50 MW SIPANSIHAPORAS HYDRO POWER PLANT, NORTH SUMATRA

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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

The 50 MW Sipansihaporas Hydro Power Plant, North Sumatra (hereinafter refer to project activity) is a new run-of-river type hydro power plant. Total installed capacity of the project is 50 MW, comprised of a 33 MW and 17 MW turbines. Stringing a circuit of the existing 150 kV single circuit transmission lines, which is being operated from Sibolga substations, connects the project to the grid. The length of the new lines from each power station to the substation is 7.8 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. Below is the technical description of the turbines and generators:

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

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

Generators 1	Brand	TOSHIBA
	Model	Francis vertical shaft
	Rated power	39,000 kVA
	Rated voltage	11 kV
	Rated current	2,047 A
	Rated frequency	50 Hertz
	Rated speed	429
	Rated factor	0.85

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

Generators 2	Brand	TOSHIBA
	Model	Francis vertical shaft
	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

The Sipansihaporas Hydroelectric project was registered as VCS project with Project ID 486. Further background on this project can be found in the Voluntary Carbon Standard Project Description (VCS PD).

Prior to the implementation of the project activity there is no existing power generation at the project location, electricity in grid is generated mainly from fossil fuel sources and is solely distributed to consumers via the electricity grid.

The estimated annual CO_2 emissions reduction of the project is 185,392 tCO_2e. During this monitoring, total amount of emissions reduction is 187,259 tCO_2e with detail as below:

Vintage Year	Emissions Reduction	Unit
01 April 2016 – 31 December 2016	141,893.00	tCO_2e
01 January 2017 – 30 April 2017	45,366.00	tCO_2e
Total	**187,259.00**	tCO_2e

1.2 Sectoral Scope and Project Type

Sectorial scope : 01. Energy industries (renewable - /non-renewable sources)

Project Type : I. Renewable energy project

Project Category : Grid connected electricity generation from renewable sources

1.3 Project Proponent

Project proponents contact information as follows:

Project owner:

Organization name	PT. PLN (Persero)
Contact person	Jurlian Sitanggang
Title	Head of Health, Safety, Security, and Environment Division (*Kepala Divisi Keselamatan Kesehatan Kerja Keamanan dan Lingkungan*)

Address	Jl. Trunojoyo blok M 1/135, Kebayoran Baru – Jakarta 12160, Indonesia
Telephone	+62-21-725 1234
Email	jurlian.sitanggang@pln.co.id

Carbon Credit buyer:

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

1.4 Other Entities Involved in the Project

Not applicable, as there are no other entities except PT. PLN (Persero) and South Pole Carbon Asset Management Ltd.

1.5 Project Start Date

As per the VCS policy announcement from the 10 September 2008, the project start date is the date on which the project activity began reducing or removing GHG emissions.

Following are the two units' commissioning date:

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

Thus, the project start date where project activity starts reducing emissions is 21 October 2002, as the earliest project start date of two units at Sipansihaporas Hydro Power Plant.

1.6 Project Crediting Period

- HEPP Project starting date : 21 October 2002
- VCS Crediting period start date : 01 April 2016
- VCS crediting period : 10 years (01-Apr-2016 until 31-Mar-2026)

1.7 Project Location

The project area of the Sipansihaporas Hydropower Plant is situated in North Sumatra Province at about 344 km south of Medan city as the capital city of North Sumatra province and 12 km east of Sibolga as the capital city of Tapanuli Tengah district. The principal structures of the Sipansihaporas project such as the main dam and waterway are situated in the downstream of the confluence of the

three tributaries upstream of the Sipansihaporas River, which are Sarumanggita river, Natolbak river and Bargot river. The water flows from Sipansihaporas River with total catchment area of 196 km^2 for power station no. 1, and 210 km^2 for power station no. 2, with a yearly average flow of 28.5 m^3/sec.

The exact location to Sipansihaporas Hydropower Plant:

Power Station	North Latitude	East Longitude
Sipansihaporas #1 power station	1.74058 N	98.86711 E
Sipansihaporas #2 power station	1.72882 N	98.84018 E

The location of the project site is shown in the following maps:

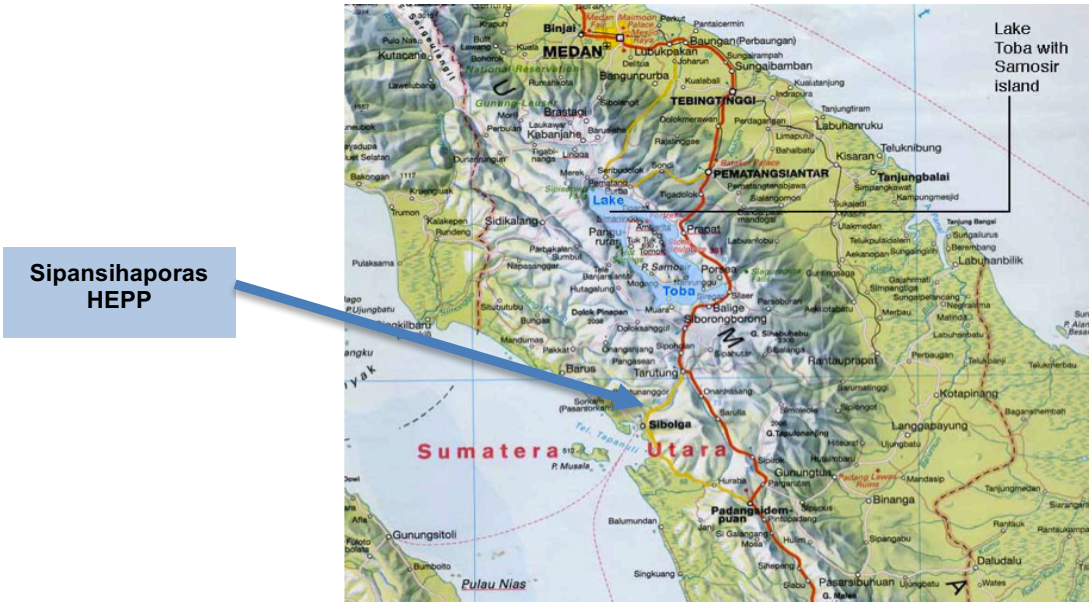

Figure 1 - Location of Sipansihaporas Hydroelectric Power Plant

1.8 Title and Reference of Methodology

Approved consolidated baseline methodology ACM0002 – "Consolidated baseline methodology for grid-connected electricity generation from renewable sources", version 17.0 (EB 89 annex 1).

Sectoral scope 01 - Energy Industries (renewable-/non-renewable sources).

1.9 Other Programs

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 Environmental Credit: The project activity currently has not applied to any other form of environmental credits.

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[1].

If the project activity will be issued under any recognized program which creates GHG-related environmental credits (such as renewable energy certificates or RECs), the GHG emission reductions or removals from one verification period can be split between the VCS Program and another GHG program[2].

Participation under Other GHG Programs: The project activity is not registered under any other GHG program.

1.10 Sustainable Development

The project is contributing to sustainable development defined by the Government of Indonesia specifically as follows:

Social well-being:

- The project contributes to the development of the region by increasing community development and corporate social responsibility of PT. PLN (Persero) such as infrastructure development (road, bridges); funds for building a new school, church and mosque in the region; upgrading health care facilities (a small clinic) as well as 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 construction phase as well as during operational stage and thus helped in controlling migration from the region and alleviation of poverty in the local area.

- The generated electricity is fed into regional grids through the local grid, thereby improving the availability of electricity to local consumers (villagers and sub-urban inhabitants) by increasing the electricity supply. Due to increased new opportunities for industries and economic activities arise with a chance for more local employment and better overall development. The project activity leads to diversification of the national energy supply that is dominated by conventional-fuel-based generating units.

- The project activity contributes to economic sustainability around the plant site and encourages economic power decentralization.

[1] According to VCS Standard: VCS Version 3, 21 June 2017, v3.7
[2] According to Registration and Issuance process: VCS Version 3, 21 June 2017, v3.8

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. 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 don't have to cope with the problem 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; and in the end contributes to environmental well-being due to the run-off river type of project activity.

Technological well-being:

- The project supports high quality equipment transfer from other regions and even other 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 view of the above explanation, the project participants consider the project activity as profoundly contributing to sustainable development.

2 IMPLEMENTATION STATUS

2.1 Implementation Status of the Project Activity

From the validated VCS PD Version 3.0, dated 30 October 2017, the 50 MW installed capacity Sipansihaporas HEPP generates about 214,800 MWh per year. During this monitoring period, the project activity has generated power of 215,490 MWh with details as below:

- 01 April – 31 December 2016 : 163,284 MWh
- 01 January – 30 April 2017 : 52,206 MWh

2.2 Deviations

2.2.1 Methodology Deviations

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

2.2.2 Project Description Deviations

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

2.3 Grouped Project

Not applicable as the project activity is not part of a grouped project.

2.4 Safeguards

2.4.1 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, or flooded area of ≥ 200 ha or installed capacity of ≥ 50 MW need to undertake an Environmental Impact Assessment (EIA). Sipansihaporas Hydroelectric Hydroelectric Power Plant project has an installed capacity of 50 MW electricity in total and 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 the 3 July 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.

Table 1 - Summary of EIA findings

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 of air and noise pollution due to increased transportation and operation of heavy equipment	Restrict the use of heavy equipment operation during the day, build project fence to reduce noise pollution, spray water to avoid dust from construction, control vehicle emission 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

Identified environmental impacts	Measures taken
	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	
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	
Changing in spatial planning structure due to project activity	Control the development around project activity by enforcing the appropriate planning regulations
Regional image	
Changing in regional image due to the development in the region	Planning controls will ensure sensitive development of the region
Traffic	
Increase 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

Identified environmental impacts	Measures taken
Working opportunity and income	
Related to utilization of local human resources	Give priority to the admission of local human resources and hold special training session 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 donation for 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 for 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.

2.4.2 Local Stakeholder Consultation

A meeting with relevant stakeholders, including the village chief, local leaders, local organisation, and people who live nearby, within the project boundary of Sipansihaporas hydro power plant was conducted for the purpose of identifying the significant impact in the region due to the project, possible positive and negative impact due to the project and to understand stakeholder perceptions due the project.

As documented, the local stakeholders have perceived that the construction of Sipansihaporas Hydro has increased their social and economical life due to road construction, additional earning from temporary jobs, and especially due to the additional supply of electricity.

The stakeholder meeting was carried out on 17 September 2004 in the village hall of the Sipan village. The meeting was documented and recorded. Attendance list, pictures, and other relevant documentation will be made available to the DOE and sent separately.

Outcome: No negative comments were received from the 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 local population. The project activity has acquired land from local population and local populations have been given compensation for this. So project activity has not received any adverse comment from their side.

No major issue which would affect the life of the local community or raise any environment related problems in the region by the implementation of the project activity were identified during the discussion with stakeholders. All the minor issues were addressed.

3 DATA AND PARAMETERS

3.1 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 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[3]
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" (EB 75 Annex 15).
Purpose of Data	Calculation of baseline emissions
Comments	-

3.2 Data and Parameters Monitored

Data / Parameter	$EG_{PJ,y}$
Data unit	kWh
Description	Net electricity supplied to the grid by the project activity during the year 'y'
Source of data	kWh meter at project activity site (switchyard) The electricity generation data used for monitoring is the monthly electricity generation report delivered to grid signed by both parties of generation department and transmission department (Joint Meter Reading/JMR).
Description of measurement methods	Electricity supplied to the grid will be measured by a watt-hour meter (connected to a digital control system and continuously monitored & recorded), which can measure export and import electricity data

[3] Source of data for $EF_{grid,OM,y}$ (0.676 tCO_2e/MWh) and $EF_{grid,BM,y}$ (0.933 tCO_2e/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>and procedures to be applied</td><td>separately. Therefore net electricity delivered to the grid would be the difference of export and import electricity.
The JMR form issued by the Sipansihaporas HEPP Generation Unit is the basis for calculation of the emission reductions. The joint meter reading taken at the transaction point is witnessed by the presence of P3B officials as transmission department and the PP representative as generation department.
The accuracy class of main and back up meter is 0.2</td></tr>
<tr><td>Frequency of monitoring/recording</td><td>The measurement of electricity supplied to the grid conducted by joint meter reading taken at the transaction point on a regular basis (monthly), where monthly data is recorded and continuous total electricity measurement is available. The measurement results summarized in regular production reports.</td></tr>
<tr><td>Value applied</td><td>
<table>
<tr><th>Year</th><th>Net electricity supplied to the grid (MWh)</th></tr>
<tr><td>01 April 2016 – 31 December 2016</td><td>163,612</td></tr>
<tr><td>01 January 2017 – 30 April 2017</td><td>52,311</td></tr>
</table>

As per applicable metering standard issued by the Minister of Energy and Mineral Resource of Republic of Indonesia, revenue meter calibration should be conducted every 5 years. However, there was a calibration delay for revenue meter of Unit #1 and Unit #2 on 01/04/2016 until 30/04/2017. Based on the UNFCCC “CDM validation and verification standard for project activities” v.01.0, where described that a maximum permissible error must be considered in BE_y calculation in case of the revenue meter calibration delay as per following formula:

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%)

Therefore, net electricity generation ($EG_{PJ,y}$) values used in the ER calculation as following table:</td></tr>
</table>

	<table><tr><th>Year</th><th>Net electricity supplied to the grid (MWh)</th></tr><tr><td>01 April 2016 – 31 December 2016</td><td>163,284</td></tr><tr><td>01 January 2017 – 30 April 2017</td><td>52,206</td></tr></table> Note: The highlighted values in red color above are the values that have been applied for conservative approach due to delayed calibration.
Monitoring equipment	**Unit #1** Type: Digital Watt-hour meter type ACTARIS SL7000 (Main Meter) Manufacturer/ Model: Actaris Accuracy class: 0.2s Serial Number: 36027177 Calibration frequency: Every 5 years Date of last calibration and validity: <table><tr><th>Certificate Number</th><th>Calibration Date</th><th>Validity</th><th>Calibrator[4]</th></tr><tr><td>1072.21.BTND .095B/10.10</td><td>10/04/2010</td><td>10/04/2015</td><td>*Laboratorium Kalibrasi - PT. PLN (Persero) Penelitian dan Pengembangan Ketenagalistrikan*</td></tr><tr><td>0165.21.BTND .331B/17.18</td><td>09/01/2018</td><td>09/01/2023</td><td>*Laboratorium Kalibrasi - PT. PLN (Persero) Penelitian dan Pengembangan Ketenagalistrikan*</td></tr></table> **Unit #2** Type: Digital Watt-hour meter type ACTARIS SL7000 (Main Meter) Manufacturer/ Model: Actaris Accuracy class: 0.2s Serial Number: 36027137 Calibration frequency: Every 5 years Date of last calibration and validity:

[4] *Laboratorium Kalibrasi - PT. PLN (Persero) Penelitian dan Pengembangan Ketenagalistrikan* (Calibration Laboratory - PT. PLN (Persero) Research and Development of Electricity) has been accredited by the National Accreditation Committee (*Komite Akreditasi Nasional / KAN*) with certificate number of LK-007-IDN for Laboratory of Calibration.

	<table><tr><th>Certificate Number</th><th>Calibration Date</th><th>Validity</th><th>Calibrator</th></tr><tr><td>1074.21.BTND .095B/10.10</td><td>10/04/2010</td><td>10/04/2015</td><td>*Laboratorium Kalibrasi - PT. PLN (Persero) Penelitian dan Pengembangan Ketenagalistrikan*</td></tr><tr><td>0167.21.BTND .331B/17.18</td><td>10/01/2018</td><td>10/01/2023</td><td>*Laboratorium Kalibrasi - PT. PLN (Persero) Penelitian dan Pengembangan Ketenagalistrikan*</td></tr></table> .
QA/QC procedures to be applied	The QA/QC conducted through crosschecking the sales electricity receipts (Monthly Electricity Protocol Report) at the transaction point with water tax payment receipts issued by North Sumatera Province Tax Office (local government). Meters at generation unit is calibrated once every five-year according to the national regulation (refer to http://jdih.esdm.go.id/peraturan/Permen%20ESDM%2037%202008.pdf) The meter at the Generation Unit (Main meter at the transaction point) will be read regularly and jointly by the person in charge from Generation unit and Transmission unit.
Purpose of data	Calculation of baseline emissions
Calculation method	Net electricity supplied to grid is calculated as the difference between EG_{export} and EG_{import} ($=EG_{export} – EG_{import}$)
Comments	-

3.3 Monitoring Plan

This section details the steps taken to monitor on a regular basis the GHG emissions reductions from the Sipansihaporas Hydroelectric Power Plant Project in Indonesia 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.

3.3.1 Monitoring Period

The monitoring period covers 01 April 2016 to 30 April 2017 (both days included)

3.3.2 Monitoring Organization

The monitoring team has been established and integrated within the existing organization structure of Sipansihaporas hydropower plant prior to the start of the verification[5]. Clear roles and responsibilities are assigned to all staff involved in the VCS project and the prospect of nominating a VCS Manager have been considered. The VCS Manager has the overall responsibility for the monitoring system on this project.

All other VCS monitoring staff will have clearly defined roles and responsibilities. The VCS manager will manage the process of training new staff; ensure trained staff performs the monitoring duties as necessary; and ensure that where trained monitoring staff is absent; the integrity of the monitoring system is maintained by other trained staff.

A formal set of monitoring procedures is established prior to the start of the verification. These procedures will 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 agreed and signed off 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]

3.3.3 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 3.2). The primary instruments include:

[5] The PLN Pandan Sector has formed the VCS Monitoring Team (for both Lau Renun and Sipansihaporas VCS Project) through the 'Keputusan Manajer PT PLN (Persero) Sektor Pembangkitan Pandan Nomor : 067.K/MSPDN/2012' letter (or Management Decision Letter of PT PLN (Persero) Pandan Generation Sector Office No : 067.K/MSPDN/2012).

[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, Sipansihaporas HEPP has develop some SOPs as follow:
- SOP to read the Electricity Meter
- SOP to calibrate the Test and Measurement equipment.
- SOP to develop an Electricity Transfer Monthly Protocol Report (BAP)
- SOP for Electricity Transfer
- SOP for Emergency Response

Metering of Electricity Supplied to the Grid

The main electricity meter for establishing the net electricity delivered to the grid (detailed in section 3.2) is installed at the Sipansihaporas 150 kV transmission line. This electricity meter will be the main meter (revenue meter), measuring the quantity of electricity supplied (net electricity delivered) to the grid. Net electricity delivered to the grid would be the difference of electricity export and import. As this meter provides the main VCS measurement, this is the key part of the verification process. The main meter is located at the Sipansihaporas power station. The main electricity meter reading record (Joint Meter Reading) then recorded on the Monthly Transfer Electricity Protocol Record (METPR) issued by Sipansihaporas HEPP Generation Unit.

The main electricity meter read together by representatives from PT PLN (Persero) Generation Division (PT PLN (Persero) Generation Unit Sipansihaporas HEPP) and PT PLN (Persero) Load Dispatcher and Transmission Division (PT PLN (Persero) Sibolga Sub-Station).

Electricity meters should meet the relevant local standards at the time of installation and calibrated by the manufacturer before installation. The meters 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.

All equipment calibrated by the manufacturer according to relevant local standards at the time of installation and maintained in accordance with the manufacturer’s recommendations to ensure accuracy of measurements. Records of the meter (type, make, model, calibration, and maintenance documentation) retained as part of the VCS monitoring system.

Main Meter Quality Control

The project developer owns the meter and is responsible for its maintenance and calibration, as stated in the 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 on request of the project developer.

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

The main meter is specified to have 0.2s class. The calibration of test and measurement equipment shall be conducted to ensure the measurement accuracy of the main meter. *PT. PLN (Persero) Penelitian dan Pengembangan Ketenagalistrikan*, National government approved laboratory certified 1702 and authorized by the Government of Indonesia, to conduct such calibration. Periodic calibrations are to be done at least once every five years as per applicable metering standard issued by the Minister of Energy and Mineral Resource of 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 Sipan #1
MAIN METER (MU 2)				
36027137	SL 7000 (Digital)	Actaris	0.2s	Main electricity meter 2 (MU 2) → to monitor electricity supply from turbine Sipan #2

Picture of the main meters are shown below:

Figure 2 - Picture of main meters

The Power Plant Operator periodically checked if all tools and equipment work in a good condition as per the SOP[7]. In the event of any broken security seal in the metering system; or when the system fails to register, or if the measurement result is found upon testing 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.

There was no metering devices breakdown or malfunction during the following monitoring period (01 April 2016 – 30 April 2017). All the meters listed above have performed well. In case of failure

[7] http://kepustakaan-presiden.pnri.go.id/uploaded_files/pdf/government_regulation/normal/UU_2_1981_soeharto.pdf

of the main meter, production meter and own consumption meter (hereinafter refer as cross-check meters) located at generation site of each power generation unit will be read to measure the quantity of electricity exported from the project. The difference between electricity produced and consumed on-site shall be valid for claiming carbon credits. In the special case of total failure of all meters no credits will be claimed during such period.

Data recording procedure

The procedures for collecting the electricity meter data is outlined in the Standard Operating Procedure as explained below.

The procedures for collecting the electricity meter data will be outlined in the Standard Operating Procedure signed between the project owner and the Grid Operator (both are under PLN)[8]. All relevant data will be archived electronically and backed up regularly. Uncertainty will be considered to achieve conservative results. Moreover, it will be 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 would develop to ensure that the project has robust data collection, processing, and archiving procedures.

Procedure for Joint Meter Reading (JMR) as per 'Procedure to develop Monthly Electricity Protocol Report' in general view:

- Joint meter reading by operator from Generation Unit (*Unit Pembangkitan / UP*) and Transmission Service Unit (*Unit Pelayanan Transmisi / UPT P3B*) conducted on the first date of each month at 10 A.M
- Operating and maintenance supervisor (O & M supervisor) responsible for recording the amount of EG imported and exported by Generation unit as the result from kWh meter downloading.
- Operating and maintenance supervisor responsible for constructing the electricity generating protocol report, which includes calculation of net electricity delivered to PLN transmission unit. This report has to be reported and signed by Unit Manager, which will then be further reported to the Sector Manager. VCS manager will have the copy of such report and be notified as well. The Sector Manager and VCS Manager have been handled by the same person during this monitoring period.
- O & M supervisor with other authorized staff from Generation unit will extract the data by downloading via computer from the kWh electronic meter and then record it in the form of Monthly Electricity Protocol (MEP), which shall be signed by both Generating unit (PLN Sipansihaporas Generation Unit) and PT. PLN P3B (*Tragi Sibolga / Sibolga Sub-station*). The joint meter reading taken at the transaction point is witnessed by the presence of P3B officials as transmission department and the PP representative as generation department.

[8] 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*"

- The MEP will be then rechecked by authorized person from PT. P3B (*UPT Pematang Siantar* / Pematang Siantar Transmission Unit) and PT PLN Generation Sector Office (Pandan Sector Office).

After all such information is rechecked and agreed by all related parties, the MEP will be signed by all authorized parties from Generation unit and Transmission unit. The report will thus be sent to PLN Medan as headquarter for all power plant units in North Sumatra.

All relevant data will be archived electronically and backed up regularly. Uncertainty will be considered to achieve conservative results. Moreover, it will be 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.

VCS data collection and record keeping arrangements

Every month the Operation Supervisor from Sipansihaporas Generation Unit (member of VCS Team) and Transmission Sub-station read the meter together and record the data on their logsheet. Based on this reading, a monthly electricity generation report was signed by both the generation department (Sipansihaporas HEPP Generation Unit) and the transmission department (Tragi Sibolga).

At the end of each month the monitoring data needs to be filed electronically. The electronic files need to have CD back-up and/or print-out. All written documentation such as maps, drawings, the EIA and the Feasibility study, should be stored for the crediting period and two years afterwards, and be made available to the verifier so that the reliability of the information may be checked.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

4.1.1. Formula used for baseline emissions calculation

The formula used for determination of the baseline emissions are described in section 4.3 of the registered VCS PD Ver. 3.0 dated 30 October 2017.

Baseline emissions are calculated as follows:

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

Parameter	Description	Unit	Value	Source
BE_y	Baseline emission in the reported monitoring period	tCO_2/year	172,856	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	MWh/year	198,913	Joint Meter Reading (JMR)

Parameter	Description	Unit	Value	Source
	project activity in the reported monitoring period. The total $EG_{PJ,y}$ during this monitoring period is 215,490 MWh (13 months) if without any delayed calibration conservative approach (correction factor) applied, hence averagely it is 198,913 MWh/year.			
$EF_{grid,CM,y}$	Combined margin CO_2 emission factor for grid connected power generation in the reported monitoring period	tCO_2/MWh	0.869	Calculation

4.1.2. Baseline emissions calculation

Vintage Month	$EG_{PJ,y}$ (MWh)	BE_y (tCO_2/year)
1 – 30 April 2016	15,984	13,890
1 – 31 May 2016	19,935	17,323
1 – 30 June 2016	14,356	12,475
1 – 31 July 2016	14,242	12,376
1 – 31 August 201	14,433	12,543
1 – 30 September 2016	16,250	14,121
1 – 31 October 2016	20,198	17,552
1 – 30 November 201	25,095	21,808
1 – 31 December 2016	22,791	19,806
TOTAL BE_y per 2016	**163,284**	**141,893.63**
TOTAL BE_y per 2016 (Round Down)	**-**	**141,893.00**
1 – 31 January 2017	24,724	21,485
1 – 28 February 2017	6,691	5,815
1 – 31 March 2017	5,710	4,962
1 – 30 April 2017	15,080	13,104
TOTAL BE_y per 2017	**52,206**	**45,366.78**

Vintage Month	$EG_{PJ,y}$ (MWh)	BE_y (tCO_2/year)
TOTAL BE_y per 2017 (Round Down)	**-**	**45,366.00**

Note: The highlighted values in red color above are the values that have been applied for conservative approach due to delayed calibration.

4.2 Project Emissions

4.2.1. Formula used for project emissions calculation

Summary of Gases and Sources included in project boundary

Source		Gas	Included?	Justification/Explanation
Project	For hydro power 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 the fossil fuel consumption (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 $PE_{GP,y}$ does not applicable as well as the project activity is a hydro power.

The project activity is a run-off-river type hydropower project. According to the methodology (For hydro power 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.

Parameter	Description	Unit	Value	Source
PE_y	Project emission in the reported monitoring period	tCO_2e/yr	0	Equation (2)
$PE_{FF,y}$	Project emissions from fossil fuel consumption	tCO_2/yr	0	"Tool to calculate project or leakage CO_2

Parameter	Description	Unit	Value	Source
	in 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/yr	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/yr	0	Not applicable Sipansihaporas HEPP is a run-off river hydro powerplant.

4.2.2. Project emissions from the consumption of fossil fuels

Year	Fuel Consumption (Litre)	Fuel Consumption (ton)
2016 (Apr – Dec)	0	0
2017 (Jan – Apr)	0	0
TOTAL	**0**	**0**

4.3 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.

$LE_y = 0$

4.4 Net GHG Emission Reductions and Removals

4.4.1. Formula used for emission reductions calculation

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \quad (5)$$

Parameter	Description	Unit	Value	Source
BE_y	Baseline emissions in the period *y*	tCO_2e	Calculated	Equation (1)
PE_y	Project emissions in the period *y*	tCO_2e	Calculated	Equation (2)

Parameter	Description	Unit	Value	Source
ER_y	Project emission in the period y	tCO_2e	Calculated	Equation (3)

4.4.2. Emission reductions calculation

Year	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)
Vintage 2016 : 01/04/2016 - 31/12/2016	141,893.00	**0**	**0**	141,893.00
Vintage 2017 : 01/01/2017 - 30/04/2017	45,366.00	**0**	**0**	45,366.00
Total	**187,259.00**	**0**	**0**	**187,259.00**