



CAPACITY UPGRADE OF GUNUNG SALAK GEOTHERMAL POWER PLANT PROJECT, INDONESIA



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CONTENTS

1	PROJECT DETAILS	4
1.1	Summary Description of the Implementation Status of the Project	4
1.2	Sectoral Scope and Project Type	5
1.3	Project Proponent	5
1.4	Other Entities Involved in the Project	6
1.5	Project Start Date	6
1.6	Project Crediting Period	6
1.7	Project Location	7
1.8	Title and Reference of Methodology	7
1.9	Participation under other GHG Programs.....	8
1.10	Other Forms of Credit	8
1.11	Sustainable Development	8
2	SAFEGUARDS	10
2.1	No Net Harm	10
2.2	Local Stakeholder Consultation	11
3	IMPLEMENTATION STATUS.....	12
3.1	Implementation Status of the Project Activity	12
3.2	Deviations	12
3.3	Grouped Projects.....	13
4	DATA AND PARAMETERS	13
4.1	Data and Parameters Available at Validation	13
4.2	Data and Parameters Monitored	18
4.3	Monitoring Plan	29
5	QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS	33
5.1	Baseline Emissions.....	33
5.2	Project Emissions.....	42
5.3	Leakage	50

5.4	Net GHG Emission Reductions and Removals	50
APPENDIX I: SPECIFIC STEAM CONSUMPTION (SSC) CALCULATION FOR EACH UNIT		
	53	
APPENDIX II: ISSUED UNDER RENEWABLE ENERGY CERTIFICATES (RECS)		56

1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

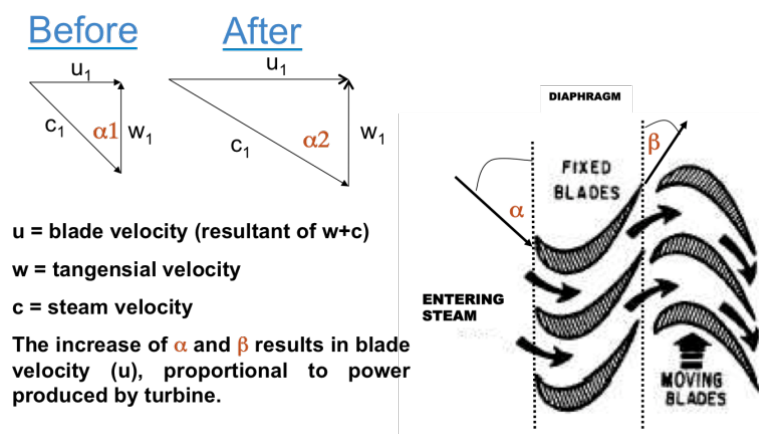
The project activity comprises of a capacity upgrade of Gunung Salak Geothermal Power Plant from 3 x 55 MW to 3 x 60 MW. The additional installed capacity of 15 MW at Gunung Salak Geothermal power plant generates and supplies an average of 213,959 MWh p.a. of electricity to the connected JAMALI Grid. The project is owned and developed by PT. Indonesia Power, a subsidiary company of PT. PLN (Persero), a state-owned electricity company. The proposed project will increase the utilization of renewable energy sources, in this case geothermal energy, by modifying turbines and steam gas ejectors. Steam for the project is provided by Chevron Geothermal Indonesia under an Energy Sales Contract (ESC) between PT. PLN (Persero) Pertamina, a state-owned oil and gas company, and Unocal Geothermal of Indonesia (Though today, Gunung Salak geothermal fields are owned by Chevron Geothermal Indonesia Ltd.).

The Capacity upgrade of Gunung Salak geothermal power plant project, Indonesia (referred later as the project activity) comprises of following modification¹ that has been undertaken to increase the steam flow, thus increasing the installed capacity of the power plant from 3 x 55 MW to 3 x 60 MW:

- Turbine modification, which means to modify first and second stage diaphragms by increasing nozzle size from α_1 to α_2 to allow steam turbine efficiency as shown in Graph 1.
- Ejector line replacement, which means to replace a smaller line of ejectors with a new design to increase the flow rate of Non-Condensable Gases (NCG) that is caused by an increase in steam flow due the project activity.

¹ Contract for Off Shore Materials Supply for Power Up-Rating of Unit 1, 2, and 3 between PT. Indonesia Power and AnsaldoEnergiaSpA, dated on 22/07/2002.

Figure 1. Nozzle increase in the diaphragms



The project does not modify and/or replace the whole power stations but only parts of their equipment. In the end, the project does not really change the established technology, which consists of a steam turbine, electrical generators, a gas extraction system, a 150kV switchyard system, and a utility system. The project is using the same hot water-dominated steam characteristic from Gunung Salak Geothermal field, with a condensate re-injection well-system to maintain groundwater supply. However, the project utilizes a higher steam flow due to a capacity increase by modifying steam turbines.

1.2 Sectoral Scope and Project Type

According to the VCS, the project activity falls under the category of renewable energy projects (wind, PV, solar thermal, biomass, liquid bio-fuels, geothermal, and run-of-river hydro) with emission reductions between 5,000-1,000,000 tCO₂e per year. The project is not part of a grouped project.

According to the CDM UNFCCC criteria, one approved GHG program by the VCS Board, the project is classified as a large scale project, which falls under Sectoral Scope 1: Energy Industries (renewable/non- renewable).

1.3 Project Proponent

Project Owner:

Organization name	PT. Indonesia Power
Contact person	Eri Prabowo
Title	Director of Operation I
Address	Jl. Jenderal Gatot Subroto Kav. 18, Jakarta 12950, Indonesia

Telephone	+62-21-526 7666
Email	eri.prabowo@indonesiapower.co.id

Carbon Credit buyer:

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

1.4 Other Entities Involved in the Project

Not applicable, as there are no other entities except PT. Indonesia Power and South Pole Carbon Asset Management Ltd.

1.5 Project Start Date

The project start date, when the power plant started to operate normally after the capacity upgrade performance test conducted by the technology provider and at the same time the project started to reduce GHG emissions:

Unit 1: 21-Jun-2005

Unit 2: 04-Apr-2005

Unit 3: 29-Sep-2004

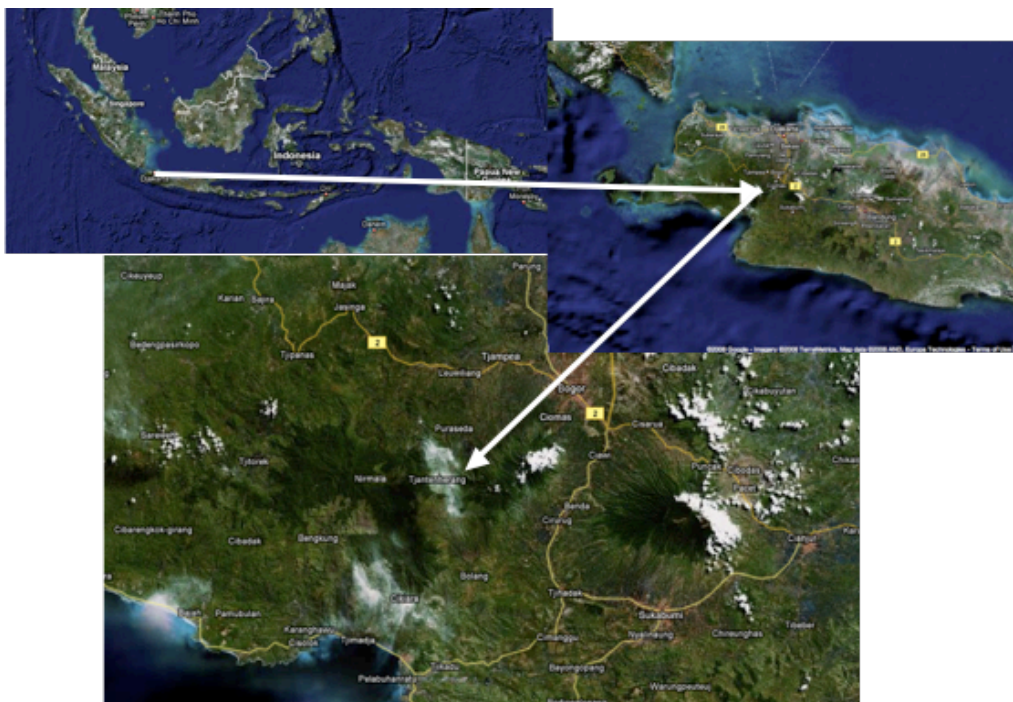
Thus, the project start date is 29-Sep-2004, as the earliest project start date of three units at Gunung Salak Geothermal Power Plant.

1.6 Project Crediting Period

The crediting period of this project activity is 10 years from 01-Apr-2016 until 31-Mar-2026.

1.7 Project Location

The project site is located in Awibengkok-Ratu area of Gunung Salak Geothermal field surrounded by Halimun Salak national park, which is administratively part of Bogor District and Sukabumi District, West Java Province, Indonesia. The project is located 988 m above sea level, approximately 82 km from Bogor and 58 km from Sukabumi. The exact location is 06° 44' 26" S, 106° 38' 28" E.



Source: Google Earth

1.8 Title and Reference of Methodology

The methodology applied for this project activity is

Type	:	I – Energy Industries (Renewable / Non Renewable Sources)
Category	:	ACM0002 “Consolidated methodology for grid-connected electricity generation from renewable sources”
Version	:	17.0

Further background information on the project activity can be found in the VCS Project Description (VCS PD) and associated documents, which had already been submitted for validation as per requirements of the Voluntary Carbon Standard, Version 3.7. The VCS PD and associated documents are available upon request.

1.9 Participation under other GHG Programs

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

1.10 Other Forms of Credit

- **Emission Trading Programs and Other Binding Limits:** The project activity is not included in an emission trading program or any other mechanism that includes GHG allowance trading.
- **Other Forms of Environmental Credit:** 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 program². For this verification period, the specific period of 1-Jun-2018 to 19-Jun 2018 and 2-Feb-2019 have been issued under International Renewable Energy certificate (I-REC).

1.11 Sustainable Development

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

Social well-being:

- The project contributes to the development of the region by increasing community development and corporate social responsibility of PT. Indonesia Power.
- During the capacity upgrade and operation, there are various kinds of mechanical work, which generates employment on regular and permanent basis.

Economic well-being:

- The project activity generates employment in the local area.
- The project activity is a good investment in a developing region, which otherwise would not have happened in the absence of project activity.
- The generated electricity is fed into regional grids through the local grid, thereby improving the grid frequency and availability of electricity to the local consumers (villagers and sub-urban inhabitants), which will provide new opportunities for

² According to VCS Standard: VCS Version 3, 21 June 2017, v3.7

industries and economic activities to be setup in the area thereby resulting in greater local employment, ultimately leading to overall development.

- The project activity also 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 geothermal power to generate electricity, which otherwise would have been generated through alternate fuel- (most likely fossil fuel-) based power plants, contributing to a reduction in specific emissions (emissions of pollutant/unit of energy generated) including GHG emissions.
- As geothermal power projects produce no end products in the form of solid waste (ash, etc.), they address the problem of solid waste disposal encountered by most other sources of power.
- Being a renewable energy source, geothermal 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.

Technological well-being:

- The project supports technology transfer from other regions or even other countries, as well as contributes to capacity building of the labour force through trainings and practical works.
- The project promotes local products developed in the region, when replacement of spare parts is necessary, and supports renewable technology development especially for geothermal power technology.

In view of the above explanation, the project participants consider that the project activity profoundly contributes to sustainable development.

2 SAFEGUARDS

2.1 No Net Harm

According to adjusted Gunung Salak geothermal power plant's Environmental Impact Assessment (EIA), a revised RKL/RPL (Environment Management Plan and Environment Monitoring Plan) for the additional installed capacity 3 x 5 MW.

The report clearly recognizes that impacts, if any, have been taking into account before and after the project activity as summarized in the letter No. 660.1/1801/I/2007 from the provincial Environmental Agency (BPLHD) of West Java to the project owner due capacity upgrade activity.

A summary of the environmental impacts of the project activity is described below:

Identified Environmental impacts	Measures taken
Operational Phase	
Air Pollution	
An increase H ₂ S gas concentration	Maintain sound operation of turbine and its system together with a fan and blower in the cooling tower.
Noise Pollution	
An increase of noise	Install a noise buffer and cover made from soundproof material for turbine and its system
Water Pollution	
Surface water body pollution	Re-inject waste water (condensates) from cooling tower to abandoned geothermal wells
Post-operational phase	
Re-construction of power plant	Will be planned 3 or 5 years before operational phase ends
Transportation of ruins	Will be planned 3 or 5 years before operational phase ends
Re-vegetation of power plant ex-location	Will be planned 3 or 5 years before operational phase ends

- Deterioration of air quality

During operational phase, some deterioration of air quality is expected to occur, especially an increase in H₂S gas released into the ambient air. The H₂S gas comes from the cooling tower during power plant operation, which emits non-condensable gases (NCG), and from the vent valve and scrubber if broken down.

To reduce this impact there will be regular maintenance and check ups for the turbine and system to prevent any H₂S gas leakage. In addition, the cooling tower must also be maintained regularly to decrease non-condensable gases (NCG) emission.

- Increased noise pollution

Increased noise pollution is expected from the turbine and its system during power plant operation.

To reduce the impact the project owner has installed a soundproof buffer and cover surrounding the turbine and its system to prevent any noise pollution to the environment.

- Deterioration of surface water quality

Minor deterioration of surface water quality due to the project activity is expected because of wastewater coming from the cooling tower.

To prevent any further increase, the project owner has managed to re-inject waste water (condensates) to abandoned geothermal wells.

Considering the mitigation controls planned as part of the project activity, EIA process and the contribution made by the project to the sustainable development of 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 will be described in the mitigation and monitoring plans.

2.2 Local Stakeholder Consultation

A meeting with relevant stakeholders, including the village chief and people who live nearby, within the project boundary of Gunung Salak geothermal power plant was conducted on 25-Sep-2008 at Raudhatul Jannah Mosque, Parung Kuda, near the power plant. The stakeholder meeting was held together with the power plant's Ramadhan (fasting month) festival to inform the local stakeholders that the capacity upgrade project at the power plant would be registered as one of carbon credit projects. The local stakeholders who attended the meeting have no objections to the proposed activity. Furthermore, as documented in the revised EIA³, the local stakeholders have perceived that Gunung Salak Geothermal Power Plant establishment has increased their social and economical life due to road construction, additional earning from temporary jobs, health services, and other pro-community activity.

The stakeholder meeting on 25-Sep-2008 was documented and recorded like attendance list, pictures, and other relevant documentation, which will be made available to DOE and sent separately.

³ The revised EIA is prepared to cover all environmental and social issue after the capacity upgrade of Gunung Salak geothermal power plant from 3x55 MW to 3x60 MW.

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.

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

As per VCS PD, the project activity includes Unit #1, Unit #2 and Unit #3 of Gunung Salak Geothermal Power Plant that were started to operate normally after the capacity upgrade performance test conducted by the technology provider and at the same time the project started to reduce GHG emissions on following dates:

Unit #1: 21-Jun-2005

Unit #2: 04-Apr-2005

Unit #3: 29-Sep-2004

The project activity generates electricity, thus displaces electricity that would have been generated from predominantly fossil fuel based power generation.

During this 2nd verification period from 01-Jul-2017 to 31-Oct-2019, the power plant is in operation continuously (with outages – forced and planned). The reasons for the planned and forced outages are due to earthquake, problem with the Bogor Baru Substation, problem with the condenser, maintenance outage, etc.

The Standard Operational Procedures signed between PT. Indonesia Power and PLN (load dispatcher) have been updated including for calibration of the meters measuring $EG_{facility,y}$. The calibration period of installed meters in power plants connected to JAMALI Grid has been changed from once per 2 years become once per 5 years⁴.

3.2 Deviations

3.2.1 Methodology Deviations

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

3.2.2 Project Description Deviations

The project developer has requested Deviation of Monitoring Plan for following parameters with details below:

⁴ Standard Operating Procedure (*Prosedur Tetap*) between PT. Indonesia Power with PT. Pertamina Geothermal Energy / Chevron Geothermal Salak, Ltd. Unit 1,2 and 3. Revision 2. September 2014

Deviation to parameter $w_{\text{steam.CO2,y}}$ and $w_{\text{steam.CH4,y}}$

As per validated VCS-PD, PP must monitor parameter $w_{\text{steam.CO2,y}}$ and $w_{\text{steam.CH4,y}}$ as described in the methodology ACM0002 version used in the registered VCS-PD of the “Grid-connected electricity generation from renewable sources” (Version 17.0, 13 May 2016, EB 89).

Subject	Original Monitoring Plan as per validated VCS PD	Deviation of the Monitoring Plan
Description of measurement methods and procedures to be applied	Non-condensable gases sampling should be carried out in production wells and at the steam field-power plant interface using ASTM Standard Practice E1675 for Sampling 2-Phase Geothermal Fluid for Purposes of Chemical Analysis (as applicable to sampling phase steam only). The Non-Condensable Gases (NCG) sampling and analysis will be performed every three months.	Non-condensable gases sampling should be carried out in production wells and/or at the steam field-power plant interface using ASTM Standard Practice E1675 for Sampling 2-Phase Geothermal Fluid for Purposes of Chemical Analysis (as applicable to sampling phase steam only). The Non-Condensable Gases (NCG) sampling and analysis will be performed every three months.

3.3 Grouped Projects

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

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Data / Parameter	$EG_{\text{historical}}$
Data unit	MWh
Description	Average net electricity delivered to the grid before the project activity until $DATE_{\text{BaselineRetrofit}}$
Source of data	Project Owner-PLN revenue meter (electricity sales) Meter No. Unit #1: PS 0512A040-01 with class of accuracy 0.2 Unit #2: PS 0512A041-01 with class of accuracy 0.2 Unit #3: PS 0512A042-01 with class of accuracy 0.2 On 1 October 2008, the electricity sales flow meter was

	replaced by PT 0806A117-01 / PT 0806A118-01 / PT 0806A119-01.										
Value applied	<table border="1"> <thead> <tr> <th></th><th>EG_{historical} until DATE_{BaselineRetrofit} (MWh)</th></tr> </thead> <tbody> <tr> <td>Unit 1</td><td>393,791</td></tr> <tr> <td>Unit 2</td><td>380,210</td></tr> <tr> <td>Unit 3</td><td>391,623</td></tr> <tr> <td>Total</td><td>1,165,624</td></tr> </tbody> </table> The data above is based on an average of historical net electricity generation data recorded by PT. Indonesia Power since 1998-2004 for Unit 3 and 1996-2005 for Units 1 and 2.		EG _{historical} until DATE _{BaselineRetrofit} (MWh)	Unit 1	393,791	Unit 2	380,210	Unit 3	391,623	Total	1,165,624
	EG _{historical} until DATE _{BaselineRetrofit} (MWh)										
Unit 1	393,791										
Unit 2	380,210										
Unit 3	391,623										
Total	1,165,624										
Justification of choice of data or description of measurement methods and procedures applied	Electricity produced is measured by a watt-hour meter (connected to a digital control system and recorded continuously), which can measure both power delivered to the grid and received from the grid. Therefore, net electricity export is measured. The measurement of electricity generation is conducted on a continuous basis, where hourly and daily total electricity measurement will be available. The measurement results is summarised transparently in regular production reports.										
Purpose of Data	Calculation of baseline emissions										
Comments	Standard Operation Procedure signed between PT. Indonesia Power and PT PLN (load dispatcher) or other documents, which update or replace this SOP.										

Data / Parameter	$\sigma_{\text{historical}}$										
Data unit	MWh										
Description	Standard deviation of average net electricity delivered to the grid before the project activity until DATE _{BaselineRetrofit}										
Source of data	Statistical calculation of standard deviation of EG _{historical}										
Value applied	<table border="1"> <thead> <tr> <th></th><th>$\sigma_{\text{historical}}$ until DATE_{BaselineRetrofit} (MWh)</th></tr> </thead> <tbody> <tr> <td>Unit 1</td><td>41,556</td></tr> <tr> <td>Unit 2</td><td>39,743</td></tr> <tr> <td>Unit 3</td><td>51,982</td></tr> <tr> <td>Total</td><td>133,281</td></tr> </tbody> </table> The data above is based on an average of historical net electricity generation data recorded by PT. Indonesia Power since 1998-2004 for Unit 3 and 1996-2005 for Units 1 and 2.		$\sigma_{\text{historical}}$ until DATE _{BaselineRetrofit} (MWh)	Unit 1	41,556	Unit 2	39,743	Unit 3	51,982	Total	133,281
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Unit 1	41,556										
Unit 2	39,743										
Unit 3	51,982										
Total	133,281										

Justification of choice of data or description of measurement methods and procedures applied	Statistical calculation
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	DATE _{BaselineRetrofit}												
Data unit	Date												
Description	Point in time when the existing equipment would need to be replaced in the absence of the project activity												
Source of data	- Energy Sales Contract (ESC) for steam purchase contract mentioned that the project must be available to supply electricity until year of 2030 (and may elect to extend the term until year of 2040). - Geothermal industry practice is the typical average technical lifetime of geothermal power plant is 30-50 years (Matek, B. Geothermal Energy Association Issue Brief: Additional Economic Values of Geothermal Power, 2015⁵).												
Value applied	<table><tr><td></td><td>Commissioning Date</td><td>DATE_{BaselineRetrofit}</td></tr><tr><td>Unit 1</td><td>12 March 1994</td><td>12 March 2040</td></tr><tr><td>Unit 2</td><td>12 June 1994</td><td>12 June 2040</td></tr><tr><td>Unit 3</td><td>16 July 1997</td><td>16 July 2043</td></tr></table> The DATE_{BaselineRetrofit} comes from commissioning date of each unit added by the average technical lifetime of 46 years.		Commissioning Date	DATE _{BaselineRetrofit}	Unit 1	12 March 1994	12 March 2040	Unit 2	12 June 1994	12 June 2040	Unit 3	16 July 1997	16 July 2043
	Commissioning Date	DATE _{BaselineRetrofit}											
Unit 1	12 March 1994	12 March 2040											
Unit 2	12 June 1994	12 June 2040											
Unit 3	16 July 1997	16 July 2043											
Justification of choice of data or description of measurement methods and procedures applied	-												
Purpose of Data	Calculation of baseline emissions												
Comments	-												

⁵ https://geo-energy.org/events/Geothermal%20Energy%20Association%20Issue%20Brief_Economic%20Values%202015_Final.pdf (accessed, 2017) / http://geo-energy.org/geo_basics_plant_cost.aspx (accessed, 2017))

Data / Parameter	GWP_{CH_4}
Data unit	tCO_2/tCH_4
Description	Global warming potential of methane, valid for the relevant commitment period
Source of data	IPCC
Value applied	Default value for the second commitment period = 25 tCO_2/tCH_4 . (Updated required for source of global warming potentials from the IPCC's Second Assessment Report to the IPCC's Fourth Assessment Report)
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of project emissions
Comments	-

Data / Parameter	$EF_{grid,OM,y}$
Data unit	tCO_2/MWh
Description	$EF_{grid,OM,y}$ is the average operating margin CO_2 emission factor of power plant connected to the JAMALI electricity grid in 3 recent years available data, calculated using average OM method for each year in which the project generation occurs. During the crediting period, this factor is calculated based on ex-ante emissions by using year 2013, 2014 and 2015 data.
Source of data	Directorate General of Electricity - Ministry of Energy and Mineral Resources (MEMR), Republic of Indonesia
Value applied	$EF_{grid,OM,y} = 0.786 tCO_2/MWh$
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.
Purpose of Data	Calculation of baseline emissions
Comments	All data relevant for the calculation of $EF_{grid,OM,y}$ are updated annually. This includes each associated fuel emission factor and corresponding net calorific values, is re-defined annually.

Data / Parameter	$EF_{grid,BM,y}$
Data unit	tCO ₂ /MWh
Description	$EF_{grid,BM,y}$ is the build margin CO ₂ emission factor of power plants in the sample group 'm' connected to the JAMALI electricity grid in year 'y'. During the crediting period, this factor is calculated based on ex-ante emissions by using year 2015 data.
Source of data	Directorate General of Electricity - Ministry of Energy and Mineral Resources (MEMR), Republic of Indonesia
Value applied	$EF_{grid,BM,y} = 0.999 \text{ tCO}_2/\text{MWh}$
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.
Purpose of Data	Calculation of baseline emissions
Comments	All data relevant for the calculation of $EF_{grid,BM,y}$ are updated annually. This includes each associated fuel emission factor and corresponding net calorific values, as well as sample group "m" power plants (its associated generation and fuel consumption data), is re-defined annually.

Data / Parameter	$EF_{grid,CM,y}$
Data unit	tCO ₂ /MWh
Description	$EF_{grid,CM,y}$ is the combined margin CO₂ emission factor of power plants connected to the JAMALI electricity grid in year 'y', calculated ex-ante based on the weighted average of $EF_{grid,OM,y}$ and $EF_{grid,BM,y}$. 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
Value applied	$EF_{grid,CM,y} = 0.946 \text{ tCO}_2/\text{MWh}$
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.

Purpose of Data	Calculation of baseline emissions
Comments	-

4.2 Data and Parameters Monitored

Data / Parameter	M _{steam,y}																																											
Data unit	t steam																																											
Description	Quantity of steam produced during the year 'y'																																											
Source of data	Project Owner-main steam line flow meter																																											
Description of measurement methods and procedures to be applied	The measurement of steam quantities is conducted on a continuous basis, where hourly steam flow is available in paper format. The measurement results are summarized in electronic format as part of monitoring plan.																																											
Frequency of monitoring/recording	Steam flow is hourly measured and recorded in paper format. Subsequently, the data is aggregated yearly in electronic format.																																											
Value monitored	<table><tr><td></td><td colspan="3">Steam produced during the year 'y' (t steam/year)</td></tr><tr><td></td><td>01/07/2017 - 31/12/2017</td><td>01/01/2018 - 31/12/2018</td><td>01/01/2019 - 31/10/2019</td></tr><tr><td>Unit 1</td><td>1,754,424.91</td><td>3,833,938.30</td><td>2,789,486.52</td></tr><tr><td>Unit 2</td><td>1,901,994.30</td><td>3,616,722.14</td><td>2,772,481.87</td></tr><tr><td>Unit 3</td><td>1,789,189.18</td><td>3,584,900.80</td><td>3,127,635.40</td></tr></table> Based on information of steam flow calibration details, there were no delay in performing steam flow calibration Unit #1, #2, and #3. The data above is based on Steam log sheet document under Steam flow column manually recorded by PT. Indonesia Power. Steam quantities based on underlying project boundary (steam attributable to the project's capacity upgrade) <table><tr><td></td><td colspan="3">Steam produced during the year 'y' (t steam/year)</td></tr><tr><td></td><td>01/07/2017 - 31/12/2017</td><td>01/01/2018 - 31/12/2018</td><td>01/01/2019 - 31/10/2019</td></tr><tr><td>Unit 1</td><td>154,479</td><td>262,625</td><td>189,692</td></tr><tr><td>Unit 2</td><td>362,187</td><td>431,619</td><td>368,048</td></tr><tr><td>Unit 3</td><td>280,869</td><td>342,791</td><td>310,831</td></tr></table>					Steam produced during the year 'y' (t steam/year)				01/07/2017 - 31/12/2017	01/01/2018 - 31/12/2018	01/01/2019 - 31/10/2019	Unit 1	1,754,424.91	3,833,938.30	2,789,486.52	Unit 2	1,901,994.30	3,616,722.14	2,772,481.87	Unit 3	1,789,189.18	3,584,900.80	3,127,635.40		Steam produced during the year 'y' (t steam/year)				01/07/2017 - 31/12/2017	01/01/2018 - 31/12/2018	01/01/2019 - 31/10/2019	Unit 1	154,479	262,625	189,692	Unit 2	362,187	431,619	368,048	Unit 3	280,869	342,791	310,831
	Steam produced during the year 'y' (t steam/year)																																											
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Unit 3	1,789,189.18	3,584,900.80	3,127,635.40																																									
	Steam produced during the year 'y' (t steam/year)																																											
	01/07/2017 - 31/12/2017	01/01/2018 - 31/12/2018	01/01/2019 - 31/10/2019																																									
Unit 1	154,479	262,625	189,692																																									
Unit 2	362,187	431,619	368,048																																									
Unit 3	280,869	342,791	310,831																																									

	Steam quantities based on underlying project boundary are calculated based on the Specific Steam Consumption (SSC).		
Monitoring equipment	Steam flow meter		
	Type & Accuracy Class	Serial Number	Calibration Details
	Unit 1 - Type: GE PanaFlow MV82 - Accuracy Class: 2%	4987429-2	Previous: 27/12/2016 Current: 30/05/2017 Next: 30/05/2022
	Unit 2 - Type: GE PanaFlow MV82 - Accuracy Class: 2%	4987429-1	Previous: 29/08/2016 Current: 30/05/2017 Next: 30/05/2022
	Unit 3 - Type: Endress+Hausser FMD78 - Accuracy Class: 0.25%	D404420109D	Previous: 13/07/2016 Current: 13/07/2017 Next: 13/07/2022
QA/QC procedures to be applied	Meters is maintained and periodically calibrated internally to ensure accurate readings. As part of the QA/QC procedure a backup check calculation (to be used during emergencies such as trip, scaling in the steam pipeline, etc.) is performed in addition to the primary venturi flow meter measurement. Meters have been calibrated according to the national standard of Java-Madura-Bali (JAMALI) Grid Code⁶ that described calibration period of installed meters in power plants connected to JAMALI Grid is once per 5 years.		
Purpose of the data	Calculation of project emissions		
Calculation method	Specific Steam Consumption (SSC) calculation: $SSC = \frac{\text{Steam flowrate (t steam)}}{\text{Net power output of the plant (MWh)}}$		

⁶ This complies with the Minister of Energy and Mineral Resources Regulation No. 3 issued in 2007 (<https://jdih.esdm.go.id/peraturan/permen-esdm-03-2007.pdf>) regarding Java--Madura--Bali (JAMALI) Grid Code.

01/07/2017 - 31/12/2017			
	Steam flowrate (t steam)	Net power output of the plant (MWh)	SSC (t steam/MWh)
Unit 1	1,754,424.91	213,864.79	8.203
Unit 2	1,901,994.30	243,548.23	7.810
Unit 3	1,789,189.18	236,713.34	7.558

01/01/2018 - 31/12/2018			
	Steam flowrate (t steam)	Net power output of the plant (MWh)	SSC (t steam/MWh)
Unit 1	3,833,938.30	455,692.53	8.413
Unit 2	3,616,722.14	449,970.80	8.038
Unit 3	3,584,900.80	469,149.90	7.641

01/01/2019 - 31/10/2019			
	Steam flowrate (t steam)	Net power output of the plant (MWh)	SSC (t steam/MWh)
Unit 1	2,789,486.52	339,747.67	8.210
Unit 2	2,772,481.87	347,859.72	7.970
Unit 3	3,127,635.40	406,457.94	7.695

- Steam quantities based on underlying project boundary calculation is SSC times the attributable electricity generation to VCS Project ($EG_{PJ,y}$)

01/07/2017 - 31/12/2017			
	SSC (t steam/MWh)	Attributable electricity generation to VCS Project ($EG_{PJ,y}$) (MWh)	Steam quantities based on underlying project boundary (t steam)
Unit 1	8.203	18,843	154,479
Unit 2	7.810	33,571	262,625
Unit 3	7.558	25,138	189,692

	01/01/2018 - 31/12/2018		
	SSC (t steam/MWh)	Attributable electricity generation to VCS Project (EG _{PJ,y}) (MWh)	Steam quantities based on underlying project boundary (t steam)
	Unit 1	8.413	42,963
	Unit 2	8.038	53,769
	Unit 3	7.641	48,418
	01/01/2019 - 31/10/2019		
	SSC (t steam/MWh)	Attributable electricity generation to VCS Project (EG _{PJ,y}) (MWh)	Steam quantities based on underlying project boundary (t steam)
	Unit 1	8.210	34,173
	Unit 2	7.970	43,019
	Unit 3	7.695	40,420
Comments	Continuous measurement, subsequently, the data will be aggregated monthly.		

Data / Parameter	W _{steam,CO2,y}
Data unit	t CO ₂ /t steam
Description	Average mass fraction of CO ₂ in the produced steam in year y
Source of data	The Non-Condensable Gases (NCG) data taken from steam sampling as prescribed in the Monitoring Methodology ACM0002 version 17.0
Description of measurement methods and procedures to be applied	Non-condensable gases sampling should be carried out at the steam field-power plant interface using ASTM Standard Practice E1675 for Sampling 2-Phase Geothermal Fluid for Purposes of Chemical Analysis (as applicable to sampling phase steam only) as prescribed in the Monitoring Methodology ACM0002 version 17.0. The Non-Condensable Gases (NCG) sampling and analysis is performed every three months, after the project is validated, by PT. Geoservices (Ltd) with a supervision of Gunung Salak Geothermal Power Plant Laboratory.
Frequency of monitoring/recording	Every three months
Value monitored	

Analysis #	Period to be used in $PE_{flash\ steam,y}$ calculation	CO ₂ values to be used in $PE_{flash\ steam,y}$ calculation (non dimensional)		
	Month/Year	UNIT #1	UNIT #2	UNIT #3
1	07/2017	0.0057443700	0.0057194820	0.0065820480
	08/2017	0.0057443700	0.0057194820	0.0065820480
	09/2017	0.0057443700	0.0057194820	0.0065820480
2	10/2017	0.0048806160	0.0057149400	0.0057197400
	11/2017	0.0048806160	0.0057149400	0.0057197400
	12/2017	0.0048806160	0.0057149400	0.0057197400
3	01/2018	0.0049251280	0.0056593980	0.0057166800
	02/2018	0.0049251280	0.0056593980	0.0057166800
	-	-	-	-
4	03/2018	0.0053354560	0.0053326560	0.0065766660
	04/2018	0.0053354560	0.0053326560	0.0065766660
	05/2018	0.0053354560	0.0053326560	0.0065766660
5	06/2018	0.0060100740	0.0061001600	0.0060111450
	07/2018	0.0060100740	0.0061001600	0.0060111450
	08/2018	0.0060100740	0.0061001600	0.0060111450
6	09/2018	0.0044983200	0.0048393900	0.0049785020
	10/2018	0.0044983200	0.0048393900	0.0049785020
	11/2018	0.0044983200	0.0048393900	0.0049785020
7	12/2018	0.0052673700	0.0058996100	0.0058809240
	01/2019	0.0052673700	0.0058996100	0.0058809240
	02/2019	0.0052673700	0.0058996100	0.0058809240
8	03/2019	0.0061655680	0.0068662800	0.0074932260
	04/2019	0.0061655680	0.0068662800	0.0074932260
	05/2019	0.0061655680	0.0068662800	0.0074932260
9	06/2019	0.0061278100	0.0064713560	0.0076930560
	07/2019	0.0061278100	0.0064713560	0.0076930560
	08/2019	0.0061278100	0.0064713560	0.0076930560
10	09/2019	0.0071982750	0.0056950930	0.0088954500
	10/2019	0.0071982750	0.0056950930	0.0088954500
	11/2019	0.0071982750	0.0056950930	0.0088954500

As per monitoring plan of VCS PD, NCG analysis must be conducted every 3 months. Planning and realization date table as following:

NCG Analysis		
Analysis #	Planned date	Realization date
1	23/06/2017	12/06/2017
2	23/09/2017	11/09/2017
3	23/12/2017	05/12/2017

		4	23/03/2018	22/02/2018	
		5	23/06/2018	15/05/2018	
		6	23/09/2018	14/08/2018	
		7	23/12/2018	22/11/2018	
		8	23/03/2018	26/03/2019	
		9	23/06/2018	14/05/2019	
		10	23/09/2018	17/07/2019	
Monitoring equipment	Equipment's monitored as per Monitoring Methodology ACM0002 version 17.0.				
QA/QC procedures to be applied	Gunung Salak Geothermal Laboratory QA/QC Procedure				
Purpose of the data	Calculation of project emissions				
Calculation method	-				
Comments	-				

Data / Parameter	$W_{\text{steam,CH}_4,y}$																				
Data unit	t CH ₄ /t steam																				
Description	Average mass fraction of CH ₄ in the produced steam in year y																				
Source of data	The Non-Condensable Gases (NCG) data taken from steam sampling as prescribed in the Monitoring Methodology ACM0002 version 17.0																				
Description of measurement methods and procedures to be applied	Non-condensable gases sampling should be carried out at the steam field-power plant interface using ASTM Standard Practice E1675 for Sampling 2-Phase Geothermal Fluid for Purposes of Chemical Analysis (as applicable to sampling phase steam only) as prescribed in the Monitoring Methodology ACM0002 version 17.0. The Non-Condensable Gases (NCG) sampling and analysis is performed every three months, after the project is validated, by PT. Geoservices (Ltd) with a supervision of Gunung Salak Geothermal Power Plant Laboratory.																				
Frequency of monitoring/recording	Every three months																				
Value monitored	<table border="1"> <thead> <tr> <th rowspan="2">Analysis #</th><th rowspan="2">Period to be used in $PE_{\text{flash steam},y}$ calculation</th><th colspan="3">CH₄ values to be used in $PE_{\text{flash steam},y}$ calculation (non dimensional)</th></tr> <tr> <th>UNIT #1</th><th>UNIT #2</th><th>UNIT #3</th></tr> </thead> <tbody> <tr> <td rowspan="2">1</td><td>07/2017</td><td>0.0000167811</td><td>0.0000005612</td><td>0.0000212658</td></tr> <tr> <td>08/2017</td><td>0.0000167811</td><td>0.0000005612</td><td>0.0000212658</td></tr> </tbody> </table>				Analysis #	Period to be used in $PE_{\text{flash steam},y}$ calculation	CH ₄ values to be used in $PE_{\text{flash steam},y}$ calculation (non dimensional)			UNIT #1	UNIT #2	UNIT #3	1	07/2017	0.0000167811	0.0000005612	0.0000212658	08/2017	0.0000167811	0.0000005612	0.0000212658
Analysis #	Period to be used in $PE_{\text{flash steam},y}$ calculation	CH ₄ values to be used in $PE_{\text{flash steam},y}$ calculation (non dimensional)																			
		UNIT #1	UNIT #2	UNIT #3																	
1	07/2017	0.0000167811	0.0000005612	0.0000212658																	
	08/2017	0.0000167811	0.0000005612	0.0000212658																	

	09/2017	0.0000167811	0.0000005612	0.0000212658
2	10/2017	0.0000121524	0.0000211860	0.0000185040
	11/2017	0.0000121524	0.0000211860	0.0000185040
	12/2017	0.0000121524	0.0000211860	0.0000185040
3	01/2018	0.0000068744	0.0000044722	0.0000070440
	02/2018	0.0000068744	0.0000044722	0.0000070440
	-	-	-	-
4	03/2018	0.0000336168	0.0000361144	0.0000362871
	04/2018	0.0000336168	0.0000361144	0.0000362871
	05/2018	0.0000336168	0.0000361144	0.0000362871
5	06/2018	0.0000451836	0.0000491072	0.0000347445
	07/2018	0.0000451836	0.0000491072	0.0000347445
	08/2018	0.0000451836	0.0000491072	0.0000347445
6	09/2018	0.0000080496	0.0000237099	0.0000268286
	10/2018	0.0000080496	0.0000237099	0.0000268286
	11/2018	0.0000080496	0.0000237099	0.0000268286
7	12/2018	0.0000513912	0.0000302622	0.0000351540
	01/2019	0.0000513912	0.0000302622	0.0000351540
	02/2019	0.0000513912	0.0000302622	0.0000351540
8	03/2019	0.0000006976	0.0000000072	0.0000295542
	04/2019	0.0000006976	0.0000000072	0.0000295542
	05/2019	0.0000006976	0.0000000072	0.0000295542
9	06/2019	0.0000220220	0.0000159188	0.0000133812
	07/2019	0.0000220220	0.0000159188	0.0000133812
	08/2019	0.0000220220	0.0000159188	0.0000133812
10	09/2019	0.0000028875	0.0000021240	0.0000377301
	10/2019	0.0000028875	0.0000021240	0.0000377301
	11/2019	0.0000028875	0.0000021240	0.0000377301

As per monitoring plan of VCS PD, NCG analysis must be conducted every 3 months. Planning and realization date table as following:

NCG Analysis		
Analysis #	Planned date	Realization date
1	23/06/2017	12/06/2017
2	23/09/2017	11/09/2017
3	23/12/2017	05/12/2017
4	23/03/2018	22/02/2018
5	23/06/2018	15/05/2018
6	23/09/2018	14/08/2018
7	23/12/2018	22/11/2018
8	23/03/2019	26/03/2019

		9	23/06/2018	14/05/2019	
		10	23/09/2018	17/07/2019	
Monitoring equipment	Equipment's monitored as per Monitoring Methodology ACM0002 version 17.0.				
QA/QC procedures to be applied	Gunung Salak Geothermal Laboratory QA/QC Procedure				
Purpose of the data	Calculation of project emissions				
Calculation method	-				
Comments	-				

Data / Parameter	EG _{facility,y}																								
Data unit	MWh																								
Description	Net electricity delivered to the grid by the project activity																								
Source of data	Project Owner-PLN revenue meter (electricity sales)																								
Description of measurement methods and procedures to be applied	Electricity produced is measured by a watt-hour meter (connected to a digital control system and recorded continuously), which can measure both power delivered to the grid and received from the grid. Therefore, net electricity export is measured. The measurement of electricity generation is conducted on a continuous basis, where hourly and daily total electricity measurement is available. The measurement results are summarized transparently in electronic format as part of monitoring plan. While, electricity invoices (in this sense, the Energy Statement Transaction) are compiled in paper format.																								
Frequency of monitoring/recording	The measurement of electricity generation is conducted on a continuous basis, where hourly and daily total electricity measurement is available.																								
Value monitored	<table><tr><td></td><th colspan="3">EG_{facility,y} (MWh)</th></tr><tr><td></td><th>01/07/2017 - 31/12/2017</th><th>01/01/2018 - 31/12/2018</th><th>01/01/2019 - 31/10/2019</th></tr><tr><td>Unit 1</td><td>213,865</td><td>455,693</td><td>339,748</td></tr><tr><td>Unit 2</td><td>243,548</td><td>449,971</td><td>347,860</td></tr><tr><td>Unit 3</td><td>236,713</td><td>469,150</td><td>406,458</td></tr><tr><td>Total</td><td>694,126</td><td>1,374,813</td><td>1,094,065</td></tr></table>		EG _{facility,y} (MWh)				01/07/2017 - 31/12/2017	01/01/2018 - 31/12/2018	01/01/2019 - 31/10/2019	Unit 1	213,865	455,693	339,748	Unit 2	243,548	449,971	347,860	Unit 3	236,713	469,150	406,458	Total	694,126	1,374,813	1,094,065
	EG _{facility,y} (MWh)																								
	01/07/2017 - 31/12/2017	01/01/2018 - 31/12/2018	01/01/2019 - 31/10/2019																						
Unit 1	213,865	455,693	339,748																						
Unit 2	243,548	449,971	347,860																						
Unit 3	236,713	469,150	406,458																						
Total	694,126	1,374,813	1,094,065																						
Monitoring equipment	Revenue meters used between 01/07/2017 – 28/02/2019 are:																								

	Revenue meter	Serial number	Class of Accuracy	Calibration date
	Unit #1	PT 0806A119-01	0.2	Previous: 03/06/2014 Current: 26/07/2016 Next: 26/07/2021
	Unit #2	PT 0806A118-01	0.2	Previous: 03/06/2014 Current: 26/07/2016 Next: 26/07/2021
	Unit #3	MT 1006A500-01	0.2	Previous: 03/06/2014 Current: 26/07/2016 Next: 26/07/2021
.				
QA/QC procedures to be applied	The QA/QC is conducted through cross checking with sales electricity receipts. Revenue meters are calibrated once per 5 years according to the Standard Operating Procedure (<i>Prosedur Tetap</i>) between PT. Indonesia Power with PT. Pertamina Geothermal Energy / Chevron Geothermal Salak, Ltd., Unit 1,2 and 3, Revision 2, September 2014, which replace to the PPA, and also for PLN owned back up meters calibration, which follows PLN's internal regulations⁷. Data measured by meters is cross-checked by electricity sales receipt. The meter (s) will either: i) be read frequently jointly by the project developer and the grid company ii) be only read by the project developer and data will be double checked with the electricity sales receipts iii) be only read by the grid company			

⁷ The calibration frequency of PLN-owned back-up meter is every 5 years. This complies with the Minister of Energy and Mineral Resources Regulation No. 3 issued in 2007 (<https://jdih.esdm.go.id/peraturan/permen-esdm-03-2007.pdf>) regarding Java-Madura-Bali (JAMALI) Grid Code that described calibration period of installed meters in power plants connected to JAMALI Grid is once per 5 years.

Purpose of the data	Calculation of baseline emissions
Calculation method	$EG_{\text{facility}} = EG_{\text{exp}} - EG_{\text{imp}}$ $EG_{\text{PJ},y} = EG_{\text{facility},y} - (EG_{\text{historical}} + \sigma_{\text{historical}}); \text{until DATE}_{\text{BaselineRetrofit}}$ In case $EG_{\text{facility},y} < (EG_{\text{historical}} + \sigma_{\text{historical}})$ in a year y then $EG_{\text{PJ},y} = 0$
Comments	PPA signed between PT. Indonesia Power and PT PLN (load dispatcher) or other documents, which update or replace this PPA. Since September 2014, an updated SOP of Metering System is applied replacing the previous SOP dated on June 2011.

Table 1. Technical details of monitoring instruments

S.No	Equipment	Description
1.	Electricity Revenue Meter Unit #1 (01/07/2017 at 10:01 AM - onwards) For $EG_{\text{facility},y}$, EG_{exp} , and EG_{imp}	Name: Static Energy Meter Manufacturer: Schneider Electric Type: ION 8600 Unit #1: PT 0806A119-01 Class of Accuracy: 0.2 Date of Calibration: 26/07/2016 Range: 0.05 - 20 A; 57 - 277 V; 50 Hz
2.	Electricity Revenue Meter Unit #2 (01/07/2017 at 10:01 AM - onwards) For $EG_{\text{facility},y}$, EG_{exp} , and EG_{imp}	Name: Static Energy Meter Manufacturer: Schneider Electric Type: ION 8600 Unit #1: PT 0806A118-01 Class of Accuracy: 0.2 Date of Calibration: 26/07/2016 Range: 0.05 - 20 A; 57 - 277 V; 50 Hz
3.	Electricity Revenue Meter Unit #3 (01/07/2017 at 10:01 AM - onwards) For $EG_{\text{facility},y}$, EG_{exp} , and EG_{imp}	Name: Static Energy Meter Manufacturer: Schneider Electric Type: ION 8600 Unit #1: MT 1006A500-01 Class of Accuracy: 0.2 Date of Calibration: 26/07/2016 Range: 0.05 - 20 A; 57 - 277 V; 50 Hz
4.	Electricity Back-up Meter Unit #1 (01/07/2017 at 10:01 AM - onwards)	Name: Static Energy Meter Manufacturer: Schneider Electric

S.No	Equipment	Description
	onwards) For back-up $EG_{facility,y}$, EG_{exp} , and EG_{imp}	Type: ION 8600 Unit #1: MT 1009A635-01 Class of Accuracy: 0.2 Date of Calibration: 05/03/2015 Range: 0.05 - 20 A; 57 - 277 V; 50 Hz
5.	Electricity Back-up Meter Unit #2 (01/07/2017 at 10:01 AM - onwards) For back-up $EG_{facility,y}$, EG_{exp} , and EG_{imp}	Name: Static Energy Meter Manufacturer: Schneider Electric Type: ION 8600 Unit #1: PT 0802A471-01 Class of Accuracy: 0.2 Date of Calibration: 05/03/2015 Range: 0.05 - 20 A; 57 - 277 V; 50 Hz
6.	Electricity Back-up Meter Unit #3 (01/07/2017 at 10:01 AM - onwards) For back-up $EG_{facility,y}$, EG_{exp} , and EG_{imp}	Name: Static Energy Meter Manufacturer: Schneider Electric Type: ION 8600 Unit #1: PT 0802A475-01 Class of Accuracy: 0.2 Date of Calibration: 05/03/2015 Range: 0.05 - 20 A; 57 - 277 V; 50 Hz
7.	Steam Flow Meter Unit #1 (01/07/2017 at 10:01 AM - onwards) For $M_{steam,y}$	Name: Main Steam Flow Meter Transmitter Manufacturer: General Electric (GE) Model No.: PanaFlow MV82 Serial No.: 4987429-2 Instrument No.: 1LBA01CF001-B01 Range: • Input: 0 ~ 2000 T/H • Output: 4 ~ 20 mA DC Accuracy: 2 % Date of Calibration: 27/12/2016, 30/05/2017
8.	Steam Flow Meter Unit #2 (01/07/2017 at 10:01 AM - onwards) For $M_{steam,y}$	Name: Main Steam Flow Meter Transmitter Manufacturer: General Electric (GE) Model No.: PanaFlow MV82 Serial No.: 4987429-1 Instrument No.: 2LBA01CF001-B01

S.No	Equipment	Description
		Range: • Input: 0 ~ 2000 T/H • Output: 4 ~ 20 mA DC Accuracy: 2 % Date of Calibration: 29/08/2016, 30/05/2017
9.	Steam Flow Meter Unit #3 For $M_{\text{steam},y}$	Name: Main Steam Flow Meter Transmitter Manufacturer: Endress-Hausser Model No.: FMD78 Serial No.: D404420109D Instrument No.: 3LBA01CF001-B01 Range: • Input: 0 ~ 200 mBar • Output: 4 ~ 20 mA DC • Scale: 0 ~ 100 % Accuracy: 0.25 % Date of Calibration: 13/07/2016, 13/07/2017

4.3 Monitoring Plan

This section presents the steps taken to monitor on regular basis the GHG emission reductions from the capacity upgrade project at Gunung Salak geothermal power plant in Indonesia.

The purpose of the monitoring plan is to present reliable and complete data and to ensure that all actual project data is well organized in term of collection and archiving.

Prior to the start of the crediting period, the organization of the monitoring team is established. Clear roles and responsibilities are assigned to all staff and the power plant manager involved in the VCS project, who have overall responsibility for the monitoring system in the project, ensuring trained staff perform the monitoring duties and that where trained monitoring staff are absent, the integrity of the monitoring system is maintained by other trained staff. Initial training is conducted and regular checks performed to ensure adequacy of monitoring data.

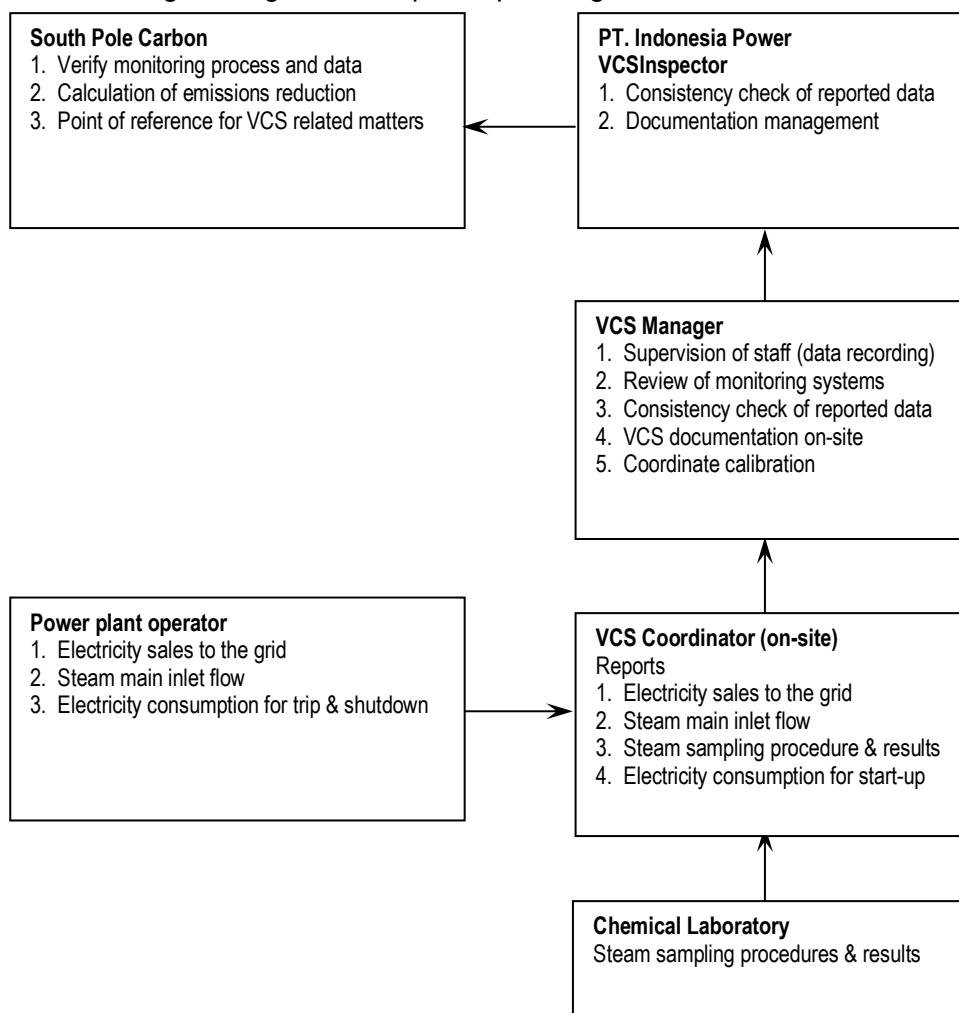
Details of Monitoring Team and Responsibilities

The electricity exported and imported together with steam flow rate and NCG characteristics required for emission reduction calculation were obtained by certain procedures set out in the monitoring plan. To address all O&M issues, the overall authority and responsibility belongs to the VCS Manager, which effectively controls and monitors the complete process in the power plant.

The Monitoring data of the equipments are recorded by the Technicians/ supervisors every shift (including the Chemical laboratory office for NCG characteristics) and submitted to the VCS Coordinator. The VCS Coordinator reports monthly to the VCS Manager. The VCS Manager submits a yearly report to the VCS Inspector, which is directly forwarded to South Pole Carbon.

Monitoring Organisation Chart

Figure 1. Gunung Salak geothermal power plant organisation chart



During monitoring period from 01/07/2017 to 31/10/2019, there is a change of person in charge (PIC), as following table.

Table 2. Gunung Salak geothermal power plant team and responsibilities

Team	Jobs and responsibilities	Position at the PT. Indonesia Power	Represented by (name)
VCS Inspector	Asses yearly report and discuss with South Pole if corrections needed in the monitoring SOP	Senior Environmental Expert	Mrs. Anna Reani
VCS Manager	- Documented and stored monthly report. - Prepare yearly report.	Gunung Salak Site Manager	Mr. Ervan Ambarita
VCS Coordinator	Prepare monthly report in the excel sheet	AMA Rernal Operation	Mr. Alan Syafrudin
Power plant operator (per shift)	Record hourly data of steam flow, EG_y, EG_{imp}, blackouts/power shutdowns and any emergencies occurred.	Operator	Operator
Chemical Laboratory	Supervise NCG sampling and analysis from the external certified Laboratory	Laboratory officer	Mr. Yuansah and Mr. Viki

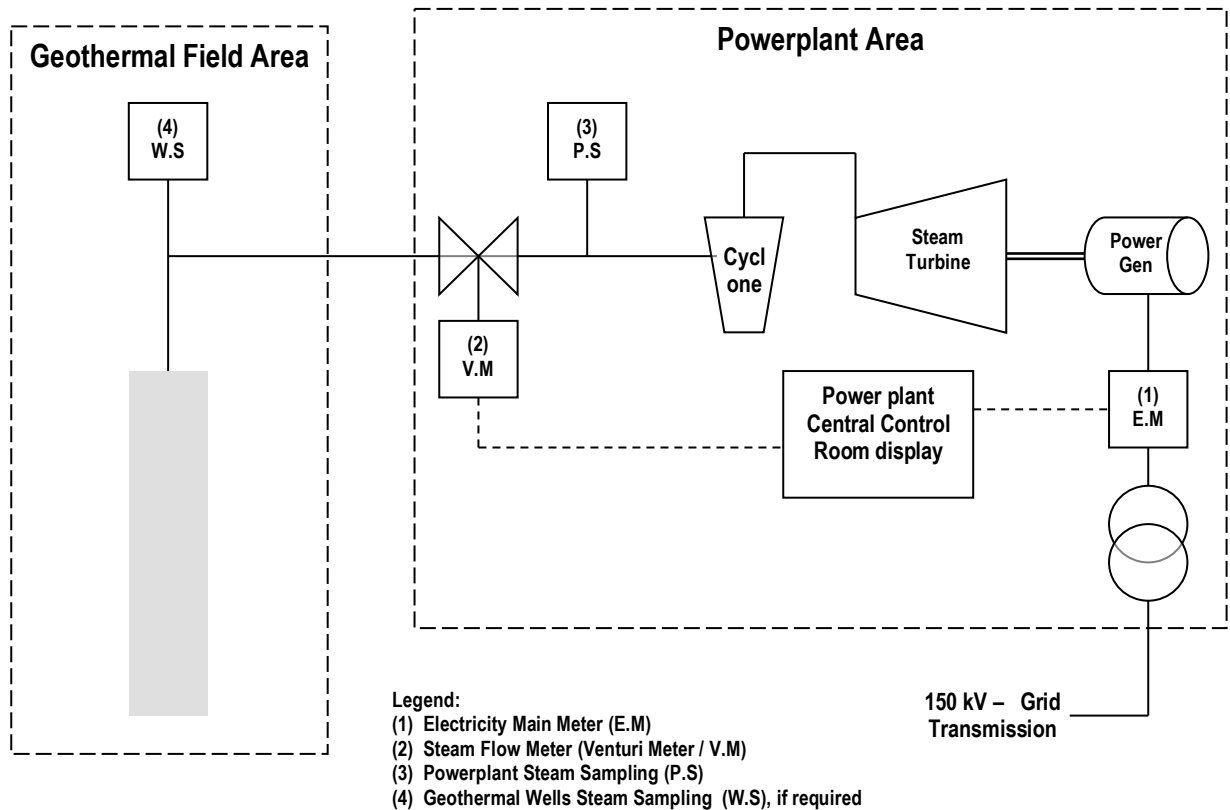
Measures to ensure the result/uncertainty analysis

The monitoring data of the equipments are recorded by supervisors for every shift and submitted to the VCS Coordinator. The VCS Coordinator compiles all daily-recorded (three-monthly assessment for NCG characteristic) data and reports monthly to the General Manager (acted as the VCS Manager). The VCS Manager documents and stores monthly report in the Project office, and then submits yearly reports to the VCS Inspector in the head office and directly forwarded to South Pole Carbon Asset Management. By this operational

structure, the VCS Inspector together with South Pole can monitor the project activity and make amendments immediately, if needed. The monitored parameters have low level of uncertainty. Therefore the possible monitoring data adjustments are not envisaged for the project. Reported results and data is compared with the previous results and data and thoroughly checked for any inconsistency.

Monitoring equipments

Figure 2. Gunung Salak geothermal power plant monitoring equipments



5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 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) minus the sum of annual average historical net electricity generation delivered to the grid by the existing renewable energy power plants/units that was operated at the project site prior to the implementation of the project activity ($EG_{historical}$ in MWh/yr) and standard deviation of the mentioned $EG_{historical}$ ($\sigma_{historical}$ in MWh/yr), as follows:

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

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 CDM 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 a retrofit or rehabilitation or replacement of an existing renewable energy power plant is calculated as follows:

$$EG_{PJ,y} = EG_{facility,y} - (EG_{historical} + \sigma_{historical}); \text{until } DATE_{BaselineRetrofit}$$

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 CDM 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)

$EG_{historical}$ = Annual average historical net electricity generation delivered to the grid by the existing renewable energy power plants/units that

was operated at the project site prior to the implementation of the project activity (MWh/yr)

$\sigma_{\text{historical}}$ = Standard deviation of the annual average historical net electricity generation delivered to the grid by the existing renewable energy power plants/units that was operated at the project site prior to the implementation of the project activity (MWh/yr)

$\text{DATE}_{\text{BaselineRetrofit}}$ = Point in time when the existing equipment would need to be replaced in the absence of the project activity (date). This only applies to retrofit or replacement projects

In case $\text{EG}_{\text{facility},y} < (\text{EG}_{\text{historical}} + \sigma_{\text{historical}})$ in a year y then $\text{EG}_{\text{PJ},y} = 0$

The emission factor is calculated in the validated VCS PD 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). According to the latest version of the tool, the JAMALI power grid is selected as the project boundary, as the regional interconnected grid covering three islands very close to each other (Java, Madura, and Bali islands) and separated by a relatively long distance from other islands in Indonesia (no interconnection exists to other islands).

The Operating Margin is fixed ex-ante by using 3 recent years available data, which are 2013, 2014, and 2015 data. The 2013, 2014, and 2015 Operating Margin Emission Factor is calculated as follows: 0.777, 0.776, and 0.807 tCO₂e/MWh. The average Operating Margin Emission Factor (2013, 2014, and 2015) is 0.786 tCO₂e/MWh. While the ex-ante Build Margin Emission Factor is calculated to be 0.999 tCO₂e/MWh by dividing total CO₂ emissions by the total annual generation data.

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): $w_{\text{OM}} = 0.5$ and $w_{\text{BM}} = 0.5$ for the first crediting period, and $w_{\text{OM}} = 0.25$ and $w_{\text{BM}} = 0.75$ 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 ($\text{EF}_{\text{grid,CM},y}$) for Jamali Grid will be:

$$EF_{\text{grid,CM,y}} = EF_{\text{grid,OM,y}} \times W_{\text{OM}} + EF_{\text{grid,BM,y}} \times W_{\text{BM}}$$

$$= (0.786 \times 0.25) + (0.999 \times 0.75)$$

$$= 0.946 \text{ tCO}_2/\text{MWh}$$

The values are presented in Table 3.

Table 3. Emission factor of Jamali Grid as per validated VCS PD

Parameter	As per the validated VCS project data
Operating Margin (OM) in tCO ₂ e/MWh	0.786
Build Margin (BM), in tCO ₂ e/MWh	0.999
Combined Margin (CM) Simple average of OM and BM in tCO ₂ e/MWh	0.946

BE_y Calculation for Gunung Salak unit #1

Table 4. Baseline emission (BE_y) calculation for Gunung Salak unit #1

Month/Year		EG _{facility,y}			
		Half-hourly production E _{exp}	Half-hourly production E _{imp}	Half-hourly production (E _{exp} -E _{imp})	As per invoice
		kWh	kWh	kWh	kWh
Jul-2017		40,060,582	6,213	40,054,369	40,054,369
Aug-2017		39,915,980	-	39,915,980	39,915,980
Sep-2017		38,340,267	-	38,340,267	38,340,267
Oct-2017		39,525,132	-	39,525,132	39,525,132
Nov-2017		13,864,457	237,674	13,626,783	13,626,783
Dec-2017		42,402,255	-	42,402,255	42,402,255
Number of months in 2017	6				
Total Jul - Dec 2017		214,108,672	243,886	213,864,786	213,864,786
Jan-2018		41,628,445	4,216	41,624,229	41,624,229
Feb-2018		38,274,727	3,824	38,270,903	38,270,903
Mar-2018		40,634,096	39,527	40,594,569	40,594,569
Apr-2018		36,933,341	32,445	36,900,896	36,900,896
May-2018		41,641,593	-	41,641,593	41,840,046
Jun-2018		15,275,486	-	15,275,486	40,049,160
Jul-2018		41,491,729	17,168	41,474,561	41,474,561
Aug-2018		41,589,257	4,424	41,584,833	41,584,833
Sep-2018		40,574,727	-	40,574,727	40,574,727
Oct-2018		36,463,357	42,269	36,421,088	36,421,088

Month/Year		EG _{facility,y}			
		Half-hourly production E _{exp}	Half-hourly production E _{imp}	Half-hourly production (E _{exp} -E _{imp})	As per invoice
		kWh	kWh	kWh	kWh
Nov-2018		40,277,727	-	40,277,727	40,277,727
Dec-2018		41,091,230	39,306	41,051,924	41,051,924
Number of months in 2018	12				
Total Jan - Dec 2018		455,875,713	183,179	455,692,534	480,664,663
Jan-2019		41,672,263	2,381	41,669,882	41,669,882
Feb-2019		26,600,230	28,372	26,571,858	26,571,858
Mar-2019		8,424,483	65,174	8,359,308	8,359,309
Apr-2019		39,769,296	-	39,769,296	39,769,296
May-2019		41,619,784	-	41,619,784	41,619,784
Jun-2019		40,060,668	-	40,060,668	40,060,668
Jul-2019		41,495,119	-	41,495,119	41,495,119
Aug-2019		16,735,362	44,888	16,690,475	16,690,474
Sep-2019		41,035,114	5,404	41,029,710	41,029,710
Oct-2019		42,481,572	-	42,481,572	42,481,572
Number of months in 2019	10				
Total Jan - Oct 2019		339,893,889	146,218	339,747,671	339,747,672

Month/Year		BE _y			
		EG _{facility,y}	(EG _{historical} +σ _{historical})	EG _{facility,y} < (EG _{historical} +σ _{historical})	Total
		MWh	MWh	MWh	tCO ₂
Jul-2017		40,054	36,279	3,775	3,571.52
Aug-2017		39,916	36,279	3,637	3,440.61
Sep-2017		38,340	36,279	2,061	1,949.98
Oct-2017		39,525	36,279	3,246	3,070.86
Nov-2017		13,627	36,279	-	-
Dec-2017		42,402	36,279	6,123	5,792.62
Number of months in 2017	6				
Total Jul - Dec 2017		213,865	217,674	18,843	17,825.60
Total Jul - Dec 2017 ROUNDUP/DOWN					17,825.00
Jan-2018		41,624	36,279	5,345	5,056.61
Feb-2018		38,271	36,279	1,992	1,884.36

Month/Year	BE _y				
		EG _{facility,y}	(EG _{historical} +σ _{historical})	EG _{facility,y} < (EG _{historical} +σ _{historical})	Total
		MWh	MWh	MWh	tCO ₂
Mar-2018		40,595	36,279	4,316	4,082.55
Apr-2018		36,901	36,279	622	588.34
May-2018		41,642	36,108	5,533	5,234.49
Jun-2018		15,275	13,831	1,444	1,366.14
Jul-2018		41,475	36,279	5,196	4,915.02
Aug-2018		41,585	36,279	5,306	5,019.34
Sep-2018		40,575	36,279	4,296	4,063.78
Oct-2018		36,421	36,279	142	134.44
Nov-2018		40,278	36,279	3,999	3,782.82
Dec-2018		41,052	36,279	4,773	4,515.21
Number of months in 2018	12				
Total Jan - Dec 2018		455,693	412,729	42,963	40,643.11
Total Jan - Dec 2018 ROUNDUP/DOWN					40,643.00
Jan-2019		41,670	36,279	5,391	5,099.80
Feb-2019		26,572	36,279	-	-
Mar-2019		8,359	36,279	-	-
Apr-2019		39,769	36,279	3,490	3,301.84
May-2019		41,620	36,279	5,341	5,052.40
Jun-2019		40,061	36,279	3,782	3,577.48
Jul-2019		41,495	36,279	5,216	4,934.47
Aug-2019		16,690	36,279	-	-
Sep-2019		41,030	36,279	4,751	4,494.20
Oct-2019		42,482	36,279	6,203	5,867.66
Number of months in 2019	10				
Total Jan - Oct 2019		339,748	362,790	34,173	32,327.85
Total Jan - Oct 2019 ROUNDUP/DOWN					32,327.00
TOTAL 2017-2019 ROUNDUP/DOWN					90,795.00

BE_y Calculation for Gunung Salak unit #2

Table 5. Baseline emission (BE_y) calculation for Gunung Salak unit #2

Month/Year		EG _{facility,y}			
		Half-hourly production E _{exp}	Half-hourly production E _{imp}	Half-hourly production (E _{exp} -E _{imp})	As per invoice
		kWh	kWh	kWh	kWh
Jul-2017		36,185,981	33,157	36,152,824	36,152,824
Aug-2017		42,007,379	-	42,007,379	42,007,379
Sep-2017		40,855,509	-	40,855,509	40,855,509
Oct-2017		42,022,638	-	42,022,638	42,022,638
Nov-2017		40,488,673	2,522	40,486,151	40,486,151
Dec-2017		42,023,727	-	42,023,727	42,023,727
Number of months in 2017	6				
Total Jul - Dec 2017		243,583,907	35,679	243,548,228	243,548,228
Jan-2018		41,080,683	9,777	41,070,905	41,070,906
Feb-2018		37,366,833	4	37,366,829	37,366,829
Mar-2018		38,425,195	15,498	38,409,697	38,409,697
Apr-2018		40,258,205	6,064	40,252,141	40,252,141
May-2018		42,126,566	-	42,126,566	42,126,566
Jun-2018		15,357,112	-	15,357,112	40,298,007
Jul-2018		41,439,074	4,521	41,434,553	41,434,553
Aug-2018		42,026,979	-	42,026,979	42,026,979
Sep-2018		32,919,436	21,306	32,898,130	32,898,130
Oct-2018		37,100,580	39,974	37,060,606	37,060,606
Nov-2018		40,153,633	-	40,153,633	40,153,633
Dec-2018		41,817,187	3,539	41,813,647	41,813,648
Number of months in 2018	12				
Total Jan - Dec 2018		450,071,482	100,684	449,970,798	474,911,695
Jan-2019		41,967,429	2,586	41,964,843	41,964,843
Feb-2019		35,666,250	15,612	35,650,638	35,650,638
Mar-2019		41,211,471	-	41,211,471	41,211,471
Apr-2019		39,653,884	-	39,653,884	39,653,884
May-2019		41,563,309	-	41,563,309	41,563,309
Jun-2019		39,941,593	-	39,941,593	39,941,593
Jul-2019		41,286,202	-	41,286,202	41,286,202
Aug-2019		41,716,524	6	41,716,519	41,716,518
Sep-2019		24,897,767	26,506	24,871,261	24,871,261
Oct-2019		-	-	-	-
Number of months in 2019	10				
Total Jan - Oct 2019		347,904,429	44,709	347,859,720	347,859,719

Month/Year	BE _y				
		EG _{facility,y}	(EG _{historical} +σ _{historical})	EG _{facility,y} < (EG _{historical} +σ _{historical})	Total
		MWh	MWh	MWh	tCO ₂
Jul-2017		36,153	34,996	1,157	1,094.23
Aug-2017		42,007	34,996	7,011	6,632.64
Sep-2017		40,856	34,996	5,859	5,542.97
Oct-2017		42,023	34,996	7,027	6,647.07
Nov-2017		40,486	34,996	5,490	5,193.55
Dec-2017		42,024	34,996	7,028	6,648.10
Number of months in 2017	6				
Total Jul - Dec 2017		243,548	209,977	33,571	31,758.55
Total Jul - Dec 2017 ROUNDUP/DOWN					31,758.00
Jan-2018		41,071	34,996	6,075	5,746.73
Feb-2018		37,367	34,996	2,371	2,242.67
Mar-2018		38,410	34,996	3,414	3,229.23
Apr-2018		40,252	34,996	5,256	4,972.18
May-2018		42,127	34,996	7,130	6,745.39
Jun-2018		15,357	13,342	2,015	1,906.03
Jul-2018		41,435	34,996	6,438	6,090.74
Aug-2018		42,027	34,996	7,031	6,651.18
Sep-2018		32,898	34,996	-	-
Oct-2018		37,061	34,996	2,064	1,952.99
Nov-2018		40,154	34,996	5,157	4,878.99
Dec-2018		41,814	34,996	6,818	6,449.37
Number of months in 2018	12				
Total Jan - Dec 2018		449,971	398,300	53,769	50,865.50
Total Jan - Dec 2018 ROUNDUP/DOWN					50,865.00
Jan-2019		41,965	34,996	6,969	6,592.40
Feb-2019		35,651	34,996	655	619.16
Mar-2019		41,211	34,996	6,215	5,879.71
Apr-2019		39,654	34,996	4,658	4,406.23
May-2019		41,563	34,996	6,567	6,212.54
Jun-2019		39,942	34,996	4,945	4,678.40
Jul-2019		41,286	34,996	6,290	5,950.40
Aug-2019		41,717	34,996	6,720	6,357.48
Sep-2019		24,871	34,996	-	-
Oct-2019		-	34,996	-	-
Number of months in 2019	10				
Total Jan - Oct		347,860	349,961	43,019	40,696.32

Month/Year	BE _y				
		EG _{facility,y}	(EG _{historical} +σ _{historical})	EG _{facility,y} < (EG _{historical} +σ _{historical})	Total
		MWh	MWh	MWh	tCO ₂
2019					
Total Jan - Oct 2019 ROUNDUP/DOWN					40,696.00
TOTAL 2017-2019 ROUNDUP/DOWN					123,319.00

BE_y Calculation for Gunung Salak unit #3

Table 6. Baseline emission (BE_y) calculation for Gunung Salak unit #3

Month/Year		EG _{facility,y}			
		Half-hourly production E _{exp}	Half-hourly production E _{imp}	Half-hourly production (E _{exp} -E _{imp})	As per invoice
		kWh	kWh	kWh	kWh
Jul-2017		42,184,154	3,637	42,180,516	42,180,517
Aug-2017		42,202,290	-	42,202,290	42,202,290
Sep-2017		26,758,673	19,133	26,739,540	26,739,540
Oct-2017		42,249,889	-	42,249,889	42,249,889
Nov-2017		41,095,933	1,664	41,094,269	41,094,269
Dec-2017		42,253,983	7,149	42,246,833	42,246,834
Number of months in 2017	6				
Total Jul - Dec 2017		236,744,921	31,583	236,713,338	236,713,339
Jan-2018		41,469,439	2,008	41,467,431	41,467,431
Feb-2018		37,724,312	0	37,724,312	37,724,312
Mar-2018		41,977,567	717	41,976,850	41,976,850
Apr-2018		40,823,302	2,834	40,820,468	40,820,468
May-2018		42,225,446	1,738	42,223,708	42,223,708
Jun-2018		15,393,645	1,361	15,392,284	40,487,916
Jul-2018		42,200,050	3,259	42,196,791	42,196,791
Aug-2018		42,174,735	-	42,174,735	42,174,735
Sep-2018		40,980,399	-	40,980,399	40,980,399
Oct-2018		42,639,848	-	42,639,848	42,639,848
Nov-2018		39,441,386	13,670	39,427,716	39,427,716
Dec-2018		42,126,711	1,353	42,125,357	42,125,358
Number of months in 2018	12				
Total Jan - Dec 2018		469,176,841	26,940	469,149,901	494,245,532
Jan-2019		42,230,992	819	42,230,173	42,230,173

Month/Year		EG _{facility,y}			
		Half-hourly production E _{exp}	Half-hourly production E _{imp}	Half-hourly production (E _{exp} -E _{imp})	As per invoice
		kWh	kWh	kWh	kWh
Feb-2019		33,383,913	49,474	33,334,439	33,334,439
Mar-2019		41,127,100	-	41,127,100	41,127,100
Apr-2019		39,742,567	-	39,742,567	39,742,567
May-2019		42,129,493	-	42,129,493	42,129,493
Jun-2019		40,431,684	-	40,431,684	40,431,684
Jul-2019		41,987,410	1,039	41,986,371	41,986,371
Aug-2019		42,252,318	1,490	42,250,828	42,250,828
Sep-2019		41,112,027	-	41,112,027	41,112,027
Oct-2019		42,128,968	15,709	42,113,259	42,113,259
Number of months in 2019	10				
Total Jan - Oct 2019		406,526,472	68,531	406,457,941	406,457,941

Month/Year		BE _y			
		EG _{facility,y}	(EG _{historical} +σ _{historical})	EG _{facility,y} < (EG _{historical} +σ _{historical})	Total
		MWh	MWh	MWh	tCO ₂
Jul-2017		42,181	36,967	5,213	4,931.92
Aug-2017		42,202	36,967	5,235	4,952.52
Sep-2017		26,740	36,967	-	-
Oct-2017		42,250	36,967	5,283	4,997.55
Nov-2017		41,094	36,967	4,127	3,904.33
Dec-2017		42,247	36,967	5,280	4,994.66
Number of months in 2017	6				
Total Jul - Dec 2017		236,713	221,802	25,138	23,780.99
Total Jul - Dec 2017 ROUNDUP/DOWN					23,780.00
Jan-2018		41,467	36,967	4,500	4,257.34
Feb-2018		37,724	36,967	757	716.35
Mar-2018		41,977	36,967	5,010	4,739.26
Apr-2018		40,820	36,967	3,853	3,645.32
May-2018		42,224	36,967	5,257	4,972.78
Jun-2018		15,392	14,094	1,299	1,228.47
Jul-2018		42,197	36,967	5,230	4,947.32
Aug-2018		42,175	36,967	5,208	4,926.45
Sep-2018		40,980	36,967	4,013	3,796.61
Oct-2018		42,640	36,967	5,673	5,366.45

Month/Year	BE _y				
		EG _{facility,y}	(EG _{historical} +σ _{historical})	EG _{facility,y} < (EG _{historical} +σ _{historical})	Total
		MWh	MWh	MWh	tCO ₂
Nov-2018		39,428	36,967	2,461	2,327.77
Dec-2018		42,125	36,967	5,158	4,879.74
Number of months in 2018	12				
Total Jan - Dec 2018		469,150	420,731	48,418	45,803.87
Total Jan - Dec 2018 ROUNDUP/DOWN					45,803.00
Jan-2019		42,230	36,967	5,263	4,978.90
Feb-2019		33,334	36,967	-	-
Mar-2019		41,127	36,967	4,160	3,935.39
Apr-2019		39,743	36,967	2,776	2,625.62
May-2019		42,129	36,967	5,162	4,883.65
Jun-2019		40,432	36,967	3,465	3,277.53
Jul-2019		41,986	36,967	5,019	4,748.26
Aug-2019		42,251	36,967	5,284	4,998.44
Sep-2019		41,112	36,967	4,145	3,921.13
Oct-2019		42,113	36,967	5,146	4,868.30
Number of months in 2019	10				
Total Jan - Oct 2019		406,458	369,671	40,420	38,237.23
Total Jan - Oct 2019 ROUNDUP/DOWN					38,237.00
TOTAL 2017-2019 ROUNDUP/DOWN					107,820.00

5.2 Project Emissions

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

where:

PE_y = Project emissions in year y (t CO₂e/yr)

PE_{FF,y} = Project emissions from fossil fuel consumption in year y (t CO₂/yr)

PE_{GP,y} = Project emissions from the operation of dry, flash steam or binary geothermal power plants in year y (t CO₂e/yr)

$PE_{HP,y}$ = Project emissions from water reservoirs of hydro power plants in year y (t CO₂e/yr)

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

$PE_y = PE_{GP,y}$

$PE_{GP,y} = PE_{\text{dry or flash steam},y} + PE_{\text{binary},y}$

where:

$PE_{GP,y}$ = Project emissions from the operation of dry, flash steam or binary geothermal power plants in year y (t CO₂e/yr)

$PE_{\text{dry or flash steam},y}$ = Project emissions from the operation of dry steam or flash steam geothermal power plants due to release of non-condensable gases in year y (t CO₂e/yr)

$PE_{\text{binary},y}$ = Project emissions from the operation of binary geothermal power plants due to physical leakage of non-condensable gases and working fluid in year y (t CO₂e/yr)

The project is the operation of flash steam geothermal power plant, so $PE_{\text{binary},y} = 0$.

$PE_{GP,y} = PE_{\text{dry or flash steam},y}$

$PE_{\text{dry or flash steam},y} = (w_{\text{steam},\text{CO}_2,y} + w_{\text{steam},\text{CH}_4,y} \times GWP_{\text{CH}_4}) \times M_{\text{steam},y}$

where:

$w_{\text{steam},\text{CO}_2,y}$ = Average mass fraction of CO₂ in the produced steam in year y (t CO₂/t steam)

$w_{\text{steam},\text{CH}_4,y}$ = Average mass fraction of CH₄ in the produced steam in year y (t CO₄/t steam)

GWP_{CH_4} = Global warming potential of CH₄ valid for the relevant commitment period (t CO₂e/t CH₄)

$M_{\text{steam},y}$ = Quantity of steam produced in year y (t steam/yr)

During current monitoring period from 01/07/2017 to 31/10/2019, there were no calibration delay for steam flow meter Unit #1, #2 and #3 and NCG analysis.

The CH₄ and CO₂ weight fraction values for all units that are used in the PE_{flash steam,y} calculation are presented in **Table 5** and **Error! Reference source not found.**

Table 5. CO₂ weight fraction values used in the project emission of NCG from the produced steam (PE_{flash steam,y}) calculation

Analysis #	Period to be used in PE _{flash steam,y} calculation	CO ₂ values to be used in PE _{flash steam,y} calculation (non dimensional)		
	Month/Year	UNIT #1	UNIT #2	UNIT #3
1	07/2017	0.0057443700	0.0057194820	0.0065820480
	08/2017	0.0057443700	0.0057194820	0.0065820480
	09/2017	0.0057443700	0.0057194820	0.0065820480
2	10/2017	0.0048806160	0.0057149400	0.0057197400
	11/2017	0.0048806160	0.0057149400	0.0057197400
	12/2017	0.0048806160	0.0057149400	0.0057197400
3	01/2018	0.0049251280	0.0056593980	0.0057166800
	02/2018	0.0049251280	0.0056593980	0.0057166800
	-			
4	03/2018	0.0053354560	0.0053326560	0.0065766660
	04/2018	0.0053354560	0.0053326560	0.0065766660
	05/2018	0.0053354560	0.0053326560	0.0065766660
5	06/2018	0.0060100740	0.0061001600	0.0060111450
	07/2018	0.0060100740	0.0061001600	0.0060111450
	08/2018	0.0060100740	0.0061001600	0.0060111450
6	09/2018	0.0044983200	0.0048393900	0.0049785020
	10/2018	0.0044983200	0.0048393900	0.0049785020
	11/2018	0.0044983200	0.0048393900	0.0049785020
7	12/2018	0.0052673700	0.0058996100	0.0058809240
	01/2019	0.0052673700	0.0058996100	0.0058809240
	02/2019	0.0052673700	0.0058996100	0.0058809240
8	03/2019	0.0061655680	0.0068662800	0.0074932260
	04/2019	0.0061655680	0.0068662800	0.0074932260
	05/2019	0.0061655680	0.0068662800	0.0074932260
9	06/2019	0.0061278100	0.0064713560	0.0076930560
	07/2019	0.0061278100	0.0064713560	0.0076930560
	08/2019	0.0061278100	0.0064713560	0.0076930560
10	09/2019	0.0071982750	0.0056950930	0.0088954500
	10/2019	0.0071982750	0.0056950930	0.0088954500
	11/2019	0.0071982750	0.0056950930	0.0088954500

Table 6. CH₄ weight fraction values used in the project emission of NCG from the produced steam (PE_{flash steam,y}) calculation

Analysis #	Period to be used in PE _{flash steam,y} calculation	CH ₄ values to be used in PE _{flash steam,y} calculation (non dimensional)		
	Month/Year	UNIT #1	UNIT #2	UNIT #3
1	07/2017	0.0000167811	0.0000005612	0.0000212658
	08/2017	0.0000167811	0.0000005612	0.0000212658
	09/2017	0.0000167811	0.0000005612	0.0000212658
2	10/2017	0.0000121524	0.0000211860	0.0000185040
	11/2017	0.0000121524	0.0000211860	0.0000185040
	12/2017	0.0000121524	0.0000211860	0.0000185040
3	01/2018	0.0000068744	0.0000044722	0.0000070440
	02/2018	0.0000068744	0.0000044722	0.0000070440
	-			
4	03/2018	0.0000336168	0.0000361144	0.0000362871
	04/2018	0.0000336168	0.0000361144	0.0000362871
	05/2018	0.0000336168	0.0000361144	0.0000362871
5	06/2018	0.0000451836	0.0000491072	0.0000347445
	07/2018	0.0000451836	0.0000491072	0.0000347445
	08/2018	0.0000451836	0.0000491072	0.0000347445
6	09/2018	0.0000080496	0.0000237099	0.0000268286
	10/2018	0.0000080496	0.0000237099	0.0000268286
	11/2018	0.0000080496	0.0000237099	0.0000268286
7	12/2018	0.0000513912	0.0000302622	0.0000351540
	01/2019	0.0000513912	0.0000302622	0.0000351540
	02/2019	0.0000513912	0.0000302622	0.0000351540
8	03/2019	0.0000006976	0.0000000072	0.0000295542
	04/2019	0.0000006976	0.0000000072	0.0000295542
	05/2019	0.0000006976	0.0000000072	0.0000295542
9	06/2019	0.0000220220	0.0000159188	0.0000133812
	07/2019	0.0000220220	0.0000159188	0.0000133812
	08/2019	0.0000220220	0.0000159188	0.0000133812
10	09/2019	0.0000028875	0.0000021240	0.0000377301
	10/2019	0.0000028875	0.0000021240	0.0000377301
	11/2019	0.0000028875	0.0000021240	0.0000377301

PE_{flash steam,y} calculation for Gunung Salak unit #1

Table 7. Project emission from fugitive carbon dioxide and methane emissions due to release of non-condensable gases from the produced steam (PE_{flash steam,y}) for Gunung Salak unit #1

Month/year		PE _{dry or flash steam,y}				
		W _{steam,CH₄,y}	W _{steam,CO₂,y}	M _{Steam,y}	M _{Steam,y} (steam attributable to the project's capacity upgrade)	Total
		tCH ₄ /t _{Steam}	tCO ₂ /t _{Steam}	tonnes / month	tonnes / month	tCO ₂
Jul-2017	6	0.0000167811	0.0057443700	326,645.00	30,788.49	189.78
Aug-2017		0.0000167811	0.0057443700	326,050.00	29,708.54	183.12
Sep-2017		0.0000167811	0.0057443700	315,634.00	16,969.47	104.60
Oct-2017		0.0000121524	0.0048806160	325,514.00	26,734.12	138.60
Nov-2017		0.0000121524	0.0048806160	112,418.81	0.00	0.00
Dec-2017		0.0000121524	0.0048806160	348,163.10	50,277.99	260.66
Number of months in 2017	6					
Total Jul - Dec 2017				1,754,424.91	154,478.60	876.76
Total Jul - Dec 2017 ROUNDUP/DOWN						877.00
Jan-2018	12	0.0000068744	0.0049251280	346,959.60	44,555.47	227.10
Feb-2018		0.0000068744	0.0049251280	319,014.90	16,604.12	84.63
Mar-2018		0.0000336168	0.0053354560	347,467.00	36,939.09	228.13
Apr-2018		0.0000336168	0.0053354560	309,583.30	5,217.66	32.22
May-2018		0.0000336168	0.0053354560	344,397.90	45,763.18	282.63
Jun-2018		0.0000451836	0.0060100740	129,143.00	12,209.03	87.17
Jul-2018		0.0000451836	0.0060100740	352,033.60	44,099.82	314.86
Aug-2018		0.0000451836	0.0060100740	351,452.00	44,842.18	320.16
Sep-2018		0.0000080496	0.0044983200	342,672.00	36,279.58	170.50
Oct-2018		0.0000080496	0.0044983200	300,845.00	1,173.88	5.52
Nov-2018		0.0000080496	0.0044983200	339,319.00	33,687.41	158.32
Dec-2018		0.0000513912	0.0052673700	360,051.00	41,861.74	274.28
Number of months in 2018	12					
Total Jan - Dec 2018				3,833,938.30	362,186.76	2,178.66
Total Jan - Dec 2018 ROUNDUP/DOWN						2,179.00
Jan-2019		0.0000513912	0.0052673700	356,220.40	46,084.87	301.95
Feb-2019		0.0000513912	0.0052673700	228,991.30	0.00	0.00
Mar-2019		0.0000006976	0.0061655680	68,707.22	0.00	0.00
Apr-2019		0.0000006976	0.0061655680	328,378.60	28,819.89	178.19
May-2019		0.0000006976	0.0061655680	345,312.10	44,311.76	273.98

Month/year		PE _{dry or flash steam,y}				
		W _{steam,CH₄,y}	W _{steam,CO₂,y}	M _{Steam,y}	M _{Steam,y} (steam attributable to the project's capacity upgrade)	Total
		tCH ₄ /t _{Steam}	tCO ₂ /t _{Steam}	tonnes / month	tonnes / month	tCO ₂
Jun-2019	10	0.0000220220	0.0061278100	330,069.50	31,158.28	208.09
Jul-2019		0.0000220220	0.0061278100	351,846.00	44,228.80	295.38
Aug-2019		0.0000220220	0.0061278100	134,602.00	0.00	0.00
Sep-2019		0.0000028875	0.0071982750	321,589.60	37,236.11	270.72
Oct-2019		0.0000028875	0.0071982750	335,804.80	49,029.77	356.47
Number of months in 2019						
Total Jan - Oct 2019				2,789,486.52	280,869.48	1,884.78
Total Jan - Oct 2019 ROUNDUP/DOWN						1,885.00
TOTAL 2017-2019 ROUNDUP/DOWN						4,941.00

PE_{flash steam,y} calculation for Gunung Salak unit #2

Table 10. Project emission from fugitive carbon dioxide and methane emissions due to release of non-condensable gases from the produced steam (PE_{flash steam,y}) for Gunung Salak unit #2

Month/year		PE _{dry or flash steam,y}				
		W _{steam,CH₄,y}	W _{steam,CO₂,y}	M _{Steam,y}	M _{Steam,y} (steam attributable to the project's capacity upgrade)	Total
		tCH ₄ /t _{Steam}	tCO ₂ /t _{Steam}	tonnes / month	tonnes / month	tCO ₂
Jul-2017	6	0.0000005612	0.0057194820	279,393.40	8,939.02	51.25
Aug-2017		0.0000005612	0.0057194820	316,177.00	52,771.53	302.57
Sep-2017		0.0000005612	0.0057194820	322,852.00	46,302.44	265.48
Oct-2017		0.0000211860	0.0057149400	329,813.10	55,147.23	344.37
Nov-2017		0.0000211860	0.0057149400	311,858.80	42,288.77	264.08
Dec-2017		0.0000211860	0.0057149400	341,900.00	57,175.63	357.04
Number of months in 2017						
Total Jul - Dec 2017				1,901,994.30	262,624.62	1,584.78
Total Jul - Dec 2017 ROUNDUP/DOWN						1,585.00

Month/year		PE _{dry or flash steam,y}				
		W _{steam,CH₄,y}	W _{steam,CO₂,y}	M _{Steam,y}	M _{Steam,y} (steam attributable to the project's capacity upgrade)	Total
		tCH ₄ /t _{Steam}	tCO ₂ /t _{Steam}	tonnes / month	tonnes / month	tCO ₂
Jan-2018	12	0.0000044722	0.0056593980	334,575.00	49,486.75	285.60
Feb-2018		0.0000044722	0.0056593980	307,388.70	19,501.89	112.55
Mar-2018		0.0000361144	0.0053326560	315,436.34	28,033.57	174.80
Apr-2018		0.0000361144	0.0053326560	326,153.10	42,588.10	265.56
May-2018		0.0000361144	0.0053326560	337,686.00	57,157.43	356.41
Jun-2018		0.0000491072	0.0061001600	122,707.00	16,099.01	117.97
Jul-2018		0.0000491072	0.0061001600	330,878.00	51,414.35	376.76
Aug-2018		0.0000491072	0.0061001600	332,196.00	55,574.25	407.24
Sep-2018		0.0000237099	0.0048393900	265,409.00	0.00	-
Oct-2018		0.0000237099	0.0048393900	295,622.00	16,467.69	89.45
Nov-2018		0.0000237099	0.0048393900	321,353.00	41,275.89	224.22
Dec-2018		0.0000302622	0.0058996100	331,318.00	54,019.78	359.56
Number of months in 2018						
Total Jan - Dec 2018				3,616,722.14	431,618.70	2,770.12
Total Jan - Dec 2018 ROUNDUP/DOWN						2,771.00
Jan-2019	10	0.0000302622	0.0058996100	332,341.00	55,188.74	367.35
Feb-2019		0.0000302622	0.0058996100	285,963.00	5,249.93	34.94
Mar-2019		0.0000000072	0.0068662800	329,993.00	49,768.11	341.73
Apr-2019		0.0000000072	0.0068662800	318,855.50	37,452.78	257.17
May-2019		0.0000000072	0.0068662800	333,455.00	52,687.25	361.77
Jun-2019		0.0000159188	0.0064713560	319,675.00	39,581.26	271.90
Jul-2019		0.0000159188	0.0064713560	328,342.50	50,023.87	343.63
Aug-2019		0.0000159188	0.0064713560	327,994.00	52,838.66	362.97
Sep-2019		0.0000021240	0.0056950930	195,862.87	-	-
Oct-2019		0.0000021240	0.0056950930	0.00	-	-
Number of months in 2019						
Total Jan - Oct 2019				2,772,481.87	342,790.60	2,341.46
Total Jan - Oct 2019 ROUNDUP/DOWN						2,342.00
TOTAL 2017-2019 ROUNDUP/DOWN						6,698.00

PE_{flash steam,y} calculation for Gunung Salak unit #3

Table 11. Project emission from fugitive carbon dioxide and methane emissions due to release of non-condensable gases from the produced steam (PE_{flash steam,y}) for Gunung Salak unit #3

Month/year		PE _{dry or flash steam,y}				
		W _{steam,CH₄,y}	W _{steam,CO₂,y}	M _{Steam,y}	M _{Steam,y} (steam attributable to the project's capacity upgrade)	Total
		tCH ₄ /t _{Steam}	tCO ₂ /t _{Steam}	tonnes / month	tonnes / month	tCO ₂
Jul-2017	6	0.0000212658	0.0065820480	313,692.00	38,771.87	275.81
Aug-2017		0.0000212658	0.0065820480	318,935.30	39,564.14	281.45
Sep-2017		0.0000212658	0.0065820480	204,536.48	0.00	0.00
Oct-2017		0.0000185040	0.0057197400	320,670.00	40,095.79	247.89
Nov-2017		0.0000185040	0.0057197400	311,417.60	31,276.46	193.36
Dec-2017		0.0000185040	0.0057197400	319,937.80	39,983.99	247.19
Number of months in 2017	6					
Total Jul - Dec 2017				1,789,189.18	189,692.25	1,245.70
Total Jul - Dec 2017 ROUNDUP/DOWN						1,246.00
Jan-2018	12	0.0000070440	0.0057166800	313,583.00	34,032.43	200.55
Feb-2018		0.0000070440	0.0057166800	309,187.70	6,206.36	36.57
Mar-2018		0.0000362871	0.0065766660	322,104.80	38,442.03	287.69
Apr-2018		0.0000362871	0.0065766660	312,715.00	29,519.91	220.92
May-2018		0.0000362871	0.0065766660	321,677.00	40,047.18	299.71
Jun-2018		0.0000347445	0.0060111450	116,757.00	9,850.36	67.77
Jul-2018		0.0000347445	0.0060111450	322,328.00	39,948.22	274.83
Aug-2018		0.0000347445	0.0060111450	318,439.00	39,320.34	270.51
Sep-2018		0.0000268286	0.0049785020	310,151.00	30,374.01	171.59
Oct-2018		0.0000268286	0.0049785020	323,055.00	42,979.05	242.80
Nov-2018		0.0000268286	0.0049785020	299,148.30	18,669.58	105.47
Dec-2018		0.0000351540	0.0058809240	323,755.00	39,644.11	267.99
Number of months in 2018	12					
Total Jan - Dec 2018				3,584,900.80	368,048.03	2,439.68
Total Jan - Dec 2018 ROUNDUP/DOWN						2,440.00
Jan-2019		0.0000351540	0.0058809240	321,375.00	40,052.66	270.75
Feb-2019		0.0000351540	0.0058809240	257,199.00	0.00	0.00
Mar-2019		0.0000295542	0.0074932260	316,907.00	32,055.35	263.88
Apr-2019		0.0000295542	0.0074932260	311,471.00	21,752.19	179.07
May-2019		0.0000295542	0.0074932260	326,000.50	39,947.16	328.85

Month/year		PE _{dry or flash steam,y}				
		W _{steam,CH₄,y}	W _{steam,CO₂,y}	M _{Steam,y}	M _{Steam,y} (steam attributable to the project's capacity upgrade)	Total
		tCH ₄ /t _{Steam}	tCO ₂ /t _{Steam}	tonnes / month	tonnes / month	tCO ₂
Jun-2019	10	0.0000133812	0.0076930560	311,458.20	26,689.06	214.25
Jul-2019		0.0000133812	0.0076930560	323,266.00	38,645.17	310.23
Aug-2019		0.0000133812	0.0076930560	324,164.00	40,538.97	325.43
Sep-2019		0.0000377301	0.0088954500	315,350.00	31,793.93	312.81
Oct-2019		0.0000377301	0.0088954500	324,230.70	39,620.62	389.82
Number of months in 2019						
Total Jan - Oct 2019				3,127,635.40	310,830.70	2,592.90
Total Jan - Oct 2019 ROUNDUP/DOWN						2,593.00
TOTAL 2017-2019 ROUNDUP/DOWN						6,279.00

5.3 Leakage

Leakage emissions as described in the ACM0002 v.17.0 is 0 for retrofit project as following:

$$LE_y = 0$$

Where:

LE_y = Leakage emissions in year y (tCO₂/yr)

5.4 Net GHG Emission Reductions and Removals

$$ER_y = BE_y - PE_y - LE_y$$

Where:

ER_y = Emission reductions in year y (tCO₂/yr)

BE_y = Baseline emission in year y (tCO₂/yr)

PE_y = Project emission in year y (tCO₂/yr)

LE_y = Leakage emission in year y (tCO₂/yr)

ER calculation for Gunung Salak Unit 1

Table 8. Emission reduction calculation for Gunung Salak unit #1

Month/Year	BE _y (tCO ₂)	PE _y (tCO ₂)	ER _y (tCO ₂)
		PE _{dry or flash steam,y}	
Total Jul - Dec 2017	17,825.60	876.76	
Total Jul - Dec 2017 ROUNDUP/DOWN	17,825.00	877.00	16,948.00
Total Jan - Dec 2018	40,643.11	2,178.66	
Total Jan - Dec 2018 ROUNDUP/DOWN	40,643.00	2,179.00	38,464.00
Total Jan - Oct 2019	32,327.85	1,884.78	
Total Jan - Oct 2019 ROUNDUP/DOWN	32,327.00	1,885.00	30,442.00
TOTAL 2017-2019 ROUNDUP/DOWN	90,795.00	4,941.00	85,854.00

ER calculation for Gunung Salak Unit 2

Table 9. Emission reduction calculation for Gunung Salak unit #2

Month/Year	BE _y (tCO ₂)	PE _y (tCO ₂)	ER _y (tCO ₂)
		PE _{dry or flash steam,y}	
Total Jul - Dec 2017	31,758.55	1,584.78	
Total Jul - Dec 2017 ROUNDUP/DOWN	31,758.00	1,585.00	30,173.00
Total Jan - Dec 2018	50,865.50	2,770.12	
Total Jan - Dec 2018 ROUNDUP/DOWN	50,865.00	2,771.00	48,094.00
Total Jan - Oct 2019	40,696.32	2,341.46	
Total Jan - Oct 2019 ROUNDUP/DOWN	40,696.00	2,342.00	38,354.00
TOTAL 2017-2019 ROUNDUP/DOWN	123,319.00	6,698.00	116,621.00

ER calculation for Gunung Salak Unit 3

Table 10. Emission reduction calculation for Gunung Salak unit #3

Month/Year	BE _y (tCO ₂)	PE _y (tCO ₂)	ER _y (tCO ₂)
		PE _{dry or flash steam,y}	
Total Jul - Dec 2017	23,780.99	1,245.70	
Total Jul - Dec 2017 ROUNDUP/DOWN	23,780.00	1,246.00	22,534.00

Month/Year	BE _y (tCO ₂)	PE _y (tCO ₂)	ER _y (tCO ₂)
Total Jan - Dec 2018	45,803.87	2,439.68	
Total Jan - Dec 2018 ROUNDUP/DOWN	45,803.00	2,440.00	43,363.00
Total Jan - Oct 2019	38,237.23	2,592.90	
Total Jan - Oct 2019 ROUNDUP/DOWN	38,237.00	2,593.00	35,644.00
TOTAL 2017-2019 ROUNDUP/DOWN	107,820.00	6,279.00	101,541.00

The summary of emission reductions for the chosen monitored period i.e. from 01/07/2017 to 31/10/2019 is provided in Table 15.

Table 11. Summary of emission reduction calculation from 01/07/2017 to 31/10/2019

Year	Baseline emissions or removals (tCO ₂ e)	Project emissions or removals (tCO ₂ e)	Leakage emissions (tCO ₂ e)	Net GHG emission reductions or removals (tCO ₂ e)
Vintage 2017: 01/07/2017- 31/12/2017	73,363	3,708	0	69,655
Vintage 2018: 01/01/2018- 31/12/2018	137,311	7,390	0	129,921
Vintage 2019: 01/01/2019- 31/10/2019	111,260	6,820	0	104,440
Total	321,934	17,918	0	304,016

APPENDIX I: SPECIFIC STEAM CONSUMPTION (SSC) CALCULATION FOR EACH UNIT

SSC calculation for Gunung Salak Unit 1

Month/Year	UNIT #1		
	Steam flowrate	Net power output of the plant	SSC
	t steam	MWh	t steam/MWh
Jul-2017	326,645.00	40,054.37	8.155
Aug-2017	326,050.00	39,915.98	8.168
Sep-2017	315,634.00	38,340.27	8.232
Oct-2017	325,514.00	39,525.13	8.236
Nov-2017	112,418.81	13,626.78	8.250
Dec-2017	348,163.10	42,402.25	8.211
Total Jul - Dec 2017	1,754,424.91	213,864.79	8.203
Jan-2018	346,959.60	41,624.23	8.336
Feb-2018	319,014.90	38,270.90	8.336
Mar-2018	347,467.00	40,594.57	8.559
Apr-2018	309,583.30	36,900.90	8.390
May-2018	344,397.90	41,641.59	8.271
Jun-2018	129,143.00	15,275.49	8.454
Jul-2018	352,033.60	41,474.56	8.488
Aug-2018	351,452.00	41,584.83	8.451
Sep-2018	342,672.00	40,574.73	8.445
Oct-2018	300,845.00	36,421.09	8.260
Nov-2018	339,319.00	40,277.73	8.424
Dec-2018	351,051.00	41,051.92	8.551
Total Jan - Dec 2018	3,833,938.30	455,692.53	8.413
Jan-2019	356,220.40	41,669.88	8.549
Feb-2019	228,991.30	26,571.86	8.618
Mar-2019	68,707.22	8,359.31	8.219
Apr-2019	328,378.60	39,769.30	8.257
May-2019	345,312.10	41,619.78	8.297
Jun-2019	330,069.50	40,060.67	8.239
Jul-2019	351,846.00	41,495.12	8.479
Aug-2019	134,602.00	16,690.47	8.065
Sep-2019	321,589.60	41,029.71	7.838
Oct-2019	335,804.80	42,481.57	7.905
Total Jan - Oct 2019	2,789,486.52	339,747.67	8.210

SSC calculation for Gunung Salak Unit 2

Month/Year	UNIT #2		
	Steam flowrate	Net power output of the plant	SSC
	t steam	MWh	t steam/MWh
Jul-2017	279,393.40	36,152.82	7.728
Aug-2017	316,177.00	42,007.38	7.527
Sep-2017	322,852.00	40,855.51	7.902
Oct-2017	329,813.10	42,022.64	7.848
Nov-2017	311,858.80	40,486.15	7.703
Dec-2017	341,900.00	42,023.73	8.136
Total Jul - Dec 2017	1,901,994.30	243,548.23	7.810
Jan-2018	334,575.00	41,070.91	8.146
Feb-2018	307,388.70	37,366.83	8.226
Mar-2018	315,436.34	38,409.70	8.212
Apr-2018	326,153.10	40,252.14	8.103
May-2018	337,686.00	42,126.57	8.016
Jun-2018	122,707.00	15,357.11	7.990
Jul-2018	330,878.00	41,434.55	7.986
Aug-2018	332,196.00	42,026.98	7.904
Sep-2018	261,409.00	32,898.13	7.946
Oct-2018	295,622.00	37,060.61	7.977
Nov-2018	321,353.00	40,153.63	8.003
Dec-2018	331,318.00	41,813.65	7.924
Total Jan - Dec 2018	3,616,722.14	449,970.80	8.038
Jan-2019	332,341.00	41,964.84	7.920
Feb-2019	285,963.00	35,650.64	8.021
Mar-2019	329,993.00	41,211.47	8.007
Apr-2019	318,855.50	39,653.88	8.041
May-2019	333,455.00	41,563.31	8.023
Jun-2019	319,675.00	39,941.59	8.004
Jul-2019	328,342.50	41,286.20	7.953
Aug-2019	327,994.00	41,716.52	7.862
Sep-2019	195,862.87	24,871.26	7.875
Oct-2019	0.00	0.00	0.000
Total Jan - Oct 2019	2,772,481.87	347,859.72	7.970

SSC calculation for Gunung Salak Unit 3

Month/Year	UNIT #3		
	Steam flowrate	Net power output of the plant	SSC
	t steam	MWh	t steam/MWh
Jul-2017	313,692.00	42,180.52	7.437

Month/Year	UNIT #3		
	Steam flowrate	Net power output of the plant	SSC
	t steam	MWh	t steam/MWh
Aug-2017	318,935.30	42,202.29	7.557
Sep-2017	204,536.48	26,739.54	7.649
Oct-2017	320,670.00	42,249.89	7.590
Nov-2017	311,417.60	41,094.27	7.578
Dec-2017	319,937.80	42,246.83	7.573
Total Jul - Dec 2017	1,789,189.18	236,713.34	7.558
Jan-2018	313,583.00	41,467.43	7.562
Feb-2018	309,187.70	37,724.31	8.196
Mar-2018	322,104.80	41,976.85	7.673
Apr-2018	312,715.00	40,820.47	7.661
May-2018	321,677.00	42,223.71	7.618
Jun-2018	116,757.00	15,392.28	7.585
Jul-2018	318,328.00	42,196.79	7.544
Aug-2018	318,439.00	42,174.74	7.550
Sep-2018	310,151.00	40,980.40	7.568
Oct-2018	323,055.00	42,639.85	7.576
Nov-2018	299,148.30	39,427.72	7.587
Dec-2018	319,755.00	42,125.36	7.591
Total Jan - Dec 2018	3,584,900.80	469,149.90	7.641
Jan-2019	321,375.00	42,230.17	7.610
Feb-2019	257,199.00	33,334.44	7.716
Mar-2019	316,907.00	41,127.10	7.706
Apr-2019	311,471.00	39,742.57	7.837
May-2019	326,000.50	42,129.49	7.738
Jun-2019	311,458.20	40,431.68	7.703
Jul-2019	323,266.00	41,986.37	7.699
Aug-2019	324,164.00	42,250.83	7.672
Sep-2019	315,350.00	41,112.03	7.671
Oct-2019	324,230.70	42,113.26	7.699
Total Jan - Oct 2019	3,127,635.40	406,457.94	7.695

APPENDIX II: ISSUED UNDER RENEWABLE ENERGY CERTIFICATES (RECS)

For this verification period, the specific period of 1-Jun-2018 to 19-Jun 2018 and 2-Feb-2019 have been issued under International Renewable Energy Certificate (I-REC) as following:

Year	Issued Under I-REC (MWh)			
	UNIT #1	UNIT #2	UNIT #3	TOTAL
1 Jul - 31 Dec 2017	-	-	-	-
1 Jan - 31 Dec 2018	24,972	24,941	25,096	75,009
1 Jan - 31 Aug 2019	1,376	-	-	1,376
TOTAL	-	-	-	76,385

The total 76,385 MWh have been issued under I-REC, therefore the GHG emission reductions or removals from this verification period have been splitted between the VCS Program and I-REC.