12/2019</td><td>263,256.00</td></tr><tr><td>01/01/2020 – 31/12/2020</td><td>214,049.00</td></tr><tr><td>Total</td><td>900,374.10</td></tr></table>Note: the numbers highlighted in red have had a conservative approach applied due to delayed calibration. For further justification, please refer to the comments.</td></tr>
<tr><td>Monitoring equipment</td><td><u>Unit 1</u>

Type: Digital watt-hour meter type ACTARIS SL7000 (main meter)

Manufacturer/model: Actaris

Accuracy class: 0.2s

Serial number: 36027216

Calibration frequency: Every five years

Date of last calibration and validity:<table><tr><th>Calibration Date</th><th>Validity</th></tr><tr><td>14/04/2010</td><td>13/04/2015</td></tr><tr><td>06/12/2017</td><td>05/12/2022</td></tr></table><u>Unit 2</u></td></tr>
</table>

<table>
<tr><td></td><td>Type: Digital watt-hour meter type ACTARIS SL7000 (main meter)
Manufacturer/model: Actaris
Accuracy class: 0.2s
Serial number: 36027222
Calibration frequency: Every five years
Date of last calibration and validity:
<table><tr><th>Calibration Date</th><th>Validity</th></tr><tr><td>14/04/2010</td><td>13/04/2015</td></tr><tr><td>05/12/2017</td><td>04/12/2022</td></tr></table></td></tr>
<tr><td>QA/QC procedures to be applied</td><td>The QA/QC conducted a thorough cross checking of the Monthly Transfer Electricity Protocol Record (METPR)at the transaction point, with sales electricity receipts (in the form of water tax payment receipts) issued by the North Sumatera Province Tax Office (local government).
Meters at the generation unit are calibrated once every five years according to national regulations (refer to http://jdih.esdm.go.id/peraturan/Permen%20ESDM%2037%202008.pdf)
The meter at the transaction point (main meter) will be read regularly and jointly by the person in charge from the Generation Unit and Transmission Unit.</td></tr>
<tr><td>Purpose of data</td><td>Calculation of baseline emissions</td></tr>
<tr><td>Calculation method</td><td>Net electricity supplied to the grid is calculated as the difference between EG_{export} and EG_{import} ($=EG_{export} - EG_{import}$)</td></tr>
<tr><td>Comments</td><td>As per applicable metering standard issued by the MEMR of the Republic of Indonesia, a revenue meter calibration should be conducted every five years. However, there were calibration delays for the revenue meter of Unit 1 from 01/05/2017 to 05/12/2017 and Unit 2 from 01/05/2017 to 04/12/2017.
According to the calibration certificates, the calibration error for Unit 1 meter (serial number 36027216) is 0.14% while for Unit 2 meter (serial number 36027222) is 0.04%. The</td></tr>
</table>

	results from the calibration certificate has been compared with the accuracy of the meter, which is 0.2%. In case of a revenue meter calibration delay, the maximum permissible error, which is based on the meter accuracy, was selected and applied to the BE_y calculation as per the following formula (based on paragraph 366 of the UNFCCC 'CDM validation and verification standard for project activities' v.03.0): EG_{exp} (Electricity exported to the grid) = EG_{exp} x (100% - accuracy of revenue meter) = EG_{exp} x (100% - 0.2%) EG_{imp} (Electricity imported from the grid) = EG_{imp} x (100% + accuracy of revenue meter) = EG_{imp} x (100% + 0.2%)

4.3 Monitoring Plan

This section details the steps that have been taken to regularly monitor the GHG emissions reductions from the project activity in accordance with ACM0002 version 17.0.

The Monitoring Plan for this project has been developed to ensure that the project collects and archives complete data from the very start.

Monitoring period

The monitoring period covers 01/05/2017 to 31/12/2020 (both days included).

Monitoring organization

The monitoring team has been established and integrated within the existing organization structure of the project activity prior to the start of the verification. Clear roles and responsibilities have been assigned to all staff involved in the VCS project and the prospect of nominating a VCS manager has been considered. The VCS manager has the overall responsibility for the monitoring system on this project.

All other VCS monitoring staff have clearly defined roles and responsibilities. The VCS manager manages the process of training new staff; ensuring trained staff perform the monitoring duties as necessary; and ensuring that where trained monitoring staff are absent, the integrity of the monitoring system is maintained by other trained staff.

A formal set of monitoring procedures has been established prior to the start of the verification. These procedures detail the organization, control, and the steps required for certain key monitoring system features, including:

a) VCS staff training

b) VCS data and record keeping arrangements

c) data collection

d) VCS data quality control and quality assurance

e) equipment maintenance

f) equipment calibration

g) equipment failure

The procedures have been developed by PT PLN (Persero) and South Pole Carbon Asset Management Ltd. Any changes to procedures need to be agreed by both parties. The VCS manager responsible for ensuring that the procedures are followed on site and for continuously improving the procedures to ensure a reliable monitoring system is established.[6]

Monitoring equipment and installation

Considering that the emission factor is calculated ex-ante and according to the Monitoring Methodology ACM0002 version 17.0, the only data to be monitored is electricity supplied to the grid by the project (detailed in section 4.2). The primary instruments include:

Metering of electricity supplied to the grid

The main electricity meter for establishing the net electricity delivered to the grid (detailed in section 4.2) was installed at the Lau Renun 150 kV transmission line. This electricity meter has been the main meter (revenue meter), that measures the quantity of electricity supplied (net electricity delivered) to the grid. Net electricity delivered to the grid is the difference between electricity export and import. This meter provides the main VCS measurement and is a key part of the verification process. The main meter is located at the Lau Renun HEPP. The main electricity meter reading record activity (Joint Meter Reading) and is then recorded on the METPR issued by the Lau Renun HEPP Generation Unit.

The main electricity meter is read by representatives from PT PLN (Persero) Generation Division (PT PLN (Persero) Lau Renun HEPP Generation Unit) and PT PLN (Persero) Load Dispatcher and Transmission Division (PT PLN (Persero) Sidikalang Sub-Station).

Electricity meters meet the relevant local standards at the time of installation and are calibrated by the manufacturer before installation. The meters are installed by the project according to the Indonesian standard “Standard Electricity Meter Equipment”. Records of the meter (type, make, model, and calibration documentation) retained in the quality control system on-site.

Main meter quality control

[6] The Pandan Sector has implemented the key monitoring system as mentioned above by having the PLN monitoring system on their management system.
As part of the PLN management system requirement, Lau Renun HEPP has develop some SOPs as follow:

- SOP tp read the Electricity Meter
- SOP to calibrate the Test and Measurement equipment.
- SOP to develop an Monthly Electricity Transfer Protocol Report (BAP)
- SOP for Electricity Transfer
- SOP for Emergency Response

The project developer owns the meter and is responsible for its maintenance and calibration, as stated in the Standard Operating Procedure (SOP). PLN Transmission Division and its representative are entitled to be present during any test, inspection, maintenance, and replacement of any part of the metering system, which will be performed by the meter manufacturer at the request of the project developer.

The project developer specifies the QC (flow-chart) procedure for the calibration of test and measurement equipment (SOP to calibrate the Test Equipment and Measurement Equipment) to ensure the accuracy of the measurement values shown by the instrument/measuring device and test or measurement system (one of the instruments mentioned in this SOP is the electricity meter). The calibration can be done internally or externally depending on the type of measuring equipment and resource capability. The electricity meter, which is located in the project area, is calibrated by the external party.

The main meter is specified to have 0.2s class. The calibration of test and measurement equipment has been conducted to ensure the measurement accuracy of the main meter. PT PLN (Persero) *Penelitian dan Pengembangan Ketenagalistrikan*, a national government approved laboratory certified 17025 and authorized by the Government of Indonesia, to conduct such calibration. Periodic calibrations have been performed at least once every five years as per applicable metering standard issued by the Minister of Energy and Mineral Resource of the Republic of Indonesia.

Main electricity meter specification:

Serial Number	Type	Factory	Class	Location
Main meter (MU 1)				
36027216	SL 7000 (digital)	Actaris	0.2s	Main electricity meter 1 (MU 1) to monitor electricity supply from turbine Renun #1
Main meter (MU 2)				
36027222	SL 7000 (digital)	Actaris	0.2s	Main electricity meter 2 (MU 2) to monitor electricity supply from turbine Renun #2

The main meters are shown below:

Figure 3: Pictures of main meters of Unit 1 (left) and Unit 2 (right)

The Power Plant Operator has been periodically checking if all tools and equipment are in good condition as per the SOP.[7] In the event of a broken security seal in the metering system, or the system failing to register; or if upon testing the measurement result is found to vary more than the allowable error from the standard meter used in the test, then an adjustment shall be made correcting all measurements of energy made by the metering system, as described in the SOP.

No metering devices broke down or malfunctioned during the following monitoring period (01/05/2017 – 31/12/2020, both dates included). All the meters listed above have performed well. In the event of meter failure, the main meter, production meter and the consumption meter (hereinafter referred to as cross-check meters) located at the generation site of each power generation unit will still be read in order to measure the quantity of electricity exported from the project. The difference between electricity produced and consumed on-site is valid for claiming carbon credits. In the rare case of total failure of all meters, no credits can be claimed during the period.

Data recording procedure

The procedures for collecting the electricity meter data is outlined in the SOP signed by the project owner and the Grid Operator (both are under PLN).[8] All relevant data are archived electronically and backed up regularly. Uncertainty has been considered to achieve conservative results. Moreover, it has been kept for the full crediting period, plus two years after the end of the crediting period or the last issuance of VCUs for this project activity (whichever occurs later). The Monitoring Plan has been developed to ensure that the project has robust data collection, processing, and archiving procedures.

[7] http://kepustakaan-presiden.pnri.go.id/uploaded_files/pdf/government_regulation/normal/UU_2_1981_soeharto.pdf
[8] Lau Renun HEPP is following the "Prosedur Pembuatan BA Pengiriman Energi Listrik PLTA Lau Renun" or the 'Procedure to develop Lau Renun HEPP Monthly Electricity Transfer Protocol Report' as the detail procedure for Electricity Transfer to the Sumatera Grid. This procedure is a further development refer to the General Operational Procedure for PLN generation unit located in the North and South Sumatera, titled "Prosedur tetap transfer tenaga listrik antara PT PLN (Persero) Pembangkitan Sumbagut, PT PLN (Persero) Pembangkitan Sumbagsel dengan PT PLN (Persero) P3B Sumatera"

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

The formula used for determination of the baseline emissions are described in section 3.1 of the registered VCS PD Ver. 4.0 dated 24/11/2017.

Baseline emissions are calculated as follows:

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

Parameter	Description	Unit	Value	Source
BE_y	Baseline emission in the reported monitoring period	tCO_2 per year	Refer to Table 3	Equation (1)
$EG_{PJ,y}$	Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the project activity in the reported monitoring period	MWh per year	Refer to Table 3	Monthly Electricity Transfer Protocol Report (METPR)
$EF_{grid,CM,y}$	Combined margin CO_2 emission factor for grid connected power generation in the reported monitoring period	tCO_2/MWh	0.869	Registered VCS PD Version 4.0 dated 24/11/2017

Table 3. Detailed baseline emissions calculation for the monitoring period 01/05/2017 – 31/12/2020(both dates included):

Vintage year	$EG_{PJ,y}$ (MWh per year)	BE_y (tCO_2e per year)
01/05/2017 – 31/12/2017	171,933.10	149,409
01/01/2018 – 31/12/2018	251,136.00	218,237
01 /01/2019 – 31/12/2019	263,256.00	228,769
01/01/2020 – 31/12/2020	214,049.00	186,008
Total	**900,374.10**	**782,423**

Note: the values highlighted in red have had a conservative approach applied due to delayed calibration.

5.2 Project Emissions

Summary of gases and sources included in project boundary:

Source		Gas	Included?	Justification/explanation
Project	For hydropower plants, emissions of CH_4 from the reservoir	CO_2	No	For all renewable energy power generation project activities, emissions due to the use of fossil fuels for the backup generator can be neglected.
		CH_4	No	Not applicable since the project is a run-of-river hydropower plant with a daily regulating pond for temporary storage.
		N_2O	No	Not applicable

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y} \quad (2)$$

The project does not involve counting project emission from fossil fuel consumption because as per ACM0002 version 17.0, for all renewable energy power generation project activities, emissions due to the use of fossil fuels for the backup generator can be neglected, so $PE_{FF,y} = 0$.

The $PE_{GP,y}$ is not applicable either, as the project activity is hydropower.

The project activity is a run-of-river type hydropower project. According to the methodology ("for hydropower project activities that result in new single or multiple reservoirs and hydro power project activities that result in the increase of single or multiple existing reservoirs"), project proponents shall account for CH_4 and CO_2 emissions from the reservoirs. If the power density of the project activity (PD) is greater than 10 W/m^2, the $PE_{HP,y}$ =0. As explained in the Registered VCS PD version 4.0 dated 24/11/2017, the power density has been calculated as per equation 7 of ACM0002 version 17.0 by taking into account the capacity of power plant (82 MW) and area of the run-of-river reservoir (100,000 m^2). From the calculation results in 820 W/m^2. Hence, $PE_{HP,y}$ is not applicable for the project activity.

Parameter	Description	Unit	Value	Source
PE_y	Project emission in the reported monitoring period	tCO_2 per year	0	Equation (2)
$PE_{FF,y}$	Project emissions from fossil fuel consumption in the reported monitoring period	tCO_2 per year	0	"Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"
$PE_{GP,y}$	Project emissions from the operation of geothermal power plants due to the release of non-condensable gasses in the reported monitoring period	tCO_2 per year	0	Not applicable Project activity is not a geothermal power plant.
$PE_{HP,y}$	Project emissions from water reservoirs in the reported monitoring period	tCO_2 per year	0	Registered VCS PD Version 4.0 dated 24/11/2017

5.3 Leakage

No leakage emissions are considered. The main emissions potentially giving rise to leakage in the context of electric sector projects are emissions arising due to activities such as power plant construction and upstream emissions from fossil fuel use (e.g., extraction, processing, transport). These emissions sources are neglected.

$LE_y = 0$

5.4 Net GHG Emission Reductions and Removals

The annual estimated GHG Emission Reduction value as per the registered PD is equal to 270,019 tCO_2e. It was noted that the monitoring period starts from 01/05/2017 – 31/12/2020. Since only 245 days were monitored in 2017, the estimated GHG Emission reduction value has been calculated by multiplying 270,019 tCO_2e/ year with $\frac{245}{365}$ days/year in 2017 and 3 years for 2018-2020 which results in 991,302 tCO_2e.

Comparing between the ex-ante emission reduction with the ex-post calculation, it was noted that the estimation is higher than the achieved emission reduction. This are reflected by a number of factors i.e. the water supply in the year, maintenance and power outage. It can be concluded that the decrease in emission reductions is not permanent and can neither be controlled nor predicted in advance.

Year	Estimated emissions reduction or removals as per the registered PD (tCO_2e)	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)
01/05/2017 – 31/12/2017	181,245[9]	149,409	0	0	149,409
01/01/2018 – 31/12/2018	270,019	218,237	0	0	218,237
01/01/2019 – 31/12/2019	270,019	228,769	0	0	228,769
01/01/2020 – 31/12/2020	270,019	186,008	0	0	186,008
Total	**991,302**	**782,423**	**0**	**0**	**782,423**

[9] 245 days were monitored in 2017, estimated GHG Emission Reduction value has been calculated by multiplying 270,019 tCO_2e with 245/365 days, resulting in 181,245 tCO_2e.