210 MW MUSI HYDRO POWER PLANT, BENGKULU



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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-of-river hydropower plant in Bengkulu 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 utilise the hydrological resources of the Musi River, which is a renewable source of energy, to generate zero emission electricity to be transmitted to the Sumatra grid (hereafter referred to as the grid) through the Pekalongan PLN main station, with a 150 kV transmission line respectively. It will displace fossil fuel based power and reduce the emissions associated with fossil fuel based power plants on the Grid. Therefore, the project activity is reducing greenhouse gas emissions.

The total installed capacity of the project is 210 MW, consisting of three 70 MW turbines, with a designed load factor of 61.97%; all of the power generated will be delivered to the grid. The electricity currently generated by the grid is rather carbon intensive, with a grid emission factor (GEF) in 2016 of 0.857 tCO_2/MWh.

Following are operation dates of all three units:

Unit 1: 19 July 2006 (Commissioning Certificate – *Laporan Inspeksi Uji Kelaikan Operasi*)

Unit 2: 19 July 2006 (Commissioning Certificate – *Laporan Inspeksi Uji Kelaikan Operasi*)

Unit 3: 19 July 2006 (Commissioning Certificate – *Laporan Inspeksi Uji Kelaikan Operasi*)

1.2 Sectoral Scope and Project Type

The project activity is a new run-of-river type hydro power plant. Total installed capacity of the project is 210 MW, consisting of three (3) x 70 MW turbines. The project is owned and developed by PT. PLN (Persero), a state-owned electricity company. The project supplies electricity to the connected Sumatra grid. The 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 a new hydropower plant.

According to the CDM UNFCCC criteria, one approved GHG program by the Voluntary Carbon Standard (VCS) Board, the project is classified as large scale. Further to this, based on Annex A of the Kyoto Protocol it falls under the following types/categories of the Clean Development Mechanism under Kyoto Protocol:

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

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

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)**	**Kindly indicate if the party involved to be considered as project participant (Yes/No)**
Indonesia (host)	PT. PLN (Persero). (as public entity)	No

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 (*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

1.4 Other Entities Involved in the Project

Name of the party involved ((host) indicates a host party)	**Private and/or public entity (ies) project participants (as applicable)**	**Kindly indicate if the party involved to be considered as project participant (Yes/No)**
Switzerland	South Pole Carbon Asset Management Ltd. (as private entity)	No

Carbon credit buyer:

Organization name	South Pole Carbon Asset Management Ltd.
Contact person	Renat Heuberger
Title	CEO
Address	Technoparkstrasse 1, Zurich 8005, Switzerland
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Email	info@southpole.com

1.5 Project Start Date

Musi Hydro Power Plant Unit 1: 19 July 2006

Musi Hydro Power Plant Unit 2: 19 July 2006

Musi Hydro Power Plant Unit 3: 19 July 2006

Thus, the project start date is 19 July 2006 (as per the commissioning certificate), as the earliest project start date of three units at Musi Hydro Power Plant. Operational lifetime of project activity: 30 years.

1.6 Project Crediting Period

1st Crediting period start date: 1 August 2006.

2nd Crediting period start date: 1 August 2016.

1st Crediting period: 10 years from 1 August 2006 until 31 July 2016.

2nd Crediting period: 10 years from 1 August 2016 until 31 July 2026.

1.7 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	
Large project	√

The project activity is a run-of-river type hydropower plant. The power density of daily regulating storage is 184.211 W/m^2. Total installed capacity of the project is 210 MW, consisting of three (3) x 70 MW turbines. The 3 x 70 MW installed capacity generates an average of 953,128 emission reduction credits per year.

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

Years	Estimated GHG emission reductions or removals (tCO_2e)*
Year 2016 (1 August 2016 - 31 July 2017)	738,461
Year 2017 (1 August 2017 - 31 July 2018)	976,980

Years	Estimated GHG emission reductions or removals (tCO_2e)*
Year 2018 (1 August 2018 - 31 July 2019)	976,980
Year 2019 (1 August 2019 - 31 July 2020)	976,980
Year 2020 (1 August 2020 - 31 July 2021)	976,980
Year 2021 (1 August 2021 - 31 July 2022)	976,980
Year 2022 (1 August 2022 - 31 July 2023)	976,980
Year 2023 (1 August 2023 - 31 July 2024)	976,980
Year 2024 (1 August 2024 - 31 July 2025)	976,980
Year 2025 (1 August 2025 - 31 July 2026)	976,980
Total estimated ERs	9,531,281
Total number of crediting years	10
Average annual ERs	953,128

* The ER calculation is based on actual operation (1 August 2016 - 31 July 2017) and designed annual electricity generation stated in Musi FS project report 1993.

1.8 Description of the Project Activity

The Project is a new run-of-river type hydropower plant. Its main purpose is to generate electricity with a total installed capacity of 210 MW (consisting of 3 x 70 MW turbines). Annual energy output is expected at 1,140 GWh; harnessing a gross water head of 404.4 m by diverting water at 42.3 m^3/sec from the Musi river to the Simpangaur river, in an adjacent watershed, through a 7.5 km long waterway and an underground powerhouse.

The electricity production can be described as follows. Water is taken from the Musi river through the intake dam and then enters into the turbine through the high-pressure pipeline to produce electricity by driving the generators. The water then discharges into to the Simpangaur river through the tailrace.

The Project will use proven technology in electricity generation and transmission. The essential equipment used in the Project had to be procured from another country. Prior to the project commissioning the project developer organized a series of training sessions with the equipment supplier. The training conducted mainly covered the following topics: management of hydropower generation, operation and maintenance of a hydropower plant, operation and maintenance of a turbine, generator and other equipment. The purpose of the training was 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 1 - Main technical parameters of the proposed project

Parameter	Capacity	Source
Installed capacity (MW)	210	Musi FS Project Report 1993
Expected annual power generation (effective supply to the grid) (MWh)	1,140,000	Musi FS Project Report 1993
Water head (m)	404.4	Musi FS Project Report 1993
Design flow (m^3/s)	42.3	Musi FS Project Report 1993
Load Factor (%)	61.97	Calculated by dividing the expected annual power generation by the maximum annual electricity production. The maximum annual electricity production is calculated by multiplying the installed capacity with 8760 hours.

1.9 Project Location

The project area of the Musi Hydroelectric Power Plant is situated in Bengkulu Province about 30 km northeast of Bengkulu city, the capital of the Province. It involves the inter-basin transfer of water from the Musi river in Rejang Lebong Regency to the Simpangaur river in North Bengkulu Regency through a 7.5 km long waterway and an underground powerhouse.

The exact location is 03^0 37' 6.59" S and 102^0 27' 25.87" E[2].

[2] Location of Musi regulating dam according to EIA page IV-2.



Figure 1 - Location of Musi 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 credit[3].

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[4].

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

Not applicable.

Leakage Management

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

[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

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).
- During both construction and operation, various kinds of mechanical work were required, providing opportunities for part-time and full-time employment.

Economic well-being:

- The project activity generates employment in the local area which is a developing region.
- The generated electricity is fed into regional grids through the local grid, thereby improving the grid frequency and availability of electricity to local consumers (villagers and sub-urban inhabitants). Due to increased grid reliability, new opportunities for industries and economic activities arise along with prospects for local employment and overall development.
- The project activity leads to diversification of the national energy supply, which is dominated by conventional fuel based generating units.
- The project activity contributes to the economic sustainability around the plant sites, which is encouraging economic power decentralization.

Environmental well-being:

- The project utilizes hydropower to generate electricity, which otherwise would have been generated through alternate fuel- (most likely fossil fuel-) based power plants. This contributes to a reduction in specific emissions (emissions of pollutant/unit of energy generated), including GHG emissions.
- As hydroelectric power projects do not produce end-products in the form of solid waste (ash, etc.), they do not 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.

Technological well-being:

- The project supports high quality equipments 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 light of the above explanation, the project participants consider that the project activity 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 "Consolidated baseline methodology for grid-connected electricity generation from renewable sources", version 17.0, 13 May 2016[5].

This methodology also refers to the latest approved versions of the approved "Tool to calculate the emission factor for an electricity system", version 06.0[6].

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).

Musi 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:

Applicability Condition	Project Compliance	Information Source
This methodology is applicable to grid-connected renewable	The project activity is a new hydro power plant (greenfield plant). It is connected with a	PLN[8,9]

[5] https://cdm.unfccc.int/methodologies/DB/8W400U6E7LFHHYH2C4JR1RJWWO4PVN
[6] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v6.pdf
[8] PLN Sumatra or South Sumatra Generation (*Pembangkitan Sumatera Bagian Selatan*) 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, 2018).
[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. 12,14. http://prokum.esdm.go.id/kepmen/2003/kepmen-55-2003.pdf (accessed, 2018).

Applicability Condition	Project Compliance	Information Source
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).	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 Sumatra[7].	
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 minimum historical reference period of five years, used for the calculation of baseline emissions and defined in the baseline emission section,	(a) The project activity is the installation of a new run-of-the river hydro power plant with an installed capacity of 210 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

Applicability Condition	Project Compliance	Information Source
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 reservoirs, calculated using	(a) Not applicable. This is a Greenfield project. (b) Not applicable. This is a Greenfield project. (c) The project activity is constructed as a run-of-river hydropower project with a design for temporary storage called daily regulating storage (a run-of-river reservoir) having a power density of 184.211 W/m^2. The area of the run-of-river reservoir (reservoir surface area) is 1.14 km^2 [10]. It is a new run-of-river reservoir[11]. (d) Not applicable. The project activity is a run-of-river type hydro power plant.	(a) PLN (b) PLN (c) PLN (d) PLN

[10] Copy of Project Report (Completion Report) on Engineering Services for Detailed Design prepared by PT. Indra Karya in association with Nippon Koei Co. Ltd. in June 1993, p.II-3.

[11] Refers to methodology ACM0002 (Large-scale Consolidated Methodology: Grid-connected electricity generation from renewable sources Version 17.0), the definition of reservoir is a water body created in valleys to store water generally made by the construction of a dam. And, according to methodology AM0103 (Renewable energy power generation in isolated grids Version 02.0.0), the definition of Renewable energy sources is "This includes: hydro power plants (either with a run-of-river reservoir or an accumulation reservoir), wind power plants, geothermal power plants, solar power plants, wave power plants or tidal power plants".

Applicability Condition	Project Compliance	Information Source
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 all possible combinations of	Not applicable. The project activity is a run-of-river type hydro power plant.	PLN

Applicability Condition	Project Compliance	Information Source
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 scenario, is "the continuation of	Not applicable. This is a Greenfield project.	PLN

Applicability Condition	Project Compliance	Information Source
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.

The power density of the project, given as the total capacity of 210,000,000 (in W) divided by the flooded surface area resulted from the widening of the river (reservoir surface area) of 1,140,000 m^2 (1.14 km^2), is shown to be 184.211 W/m^2. According to ACM0002 (Version 17.0), hydroelectric power plants with a power density greater than 10 W/m^2 can use current approved methodology and may neglect project emissions from the reservoir.

2.3 Project Boundary

Table 2 - 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_2O	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	Minor emission source (Power density is greater than 10 W/m^2)
		N_2O	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. 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).[12]

Step 1.2: Assess the impact of circumstances

This step requires assessment of impact of circumstance existing at the time of requesting renewal of the crediting period on the current baseline emissions, without reassessing the baseline scenario. It needs to be evaluated whether the conditions used to determine the baseline emissions in the previous crediting period are still valid including assessment of availability of new fuels or raw materials and the impact of electricity or fuel prices.

The impact on current baseline emissions can be directly assessed based on reviewing current mix of the grid to which the project is connected and exporting electricity.

The project activity delivers electricity to the Sumatra Grid in Indonesia. As per latest Sumatra grid data (until year 2016) from the government of Directorate General of Electricity – Ministry of Energy and Mineral Resources (MEMR), the proportions of the total installed capacity of all power plants (MW) versus total installed capacity of hydropower plants with similar hydro installed capacity (as range of 105 MW to 315 MW) is only 8.84%. The market is still dominated by coal power plant and in the last four years, more than 1,700 MW of new coal based power plants have been established. Other projects/fuel types of fossil fuel have been implemented. Hence the hydroelectric plants with similar hydro installed capacity in the Sumatra grid is very limited. The grid emission factor of the grid has also been updated to reflect the most recent GHG intensity and applied for the calculation of 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.

[12] Decree of Ministry of Energy and Mineral Resources No. 1415/K/20/MEM2017 dated on 29 March 2017 concerning Ratification of PT. PLN (Persero)'s Electricity Supply Business Plan Year 2017 – 2026. https://djk.esdm.go.id/pdf/RUPTL/RUPTL%20PLN%202017-2026.pdf (accessed, 2018).

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)[13].

[13] 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://djk.esdm.go.id/pdf/RUPTL/RUPTL%20PLN%202017-2026.pdf (accessed, 2018).

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:

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

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 2016 already determined and calculated[14] 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

[14] Based on notification letter number 364/04/DLT.3/2018 dated on February 13th, 2018 from the MEMR.

(MEMR). Even though the "Tool to calculate the emission factor for an electricity system" (Version 06.0) 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 06.0, EB97) offers four methods to calculate the OM and any of the four methods can be used:

(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 364/04/DLT.3/2018 dated on February 13th, 2018 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 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	=	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 2014, 2015, and 2016 data.

The Operating Margin emission factors for 2014, 2015, and 2016 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, in the notification letter number 364/04/DLT.3/2018 dated on February 13th, 2018 from the MEMR, is calculated to be 0.735 tCO_2e/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 364/04/DLT.3/2018 dated on February 13th, 2018 from the MEMR, the ex-ante Build Margin Emission Factor is calculated to be 0.898 tCO_2e/MWh by dividing total CO_2 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, 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 v06.0, 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:

$EF_{grid,CM,y}$ = ($EF_{grid,OM,y}$ x w_{OM}) + ($EF_{grid,BM,y}$ x w_{BM})

= (0.735 x 0.25) + (0.898 x 0.75)

= 0.857 tCO_2/MWh

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_2e/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_2e/yr)
$PE_{HP,y}$	=	Project emissions from water reservoirs of hydro power plants in year y (t CO_2e/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-of-river type hydropower project with a daily regulating dam (run-of-river reservoir). 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 as per para 43 (c) of ACM0002 version 17.0.

The power density of the project activity needs to be considered[15] 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/m^2)
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 (m^2)

[15] According to the clarification on UNFCCC CDM approved large scale methodologies ACM0002, the Meth Panel clarified that "Therefore, as long as the power plant involves a new reservoir or the increase of an existing reservoir, be it run-of-river or not, greenhouse gases emissions from the reservoir must be considered and, hence, the assessment of the power density is required as a necessary applicability condition of ACM0002;" (AM_CLA_0049: Calculation of power density https://cdm.unfccc.int/methodologies/PAmethodologies/clarifications/11717).

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 (m^2). 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.

$LE_y = 0$

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_2e/yr	976,980	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	1,140,000	Planned electricity production as per feasibility study
$EF_{grid,CM,y}$	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_2e/MWh	0.857	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 2014 concluding an emission factor of 0.857 tCO_2e/MWh.

Summary of Baseline Emissions (BE_y)

Year	Vintage Year	BEy (tCO_2e)
2016 - 2017	1 August 2016 - 31 July 2017	738,461
2017 - 2018	1 August 2017 - 31 July 2018	976,980
2018 - 2019	1 August 2018 - 31 July 2019	976,980
2019 - 2020	1 August 2019 - 31 July 2020	976,980
2020 - 2021	1 August 2020 - 31 July 2021	976,980
2021 - 2022	1 August 2021 - 31 July 2022	976,980
2022 - 2023	1 August 2022 - 31 July 2023	976,980
2023 - 2024	1 August 2023 - 31 July 2024	976,980
2024 - 2025	1 August 2024 - 31 July 2025	976,980
2025 - 2026	1 August 2025 - 31 July 2026	976,980

Power Density

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}}$$

$$= \frac{210{,}000{,}000 - 0}{1{,}140{,}000 - 0}$$

$$= 184.211 \text{ W/m}^2$$

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_2e/yr	0	Calculated equation (5)
$PE_{FF,y}$	Project emissions from fossil fuel consumption in year y	t CO_2e/yr	0	Tool to calculate project or leakage CO2

Parameter	Description	Unit	Value	Source
				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_2e/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_2e/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 baseline emission for the 10-year crediting period is 9,531,281 tCO_2e or 953,128 tCO_2e/year, as shown in the summary below:

Year	Vintage	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
2016	1 August 2016 – 31 July 2017	738,461	0	0	738,461
2017	1 August 2017 – 31 July 2018	976,980	0	0	976,980
2018	1 August 2018 – 31 July 2019	976,980	0	0	976,980
2019	1 August 2019 – 31 July 2020	976,980	0	0	976,980
2020	1 August 2020 – 31 July 2021	976,980	0	0	976,980
2021	1 August 2021 – 31 July 2022	976,980	0	0	976,980

Year	Vintage	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
2022	1 August 2022 – 31 July 2023	976,980	0	0	976,980
2023	1 August 2023 – 31 July 2024	976,980	0	0	976,980
2024	1 August 2024 – 31 July 2025	976,980	0	0	976,980
2025	1 August 2025 – 31 July 2026	976,980	0	0	976,980
Total		9,531,281	0	0	9,531,281

4 MONITORING

4.1 Data and Parameters Available at Validation

Data / Parameter	$EF_{grid,CM,y}$
Data unit	tCO_2e/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 v06.0, 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[16]
Value applied	0.857
Justification of choice of data or description of	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).

[16] Source of data for $EF_{grid,OM,y}$ (0.735 tCO_2e/MWh) and $EF_{grid,BM,y}$ (0.898 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 364/04/DLT.3/2018 dated on February 13th, 2018.

measurement methods and procedures applied	
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) Electricity Generation (EG) data used for monitoring is the monthly electricity generation delivered to grid summarized in Electricity Transfer Protocol Report signed by both parties of Generation department and Transmission department. For ex-ante calculation, EG value uses the designed annual electricity generation provided by Musi FS Project Report 1993.
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. 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	1,140,000
Monitoring equipment	

kWH meter		
Type	Accuracy	Serial

	<table><tr><td></td><td></td><td>Class</td><td>Number</td></tr><tr><td>Unit 1</td><td>Digital Watt-hour meter type ACTARIS SL7000 (Main Meter)</td><td>0.2</td><td>36027156</td></tr><tr><td>Unit 2</td><td>Digital Watt-hour meter type ACTARIS SL7000 (Main Meter)</td><td>0.2</td><td>36027159</td></tr><tr><td>Unit 3</td><td>Digital Watt-hour meter type ACTARIS SL7000 (Main Meter)</td><td>0.2</td><td>36027158</td></tr></table> .
QA/QC procedures to be applied	The QA/QC will be conducted through cross-checking the main meter reading report (Monthly Electricity Protocol report) at the transaction point with the Water Tax payment receipt issued by Bengkulu Province Tax Office (local government). The main meters at the transaction point will be read regularly and jointly by the person in charge from PLN Musi HEPP Generation unit and PLN Transmission unit. Meters will be calibrated on every 5 yearly basis according to the national standard or other documents.
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 Musi 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 Musi 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 Musi 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 Musi 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 Musi HEPP

No.	Description	
1.	Electricity Meter Transfer 1 from power generation unit 1, Musi hydropower plant	Type: Actaris type SL 7000 Serial Number: 36027156 Class: 0.2 Date of Calibration: 06/07/2012, valid until 06/07/2017
2.	Electricity Meter Transfer 2 from power generation unit 2, Musi hydropower plant	Type: Actaris type SL 7000 Serial Number: 36027159 Class: 0.2 Date of Calibration: 06/07/2012, valid until 06/07/2017
3.	Electricity Meter Transfer 3 from power generation unit 3, Musi hydropower plant	Type: Actaris type SL 7000 Serial Number: 36027158 Class: 0.2 Date of Calibration: 08/07/2012, valid until 08/07/2017

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 transaction point of PLN grid. 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 standard[17]. 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

[17]The 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 28 February 2018]

in the test, then an adjustment shall be made correcting all measurements of energy made by the metering system, as described in the PPA.

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.

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, 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.

In case, both, the main meter and the check-meters are found to be beyond the permissible limit of error, then the meters shall be replaced with spare set of calibrated meters.

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.

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 Musi 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 Bandar Lampung 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 Palembang as headquarter for all power plant units in Southern 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 with a minor adjustment to allow for transmission losses.
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 3 - 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, 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, use protective masks for employees.
Water pollution	

Identified Environmental impacts	Measures taken
Change in surface water flow due to land clearing and covering.	Create a drainage system to the nearest water body, perform a gradual land covering based on project phase, and execute land clearing only on the project site.
Solid waste	
Construction waste from the transportation of soil material.	Perform continuous cleaning during the construction period to remove debris and deposit them 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, maintain the minimum river flow to preserve the natural biodiversity within the river.
Employment impacts	
Utilisation 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, 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, 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.	Provide employment opportunities to local human resources following high Health and Safety standards.

Identified Environmental impacts	Measures taken
Working opportunity and income	
Related to utilisation of local human resources.	Give priority to the admission of local human resources, hold special training 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 road side.
Social responsibility	
Community perception related to project operation	Contribution to the surrounding environment by building school and local health service.

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). The Musi Hydroelectric Power Plant project has an installed capacity of total 210 MW electricity in total and requires an EIA.

An EIA has been developed for this project and approved by the Department of Energy and Mining in 1993.

5.3 Local Stakeholder Consultation

A meeting with relevant stakeholders which was held on 6 May 2003, including the village chief and people who live nearby, within the project boundary of Musi hydro power plant was conducted for the purpose of the EIA. As documented in the EIA, the local stakeholders have perceived that the construction of Musi 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.

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.

5.4 Public Comments

N/A