50 MW SIPANSIHAPORAS HYDRO POWER PLANT, NORTH SUMATRA

Document Prepared by South Pole Carbon Asset Management Ltd.

Project Title	50 MW Sipansihaporas Hydro Power Plant, North Sumatra
Version	04
Report ID	01
Date of Issue	24 June 2022
Project ID	486
Monitoring Period	01-May-2017 to 31 December 2020 (both dates included)
Prepared By	South Pole Carbon Asset Management Ltd.
Contact	Technoparkstrasse 1, 8005 Zurich, Switzerland Tel: +41 43 501 35 50 Email: registration@southpole.com Website: www.southpole.com

CONTENTS

1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

The 50 MW Sipansihaporas Hydro Power Plant, North Sumatra (hereinafter referred to as 'project activity') is a new type of run-of-river hydropower plant. The project start date was 21/10/2002. The total installed capacity of the project is 50 megawatts (MW), comprised of a 33 MW generator and a 17 MW generator. The project is connected to the grid by stringing a circuit from the existing 150 kilovolt (kV) single-circuit transmission line, which is operated from substations in Sibolga. The length of the new lines from each power station to the substation is 7.8 kilometers (km) and 0.9 km respectively. The project is owned and developed by PT. PLN (Persero), a state-owned electricity company. The project supplies electricity to the connected Sumatra grid. The estimated electricity generated according to the Verified Carbon Standard Project Description (VCS-PD) is 214,800 megawatt hours per year (MWh/yr).

The project activity is registered as a VCS project with Project ID 486. Further background on this project can be found in the Verified Carbon Standard Project Description (VCS-PD).

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 distributed to consumers via the electrical grid.

The estimated annual carbon dioxide (CO_2) emissions reduction of the project is 185,392 tons of carbon dioxide equivalent (tCO_2e). During the second monitoring period under the second crediting period, which spans from 01/05/2017 – 31/12/2020 (both dates included), the total emissions reduction is 585,739 tCO_2e (see below):

Vintage year	Emissions reduction (tCO_2e)
01/05/2017 – 31/12/2017	106,776.00
01/01/2018 – 31/12/2018	181,982.00
01/01/2019 – 31/12/2019	143,197.00
01/01/2020 – 31/12/2020	153,784.00
Total	**585,739.00**

The project was validated under the VCS and was initially registered on 25/08/2010 (for 1st crediting period) and final validation report for renewal of 2nd crediting period was issued on 31/10/2017. 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.

1.2 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, 8005 Zurich, Switzerland
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 the 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:

- Sipansihaporas Hydro Power Plant Unit 1: 14/12/2004 (Certificate for Proper Operation or *Sertifikat Laik Operasi*)
- Sipansihaporas Hydro Power Plant Unit 2: 21/10/2002 (Certificate for Proper Operation or *Sertifikat Laik Operasi*)

Thus, the project start date is 21/10/2002, as it is the earliest project start date of the two units that make up the project activity.

1.6 Project Crediting Period

- First crediting period: 01/04/2006 – 01/03/2016 (both dates included, 10 years)
- Second crediting period: 01/04/2016 – 31/03/2026 (both dates included, 10 years). This report covers the monitoring period from 01/05/2017 – 31/12/2020 (both dates included), which is the second monitoring period under the second crediting period.

1.7 Project Location

The project area of the Sipansihaporas Hydro Power Plant (HEPP) is situated in Sipan village, Tapanuli Tengah district, North Sumatra province, Indonesia, which is about 344 km south of Medan city, the capital city of North Sumatra, and 12 km east of Sibolga, the capital city of Tapanuli Tengah. The water flows from Sipansihaporas river with a total catchment area of 196 km^2 for Unit 1, and 210 km^2 for Unit 2, with a yearly average flow of 28.5 m^3/sec.

The exact location of the project activity is shown below:

Power plant	North latitude	East longitude
Sipansihaporas HEPP Unit 1	1.74058 N	98.86711 E
Sipansihaporas HEPP Unit 2	1.72882 N	98.84018 E

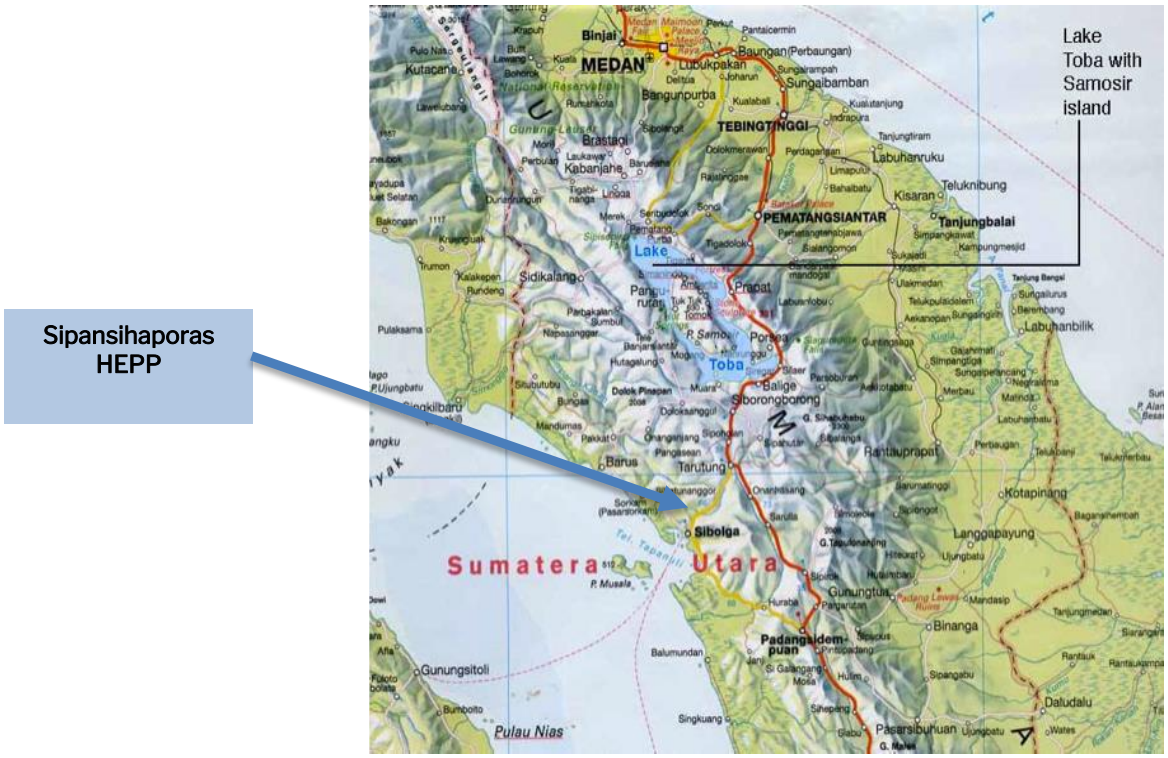

Figure 1: Location of the Sipansihaporas HEPP

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

The project activity is not registered under any other GHG program.

1.10 Other Forms of Credit

Emission trading programs and other binding limits:

The project activity is not included in an emission trading program or any other mechanism that includes GHG allowance trading.

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), however GHG emission reductions and removals presented for VCU issuance shall not be recognized as another form of GHG-related environmental credit.

If the project activity is 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.

1.11 Sustainable Development

The project contributes to the sustainable development defined by the Government of Indonesia and the project owner; PT. PLN (Persero), actively monitors and report their sustainable development contribution which can be seen through several different reports 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.
- With the project implementation of Standard Operation Procedure (SOP) specifically in section 6.15, the Project Proponent (PP) regularly holds CSR activities, and further be seen through the Socialization and Implementation Report. With this procedure, the communities can voice their concerns and inquiries to the PP.

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 as documented in the joint meter reading report issued by PLN, 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 documented in this monitoring report.
- 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. The project causes no negative impact on the surrounding environment, and ultimately contributes to environmental well-being due to the run-of-river type of project activity.
- Furthermore, with the implementation of Environmental Impact Assessment (EIA) and the SOP (as stated in section 6.1.4), it could be confirmed that the monitoring of environmental aspect has already been in place with the frequency of reporting every three months.

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. PP has set up the annual training program for employees, this has also been reported, through training record.
- 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.

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 50 MW electricity, and thus requires an EIA.

An EIA has been developed for this project and was completed in 1996 and approved by the Ministry of Energy and Mining on 03/07/1996. 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

Identified environmental impacts	Measures taken
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	
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

Identified environmental impacts	Measures taken
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, the local stakeholders felt that the construction of the project activity 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 17/09/2004 in the village hall of Sipan 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.

During the stakeholder consultation, no major issues were identified that would affect the life of the local community or produce any environment-related issues in the region through the implementation of the project activity. All of the minor issues were addressed.

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 has also been conducting a survey of the local community around the project location regarding the benefits perceived during project operations. The local community is not disturbed by the operation of the Sipansihaporas HEPP. During this monitoring period, the surrounding community voiced their suggestions and expectations, for example that the Sipansihaporas HEPP would help 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 (for 1st Crediting Period) and already completed renewal for the 2nd Crediting Period on 19/01/2018[1]. The current monitoring period is from 01/05/2017 – 31/12/2020 (both dates included). The emission reductions for this period are 585,739 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.

Sipansihaporas HEPP is a cascade hydro power plant system that consists of two units (of Unit 1 & Unit 2). This system comprises two headrace tunnels and two penstocks, a pressure adjustment well and high pressure pipelines. The turbines have type of vertical shaft type. The water from the intake structure flows through the headrace tunnel and penstock to the power station No.1. The water discharged from the power station No.1 flows through the headrace and the penstock to the power station No.2.

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

Turbine 1	**Brand**	Toshiba
	Model	Francis vertical shaft
	Rated output	34,000 kW
	Rated head	128.4 m
	Rated speed	429 rpm
	Rated flow	28.5m^3/s
	Serial number	M211071 CR1101

Generator 1	**Brand**	Meiden
	Model	Synchronous generator
	Rated output	39,000 kVA
	Rated voltage	11 kV
	Rated current	2,047 A
	Rated frequency	50 hertz

[1] Refer to the "Date Updated" Verra Registry (VCS program), https://registry.verra.org/app/projectDetail/VCS/486

	Rated speed	429
	Rated factor	0.85
	Serial Number	8N5554R1

Main Transformer 1	**Brand**	Pauwels
	Model	Generator transformer
	Rated Power	39 MVA
	Rated voltage	11 kV/150kV
	Rated frequency	50 hertz
	Serial Number	99P0041

Turbine 2	**Brand**	Toshiba
	Model	Francis vertical shaft
	Rated output	17,600 kW
	Rated head	67 m
	Rated speed	375 rpm
	Rated flow	28.5m^3/s
	Serial number	M211071 CR2101

Generator 2	**Brand**	Meiden
	Model	Synchronous generator
	Rated power	20,000 kVA
	Rated voltage	11 kV
	Rated current	1,050 A
	Rated frequency	50 hertz
	Rated speed	375
	Rated factor	0.85
	Serial Number	8N5555R1

Main Transformer 2	**Brand**	Pauwels

	Model	Generator transformer
	Rated Power	20 MVA
	Rated voltage	11 kV/150 kV
	Rated frequency	50 hertz
	Serial Number	99P0040

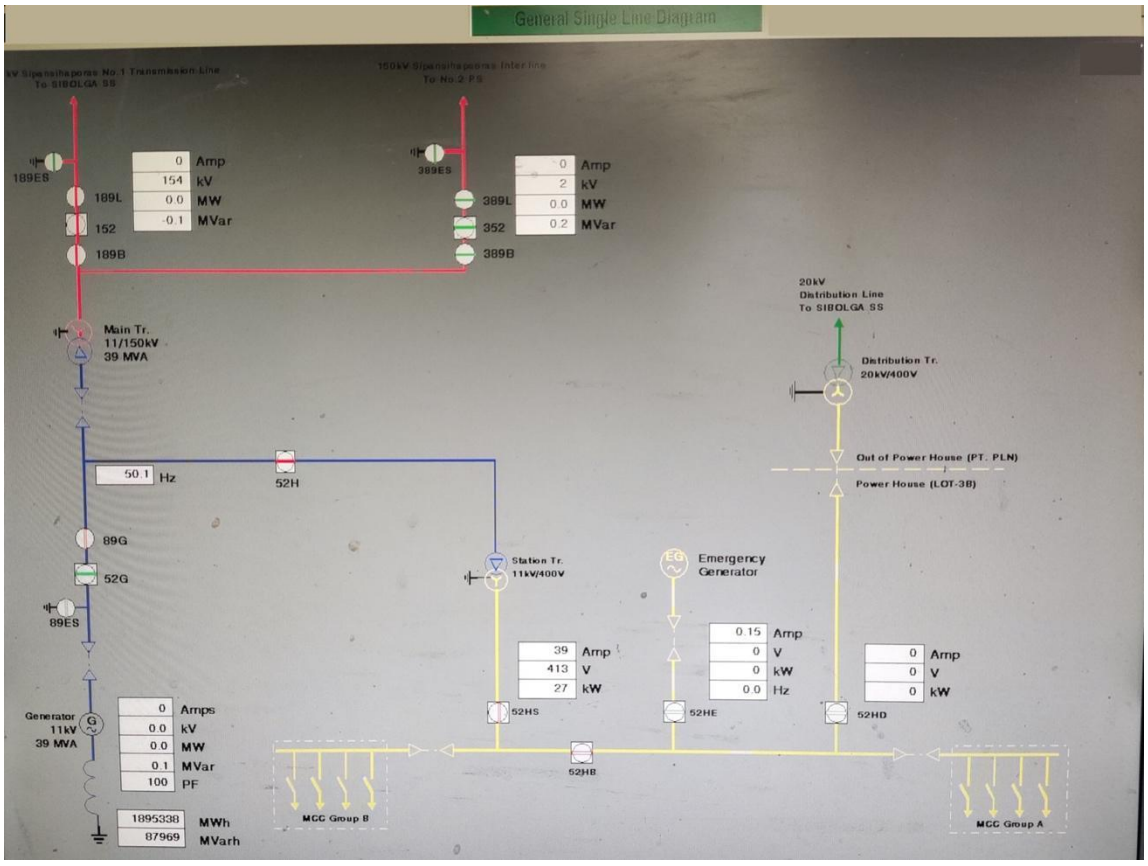

Figure 2. Single Line Electrical Diagram in Unit 1

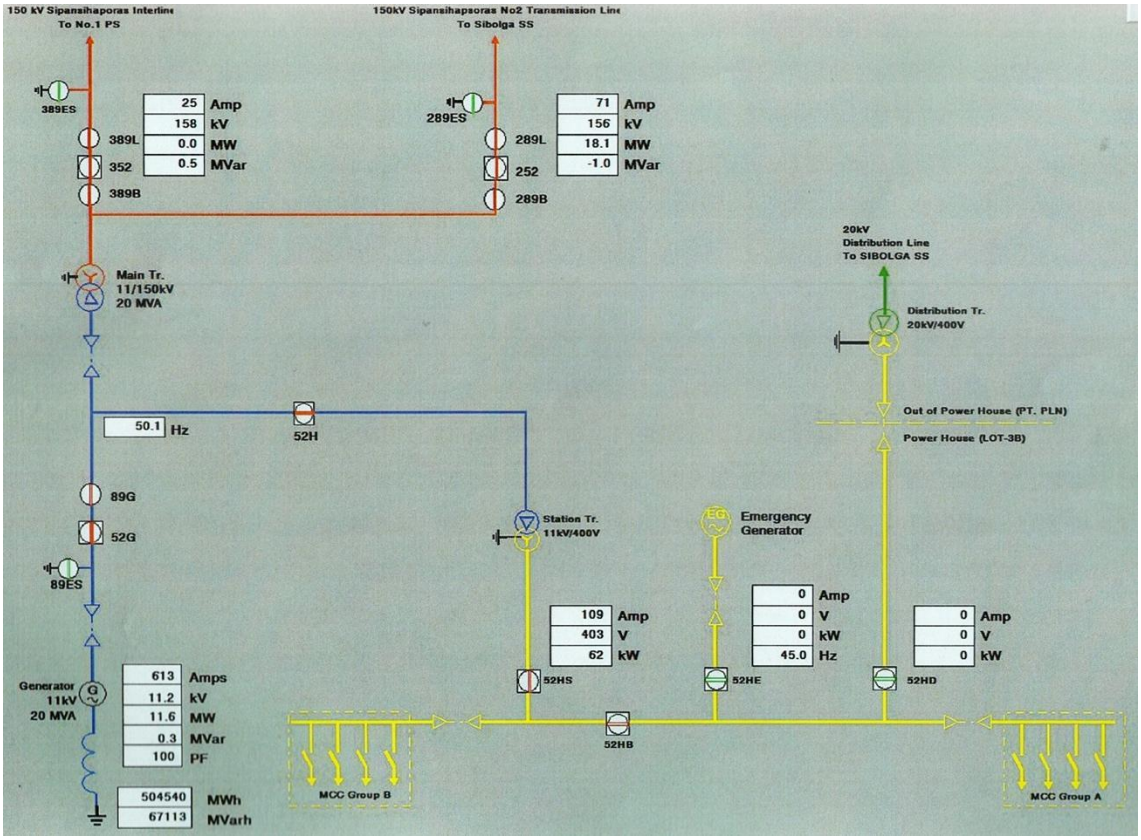

Figure 3. Single Line Electrical Diagram in Unit 2

The operation of the project activity during this monitoring period (01/05/2017 – 31/12/2020 , both dates included) was under normal conditions, where all of 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
21/10/2002	Project Start Date
01/04/2006	First crediting period start date
25/08/2010	Initial Registration with VCS
19/01/2018	Renewal of second crediting period date as per VERRA Registry (VCS program), "Date Updated"

01/04/2016 – 30/04/2017 (both dates included)	First monitoring period under second crediting period
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 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[2]
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/yr

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

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 grid signed by both parties of generation division and transmission division.
Description of measurement methods and procedures to be applied	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).
Frequency of monitoring/recording	Monitoring is continuous with the monthly recording of data.
Value monitored	**Monitoring period** / **Applied value** 01/05/2017 – 31/12/2017 / 122,872.59 01/01/2018 – 31/12/2018 / 209,415.43 01/01/2019 – 31/12/2019 / 164,784.29 01/01/2020 – 31/12/2020 / 176,966.78 **Total** / **674,039.09** Note: the values highlighted in red have had a conservative approach applied due to delayed calibration. For further justification, please refer to the comments.

<table>
<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: 36027177
Calibration frequency: Every five years
Date of last calibration and validity:
<table>
<tr><th>Calibration Date</th><th>Validity</th></tr>
<tr><td>10/04/2010</td><td>09/04/2015</td></tr>
<tr><td>09/01/2018</td><td>08/01/2023</td></tr>
</table>
<u>Unit 2</u>
Type: Digital watt-hour meter type ACTARIS SL7000 (main meter)
Manufacturer/model: Actaris
Accuracy class: 0.2s
Serial number: 36027137
Calibration frequency: Every five years
Date of last calibration and validity:
<table>
<tr><th>Calibration Date</th><th>Validity</th></tr>
<tr><td>10/04/2010</td><td>09/04/2015</td></tr>
<tr><td>10/01/2018</td><td>09/01/2023</td></tr>
</table>
</td></tr>
<tr><td>QA/QC procedures to be applied</td><td>The QA/QC conducted a thorough crosschecking of the 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 the 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 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</td></tr>
</table>

	calibration delays for the revenue meter of Unit 1 from 01/05/2017 to 09/01/2018 (both dates included) and Unit 2 from 01/05/2017 to 10/01/2018 (both dates included). According to the calibration certificates, the calibration error for Unit 1 meter (serial number 36027177) is 0.09% while for Unit 2 meter (serial number 36027137) is 0.12%. The results from the calibration certificate has been compared with the accuracy of the meter 0.2%. In case of a revenue meter calibration delay, the maximum permissible error which is based on 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 outset.

Monitoring period

The monitoring period covers 01/05/2017 – 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 is responsible for ensuring that the procedures are followed on site and for continuously improving the procedures to ensure a reliable monitoring system is established.[3]

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 Sipansihaporas 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 Sipansihaporas HEPP. The main electricity meter reading

[3] 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, the Sipansihaporas HEPP has developed SOPs as follows:

- SOP to 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

records the activity (Joint Meter Reading) and is then recorded on the METPR issued by Sipansihaporas HEPP Generation Unit.

The main electricity meter is read by representatives from PT PLN (Persero) Generation Division (PT. PLN (Persero) Sipansihaporas HEPP Generation Unit), PT PLN (Persero) Load Dispatcher and Transmission Division (PT PLN (Persero) Sibolga 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) are retained in the quality control system on-site.

Main meter quality control

The project developer owns the meter and is responsible for its maintenance and calibration, as stated in the Standard Operating Procedures (SOPs). 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 shall be 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)				
36027177	SL 7000 (digital)	Actaris	0.2s	Main electricity meter 1 (MU 1) □to monitor electricity supply from turbine

Serial Number	Type	Factory	Class	Location
				Sipansihaporas #1
Main meter (MU 2)				
36027137	SL 7000 (digital)	Actaris	0.2s	Main electricity meter 2 (MU 2) □ to monitor electricity supply from turbine Sipansihaporas #2

The main meters are shown below:

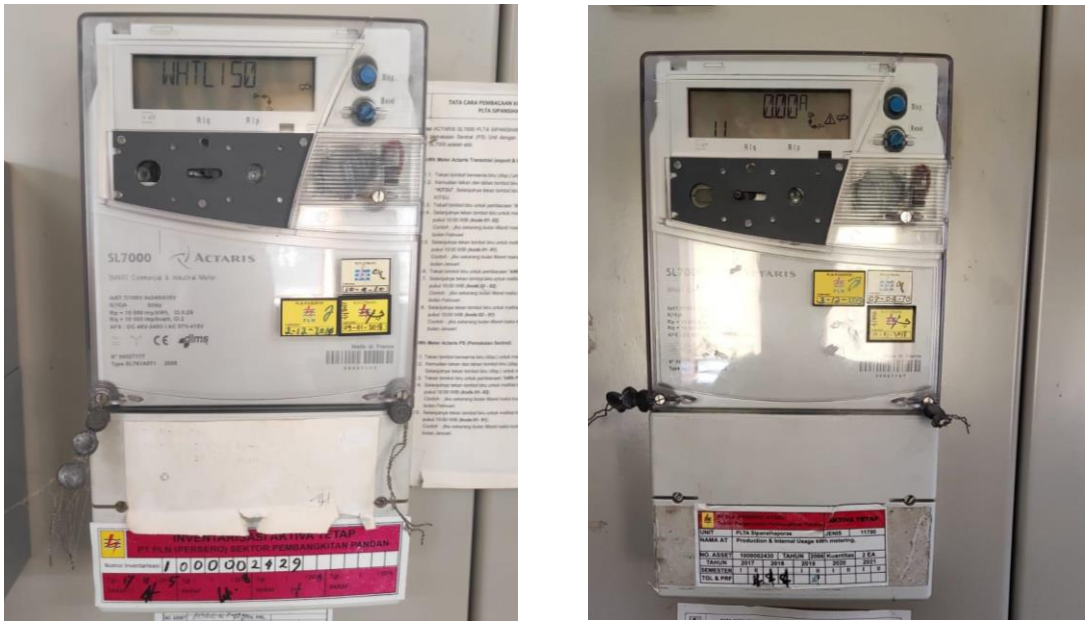

Figure 4: Pictures of main meters Unit 1 (left) and Unit 2 (right).

The Power Plant Operator has been periodically checking if all tools and equipment are in good condition as per the SOP[4]. 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 monitoring period (01/05/2017 – 31/12/2020 , both dates included). All the meters listed above have performed well.

4 http://kepustakaan-presiden.pnri.go.id/uploaded_files/pdf/government_regulation/normal/UU_2_1981_soeharto.pdf

Data recording procedure

The procedures for collecting the electricity meter data is outlined in the SOP signed between the project owner and the Grid Operator (both are under PLN).[5] 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.

[5] Sipansihaporas HEPP is following the "Prosedur Pembuatan BA Pengiriman Energi Listrik PLTA Sipansihaporas" or the 'Procedure to develop Sipansihaporas HEPP Monthly Electricity 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 the determination of the baseline emissions are described in section 3.1 of the registered VCS PD Ver. 3.0 dated 30/10/2017.

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 3.0 dated 30/10/2017.

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	122,872.59	106,776
01/01/2018 – 31/12/2018	209.415,43	181,982
01/01/2019 – 31/12/2019	164.784,29	143,197
01/01/2020 – 31/12/2020	176.966,78	153,784
Total	674,039.09	**585,739.00**

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 for 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 hydropower 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 3.0 dated 30/10/2017, the power density has been calculated as per equation 7 of ACM0002 version 17.0 by taking into account the capacity of power plant(50 MW) and area of the run-of-river reservoir (178,000 m^2). From the calculation results in 281 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_2e per year	0	Equation (2)
$PE_{FF,y}$	Project emissions from fossil fuel consumption in	tCO_2 per year	0	"Tool to calculate project or leakage CO_2

Parameter	Description	Unit	Value	Source
	the reported monitoring period			emissions from fossil fuel combustion"
$PE_{GP,y}$	Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in the reported monitoring period	tCO_2 per year	0	Not applicable Project activity is not a geothermal powerplant.
$PE_{HP,y}$	Project emissions from water reservoirs in the reported monitoring period	tCO_2 per year	0	Registered VCS PD version 3.0 dated 30/10/2017

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 185,392 tCO_2e. It was noted that monitoring period starts from 01/05/2017 to 31/12/2020 which is equal to 3 years and 8 months. Since only 245 days were monitored in 2017 , the estimated GHG Emission Reduction value has been calculated by mulby multiplying 185,392 tCO_2e/ year with $\frac{245}{365}$ days/ year in 2017, and 3years for 2018-2020 , which results in 680,617.21 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 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 as per the 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	124,441[6]	106,776	0	0	106,776
01/01/2018 – 31/12/2018	185,392	181,982	0	0	181,982
01/01/2019 – 31/12/2019	185.392	143,197	0	0	143,197
01/01/2020 – 31/12/2020	185,392	153,784	0	0	153,784
Total	680,617.21	**585,739.00**	**0**	**0**	**585,739.00**

[6] 245 days were monitored in 2017, estimated GHG Emission Reduction value has been calculated by multiplying 185,392 tCO_2e with *245365* days, results in 124,441 tCO_2e