

50 MW SIPANSIHAPORAS HYDRO POWER PLANT, NORTH SUMATRA



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1 PROJECT DETAILS

1.1 Summary Description of the Project

Indonesia has great potential for hydro energy resources that are not yet fully exploited. According to the national energy policy, the potential capacity of hydro resources in Indonesia is 75,000 MW of which only 3,200 MW has so far been used to generate electricity (including captive power and private entities)¹.

The project is a new run-off-river hydropower plant in North Sumatra Province in Indonesia. The project is owned and developed by PT. PLN (Persero), a state-owned electricity company.

The key purpose of the project is to utilize the hydrological resources of the Sibuluan River and another three lateral tributaries, thus a renewable source of energy, generating zero emission electricity to be transmitted to the Sumatra grid (hereafter referred to as the grid) through the Sibolga PLN substations. The electricity currently generated by the grid is relatively carbon intensive. It will displace fossil-fuel-based power plants and reduce the associated GHG emissions with fossil-fuel-based power plant in Sumatra grid. Therefore, the project activity is reducing greenhouse gas emissions.

The total installed capacity of the Project is 50 MW, comprised of a 33 MW and a 17 MW turbine, with annual energy generation of the project of 214,800 MWh, in which all of power generated will be delivered to the Sumatra grid. The electricity currently generated by the grid is relatively carbon intensive.

1.2 Sectoral Scope and Project Type

The project activity is a run-of river type hydro power plant in North Sumatra province in Indonesia. The total actual installed capacity of the project is 50 MW, comprised of a 33 MW and a 17 MW turbine, with a predicted electricity supply to the grid of 214,800 MWh per annum². The project is owned and developed by PT. PLN (Persero), a state-owned electricity company in Indonesia. The project generates and supplies the electricity to the connected Sumatra grid. The electricity currently generated by the grid is relatively carbon intensive. The proposed project will increase the utilization of renewable energy sources, in this case hydro energy, by operating new hydropower plant.

According to the CDM UNFCCC criteria, one approved GHG program by the VCS Board, the project is classified as large scale and, based on Annex A of the Kyoto Protocol, falls under the following types/categories of the Clean Development Mechanism under Kyoto Protocol:

- “Consolidated baseline methodology for grid-connected electricity generation from renewable sources”

¹ Indonesia Power Sector, EU-Indonesia Infrastructure Forum, November 2007.
www.eurocham.or.id/download.php?path=EUROCHAM_UPLOAD_DIR&cid=217&id=185

² Feasibility Study page 14/19

Reference: Approved consolidated baseline methodology ACM0002 version 17.0, sectoral scope 01-Energy Industries (renewable-/non-renewable sources), effect as of EB 47

- The specified project is not a part of a grouped project.

1.3 Project Proponent

Name of the party involved ((host) indicates a host party)	Private and/or public entity (ies) project participants (as applicable)	Responsibilities
Indonesia (host)	PT. PLN (Persero). (as public entity)	Project owner and operator
Switzerland	South Pole Carbon Asset Management Ltd. (as private entity)	Carbon credit buyer

Project proponents contact information as follows:

Project owner:

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

No any other entities are involved in the project.

1.5 Project Start Date

Sipansihaporas Hydro Power Plant Unit 1: 14 December 2004

Sipansihaporas Hydro Power Plant Unit 2: 21 October 2002

Thus, the project start date is 21 October 2002, as the earliest project start date of two units at Sipansihaporas Hydro Power Plant. Operational lifetime of project activity: 30 years.

1.6 Project Crediting Period

1st Crediting period start date: 1 April 2006.

2nd Crediting period start date: 1 April 2016.

1st Crediting period: 10 years from 1 April 2006 until 31 March 2016.

2nd Crediting period: 10 years from 1 April 2016 until 31 March 2026.

1.7 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	√
Large project	

The project activity is a run-off-river type hydropower plant with a daily regulating pond. The power density of regulating pond is 281 W/m². Total installed capacity of the project is 50 MW, consisting of a 33 MW and a 17 MW turbine. The 50 MW installed capacity generates an average of 185,392 tCO₂e emission reduction credits per year.

Emission reduction estimates over a crediting period of 10 (ten) years from 1 April 2016 until 31 March 2026 is provided in the table below:

Years	Estimated GHG emission reductions or removals (tCO ₂ e)*
Year 2016 (1 April 2016 - 31 March 2017)	174,456
Year 2017 (1 April 2017 - 31 March 2018)	186,608
Year 2018 (1 April 2018 - 31 March 2019)	186,608
Year 2019 (1 April 2019 - 31 March 2020)	186,608
Year 2020 (1 April 2020 - 31 March 2021)	186,608
Year 2021 (1 April 2021 - 31 March 2022)	186,608
Year 2022 (1 April 2022 - 31 March 2023)	186,608
Year 2023 (1 April 2023 - 31 March 2024)	186,608
Year 2024 (1 April 2024 - 31 March 2025)	186,608
Year 2025 (1 April 2025 - 31 March 2026)	186,608

Years	Estimated GHG emission reductions or removals (tCO ₂ e)*
Total estimated ERs	1,853,928
Total number of crediting years	10
Average annual ERs	185,392

* The ER calculation is based on designed annual electricity generation stated in Sipansihaporas FS project report 1990.

1.8 Description of the Project Activity

The project uses well-established hydropower generation technology for electricity generation and transmission, and is a run-of-river hydropower project with a total installed capacity of 50 MW (consisting of a 33 MW and a 17 MW turbine). Stringing another circuit of the existing 150 kV single circuit transmission lines, which is being operated in 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 consists of a main intake, tributary intakes, a waterway, a power station, hydro mechanical works, generating equipments, transmission line and substations, permanent roads, a base camp and an inflow monitoring system.

The intake structure was built downstream of the confluence of the three tributaries upstream of the Sipansihaporas River, which are Sarumanggita river, Natolbak river and Bargot river. It has a type of concrete gravity with the height of 38 m and the volume of 76,600 m³. This intake structure will control the water level in order to gain steady water flow. This will result in flooded area of less than 0.184 km² (an area of 0.184 km² will be used for any further calculations).

Following the intake structure will be the conveyance system. The conveyance system comprises two headrace tunnels and two penstocks, a pressure adjustment well and high pressure pipelines. The waterway has type of vertical shaft type. The water from the intake structure will flow through the headrace tunnel with a length of 1,502 m and penstock with a length of 272.2 m to the power station no. 1. The water discharged from the power station no.1 will flow through the headrace with a length of 2,843 m and the penstock with a length of 115.9 m to the power station no. 2. After power station no. 2 the water is discharged in to the Sibuluan River through a tailrace.

The headrace tunnel for power station no. 1 has a type of pressure tunnel and the headrace for power station no. 2 has a type of non-pressure tunnel. The penstocks have type of above ground. The power station is of a semi-underground type. The specific technical data of the turbines / generators are listed in Table 1 below:

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 electricity production can be described as follows: Water is taken from the intake structure, and then enters into the turbine through the high-pressure and non-pressure pipeline to produce

electricity by driving the generators. In the end, the water will finally discharge into to the Sibuluan River through the tailrace.

The project uses well-established technology in electricity generation and transmission. The essential equipment used in the Project has to be procured from Japan, ensuring state of the art technology. Prior to project commissioning the project developer has organized a series of training together with the equipment supplier. The training conducted covered mainly the following topics: management of hydropower generation, operation and maintenance of hydro power plant, operation and maintenance of turbine, generator and other equipments. The purpose of the training is to enable the local staff to perform regular and safe operation and maintenance.

The main technical parameters of the proposed project are shown in table below:

Table 2 - Main technical parameters of the proposed project

Parameter	Capacity	Source
Installed capacity (MW) • Unit 1 • Unit 2	• 33 • 17	Feasibility study page 14/19
Expected annual power generation (effective supply to the grid) (MWh) • Unit 1 • Unit 2	• 142,200 • 72,600	Feasibility study page 14/19
Water head (m) • Unit 1 • Unit 2	• 131.4 • 67.6	Feasibility study page 14/19
Design flow (m ³ /s) unit 1 and unit 2	18.76	Feasibility study page 14/19
Capacity Factor (%)	49%	Calculated based on feasibility study
Transmission loss (%)	1.00%	Feasibility study page 9-3

1.9 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 Barget river. The water flows from Sipansihaporas River with total catchment area of 196 km² for power station no. 1 and 210 km² for power station no. 2, with a yearly average flow of 28,5 m³/sec. The exact location is 01° 44' N and 98° 51' E.



Figure 1 - Location of Sipansihaporas Hydroelectric Power Plant

1.10 Conditions Prior to Project Initiation

Not applicable. This is a Greenfield project.

1.11 Compliance with Laws, Statutes and Other Regulatory Frameworks

The project meets all local laws and regulations of the government of Indonesia. The project activity, in using hydro power to generate electricity, is a voluntary action that has not been imposed by the government of Indonesia.

The project has a land deed agreement, construction permit, and underwent an Environmental Impact Assessment (EIA).

1.12 Ownership and Other Programs

1.12.1 Project Ownership

Proof of Title: The contract agreement can be referred as the proof of the ownership of the project activity.

1.12.2 Emissions Trading Programs and Other Binding Limits

Not applicable.

1.12.3 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 credit³.

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 program⁴.

1.12.4 Participation under Other GHG Programs

Not applicable.

1.12.5 Projects Rejected by Other GHG Programs

Not applicable.

1.13 Additional Information Relevant to the Project

Eligibility Criteria

³ According to VCS Standard: VCS Version 3, 21 June 2017, v3.7

⁴ According to Registration and Issuance process: VCS Version 3, 21 June 2017, v3.8

Not applicable.

Leakage Management

According to ACM0002 version 17.0, the leakage of the proposed project is not considered. No leakage is expected.

Commercially Sensitive Information

All information provided in this project document and relevant supporting calculation sheets can be publicly published.

Sustainable Development

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.

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.

Further Information

No further information.

2 APPLICATION OF METHODOLOGY

2.1 Title and Reference of Methodology

The project uses the VCS board-approved consolidated baseline and monitoring methodology ACM0002 “Large-scale Consolidated Methodology: Grid-connected electricity generation from renewable sources”, version 17.0, 13 May 2016⁵.

This methodology also refers to the latest approved versions of the approved “Tool to calculate the emission factor for an electricity system”, version 05.0⁶.

2.2 Applicability of Methodology

The project primarily displaces power to the Sumatra grid. According to Annex A of the Kyoto Protocol, this project falls into Sectoral Scope 1 – Energy Industries (renewable-/non-renewable sources).

Sipansihaporas hydroelectric power plant (HEPP) is a new grid-connected run-of-river type hydropower plant. According to “Section I: Source, Definitions and Applicability of Approved consolidated baseline and monitoring methodology ACM0002 Version 17.0”, the project activity is applicable under the following conditions:

⁵ <https://cdm.unfccc.int/methodologies/DB/8W400U6E7LFHHYH2C4JR1RJWWO4PVN>

⁶ <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v5.0.pdf>

Applicability Condition	Project Compliance	Information Source
This methodology is applicable to grid-connected renewable energy power generation project activities that: (a) Install a Greenfield power plant; (b) Involve a capacity addition to (an) existing plant(s); (c) Involve a retrofit of (an) existing operating plants/units; (d) Involve a rehabilitation of (an) existing plant(s)/unit(s); or (e) (d) Involve a replacement of (an) existing plant(s)/unit(s).	The project activity is a new hydro power plant (greenfield plant). It is connected with a regional power grid, the Sumatra grid; the Sumatra grid is clearly identified and information on the characteristics of this grid is publicly available from PLN Sumatra⁷.	PLN^{8,9}
The methodology is applicable under the following conditions: (a) The project activity may include renewable energy power plant/unit of one of the following types: hydro power plant/unit with or without reservoir, wind power plant/unit, geothermal power plant/unit, solar power plant/unit, wave power plant/unit or tidal power plant/unit; (b) In the case of capacity additions, retrofits, rehabilitations or replacements (except for wind, solar, wave or tidal power capacity addition projects the existing plant/unit started commercial operation prior to the start of	(a) The project activity is the installation of a new run of the river hydro power plant with an installed capacity of 50 MW. (b) Not applicable. This is a Greenfield project.	(a) PLN (b) PLN

⁷ PLN Sumatra is a regional state owned electricity company in Sumatra

⁸ PLN Sumatra or North Sumatra Generation (*Pembangkitan Sumatera Bagian Utara*) is under Sumatra Regional Business Director (*Direktur Bisnis Regional Sumatera*). Ref.: Annual Report 2016 (*Laporan Tahunan 2016*), p. 92. (2017). PT. PLN (Persero). http://www.pln.co.id/statics/uploads/2017/06/PLN_AR2016_HIRES.pdf (accessed, 2017).

⁹ Decree of Ministry of Energy and Mineral Resources No. 55 K/30/MEM/2003 dated on 7 February 2003 concerning National Transmission Grid (*Jaringan Transmisi Nasional / JTN*), p. 7-8. <http://prokum.esdm.go.id/kepmen/2003/kepmen-55-2003.pdf> (accessed, 2017).

Applicability Condition	Project Compliance	Information Source
a minimum historical reference period of five years, used for the calculation of baseline emissions and defined in the baseline emission section, and no capacity expansion, retrofit, or rehabilitation of the plant/unit has been undertaken between the start of this minimum historical reference period and the implementation of the project activity.		
In case of hydro power plants, one of the following conditions shall apply: (a) The project activity is implemented in existing single or multiple reservoirs, with no change in the volume of any of the reservoirs; or (b) The project activity is implemented in existing single or multiple reservoirs, where the volume of the reservoir(s) is increased and the power density calculated using equation (3) of ACM0002 version 17.0, is greater than 4 W/m^2; or (c) The project activity results in new single or multiple reservoirs and the power density, calculated using equation (3) of ACM0002 version 17.0, is greater than 4 W/m^2; or (d) The project activity is an integrated hydro power project involving multiple reservoirs, where the power density for any of the	(a) Not applicable. This is a Greenfield project. (b) Not applicable. This is a Greenfield project. (c) The project activity is a run-off-river hydropower plant. No reservoir exists in this sense but a regulating pondage can be seen as a reservoir. The power density of such is 281 W/m^2. (d) Not applicable. The project activity is a run-off-river type hydro power plant with a daily regulating pond.	(a) PLN (b) PLN (c) PLN (d) PLN

Applicability Condition	Project Compliance	Information Source
reservoirs, calculated using equation (3) of ACM0002 version 17.0, is lower than or equal to 4 W/m^2, all of the following conditions shall apply: (i) The power density calculated using the total installed capacity of the integrated project, as per equation (4) of ACM0002 version 17.0, is greater than 4 W/m^2; (ii) Water flow between reservoirs is not used by any other hydropower unit which is not a part of the project activity; (iii) Installed capacity of the power plant(s) with power density lower than or equal to 4 W/m^2 shall be: a. Lower than or equal to 15 MW; and b. Less than 10 per cent of the total installed capacity of integrated hydro power project.		
In the case of integrated hydro power projects: (a) Demonstrate that water flow from upstream power plants/units spill directly to the downstream reservoir and that collectively constitute to the generation capacity of the integrated hydro power project; or (b) Provide an analysis of the water balance covering the water fed to power units, with	Not applicable. The project activity is a run-off-river type hydro power plant with a daily regulating pond.	PLN

Applicability Condition	Project Compliance	Information Source
all possible combinations of reservoirs and without the construction of reservoirs. The purpose of water balance is to demonstrate the requirement of specific combination of reservoirs constructed under CDM project activity for the optimization of power output. This demonstration has to be carried out in the specific scenario of water availability in different seasons to optimize the water flow at the inlet of power units. Therefore this water balance will take into account seasonal flows from river, tributaries (if any), and rainfall for minimum five years prior to implementation of CDM project activity.		
The methodology is not applicable to: (a) Project activities that involve switching from fossil fuels to renewable energy sources at the site of the project activity, since in this case the baseline may be the continued use of fossil fuels at the site; (b) Biomass fired power plants/units.	(a) Not applicable. This is a Greenfield project. (b) Not applicable. This is a Greenfield project.	(a) PLN (b) PLN
In the case of retrofits, rehabilitations, replacements, or capacity additions, this methodology is only applicable if the most plausible baseline scenario, as a result of the identification of baseline	Not applicable. This is a Greenfield project.	PLN

Applicability Condition	Project Compliance	Information Source
scenario, is “the continuation of the current situation, that is to use the power generation equipment that was already in use prior to the implementation of the project activity and undertaking business as usual maintenance”.		

The applicability criteria stated in methodology ACM0002 (Version 17.0) are met on the basis of the reasons above.

2.3 Project Boundary

Table 3 - Summary of Gases and Sources included in project boundary

Source		Gas	Included?	Justification/Explanation
Baseline	CO ₂ emission from electricity generation in fossil fuel- fired power plants that are displaced due to the project activity.	CO ₂	Yes	Main emission source. CO ₂ emissions from grid electricity production.
		CH ₄	No	Minor emission source
		N ₂ O	No	Minor emission source
Project	For hydro power plants, emissions of CH ₄ from the reservoir	CO ₂	No	Minor emission source
		CH ₄	No	Not applicable since the project is a run-of river hydropower plant with a daily regulating pond for temporary storage.
		N ₂ O	No	Minor emission source

2.4 Baseline Scenario

As per the approved consolidated methodology ACM0002 version 17.0, since the project activity involves the installation of a new grid-connected hydro power plant (Greenfield power plant), the baseline scenario is the following:

If the project activity is the installation of a Greenfield power plant, the baseline scenario is electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the “Tool to calculate the emission factor for an electricity system”.

For the second crediting period, the continued validity of the original baseline should be assessed.

According to the tool “Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period (Version 03.0.1)”, following steps should be adopted:

Step 1: Assess the validity of the current baseline for the next crediting period

Step 1.1: Assess compliance of the current baseline with relevant mandatory national and/or sectoral policies

There is no mandatory law or regulation, which forced the project proponent to install a new hydro power plant (greenfield plant). Also, there are no new national and/or sectoral policies that could affect the baseline scenario during the renewal of the crediting period.

Step 1.2: Assess the impact of circumstances

There is no impact of circumstances existing at the time of requesting renewal of crediting period on the current baseline emissions.

Step 1.3: Assess whether the continuation of use of current baseline equipment(s) or an investment is the most likely scenario for the crediting period for which renewal is requested.

This sub-step is applicable to the project activity since the baseline is the continuation of the current practice, i.e. the electricity would be supplied by the power grid in the absence of the project activity. It is clear that the power grid as an electricity system would maintain its technical possibility for a much longer time than the crediting period of the project activity.

Step 1.4: Assessment of the validity of the data and parameters

There are some parameters, which are determined at the start of the first crediting period and not monitored during the first crediting period, are not valid anymore. So, the current baseline needs to be updated for the second crediting period according to the tool. This update includes grid emission factor and emissions from fossil fuel combustion ($PE_{FF,y}$) as per methodology version 17.0.

Hence, the data and parameters need to be updated. Therefore step 2 is used.

Step 2: Update the current baseline and the data and parameters

Step 2.1: Update the current baseline

The baseline emissions for the second crediting period have been updated, without reassessing the baseline scenario, based on the latest approved version of the methodology. This update was applied in the context of the sectoral policies and circumstances that is applicable at the time of requesting for renewal of the crediting period.

Step 2.2: Update the data and parameters

As mentioned in step 1.4, all parameters regarding the grid emission factor, and emissions from fossil fuel combustion ($PE_{FF,y}$) calculation are updated in the second crediting period.

As per methodology 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. Hence the $PE_{FF,y}$ has been updated using mentioned rule.

2.5 Additionality

According to the section 3.8.5 of VCS Standard version 3.7, a full reassessment of additionality is not required when renewing the project crediting period. However, regulatory surplus shall be demonstrated in accordance with Section 4.6.3 of VCS Standard version 3.7.

It is confirmed that the proposed project is not mandated by any law, statute or other regulatory framework. There is no mandatory law or regulation, which forced the project proponent to install a new hydro power plant (greenfield plant).¹⁰

There is no any mandatory program from the Government of Indonesia that forces private or public entities to install a new hydro power plant (greenfield plant).

2.6 Methodology Deviations

There are no methodology deviations.

3 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

3.1 Baseline Emissions

Based on ACM0002 version 17.0, the baseline emission (BE_y in tCO_2) is the product of the baseline emission factor ($EF_{grid,CM,y}$ in tCO_2/MWh) times the electricity supplied by the project activity to the grid ($EG_{PJ,y}$ in MWh). $EG_{PJ,y}$ is calculated as a quantity of net electricity generation supplied by the project plants/units to the grid ($EG_{facility,y}$ in MWh), as follows:

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

where:

- BE_y = Baseline emissions in year y ($t CO_2/yr$)
- $EG_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the VCS project activity in year y (MWh/yr)
- $EF_{grid,CM,y}$ = Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the “Tool to calculate the emission factor for an electricity system” ($t CO_2/MWh$)

$EG_{PJ,y}$ for the installation of a Greenfield power plant is calculated as follows:

¹⁰ According to PLN's Electricity Supply Business Plan (RUPTL PT. PLN (Persero)) year 2017-2026 there is no mandatory for PT. PLN (Persero) to install a new hydro power plant (greenfield plant). Decree of Ministry of Energy and Mineral Resources No. 1415 K/20/MEM/2017 dated on 29 March 2017 concerning Ratification of PT. PLN (Persero)'s Electricity Supply Business Plan Year 2017 – 2026. <https://djke.esdm.go.id/pdf/RUPTL/RUPTL%20PLN%202017-2026.pdf> (accessed, 2017).

$$EG_{PJ,y} = EG_{facility,y}$$

where:

- $EG_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the VCS project activity in year y (MWh/yr)
- $EG_{facility,y}$ = Quantity of net electricity generation supplied by the project plants/units to the grid in year y (MWh/yr)

Calculation of $EF_{grid,CM,y}$

The latest of weighted average of the Operating Margin emission factor ($EF_{grid,OMsimple,y}$), Build Margin emission factor ($EF_{grid,BM,y}$), and Combined Margin emission factor ($EF_{grid,CM,y}$) of Sumatera grid of year 2015 already determined and calculated¹¹ according to the procedures prescribed in the “Tool to calculate the emission factor for an electricity system, Version 04.0 by the Indonesian government under the Directorate General of Electricity - Ministry of Energy and Mineral Resources (MEMR).¹² Even though the “Tool to calculate the emission factor for an electricity system” (Version 05.0) has been issued at the time of renewal of the project crediting period there is not affected to the result of $EF_{grid,CM,y}$.

Step 1: Identify the relevant electricity systems

According to the latest version of the tool, the Sumatra power grid is selected as the project boundary, as the regional interconnected grid covering all provinces in Sumatra Island. The project is located in North Sumatra province, and is connected to the existing Sumatra power transmission line. The Sumatra power grid is therefore determined as the project boundary. Both the OM and the BM will be calculated ex-ante.

Step 2: Choose whether to include off-grid power plants in the project electricity system (optional)

Project participants may choose between the following two options to calculate the operating margin and build margin emission factor:

Option I: Only grid power plants are included in the calculation.

Option II: Both grid power plants and off-grid power plants are included in the calculation.

The MEMR chooses only to include the grid power plants in the calculation (Option I), as information of the off-grid power plants are not completely publicly accessible.

Step 3: Select a method to determine the operating margin (OM)

The “Tool to calculate the emission factor for an electricity system” (version 05.0, EB87) offers four methods to calculate the OM and any of the four methods can be used:

¹¹ Based on notification letter number 322/20/DJL.4/2017 dated on February 7th, 2017 from the MEMR.

¹² Based on notification letter number 1515/03/DLT.3/2017 dated on May 30th, 2017 from the MEMR.

- (a) Simple OM; or
- (b) Simple adjusted OM; or
- (c) Dispatch data analysis OM; or
- (d) Average OM.

The MEMR has been considered the methods to determine the operating margin (OM) as following:

- (a) Simple OM: The Low Cost/Must Run (LC/MR) of the power plants cannot be determined.
- (b) Simple adjusted OM: The required of hourly LC/MR operation data of the power plants are not available.
- (c) Dispatch data analysis OM: The required of hourly actual operation data of the power plants are not available.
- (d) Average OM: Annual aggregated data from the grid on power generation, fuel type and fuel consumption of the power plants are available, which is calculated as Simple OM.

The Operating Margin Emission Coefficient ($EF_{grid,OM,y}$) can be calculated based on Simple OM or Average OM, with consideration of the restrictions to use each approach. The selection of the most suitable method is based on the analysis of the proportion of low-cost/must-run generation sources in the concerning grid. The OM will be calculated ex-ante.

Step 4: Calculate the operating margin emission factor according to the selected method

The operating margin emission factor for each year 'y' was calculated using equation 3 (preferred option) of the 'Tool to calculate the emission factor for an electricity system', adapted to data available from PLN, which has grouped the power plants according to type as shown in the notification letter number 1515/03/DLT.3/2017 dated on May 30th, 2017 from the MEMR.

$$EF_{grid,OMsimple,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad (2)$$

where:

- $EF_{grid,OMsimple,y}$ = Simple operating margin CO₂ emission factor in year y (t CO₂/MWh)
- $EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
- $EF_{EL,m,y}$ = CO₂ emission factor of power unit m in year y (t CO₂/MWh)
- m = All power units serving the grid in year y except low-cost/must-run power units
- y = The relevant year as per the data vintage chosen in Step 3

The Operating Margin will be calculated ex-ante, therefore the factor is calculated based on 3 recent years available data, which are 2013, 2014, and 2015 data.

The Operating Margin emission factors for 2013, 2014 and 2015 are calculated separately and then the three- year average is calculated as a full-generation weighted average of the emission factors.

The result of the Operation Margin Emission Factor of Sumatra calculation is 0.676 tCO₂e/MWh.

The operating margin emission factor of the baseline is calculated as a fixed ex-ante value and will not be renewed within the second crediting period of the project activity.

Step 5: Calculate the build margin (BM) emission factor

Once the sample group 'm' is defined, the build margin is calculated ex-ante using the following equation:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad (3)$$

where:

$EF_{grid,BM,y}$	=	Build margin CO ₂ emission factor in year y (t CO ₂ /MWh)
$EG_{m,y}$	=	Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
$EF_{EL,m,y}$	=	CO ₂ emission factor of power unit m in year y (t CO ₂ /MWh)
m	=	Power units included in the build margin
y	=	Most recent historical year for which electricity generation data is available

Based on sample group 'm' identified in the notification letter number 1515/03/DLT.3/2017 dated on May 30th, 2017 from the MEMR, the ex-ante Build Margin Emission Factor is calculated to be 0.933 tCO₂e/MWh by dividing total CO₂ emissions by the total annual generation data.

Step 6: Calculate the combined margin (CM) emission factor

The Baseline Emission Factor is calculated as a Combined Margin, based on the Operating Margin (OM) and Build Margin (BM), using the weighted average (preferred option) of the Operating Margin and Build Margin.

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times W_{OM} + EF_{grid,BM,y} \times W_{BM} \quad (4)$$

where:

$EF_{grid,BM,y}$	=	Build margin CO ₂ emission factor in year y (t CO ₂ /MWh)
$EF_{grid,OM,y}$	=	Operating margin CO ₂ emission factor in year y (t CO ₂ /MWh)
W_{OM}	=	Weighting of operating margin emissions factor (per cent)

w_{BM} = Weighting of build margin emissions factor (per cent)

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.

Therefore using the approach above, the ex-ante emission factor ($EF_{grid,CM,y}$) for Sumatra Grid will be:

$$\begin{aligned} EF_{grid,CM,y} &= (EF_{grid,OM,y} \times w_{OM}) + (EF_{grid,BM,y} \times w_{BM}) \\ &= (0.676 \times 0.25) + (0.933 \times 0.75) \\ &= 0.869 \text{ tCO}_2/\text{MWh} \end{aligned}$$

3.2 Project Emissions

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y} \quad (5)$$

where:

PE_y	=	Project emissions in year y (t CO ₂ e/yr)
$PE_{FF,y}$	=	Project emissions from fossil fuel consumption in year y (t CO ₂ /yr)
$PE_{GP,y}$	=	Project emissions from the operation of dry, flash steam or binary geothermal power plants in year y (t CO ₂ e/yr)
$PE_{HP,y}$	=	Project emissions from water reservoirs of hydro power plants in year y (t CO ₂ e/yr)

The project does not involve the fossil fuel consumption (as per para 38 of 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 CH₄ and CO₂ emissions from the reservoirs. If the power density of the project activity (PD) is greater than 10 W/m², the $PE_{HP,y} = 0$ as per para 43 (c) of ACM0002 version 17.0.

The power density of the project activity needs to be considered using the following equation as per para 42 of ACM0002 version 17.0:

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}} \quad (6)$$

where:

- PD = Power density of the project activity (W/m²)
- Cap_{PJ} = Installed capacity of the hydro power plant after the implementation of the project activity (W)
- Cap_{BL} = Installed capacity of the hydro power plant before the implementation of the project activity (W). For new hydro power plants, this value is zero
- A_{PJ} = Area of the single or multiple reservoirs measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m²)
- A_{BL} = Area of the single or multiple reservoirs measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m²). For new reservoirs, this value is zero

Power density calculation referred to in Section 3.4 below.

3.3 Leakage

According to the methodology, leakage from related emission sources do not need to be considered, thus leakage is zero as per Section 5.6 of ACM0002 version 17.0.

$$LE_y = 0$$

3.4 Net GHG Emission Reductions and Removals

According to the latest version of ACM0002 version 17, the procedure of determining baseline emission, project emission, leakage, and emission reduction for the project activity are as follows:

Baseline Emissions

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

Parameter	Description	Unit	Value	Source
BE _y	Baseline emissions in year y	t CO ₂ e/yr	186,608	Calculated 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 VCS project activity in year y	MWh/yr	214,800	Planned electricity production as per feasibility study

Parameter	Description	Unit	Value	Source
EF _{grid,CM,y}	Combined margin CO ₂ emission factor for grid connected power generation in year y calculated using the latest version of the “Tool to calculate the emission factor for an electricity system”	t CO ₂ e/MWh	0.869	See explanation below

Calculation of EF_{grid,CM,y}

As per newest “Tool to calculate the emission factor for an electricity system” for each crediting period the most recent data available at time of submission of the PD to the DOE for validation shall be used. The latest available data at the time is the official emission factor published by the Indonesian MEMR using data from the year 2013 concluding an emission factor of 0.869 tCO₂e/MWh.

Summary of Baseline Emissions (BE_y)

Year	Vintage Year	BE _y (tCO ₂ e)
2016 - 2017	1 April 2016 - 31 March 2017	174,456
2017 - 2018	1 April 2017 - 31 March 2018	186,608
2018 - 2019	1 April 2018 - 31 March 2019	186,608
2019 - 2020	1 April 2019 - 31 March 2020	186,608
2020 - 2021	1 April 2020 - 31 March 2021	186,608
2021 - 2022	1 April 2021 - 31 March 2022	186,608
2022 - 2023	1 April 2022 - 31 March 2023	186,608
2023 - 2024	1 April 2023 - 31 March 2024	186,608
2024 - 2025	1 April 2024 - 31 March 2025	186,608
2025 - 2026	1 April 2025 - 31 March 2026	186,608

Power Density

$$\begin{aligned}
 PD &= \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}} \\
 &= \frac{50,000,000 - 0}{178,000 - 0} \\
 &= 281 \text{ W/m}^2
 \end{aligned}$$

According to ACM0002 version 17, no project emissions have to be taken into consideration as the power density exceeds 10 W/m^2 . Therefore there are no emissions to consider that may have arisen from such a flooded area. Thus, $PE_{HP,y} = 0$.

Project Emissions

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y}$$

Parameter	Description	Unit	Value	Source
PE_y	Project emissions in year y	t CO ₂ e/yr	0	Calculated equation (5)
$PE_{FF,y}$	Project emissions from fossil fuel consumption in year y	t CO ₂ e/yr	0	Tool to calculate project or leakage CO ₂ emissions from fossil fuel combustion
$PE_{GP,y}$	Project emissions from the operation of dry, flash steam or binary geothermal power plants in year y	t CO ₂ e/yr	0	Project activity is not a geothermal power plant
$PE_{HP,y}$	Project emissions from water reservoirs of hydro power plants in year y	t CO ₂ e/yr	0	Calculated equation (6)

Leakage Emissions

According to ACM0002, the leakage of the proposed project is not considered. No leakage is expected. Therefore, $LE_y = 0$

The ex-ante emission reductions calculations are as follows:

$$ER_y = BE_y - PE_y$$

Using the calculation above the total emission reduction for the 10-year crediting period is 1,853,928 tCO₂e or 185,392 tCO₂e/year, as shown in the summary below:

Year	Vintage	Estimated baseline emissions or removals (tCO ₂ e)	Estimated project emissions or removals (tCO ₂ e)	Estimated leakage emissions (tCO ₂ e)	Estimated net GHG emission reductions or removals (tCO ₂ e)
2016	1 April 2016 – 31 March 2017	174,456	0	0	174,456
2017	1 April 2017 – 31 March 2018	186,608	0	0	186,608
2018	1 April 2018 – 31 March 2019	186,608	0	0	186,608
2019	1 April 2019 – 31 March 2020	186,608	0	0	186,608
2020	1 April 2020 – 31 March 2021	186,608	0	0	186,608
2021	1 April 2021 – 31 March 2022	186,608	0	0	186,608
2022	1 April 2022 – 31 March 2023	186,608	0	0	186,608
2023	1 April 2023 – 31 March 2024	186,608	0	0	186,608
2024	1 April 2024 – 31 March 2025	186,608	0	0	186,608
2025	1 April 2025 – 31 March 2026	186,608	0	0	186,608
Total		1,853,928	0	0	1,853,928

4 MONITORING

4.1 Data and Parameters Available at Validation

Data / Parameter	EF _{grid,CM,y}
Data unit	tCO ₂ e/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 ¹³
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	-

4.2 Data and Parameters Monitored

Data / Parameter	$EG_{PJ,y}$
Data unit	MWh/yr
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's 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).
Description of measurement methods and procedures to be applied	Electricity produced will be measured by a watt-hour meter (connected to a digital control system and recorded continuously), which can measure export and import electricity data separately. Therefore net electricity delivered to the grid would be the difference of export and import energy. The Electricity Transfer Protocol Report form will be 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.

¹³ Source of data for $EF_{grid,OM,y}$ (0.676 tCO₂e/MWh) and $EF_{grid,BM,y}$ (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.

	The measurement of electricity generation will be conducted on a continuous basis, where monthly data is recorded and continuous total electricity measurement will be available. The measurement results will be summarised in regular production reports. The accuracy class of main and back up meter is 0.2.																		
Frequency of monitoring/recording	Monitoring is continuous with monthly recording of data.																		
Value applied	214,800																		
Monitoring equipment	<table><tr><td></td><td colspan="3">kWH meter</td></tr><tr><td></td><td>Type</td><td>Accuracy Class</td><td>Serial Number</td></tr><tr><td>Unit 1</td><td>Digital Watt-hour meter type ACTARIS SL7000 (Main Meter)</td><td>0.2</td><td>36027177</td></tr><tr><td>Unit 2</td><td>Digital Watt-hour meter type ACTARIS SL7000 (Main Meter)</td><td>0.2</td><td>36027137</td></tr></table>				kWH meter				Type	Accuracy Class	Serial Number	Unit 1	Digital Watt-hour meter type ACTARIS SL7000 (Main Meter)	0.2	36027177	Unit 2	Digital Watt-hour meter type ACTARIS SL7000 (Main Meter)	0.2	36027137
	kWH meter																		
	Type	Accuracy Class	Serial Number																
Unit 1	Digital Watt-hour meter type ACTARIS SL7000 (Main Meter)	0.2	36027177																
Unit 2	Digital Watt-hour meter type ACTARIS SL7000 (Main Meter)	0.2	36027137																
QA/QC procedures to be applied	The QA/QC will be conducted through cross-checking with sales electricity receipts. Meters will be calibrated on every 5 yearly basis according to the national standard or other documents. Data measured by meters will be cross-checked by electricity sales receipts. The meter (s) will either: i. be read frequently and jointly by the generation unit and transmission unit, ii. be read by the project proponent (generation unit) and the data will then be double checked with the electricity sales receipts using comparison meter, iii. only be read by the grid company (transmission department).																		
Purpose of data	Calculation of baseline emissions																		
Calculation method	-																		
Comments	-																		

4.3 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.

1. Monitoring organization

The monitoring team has been established and integrated within the existing organization structure of the Sipansihaporas hydropower plant prior to the start of the verification. Clear roles and responsibilities is 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 have clearly defined roles and responsibilities. The VCS Manager manages the process of training new staff, ensuring trained staff performs the monitoring duties properly, 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 is established prior to the start of the project. These procedures will detail the organization, control and 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 will be agreed and signed off by PT PLN (Persero) and South Pole Carbon Asset Management Ltd. Any changes to procedures will need to be agreed by both parties. The VCS Manager will be responsible for ensuring that the procedures are followed on site and for continuously improving the procedures to ensure a reliable monitoring system is established.

2. Monitoring equipment and installation

Given 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).

Metering of electricity supplied to the grid

The main electricity meter of each power generation unit for establishing the electricity delivered to the grid (detailed in section 3.3) is installed at the transaction point in Sipansihaporas power plant. This electricity meter will be the main meter (revenue meter) that measures the quantity of electricity supplied to the grid that will be paid by the PLN. As this meter provides the main VCS measurement, it will play a key role in the verification process.

The project developer owns the meter and is responsible for its maintenance and calibration, as stated in the SOPs agreed upon with the PLN. PLN 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.

To ensure maximum data availability and to introduce data quality controls, two cross-check meters are installed in addition to the revenue meter for each power generation unit. Those meters are located at the Sipansihaporas power station, measuring electricity production from the project and own consumption.

Electricity meters should meet the relevant local standards at the time of installation. Before the installation of the meters, they should be calibrated by the manufacturer. The meters will be installed by the project developer according to the following national Indonesian standard “Standard Electricity Meter Equipment”. Records of the meter (type, make, model and calibration documentation) is shown in the table below.

Below are the characteristics of the kWh main-meters at Sipansihaporas HEPP

No.	Description	
1.	Electricity Meter Transfer 1 from power generation unit 1, Sipansihaporas hydropower plant	Type: Actaris type SL 7000 Serial Number: 36027177 Class: 0.2 Date of Calibration: 10/04/2010, valid until 10/04/2015
2.	Electricity Meter Transfer 2 from power generation unit 2, Sipansihaporas hydropower plant	Type: Actaris type SL 7000 Serial Number: 36027137 Class: 0.2 Date of Calibration: 10/04/2010, valid until 10/04/2015

Equipment will be calibrated by the manufacturer or any accredited institution 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) will be retained as part of the VCS monitoring system.

Quality Control

The main meter of each power generation unit is owned by the project developer and installed at the Sipansihaporas power plant. The project developer specifies the QC procedure for measurement and calibration to ensure the measurement accuracy of the main meter. Periodic checks should be conducted according to the relevant national standard¹⁴. In the event of: any seal securing the metering system is broken, the system fails to register, or 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.

In case of failure of the main meter, production meter and own consumption meter which also located at generation site of each power generation unit will be used as cross-check meters, measuring 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.

During monthly monitoring of electricity delivered, the main meter and check-meters will be read and if the difference between the respective main meter and check-meters exceeds the maximum error for such meters then all meters shall be tested in turn. The main meter shall be used as transfer data and provide a letter of agreement.

During testing, if all meters are found to be working beyond the permissible limits of error, then the electricity delivered for the previous billing month shall be corrected to account for this error. The meters shall be calibrated and data will be calculated manually. However, manually calculated electricity production will not be used to claim carbon credits.

During annual tests, if the main meter is found to be within the permissible limits of errors, and the check-meters are found to be beyond the permissible limits of errors, the main meter shall be used for electricity delivered.

In case, during the annual tests, the main meter is found to be beyond the permissible limit of error but check-meters are found to be within the permissible limit of error, then check-meters reading shall be used for electricity delivered.

The electricity delivered for this period (from the date of last calibration) shall be corrected for the maximum error in meters.

3. Data recording procedure

The procedures for collecting the electricity meter data will be outlined in the Standard Operating Procedure signed between the Generating Unit and the Transmission Unit, which both are under PLN.

¹⁴The Ministry of Energy and Mineral Resource's regulation number 37 year 2008 dated November 27, 2008 on the Grid Code Sumatra Electricity Power System, the calibration of kWh meter must be done every 5 (five) years, as stated in the Metering Code section, MC 4.1.1 (Test after metering code commissioning, page 138), available from: <http://jdih.esdm.go.id/peraturan/Permen%20ESDM%2037%202008.pdf> [Accessed 26 July 2017]

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.

Other data for VER procedures will be managed by the dedicated VCS Manager.

EG recording procedure and Monthly Electricity Protocol Report (*Berita Acara*):

- Operating and maintenance supervisor (O&M supervisor) responsible for recording the amount of EG exported by Generating 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.
- O&M supervisor with other authorized staff from Generating unit will attract 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 Generating Unit) and PT. PLN (transmission unit). 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 MEP will be then rechecked by authorized person from transmission unit for Pandan sector.

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

Main meter failure – use of cross-check meter data

If the main electricity meter is found to be faulty during its reading, data from the production and own consumption meter will be used in its place. In this circumstance, the electricity exported to the grid should be calculated as follows:

- a) The data from the production and own consumption meter will be used for the period of the main meter failure. As all meters are situated after the transformer, no losses occur.
- b) The electricity used and measured for own consumption should be deducted from the produced electricity measured. The difference will be equal to the net electricity produced.

Cross-check meter failure

A failing cross-check meter will be repaired or replaced by an accredited equipment testing organization appointed by PLN. Maintenance records and any calibration documents will be retained by the project and ensured by the operation and maintenance supervisor that the calibration documents comply with calibration requirements. In case of a cross-check meter failure simultaneously to a main meter failure no electricity produced can be measured and therefore no credits can be claimed.

Possible fault with either meter

During the process of cross-checking the electricity data from the meters, a difference may be established that is considerably larger than the historic difference (allowing for transmission losses). In this unlikely event, it could be either electricity meter at fault. The data recording procedures for this circumstance will be specified in a separate procedure.

4. Data and records management

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. The project developer needs to keep electricity sale and purchase invoices. 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.

In order to make it easy for the verifier to retrieve the documentation and information in relation to the project emission reduction verification, the project developer should provide a document register. The document management system will be developed to ensure adequate document control for VCS purposes.

The dedicated VCS Manager of the project developer is responsible for checking the data (according to a formal procedure) and the VCS Manager will be responsible for managing the collection, storage and archive of all data and records. A procedure will be developed to manage the VCS record keeping arrangements. All the data shall be kept until two years after the end of credit period.

5 SAFEGUARDS**5.1 No Net Harm**

Based on approved Environmental Impact Assessment (EIA), 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 4 - Summary of EIA findings

Identified environmental impacts	Measures taken
Pre-Construction phase	
<i>Social responsibility</i>	
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	
<i>Air and noise pollution</i>	

Identified environmental impacts	Measures taken
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
<i>Water pollution</i>	
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.
<i>Solid waste</i>	
Construction waste from the transportation of soil material	Perform continuous cleaning during the construction period to remove debris and deposit of it appropriately
<i>Biodiversity and ecosystems</i>	
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.
<i>Employment impacts</i>	
Utilization of local human resources	Give priority to local employment and hold special training to enhance the local community's skills.
Operation phase	
<i>Water pollution</i>	
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
<i>Environmental</i>	
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
<i>Spatial planning</i>	
Changing in spatial planning structure due to project activity	Control the development around project activity by enforcing the appropriate planning regulations
<i>Regional image</i>	

Identified environmental impacts	Measures taken
Changing in regional image due to the development in the region	Planning controls will ensure sensitive development of the region
<i>Traffic</i>	
Increase traffic activity due to the project's operational activity	Restore the trans-Sumatra main road and set up traffic signs
<i>Health and Safety</i>	
Human resources needed to operate the project and its facilities	Give employment opportunities to local human resources following high health and safety standards
<i>Working opportunity and income</i>	
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.
<i>Comfort</i>	
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
<i>Social responsibility</i>	
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.

5.2 Environmental Impact

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 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.

5.3 Local Stakeholder Consultation

A meeting with relevant stakeholders, including the village chief, local leaders, local organization, NGO, 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.

5.4 Public Comments

N/A