

CAPACITY UPGRADE OF GUNUNG SALAK GEOTHERMAL POWER PLANT PROJECT, INDONESIA



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1 PROJECT DETAILS

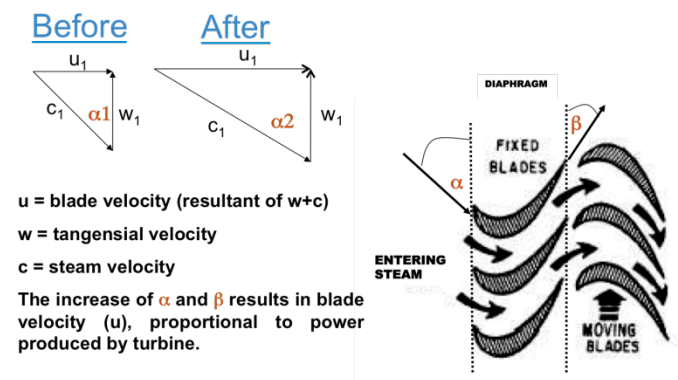
1.1 Summary Description of the Implementation Status of the Project

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 $\alpha 1$ to $\alpha 2$ 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.

Figure 1. Nozzle increase in the diaphragms



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.

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 tCO₂-e 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

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. Indonesia Power	No
Switzerland	South Pole Carbon Asset Management Ltd. (as carbon credit buyer)	No

Project proponents contact information as follows:

Project owner:

Organization name	PT. Indonesia Power
Contact person	Artono Antonius
Title	Mr.
Address	Jl. Jenderal Gatot Subroto Kav. 18, Jakarta 12950, Indonesia
Telephone	+62-21-526 7666
Email	agcc@indonesiapower.co.id

Carbon Credit buyer:

Organization name	South Pole Carbon Asset Management Ltd.
Contact person	Renat Heuberger
Title	Mr.
Address	Technoparkstrasse 1, Zurich 8005, Switzerland
Telephone	+41-44 633 7870
Email	registration@southpolecarbon.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: 21/06/2005

Unit 2: 04/04/2005

Unit 3: 29/09/2004

Thus, the project start date is 29/09/2004, as the earliest project start date of three units at Gunung Salak Geothermal Power Plant.

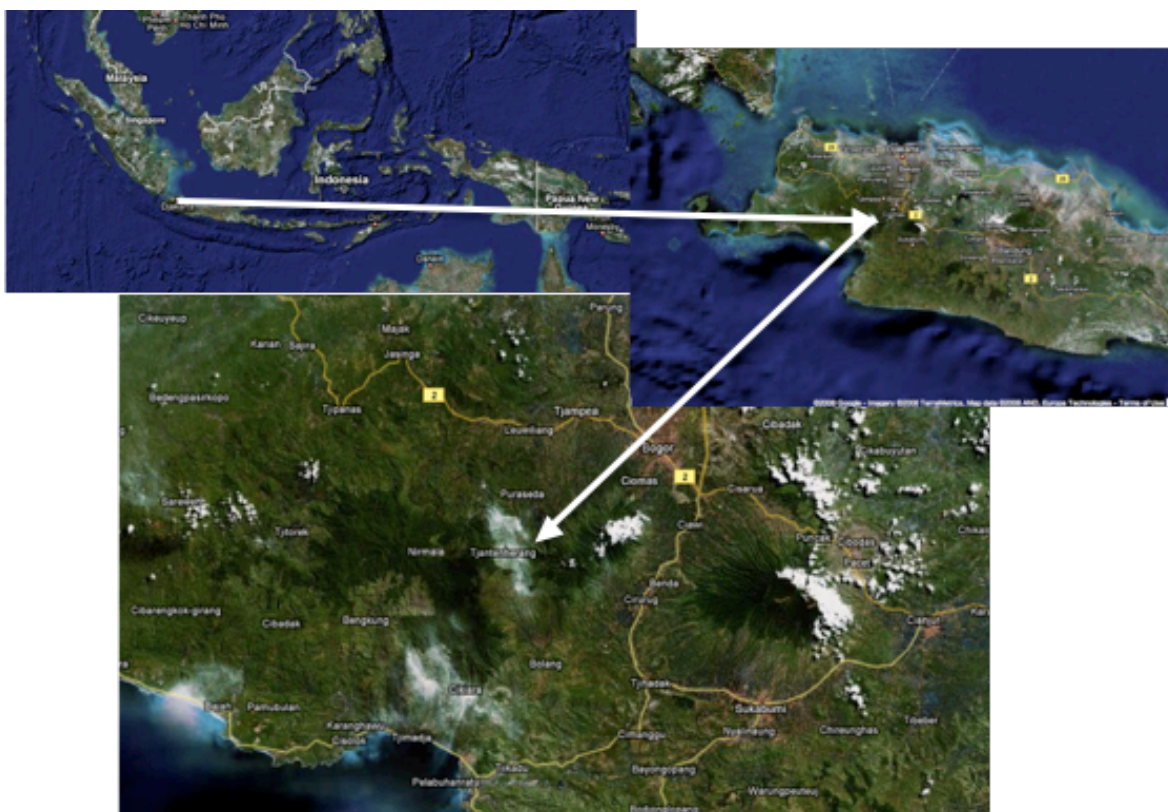
1.6 Project Crediting Period

The crediting period of this project activity is 10 years from 01/04/2006 until 31/03/2016.

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.

Figure 2. Gunung Salak geothermal power plant location



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 : 07

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 2007.1. The VCS PD and associated documents are available upon request.

1.9 Other Programs

- Emission Trading Programs and Other Binding Limits: The project activity is not included in an emission trading program or any other mechanism that includes GHG allowance trading.

- Other Forms of Environmental Credit: The project activity is not creating any other form of environmental credit under any specific program.
- Participation under Other GHG Programs: The project activity is not registered under any other GHG program.

2 IMPLEMENTATION STATUS

2.1 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: 21/06/2005

Unit #2: 04/04/2005

Unit #3: 29/09/2004

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

During this 4th verification period from 01/08/2012 to 31/03/2014, the power plant is in operation continuously (with outages – forced and planned). The reasons for the planned and forced outages are shown in the table below:

Table 1; Planned and forced outages from 01/08/2012 to 31/12/2012

No.	Unit #	Reasons	Period of outages	
			Start date & time	Finish date & time
1	1	Earthquake	09/09/2012 01:24	09/09/2012 11:13
2	1	Problem with 150 kV connection	25/09/2012 12:02	10/10/2012 03:27
3	1	Problem in GIS	28/10/2012 06:14	28/10/2012 08:40
4	1	Problem in turbine	08/12/2012 10:36	08/12/2012 11:30
5	1	Problem with 150 kV connection	19/12/2012 12:01	19/12/2012 16:39
6	2	Earthquake	09/09/2012 01:24	09/09/2012 08:36
7	2	Problem with 150 kV connection	25/09/2012 12:02	26/09/2012 02:21

8	2	Problem with 150 kV connection	04/10/2012 13:53	04/10/2012 18:32
9	2	Problem in GIS	28/10/2012 09:45	28/10/2012 11:08
10	2	Problem in communication control	14/12/2012 21:22	15/12/2012 04:39
11	2	Problem with 150 kV connection	19/12/2012 09:21	19/12/2012 16:32
12	3	Simple inspection	23/08/2012 00:57	26/09/2012 01:25
13	3	Problem in steam turbine	02/10/2012 08:45	02/10/2012 16:20
14	3	Problem with 150 kV connection	04/10/2012 13:51	04/10/2012 17:52
15	3	Problem in condensor	18/10/2012 16:05	18/10/2012 20:20
16	3	Problem in condensor	28/11/2012 08:07	28/11/2012 11:13
17	3	Problem with 150 kV connection	30/11/2012 13:06	30/11/2012 15:37
18	3	Problem with 150 kV connection	19/12/2012 09:21	19/12/2012 14:12

Table 2:Planned and forced outages from 01/01/2013 to 31/12/2013

No.	Unit #	Reasons	Period of outages	
			Start date & time	Finish date & time
1	1	Problem in MCWP No. 1	30/01/2013 14:17	30/01/2013 20:47
2	1	IBT1 & IBT2 Cibinong tripped	09/10/2013 20:50	10/10/2013 11:00
3	1	Malfunction in DEHC	16/10/2013 05:55	16/10/2013 06:45
4	1	Major Inspection	26/10/2013 01:41	17/11/2013 23:59
5	1	Problem in MCWP No. 2	22/11/2013 13:17	22/11/2013 14:59
6	1	Problem in turbine	29/11/2013 12:00	29/11/2013 13:29
7	1	Problem in MCWP No. 2	07/12/2013 21:42	14/12/2013 06:41
8	1	Problem in 150 kV line	14/12/2013 23:55	15/12/2013 01:08
9	1	Problem on cable of relay trip signal	15/12/2013 11:52	15/12/2013 16:00
10	2	Simple Inspection	15/06/2013 01:47	09/07/2013 09:12
11	2	Problem in MCWP No.1	19/07/2013 13:30	19/07/2013 15:44
12	2	IBT1 & IBT2 Cibinong tripped	09/10/2013 20:50	10/10/2013 10:47
13	2	Problem in turbine	10/10/2013 18:07	10/10/2013 18:56
14	2	Problem in breaker 0BMA01	27/10/2013 14:01	27/10/2013 19:09
15	2	Problem in Sentul-Cibinong line	29/10/2013 07:02	29/10/2013 12:05

16	2	Problem in excitation system	12/11/2013 14:07	15/11/2013 10:13
17	2	Problem in bearing temperature	19/11/2013 00:07	19/11/2013 01:47
18	2	Problem in Sealing end phase S cable	01/12/2013 17:39	16/12/2013 13:00
19	3	Turbine inspection and repair	18/01/2013 00:29	25/01/2013 23:00
20	3	Earthquake	09/04/2013 01:54	09/04/2013 02:17
21	3	Problem in 150 kV line	17/04/2013 18:15	17/04/2013 22:46
22	3	Problem in MCWP No.2	13/08/2013 03:38	13/08/2013 09:50
23	3	IBT1 & IBT2 Cibinong tripped	09/10/2013 20:50	10/10/2013 08:55
24	3	Problem in board 3BBA07	12/10/2013 09:01	12/10/2013 15:34
25	3	Problem in inverter	24/10/2013 17:44	25/10/2013 07:37
26	3	Problem in overfrequency	29/10/2013 07:00	29/10/2013 07:43
27	3	Problem in secondary pump	04/12/2013 14:49	04/12/2013 15:46

Table3:Planned and forced outages from 01/01/2014 to 31/03/2014

No.	Unit #	Reasons	Period of outages	
			Start date & time	Finish date & time
1	1	Problem in Condensor	05/01/2014 23:40	06/01/2014 12:00
2	1	Earthquake	23/01/2014 00:40	23/01/2014 17:15
3	2	Problem in exciter	19/01/2014 16:15	01/02/2014 19:44
4	2	Problem in MCWP 01	08/03/2014 09:37	08/03/2014 21:00
5	2	Problem in MCWP 01	19/03/2014 08:14	19/03/2014 16:57
6	3	Earthquake	23/01/2014 00:40	23/01/2014 01:41
7	3	Maintenance Outage	22/02/2014 00:26	25/02/2014 07:34
8	3	Problem in Condenser	03/03/2014 18:31	04/03/2014 03:56

Table4:Total shutdowns and blackouts from 01/08/2012 to 31/03/2014

Year	Shutdown and blackout	
	Total (Times)	Total (Hours)
2012	18	1,254.33
2013	27	2,004.83
2014	8	454.07
Total 01/08/2012 - 31/03/2014	53	3,713.23

2.2 Deviations

2.2.1 Methodology Deviations

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

2.2.2 Project Description Deviations

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

2.3 Grouped Project

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

3 DATA AND PARAMETERS

3.1 Data and Parameters Available at Validation

Data and parameters available during validation:

Data Unit / Parameter:	EG _{historical}										
Data unit:	MWh										
Description:	Average net electricity delivered to the grid before the project activity until DATE _{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>411,363</td></tr> <tr> <td>Unit 2</td><td>399,102</td></tr> <tr> <td>Unit 3</td><td>394,696</td></tr> <tr> <td>Total</td><td>1,205,161</td></tr> </tbody> </table> The data above is based on an average of historical net electricity generation data recorded by PT. Indonesia Power since 1999-2004 for Unit 3 and 2000-2005 for Units 1 and 2.		EG _{historical} until DATE _{BaselineRetrofit} (MWh)	Unit 1	411,363	Unit 2	399,102	Unit 3	394,696	Total	1,205,161
	EG _{historical} until DATE _{BaselineRetrofit} (MWh)										
Unit 1	411,363										
Unit 2	399,102										
Unit 3	394,696										
Total	1,205,161										
Justification of choice of data or description of	-										

measurement methods and procedures applied	
Purpose of the data:	Baseline emission calculation
Comments:	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 are summarized transparently in regular production reports. The QA/QC is conducted through cross checking with sales electricity receipts. Meters are calibrated according to the Standard Operational Procedures signed between PT. Indonesia Power and PLN (load dispatcher) or other documents, which update or replace this SOP. Data measured by meters are cross-checked by electricity sales receipt. The meter (s) is either: - be read frequently jointly by the project developer and the grid company - be only read by the project developer and data will be double checked with the electricity sales receipts - be only read by the grid company

Data Unit / 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:	The Government Regulation No. 59 year 2007 on Geothermal Activities for 30 years average technical lifetime.											
Value applied:	<table><tr><th></th><th>Commissioning date</th><th>DATE_{BaselineRetrofit}</th></tr><tr><td>Unit 1</td><td>12/03/1994</td><td>12/03/2024</td></tr><tr><td>Unit 2</td><td>12/06/1994</td><td>12/06/2024</td></tr></table>				Commissioning date	DATE _{BaselineRetrofit}	Unit 1	12/03/1994	12/03/2024	Unit 2	12/06/1994	12/06/2024
	Commissioning date	DATE _{BaselineRetrofit}										
Unit 1	12/03/1994	12/03/2024										
Unit 2	12/06/1994	12/06/2024										

	Unit 3	16/07/1997	16/07/2027
	The DATE _{BaselineRetrofit} comes from commissioning date of each unit added by the average technical lifetime of 30 years		
Justification of choice of data or description of measurement methods and procedures applied	-		
Purpose of the data:	Baseline emission calculation		
Comments:	-		

Data Unit / Parameter:	GWP _{CH4}
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 first commitment period = 21 tCO ₂ /tCH ₄
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of the data:	Project emission calculation
Comments:	-

Data Unit / Parameter:	P _i
Data unit:	kg/m ³
Description:	Density of diesel fuel
Source of data:	Pertamina diesel fuel specification ²
Value applied:	0.815 kg/litre = 815 kg/m ³
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of the data:	Project emission calculation

² Material Safety Data Sheet (MSDS) of Diesel fuel from Pertamina, <http://www.pertamina.com/index.php/detail/read/solar>, retrieved on 24/05/2012

Comments:	-
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Data Unit / Parameter:	EF _{CM,y}
Data unit:	tCO ₂ /MWh
Description:	EF _{CM,y} is the combined margin CO ₂ emission factor of power plants connected to the JAMALI electricity grid in year 'y', calculated ex-ante based on the 50% weighted average of EF _{OM,y} and EF _{BM,y}
Source of data:	PLN
Value applied:	EF _{CM,y} = 0.882 tCO ₂ /MWh
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of the data:	Baseline and project emission calculations
Comments:	No measurement required. Data is obtained based on analysis of PLN published information.

Data Unit / Parameter:	EF _{OM,y}
Data unit:	tCO ₂ /MWh
Description:	EF _{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 simple 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 2004, 2005 and 2006 data.
Source of data:	PLN
Value applied:	EF _{OM,y} = 0.829 tCO ₂ /MWh
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of the data:	Baseline and project emission calculations
Comments:	No measurement required. Data is obtained based on analysis of PLN published information.

	All data relevant for the calculation of $EF_{OM,y}$ are updated annually. This includes each associated fuel emission factor and corresponding net calorific values, is re-defined annually.
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Data Unit / Parameter:	$EF_{BM,y}$
Data unit:	tCO ₂ /MWh
Description:	$EF_{BM,y}$ 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 2006 data.
Source of data:	PLN
Value applied:	$EF_{BM,y} = 0.936 \text{ tCO}_2/\text{MWh}$
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of the data:	Baseline and project emission calculations
Comments:	No measurement required. Data is obtained based on analysis of PLN published information. All data relevant for the calculation of $EF_{BM,y}$ 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 Unit / Parameter:	$FC_{i,j,y}$
Data unit:	kT
Description:	Consumption of fuel type 'i', in year 'y', for power plant in group 'j', where: Group 'j' is power plants in JAMALI grid excluding the low-cost/must-run sources (Whichever is larger compare to group 'm').
Source of data:	PLN
Value applied:	Refer to: JAMALI EF grid calculation
Justification of choice of	-

data or description of measurement methods and procedures applied	
Purpose of the data:	Baseline and project emission calculations
Comments:	No measurement required. Data is obtained based on analysis of PLN published information.

Data Unit / Parameter:	$FC_{i,m,y}$
Data unit:	kT
Description:	Consumption of fuel type 'i', in year 'y', for power plant in group 'm', where: Group 'm' is five most recently build power plants or power plants capacity additions that comprise 20% of system generation (whichever is larger compare to group 'j').
Source of data:	PLN
Value applied:	Refer to: JAMALI EF grid calculation
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of the data:	Baseline and project emission calculations
Comments:	No measurement required. Data is obtained based on analysis of PLN published information.

Data Unit / Parameter:	$\sum_j EG_{j,y}$
Data unit:	MWh
Description:	Generation data of power plants in sample group 'j' in year 'y', where: Group 'j' is power plants in JAMALI grid excluding the low-cost/must-run sources (Whichever is larger compare to group 'm').
Source of data:	PLN
Value applied:	Refer to: JAMALI EF grid calculation
Justification of choice of	-

data or description of measurement methods and procedures applied	
Purpose of the data:	Baseline and project emission calculations
Comments:	No measurement required. Data is obtained based on analysis of PLN published information.

Data Unit / Parameter:	$\sum_m EG_{m,y}$
Data unit:	MWh
Description:	Generation data of power plants in sample group 'm' in year 'y', where: Group 'm' is five most recently build power plants or power plants capacity additions that comprise 20% of system generation (whichever is larger compare to group 'j').
Source of data:	PLN
Value applied:	Refer to: JAMALI EF grid calculation
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of the data:	Baseline and project emission calculations
Comments:	No measurement required. Data is obtained based on analysis of PLN published information.

Data Unit / Parameter:	NCV _i
Data unit:	TJ/kt
Description:	Net calorific value of fuel type 'i' for purpose of calculating grid emission factor and diesel fuel consumption
Source of data:	Publication from various country relevant sources or 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook volume 2 chapter 1 Table 1.2, page 1.18
Value applied:	HSD & Diesel Fuel = 43 TJ/kt (= 0.043 GJ/kg) MFO = 40.4 TJ/kt Coal = 21.34TJ/kt Natural gas = 48 TJ/kt

Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of the data:	Baseline and project emission calculations
Comments:	-

Data Unit / Parameter:	EF _{CO2}
Data unit:	tCO ₂ /TJ
Description:	CO ₂ emission factor of fuel type 'i' for purpose of calculating grid emission factor and diesel fuel consumption
Source of data:	2006 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook volume 2 chapter 1 Table 1.4, page 1.23
Value applied:	HSD & Diesel Fuel = 74.1 tCO ₂ /TJ (= 0.074 tCO ₂ /GJ) MFO = 77.4 tCO ₂ /TJ Coal = 96.1 tCO ₂ /TJ Natural gas = 56.1 tCO ₂ /TJ
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of the data:	-
Comments:	-

3.2 Data and Parameters Monitored

Data and parameters monitored according to monitoring plan:

Data Unit / Parameter:	M _{S,y}
Data unit:	Tonnes
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	The measurement of steam quantities is conducted on a continuous basis, where hourly steam flow is available in paper format. The

applied:	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' (tons/year)</td></tr><tr><td></td><td>01/08/2012 - 31/12/2012</td><td>01/01/2013 - 31/12/2013</td><td>01/01/2014 - 31/03/2014</td></tr><tr><td>Unit 1</td><td>1,521,779.00</td><td>3,691,805.00</td><td>981,110.00</td></tr><tr><td>Unit 2</td><td>1,634,437.60</td><td>3,525,280.00</td><td>757,323.00</td></tr><tr><td>Unit 3</td><td>1,283,491.10</td><td>3,805,492.00</td><td>904,745.00</td></tr><tr><td>Total</td><td>4,439,707.70</td><td>11,022,577.00</td><td>2,643,178.00</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 produced during the year 'y' (tons/year)				01/08/2012 - 31/12/2012	01/01/2013 - 31/12/2013	01/01/2014 - 31/03/2014	Unit 1	1,521,779.00	3,691,805.00	981,110.00	Unit 2	1,634,437.60	3,525,280.00	757,323.00	Unit 3	1,283,491.10	3,805,492.00	904,745.00	Total	4,439,707.70	11,022,577.00	2,643,178.00
	Steam produced during the year 'y' (tons/year)																								
	01/08/2012 - 31/12/2012	01/01/2013 - 31/12/2013	01/01/2014 - 31/03/2014																						
Unit 1	1,521,779.00	3,691,805.00	981,110.00																						
Unit 2	1,634,437.60	3,525,280.00	757,323.00																						
Unit 3	1,283,491.10	3,805,492.00	904,745.00																						
Total	4,439,707.70	11,022,577.00	2,643,178.00																						
Monitoring equipment:	Steam flow meters used from 01/08/2012 to 31/03/2014 as follows: <table><tr><th>Steam flow meter</th><th>Serial number</th><th>Accuracy</th><th>Calibration Details</th></tr><tr><td>Unit #1</td><td>1LBA01CF001-B01</td><td>0.25%</td><td>Previous: 08/09/2008 13/07/2009 26/07/2010 25/07/2011 25/07/2012 Current: 25/07/2013 Next: 25/07/2014</td></tr><tr><td>Unit #2</td><td>2LBA01CF001-B01</td><td>0.25%</td><td>Previous: 08/09/2008 15/07/2009 27/07/2010 25/07/2011 25/07/2012 Current:</td></tr></table>	Steam flow meter	Serial number	Accuracy	Calibration Details	Unit #1	1LBA01CF001-B01	0.25%	Previous: 08/09/2008 13/07/2009 26/07/2010 25/07/2011 25/07/2012 Current: 25/07/2013 Next: 25/07/2014	Unit #2	2LBA01CF001-B01	0.25%	Previous: 08/09/2008 15/07/2009 27/07/2010 25/07/2011 25/07/2012 Current:												
Steam flow meter	Serial number	Accuracy	Calibration Details																						
Unit #1	1LBA01CF001-B01	0.25%	Previous: 08/09/2008 13/07/2009 26/07/2010 25/07/2011 25/07/2012 Current: 25/07/2013 Next: 25/07/2014																						
Unit #2	2LBA01CF001-B01	0.25%	Previous: 08/09/2008 15/07/2009 27/07/2010 25/07/2011 25/07/2012 Current:																						

				25/07/2013 Next: 25/07/2014
	Unit #3	3LBA01CF001-B01	0.25%	Previous: 08/09/2008 14/07/2009 28/07/2010 26/07/2011 26/07/2012 Current: 26/07/2013 Next: 26/07/2014
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.			
Purpose of the data	Calculation of project emissions			
Calculation method:	A back up check calculation is only applicable during emergencies such as trip or scaling in the steam pipeline occurred, which steam flow data could not be recorded.			
Comments:	Steam flow is read continuously and logged daily. Data is entered into the Steam flow report and is checked for consistency when entered. During emergencies such as trip, scaling in the steam pipeline, etc, caused no steam flow recorded, a backup check calculation is performed conservatively replacing unavailability measured steam flow for certain period. The backup check calculation is described in more detail in the SOP Carbon Credit Gunung Salak.			

Data Unit / Parameter:	W_{main,CO_2}
Data unit:	t CO ₂ /t steam
Description:	Average mass fraction of carbon dioxide in the produced steam (non-dimensional)
Source of data:	The Non-Condensable Gases (NCG) data taken from steam

	sampling as prescribed in the Monitoring Methodology ACM0002 version 07.																																																																																																															
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 07. The Non-Condensable Gases (NCG) sampling and analysis is performed every four 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 4 months																																																																																																															
Value monitored:	<table><tr><th rowspan="2">Anal ysis #</th><th>Period to be used in PES_y calculation</th><th colspan="3">CO₂ values to be used in PES_y calculation (non dimensional)</th></tr><tr><th>Month/Year</th><th>UNIT #1</th><th>UNIT #2</th><th>UNIT #3</th></tr><tr><td rowspan="4">1</td><td>08/2012</td><td>0.0073685</td><td>0.0070751</td><td>0.0041449</td></tr><tr><td>09/2012</td><td>0.0073685</td><td>0.0070751</td><td>0.0041449</td></tr><tr><td>10/2012</td><td>0.0073685</td><td>0.0070751</td><td>0.0041449</td></tr><tr><td>11/2012</td><td>0.0073685</td><td>0.0070751</td><td>0.0041449</td></tr><tr><td rowspan="4">2</td><td>12/2012</td><td>0.0030059</td><td>0.0036804</td><td>0.0024562</td></tr><tr><td>01/2013</td><td>0.0030059</td><td>0.0036804</td><td>0.0024562</td></tr><tr><td>02/2013</td><td>0.0030059</td><td>0.0036804</td><td>0.0024562</td></tr><tr><td>03/2013</td><td>0.0030059</td><td>0.0036804</td><td>0.0024562</td></tr><tr><td rowspan="4">3</td><td>04/2013</td><td>0.0048223</td><td>0.0050337</td><td>0.0058743</td></tr><tr><td>05/2013</td><td>0.0048223</td><td>0.0050337</td><td>0.0058743</td></tr><tr><td>06/2013</td><td>0.0048223</td><td>0.0050337</td><td>0.0058743</td></tr><tr><td>07/2013</td><td>0.0048223</td><td>0.0050337</td><td>0.0058743</td></tr><tr><td rowspan="4">4</td><td>08/2013</td><td>0.0046304</td><td>0.0046802</td><td>0.0044174</td></tr><tr><td>09/2013</td><td>0.0046304</td><td>0.0046802</td><td>0.0044174</td></tr><tr><td>10/2013</td><td>0.0046304</td><td>0.0046802</td><td>0.0044174</td></tr><tr><td>11/2013</td><td>0.0046304</td><td>0.0046802</td><td>0.0044174</td></tr><tr><td rowspan="4">5</td><td>12/2013</td><td>0.0037524</td><td>0.0042938</td><td>0.0048715</td></tr><tr><td>01/2014</td><td>0.0037524</td><td>0.0042938</td><td>0.0048715</td></tr><tr><td>02/2014</td><td>0.0037524</td><td>0.0042938</td><td>0.0048715</td></tr><tr><td>03/2014</td><td>0.0037524</td><td>0.0042938</td><td>0.0048715</td></tr><tr><td rowspan="4">6</td><td>04/2014</td><td>0.0051340</td><td>0.0037354</td><td>0.0043279</td></tr><tr><td>05/2014</td><td>0.0051340</td><td>0.0037354</td><td>0.0043279</td></tr><tr><td>06/2014</td><td>0.0051340</td><td>0.0037354</td><td>0.0043279</td></tr><tr><td>07/2014</td><td>0.0051340</td><td>0.0037354</td><td>0.0043279</td></tr></table> As per monitoring plan of VCS PD, NCG analysis must be	Anal ysis #	Period to be used in PES _y calculation	CO ₂ values to be used in PES _y calculation (non dimensional)			Month/Year	UNIT #1	UNIT #2	UNIT #3	1	08/2012	0.0073685	0.0070751	0.0041449	09/2012	0.0073685	0.0070751	0.0041449	10/2012	0.0073685	0.0070751	0.0041449	11/2012	0.0073685	0.0070751	0.0041449	2	12/2012	0.0030059	0.0036804	0.0024562	01/2013	0.0030059	0.0036804	0.0024562	02/2013	0.0030059	0.0036804	0.0024562	03/2013	0.0030059	0.0036804	0.0024562	3	04/2013	0.0048223	0.0050337	0.0058743	05/2013	0.0048223	0.0050337	0.0058743	06/2013	0.0048223	0.0050337	0.0058743	07/2013	0.0048223	0.0050337	0.0058743	4	08/2013	0.0046304	0.0046802	0.0044174	09/2013	0.0046304	0.0046802	0.0044174	10/2013	0.0046304	0.0046802	0.0044174	11/2013	0.0046304	0.0046802	0.0044174	5	12/2013	0.0037524	0.0042938	0.0048715	01/2014	0.0037524	0.0042938	0.0048715	02/2014	0.0037524	0.0042938	0.0048715	03/2014	0.0037524	0.0042938	0.0048715	6	04/2014	0.0051340	0.0037354	0.0043279	05/2014	0.0051340	0.0037354	0.0043279	06/2014	0.0051340	0.0037354	0.0043279	07/2014	0.0051340	0.0037354	0.0043279
Anal ysis #	Period to be used in PES _y calculation		CO ₂ values to be used in PES _y calculation (non dimensional)																																																																																																													
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	conducted every 4 months. Planning and realization date table as following: <table><tr><th colspan="3">NCG Analysis</th></tr><tr><th>Analysis #</th><th>Planned date</th><th>Realization date</th></tr><tr><td>1</td><td>23/07/2012</td><td>20/07/2012</td></tr><tr><td>2</td><td>23/11/2012</td><td>20/11/2012</td></tr><tr><td>3</td><td>23/03/2013</td><td>21/03/2013</td></tr><tr><td>4</td><td>23/07/2013</td><td>19/07/2013</td></tr><tr><td>5</td><td>23/11/2013</td><td>21/11/2013</td></tr><tr><td>6</td><td>23/03/2014</td><td>20/03/2014</td></tr></table> NCG analysis is conducted as per 4-months schedule.	NCG Analysis			Analysis #	Planned date	Realization date	1	23/07/2012	20/07/2012	2	23/11/2012	20/11/2012	3	23/03/2013	21/03/2013	4	23/07/2013	19/07/2013	5	23/11/2013	21/11/2013	6	23/03/2014	20/03/2014
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6	23/03/2014	20/03/2014																							
Monitoring equipment:	Equipment's monitored as per Monitoring Methodology ACM0002 version 07.																								
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 Unit / Parameter:	$W_{\text{main,CH}_4}$
Data unit:	t CH ₄ /t steam
Description:	Average mass fraction of methane gas in the produced steam (non-dimensional).
Source of data:	The Non-Condensable Gases (NCG) data taken from steam sampling as prescribed in the Monitoring Methodology ACM0002 version 07.
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 07. The Non-Condensable Gases (NCG) sampling and analysis is performed every four months, after the project is validated, by PT. Geoservices (Ltd) with a supervision of Gunung Salak Geothermal

	Power Plant Laboratory.																																																																																																																			
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Analysis #	Period to be used in PES _y calculation	CH ₄ values to be used in PES _y calculation (non dimensional)																																																																																																																		
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	NCG analysis is conducted as per 4-months schedule.
Monitoring equipment:	Equipment's monitored as per Monitoring Methodology ACM0002 version 07.
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 Unit / Parameter:	EG _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><th rowspan="2"></th><th colspan="3">EG_y (MWh)</th></tr><tr><th>01/08/2012 - 31/12/2012</th><th>01/01/2013 - 31/12/2013</th><th>01/01/2014 - 31/03/2014</th></tr><tr><td>Unit 1</td><td>187,009.95</td><td>454,011.07</td><td>120,015.46</td></tr><tr><td>Unit 2</td><td>206,384.68</td><td>433,457.62</td><td>92,541.89</td></tr><tr><td>Unit 3</td><td>161,267.76</td><td>478,899.75</td><td>113,657.55</td></tr><tr><td>Total</td><td>554,662.40</td><td>1,366,368.44</td><td>326,214.90</td></tr></table> As per monitoring plan of VCS PD and SOP for electricity metering scheme, revenue meter calibration should be conducted every 2 years.		EG _y (MWh)			01/08/2012 - 31/12/2012	01/01/2013 - 31/12/2013	01/01/2014 - 31/03/2014	Unit 1	187,009.95	454,011.07	120,015.46	Unit 2	206,384.68	433,457.62	92,541.89	Unit 3	161,267.76	478,899.75	113,657.55	Total	554,662.40	1,366,368.44	326,214.90
	EG _y (MWh)																							
	01/08/2012 - 31/12/2012	01/01/2013 - 31/12/2013	01/01/2014 - 31/03/2014																					
Unit 1	187,009.95	454,011.07	120,015.46																					
Unit 2	206,384.68	433,457.62	92,541.89																					
Unit 3	161,267.76	478,899.75	113,657.55																					
Total	554,662.40	1,366,368.44	326,214.90																					
Monitoring equipment:	Revenue meters used between 01/08/2012 – 31/03/2014 are: <table><tr><th>Revenue meter</th><th>Serial number</th><th>Class of Accuracy</th><th>Calibration date</th></tr><tr><td rowspan="3">Unit #1</td><td>PT 0806A117-01</td><td>0.2</td><td>Previous: 12/09/2008</td></tr><tr><td>MT-1006A500-01</td><td>0.2</td><td>Previous: 10/08/2010</td></tr><tr><td>MT-1009A635-01</td><td>0.2</td><td>Valid:</td></tr></table>	Revenue meter	Serial number	Class of Accuracy	Calibration date	Unit #1	PT 0806A117-01	0.2	Previous: 12/09/2008	MT-1006A500-01	0.2	Previous: 10/08/2010	MT-1009A635-01	0.2	Valid:									
Revenue meter	Serial number	Class of Accuracy	Calibration date																					
Unit #1	PT 0806A117-01	0.2	Previous: 12/09/2008																					
	MT-1006A500-01	0.2	Previous: 10/08/2010																					
	MT-1009A635-01	0.2	Valid:																					

		(PLN owned back-up meter)		20/12/2010 Next: 20/12/2015
		PT 0806A119-01	0.2	Current: 01/06/2012 Next: 01/06/2014
	Unit #2	PT 0806A118-01	0.2	Previous: 12/09/2008 20/04/2011
		PT-0802A471-01 (PLN owned back-up meter)	0.2	Valid: 20/12/2010 Next: 20/12/2015
		PT 0806A118-01	0.2	Current: 01/06/2012 Next: 01/06/2014
	Unit #3	PT 0806A119-01	0.2	Previous: 12/09/2008 04/11/2009 ³ 20/04/2011
		PT-0802A475-01 (PLN owned back-up meter)	0.2	Valid: 20/12/2010 Next: 20/12/2015
		MT 1006A500-01	0.2	Current: 01/06/2012 Next: 01/06/2014
	QA/QC procedures to be applied:			
	The QA/QC is conducted through cross checking with sales electricity receipts. Revenue meters are calibrated once per 2 years according to the PPA signed between PT. Indonesia Power and PLN (load			

³ The reason for having only a year gap for Unit #3 revenue meter calibration is LAN communication failure, which then needed to be fixed and subsequently recalibrated. During that time, a back-up meter owned by PT. PLN (Persero) was used to measure electricity generation from Unit #3

	dispatcher) or other documents, which update or replace this PPA except for PLN owned back up meters calibration, which follows PLN's internal regulations⁴. Data measured by meters is cross-checked by electricity sales receipt. The meter (s) is 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
Purpose of the data	Calculation of baseline emissions
Calculation method:	-
Comments:	PPA signed between PT. Indonesia Power and PT PLN (load dispatcher) or other documents, which update or replace this PPA. Since June 2011, an updated SOP of Metering System is applied replacing the previous SOP dated 23 January 2003.

Data Unit / Parameter:	EG _{baseline}
Data unit:	MWh
Description:	Baseline electricity supplied to the grid in the case of modified or retrofit facilities (MWh)
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 result is summarized transparently in regular production reports.
Frequency of monitoring/recording:	The measurement of electricity generation is conducted on a continuous basis, where hourly and daily total electricity

⁴ 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 (<http://portal.djmbp.esdm.go.id/sijh/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.

	measurement is available.																
Value monitored:	$EG_{baseline} = EG_{historical}, until DATE_{Baseline Retrofit}$$EG_{baseline} = EG_{y, on / after Date_{Baseline Retrofit}}$ <table><tr><th></th><th>EG_{baseline}(MWh)</th></tr><tr><td>Unit 1</td><td>411,363.29</td></tr><tr><td>Unit 2</td><td>399,102.44</td></tr><tr><td>Unit 3</td><td>394,696.30</td></tr><tr><td>Total</td><td>1,205,162.03</td></tr></table> The data above is based on 5-years historical data recorded by PT. Indonesia Power between 1999-2004 for Unit 3 and 2000-2005 for Units 1 and 2 before the project activity.		EG _{baseline} (MWh)	Unit 1	411,363.29	Unit 2	399,102.44	Unit 3	394,696.30	Total	1,205,162.03						
	EG _{baseline} (MWh)																
Unit 1	411,363.29																
Unit 2	399,102.44																
Unit 3	394,696.30																
Total	1,205,162.03																
Monitoring equipment:	Revenue meters used between 1999 to 2004 are: <table><tr><th>Revenue meter</th><th>Serial number</th><th>Class of Accuracy</th><th>Calibration date</th></tr><tr><td>Unit #1</td><td>PS 0512A040-01</td><td>0.2</td><td>1994, 1999 and 2005</td></tr><tr><td>Unit #2</td><td>PS 0512A041-01</td><td>0.2</td><td>1994, 1999 and 2005</td></tr><tr><td>Unit #3</td><td>PS 0512A042-01</td><td>0.2</td><td>1994, 1999 and 2005</td></tr></table> The revenue meters were externally calibrated in 1994, 1999 and 2005 by Laboratorium Kalibrasi PT. PLN (Persero). Note: On 01/10/2008, the revenue meter was replaced by PT 0806A117-01 / PT 0806A118-01 / PT 0806A119-01.	Revenue meter	Serial number	Class of Accuracy	Calibration date	Unit #1	PS 0512A040-01	0.2	1994, 1999 and 2005	Unit #2	PS 0512A041-01	0.2	1994, 1999 and 2005	Unit #3	PS 0512A042-01	0.2	1994, 1999 and 2005
Revenue meter	Serial number	Class of Accuracy	Calibration date														
Unit #1	PS 0512A040-01	0.2	1994, 1999 and 2005														
Unit #2	PS 0512A041-01	0.2	1994, 1999 and 2005														
Unit #3	PS 0512A042-01	0.2	1994, 1999 and 2005														
QA/QC procedures to be applied:	The QA/QC is conducted through cross checking with sales electricity receipts. Revenue meters are calibrated once per 2 years according to the PPA signed between PT. Indonesia Power and PLN (load dispatcher) or other documents, which update or replace this PPA except for PLN owned back up meters calibration, which follows PLN's internal regulations.																

	Data measured by meters are cross-checked by electricity sales receipt. The meter (s) is 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
Purpose of the data	Calculation of baseline emissions
Calculation method:	-
Comments:	PPA signed between PT. Indonesia Power and PT PLN (load dispatcher) or other documents, which update or replace this PPA. Since June 2011, an updated SOP of Metering System is applied replacing the previous SOP dated 23 January 2003.

Data Unit / Parameter:	EG _{imp}										
Data unit:	MWh										
Description:	Electricity imported from the grid										
Source of data:	Project Owner-PLN revenue meter										
Description of measurement methods and procedures to be applied:	Electricity imported 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 imported 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. The electricity-imported data refers to regular production spreadsheet that is recorded in electronic format.										
Frequency of monitoring/recording:	The measurement of electricity imported is conducted on a continuous basis, where hourly and daily total electricity measurement is available.										
Value monitored:	<table><tr><td></td><td colspan="3">EG_{imp} (MWh)</td></tr><tr><td></td><td>01/08/2012 - 31/12/2012</td><td>01/01/2013 - 31/12/2013</td><td>01/01/2014 - 31/03/2014</td></tr></table>				EG _{imp} (MWh)				01/08/2012 - 31/12/2012	01/01/2013 - 31/12/2013	01/01/2014 - 31/03/2014
	EG _{imp} (MWh)										
	01/08/2012 - 31/12/2012	01/01/2013 - 31/12/2013	01/01/2014 - 31/03/2014								

	Unit 1	216,535.67	286,336.57	43,104.00
	Unit 2	48,682.43	392,671.33	165,510.00
	Unit 3	177,812.73	91,856.01	31,240.00
	Total	443,030.83	770,863.91	239,854.00
	As per monitoring plan of VCS PD and SOP for electricity metering scheme, revenue meter calibration should be conducted every 2 years.			
Monitoring equipment:	Revenue meters used between 01/08/2012 – 31/03/2014 are:			
	Unit #1	Revenue meter	Serial number	Class of Accuracy
				Calibration date
			PT 0806A117-01	0.2
				Previous: 12/09/2008
	Unit #1		MT-1006A500-01	0.2
				Previous: 10/08/2010
			MT- 1009A635-01 (PLN owned back-up meter)	0.2
				Valid: 20/12/2010 Next: 20/12/2015
	Unit #2		PT 0806A119-01	0.2
				Current: 01/06/2012 Next: 01/06/2014
			PT 0806A118-01	0.2
				Previous: 12/09/2008 20/04/2011
	Unit #3		PT-0802A471-01 (PLN owned back-up meter)	0.2
				Valid: 20/12/2010 Next: 20/12/2015
			PT 0806A118-01	0.2
				Current: 01/06/2012 Next: 01/06/2014
	Unit #3		PT 0806A119-01	0.2
				Previous: 12/09/2008 04/11/2009

				20/04/2011	
		PT-0802A475-01 (PLN owned back-up meter)	0.2	Valid: 20/12/2010 Next: 20/12/2015	
		MT 1006A500-01	0.2	Current: 01/06/2012 Next: 01/06/2014	
QA/QC procedures to be applied:	Revenue meters are calibrated once per 2 years according to the PPA signed between PT. Indonesia Power and PLN (load dispatcher) or other documents, which update or replace this PPA except for PLN owned back up meters calibration, which follows PLN's internal regulations.				
Purpose of the data	Calculation of baseline emissions				
Calculation method:	-				
Comments:	PPA signed between PT. Indonesia Power and PT PLN (load dispatcher) or other documents, which update or replace this PPA. Since June 2011, an updated SOP of Metering System is applied replacing the previous SOP dated 23 January 2003.				

Data Unit / Parameter:	FC _{i,y}
Data unit:	Litres/year
Description:	Amount of diesel fuel used in the geothermal power plant operation
Source of data:	Project Owner-diesel fuel operational logbook
Description of measurement methods and procedures to be applied:	Fuel consumption is recorded monthly, specifically for each fuel (currently only diesel consumption is available). Fuel consumption is calculated from power shutdown records (hours) and/or diesel usage by using emergency diesel genset 400 kVA/320 kWh technical specification incl. its fuel consumption specification (0.260—it depends on each diesel genset), resulted in litres then converted to tonnes using fuel specific density or scientifically proven fuel densities.
Frequency of monitoring/recording:	Fuel consumption is recorded monthly, specifically for each fuel (currently only diesel consumption is available).
Value monitored:	

	Monitoring year	Power shutdown/diesel usage (hours)	Diesel specification		Diesel fuel (litres/year)
			Energy (kWh)	Fuel consumption	
	01/08/2012 -31/12/2012	1,259.13	320	0.260	104,759.89
	01/01/2013 -31/12/2013	2,016.17	320	0.260	167,745.07
	01/01/2014 -31/03/2014	534.97	320	0.260	44,509.23
	Total 01/08/2012 -31/03/2014	3,275.30			317,014.19
	The data above is based on actual data recorded by PT. Indonesia Power. Power shutdown data is recorded for the whole power plant. For simplification, to calculate the actual ER, project emission from total diesel consumption recorded by the Project Owner is only inserted in table ER calculation Unit #1 (while PE from diesel consumption in both Unit 2 and Unit 3 is considered zero). .				
Monitoring equipment:	-				
QA/QC procedures to be applied:	-				
Purpose of the data	Calculation of project emissions				
Calculation method:	Fuel consumption is calculated from power shutdown records (hours) and/or diesel usage by using emergency diesel genset 400 kVA/320 kWh technical specification incl. its fuel consumption specification (0.260—it depends on each diesel genset), resulted in litres then converted to tonnes using fuel specific density or scientifically proven fuel densities. Following is formulae to calculate fuel consumption: $\sum_i FC_{i,j,y} = Total\ shutdown\ time(hours) \times Energy(kWh) \times specific\ fuel\ consumption(0.260)$ Example of fuel consumption calculation for 01/04/2011-31/12/2011: $\sum_i FC_{i,j,y} = 598.75\ hours \times 320\ kWh \times 0.260 = 49,816.00\ litres$				
Comments:	Fuel consumption only occurs in emergencies when power plant is not operational and the grid is also not available, a confluence of events which is expected to happen very rarely; at other times the				

	plant runs on grid electricity. Emergency diesel genset 400 kVA/320 kWh is only for critical instrument/control system during turbine trip and shutdown.
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Table 5. Technical details of monitoring instruments

S.No	Equipment	Description
1	Electricity Revenue Meter Unit #1 (01/04/2009 – 10/08/2010) For EG _y and EG _{imp}	Name: Static Energy Meter Manufacturer: ION Type: 8600 Unit #1: PT 0806A117-01 Class of Accuracy: 0.2 Date of Calibration: 12/09/2008 Range: 5 A; 57.7 V; 50 Hz
2	Electricity Revenue Meter Unit #1 (10/08/2010 – 16/02/2012 at 10:00 AM) For EG _y 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: 10/08/2010 Range: 2.5 A; 57 - 277 V; 50 Hz
3	PLN Owned Back Up Electricity Revenue Meter Unit #1 (16/02/2012 at 10:01 AM – 01/06/2012 at 10:00 AM) For EG _y and EG _{imp}	Name: Static Energy Meter Manufacturer: Schneider Electric Type: ION 8600 Unit #1: MT-1009A635-01 Class of Accuracy: 0.2 Date of Calibration: 20/12/2010 Range: 2.5 A; 57 - 277 V; 50 Hz
4	Electricity Revenue Meter Unit #1 (01/06/2012 at 10:01 AM onwards) For EG _y 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: 01/06/2012 Range: 0.05 - 20 A; 57 - 277 V; 50 Hz
5	Electricity Revenue Meter Unit #2 (01/04/2009 - 16/02/12 at 10:00	Name: Static Energy Meter Manufacturer: ION

	AM) For EG _y and EG _{imp}	Type: 8600 Unit #2: PT 0806A118-01 Class of Accuracy: 0.2 Date of Calibration: 12/09/2008 & 20/04/2011 Range: 5 A; 57.7 V; 50 Hz
6	PLN Owned Back Up Electricity Revenue Meter Unit #2 (16/02/2012 at 10:01 AM – 01/06/2012 at 10:00 AM) For EG _y and EG _{imp}	Name: Static Energy Meter Manufacturer: Power Measurement Type: ION 8600 Unit #2: PT-0802A471-01 Class of Accuracy: 0.2 Date of Calibration: 20/12/2010 Range: 2.5 A; 57 - 277 V; 50 Hz
7	Electricity Revenue Meter Unit #2 (01/06/2012 at 10:01 AM onwards) For EG _y and EG _{imp}	Name: Static Energy Meter Manufacturer: ION Type: 8600 Unit #2: PT 0806A118-01 Class of Accuracy: 0.2 Date of Calibration: 01/06/2012 Range: 5 A; 57.7 V; 50 Hz
8	Electricity Revenue Meter Unit #3 (01/04/2009 - 16/02/2012 at 10:00 AM) For EG _y and EG _{imp}	Name: Static Energy Meter Manufacturer: ION Type: 8600 Unit #3: PT 0806A119-01 Class of Accuracy: 0.2 Date of Calibration: 12/09/2008 & 04/11/2009 Range: 0.05 - 20 A; 57 - 277 V; 50 Hz
9	PLN Owned Back Up Electricity Revenue Meter Unit #3 (16/02/2012 at 10:01 AM – 01/06/2012 at 10:00 AM) For EG _y and EG _{imp}	Name: Static Energy Meter Manufacturer: Power Measurement Type: ION 8600 Unit #3: PT-0802A475-01 Class of Accuracy: 0.2 Date of Calibration: 20/12/2010 Range: 2.5 A; 57 - 277 V; 50 Hz
10	Electricity Revenue Meter Unit #3 (01/06/2012 at 10:01 AM onwards)	Name: Static Energy Meter Manufacturer: Schneider Electric Type: ION 8600 Unit #3: MT-1006A500-01

	For EG_y and EG_{imp}	Class of Accuracy: 0.2 Date of Calibration: 01/06/2012 Range: 2.5 A; 57 - 277 V; 50 Hz
11	Steam Flow Meter Unit #1 For $M_{S,y}$	Name: Main Steam Flow Meter Transmitter Manufacturer: Endress-Hausser Model No.: FMD78 Instrument No.: 1LBA01CF001-B01 Range: Input: 0 ~ 200 mBar Output: 4 ~ 20 mA DC Scale: 0 ~ 100 % Accuracy: 0.25 % Date of Calibration: 08/09/2008, 13/07/2009, 26/07/2010, 25/07/2011, 25/07/2012, & 25/07/2013
12	Steam Flow Meter Unit #2 For $M_{S,y}$	Name: Main Steam Flow Meter Transmitter Manufacturer: Endress-Hausser Model No.: FMD78 Instrument No.: 2LBA01CF001-B01 Range: Input: 0 ~ 200 mBar Output: 4 ~ 20 mA DC Scale: 0 ~ 100 % Accuracy: 0.25 % Date of Calibration: 08/09/2008, 15/07/2009, 27/07/2010, 25/07/2011, 25/07/2012, & 25/07/2013
13	Steam Flow Meter Unit #3 For $M_{S,y}$	Name: Main Steam Flow Meter Transmitter Manufacturer: Endress-Hausser Model No.: FMD78 Instrument No.: 3LBA01CF001-B01 Range: Input: 0 ~ 200 mBar Output: 4 ~ 20 mA DC Scale: 0 ~ 100 % Accuracy: 0.25 % Date of Calibration: 08/09/2008, 14/07/2009, 28/07/2010, 26/07/2011, 26/07/2012, & 26/07/2013

3.3 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.

Table 6. List of training from 01/08/2012 to 31/03/2014

No.	Date	Name of Training	Participants	Organizer
1	15/10/2012	Energy Auditing of Thermal Power Station	Operator	Udiklat Suralaya

Besides above Energy Auditing of Thermal Power Station training, there are also other internal trainings such as Preparation of Visual Management UBP Kamojang, Maximo 7 Modul Purchasing Request (PR), Operation Management of Real Time System, WGD Efficiency Management, Management of Energy Audit, Steam Turbine Operation, and also other competencies such as Basic Office Administration, Coaching Mentoring Counseling (CMC), etc that have been conducted from 01/08/2012 to 31/03/2014 referring to internal training documentation.

Details of Monitoring Team and Responsibilities

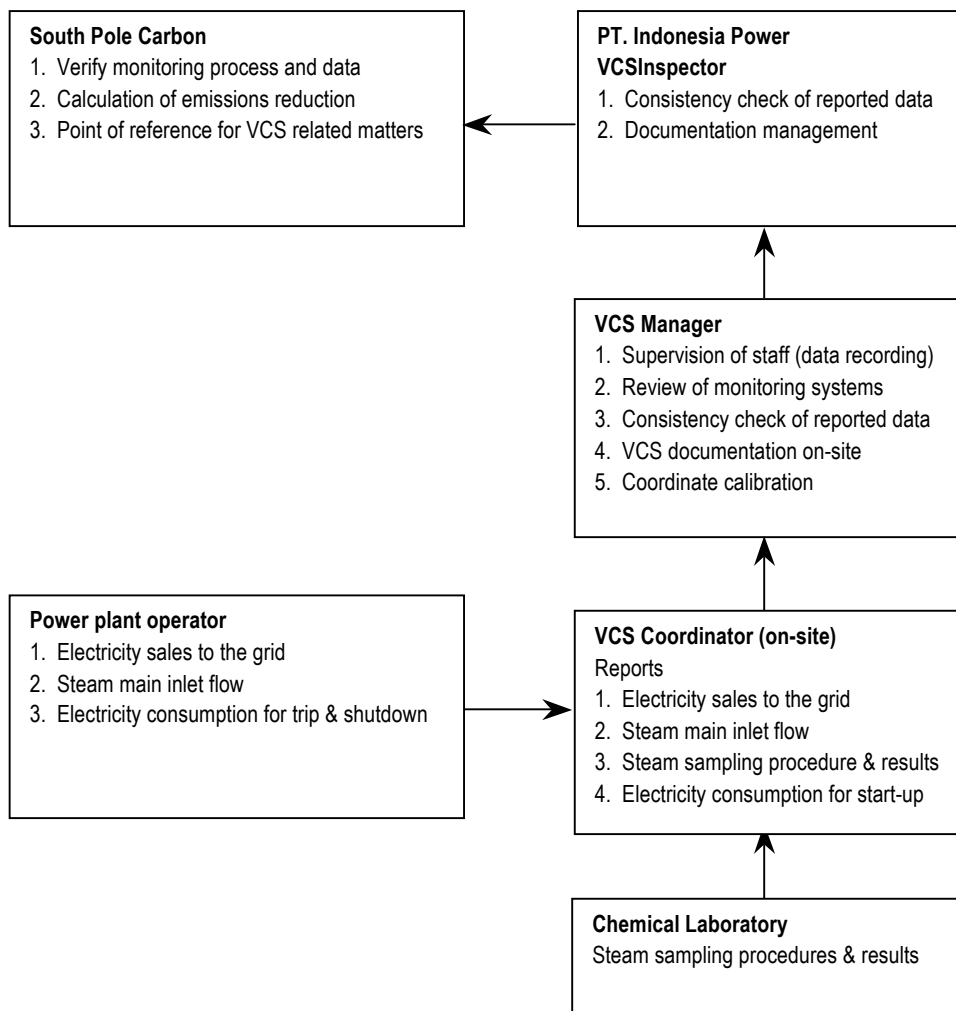
The electricity exported and imported together with steam flow rate and NCG characteristics required for emission reduction calculation were obtained by certain procedures set out in the monitoring plan. To address all O&M issues, the overall authority and responsibility belongs to the VCS Manager, which 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 3. Gunung Salak geothermal power plant organization chart



During monitoring period from 01/08/2012 to 31/03/2014, there is a change of person in charge (PIC) due to retirement. Therefore, following table shows person in charge during monitoring period from 01/09/2013 to 31/03/2014.

Table 7. Gunung Salak geothermal power plant team and responsibilities

Team	Jobs and	Position at the PT.	Represented by
------	----------	---------------------	----------------

	responsibilities	Indonesia Power	(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. Doni Bakar
VCS Coordinator	Prepare monthly report in the excel sheet	AMA Renval Operation	Mr. Henrey
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

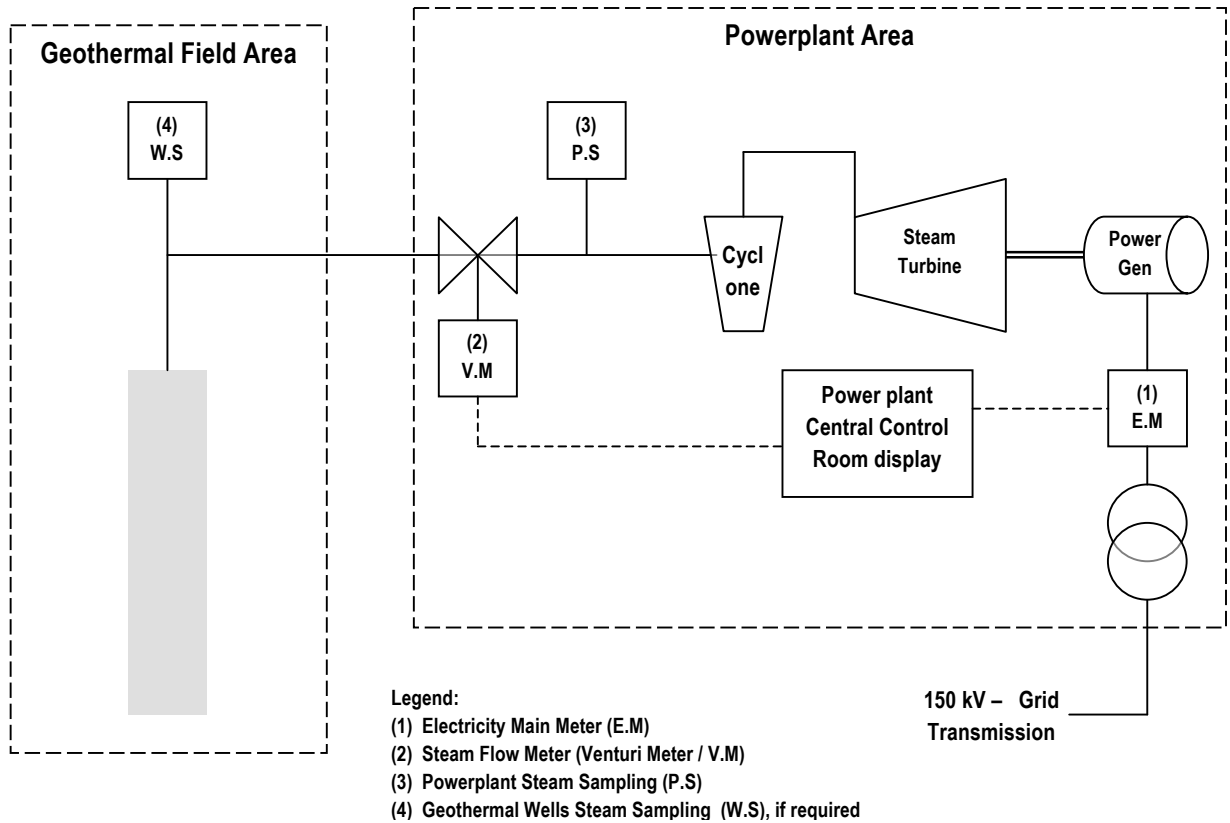
Measures to ensure the result/uncertainty analysis

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 (four-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 4. Gunung Salak geothermal power plant monitoring equipments



4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

Baseline emissions as described in the ACM0002 v.07 is calculated as following:

$$BE_y = (EG_y - EG_{baseline}) EF_{grid,CM,y}$$

$$EG_{baseline} = EG_{historical}, until Date_{Baseline Retrofit}$$

$$EG_{baseline} = EG_y, on / after Date_{Baseline Retrofit}$$

Where:

BE_y	Baseline emissions in year y (tCO_2/yr)
EG_y	Electricity supplied by the project activity to the grid (MWh)
$EG_{baseline}$	Baseline electricity supplied to the grid in the case of modified or retrofit facilities (MWh). For new power plants this value is taken as zero.
$EF_{grid,CM,y}$	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”
$EG_{historical}$	Average of historical electricity delivered by the existing facility to the grid (MWh).
$DATE_{BaselineRetrofit}$	Point in time when the existing equipment would need to be replaced in the absence of the project activity (date)

The project has taken the emission factor 0.882 tCO_2/MWh for estimation of baseline emission reductions as conservative. 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 01, 19/10/2007 (EB 35). 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 2004, 2005 and 2006 data. The 2004, 2005 and 2006 Operation Margin Emission Factor is calculated as follows: 0.764, 0.854 and 0.867 tCO_2e/MWh . The average Operating Margin Emission Factor (2004, 2005 and 2006) is 0.829 tCO_2e/MWh . While the ex-ante Build Margin Emission Factor is calculated to be 0.936 tCO_2e/MWh by dividing total CO_2 emissions by the total annual generation data. The values are presented in **Table 8**.

Table 8. Emission factor of Jamali Grid as per validated VCS PD

Parameter	As per the validated VCS project data
Operating Margin (OM) in $t CO_2 / MWh$	0.829
Build Margin (BM), in $t CO_2 / MWh$	0.936
Combined Margin (CM) Simple average of OM and BM in $t CO_2 / MWh$	0.882

BE_y Calculation for Gunung Salak unit #1

Table 9. Baseline emission (BE_y) calculation for Gunung Salak unit #1

Month/Y ear	EG _y				BE _y		
	Half-hourly production E _{exp}	Half-hourly production E _{imp}	Half-hourly production (E _{exp} -E _{imp})	As per invoice	EG _y	EG _{baseline}	Total
	kWh	kWh	kWh	kWh	MWh	MWh	tCO ₂
08/2012	42,321,338.62	0.00	42,321,338.62	42,321,338.62	42,321.34	34,280.27	7,092.22
09/2012	32,390,513.36	115,561.58	32,274,951.78	32,274,951.78	32,274.95	34,280.27	-1,768.69
10/2012	29,638,743.37	92,927.06	29,545,816.31	29,545,816.31	29,545.82	34,280.27	-4,175.79
11/2012	40,843,551.20	0.00	40,843,551.20	40,843,551.20	40,843.55	34,280.27	5,788.81
12/2012	42,032,342.69	8,047.03	42,024,295.66	42,024,295.66	42,024.30	34,280.27	6,830.23
Total 2012	187,226,489.24	216,535.67	187,009,953.57	187,009,953.57	187,009.95	171,401.37	13,766.77
Total 2012 ROUND DOWN							13,766
01/2013	42,068,853.14	17,897.57	42,050,955.57	42,050,955.57	42,050.96	34,280.27	6,853.74
02/2013	38,266,176.04	0.00	38,266,176.04	38,266,176.04	38,266.18	34,280.27	3,515.57
03/2013	42,329,586.17	0.00	42,329,586.17	42,329,586.17	42,329.59	34,280.27	7,099.49
04/2013	40,903,035.85	0.00	40,903,035.85	40,903,035.85	40,903.04	34,280.27	5,841.28
05/2013	41,553,974.58	0.00	41,553,974.58	41,553,974.58	41,553.97	34,280.27	6,415.40
06/2013	40,249,846.13	0.00	40,249,846.13	40,249,846.13	40,249.85	34,280.27	5,265.16
07/2013	42,506,764.00	0.00	42,506,764.00	42,506,764.00	42,506.76	34,280.27	7,255.76
08/2013	42,562,203.00	0.00	42,562,203.00	42,562,203.00	42,562.20	34,280.27	7,304.66
09/2013	41,901,380.99	0.00	41,901,380.99	41,901,381.00	41,901.38	34,280.27	6,721.82
10/2013	33,322,778.00	18,056.00	33,304,722.00	33,304,722.00	33,304.72	34,280.27	-860.44
11/2013	17,466,394.00	32,985.00	17,433,409.00	17,433,409.00	17,433.41	34,280.27	-14,858.94
12/2013	31,166,416.00	217,398.00	30,949,018.00	30,949,018.00	30,949.02	34,280.27	-2,938.17
Total 2013	454,297,407.90	286,336.57	454,011,071.33	454,011,071.34	454,011.07	411,363.29	37,615.34
Total 2013 ROUND DOWN							37,615
01/2014	39,993,042.00	43,104.00	39,949,938.00	39,949,938.00	39,949.94	34,280.27	5,000.64
02/2014	38,447,580.00	0.00	38,447,580.00	38,447,580.00	38,447.58	34,280.27	3,675.56
03/2014	41,617,939.00	0.00	41,617,939.00	41,617,939.00	41,617.94	34,280.27	6,471.82
Total 2014	120,058,561.00	43,104.00	120,015,457.00	120,015,457.00	120,015.46	102,840.82	15,148.03
Total 2014 ROUND DOWN							15,148
TOTAL 2012- 2014 ROUND DOWN							66,529

BE_y Calculation for Gunung Salak unit #2

Table 10. Baseline emission (BE_y) calculation for Gunung Salak unit #2

Month/Y ear	EG _y				BE _y		
	Half-hourly production E _{exp}	Half-hourly production E _{imp}	Half-hourly production (E _{exp} -E _{imp})	As per invoice	EG _y	EG _{baseline}	Total
	kWh	kWh	kWh	kWh	MWh	MWh	tCO ₂
08/2012	42,491,471.83	0.00	42,491,471.83	42,491,471.83	42,491.47	33,258.54	8,143.45
09/2012	40,013,222.87	14,019.72	39,999,203.15	39,999,203.15	39,999.20	33,258.54	5,945.27
10/2012	41,605,763.76	6,452.29	41,599,311.47	41,599,311.47	41,599.31	33,258.54	7,356.56
11/2012	40,598,663.08	0.00	40,598,663.08	40,598,663.08	40,598.66	33,258.54	6,473.99
12/2012	41,724,244.35	28,210.42	41,696,033.93	41,696,033.93	41,696.03	33,258.54	7,441.87
Total 2012	206,433,365.89	48,682.43	206,384,683.46	206,384,683.46	206,384.68	166,292.68	35,361.14
Total 2012 ROUND DOWN							35,361
01/2013	42,480,616.13	0.00	42,480,616.13	42,480,616.13	42,480.62	33,258.54	8,133.87
02/2013	38,353,488.60	0.00	38,353,488.60	38,353,488.60	38,353.49	33,258.54	4,493.75
03/2013	42,431,025.23	0.00	42,431,025.23	42,431,025.23	42,431.03	33,258.54	8,090.13
04/2013	41,062,564.90	0.00	41,062,564.90	41,062,564.90	41,062.56	33,258.54	6,883.15
05/2013	41,734,973.93	0.00	41,734,973.93	41,734,973.93	41,734.97	33,258.54	7,476.22
06/2013	18,736,742.81	29,913.33	18,706,829.48	18,706,829.48	18,706.83	33,258.54	-12,834.61
07/2013	31,886,785.00	120,013.00	31,766,772.00	31,766,772.00	31,766.77	33,258.54	-1,315.74
08/2013	41,207,349.00	0.00	41,207,349.00	41,207,349.00	41,207.35	33,258.54	7,010.85
09/2013	40,769,825.79	0.00	40,769,825.79	40,769,826.00	40,769.83	33,258.54	6,624.96
10/2013	39,171,980.00	42,279.00	39,129,701.00	39,129,701.00	39,129.70	33,258.54	5,178.37
11/2013	34,978,550.00	178,149.00	34,800,401.00	34,800,401.00	34,800.40	33,258.54	1,359.92
12/2013	21,036,388.00	22,317.00	21,014,071.00	21,014,071.00	21,014.07	33,258.54	-10,799.62
Total 2013	433,850,289.39	392,671.33	433,457,618.06	433,457,618.27	433,457.62	399,102.44	30,301.27
Total 2013 ROUND DOWN							30,301
01/2014	23,899,766.00	123,511.00	23,776,255.00	23,776,256.00	23,776.26	33,258.54	-8,363.37
02/2014	37,746,897.00	17,162.00	37,729,735.00	37,729,735.00	37,729.74	33,258.54	3,943.60
03/2014	31,060,739.00	24,837.00	31,035,902.00	31,035,903.00	31,035.90	33,258.54	-1,960.36
Total 2014	92,707,402.00	165,510.00	92,541,892.00	92,541,894.00	92,541.89	99,775.61	-6,380.14
Total 2014 ROUND DOWN							-6,380
TOTAL 2012- 2014 ROUND DOWN							59,282

BE_y Calculation for Gunung Salak unit #3

Table 11. Baseline Emission (BE_y) calculation for Gunung Salak unit #3

Month/Y ear	EG _y				BE _y		
	Half-hourly production E _{exp}	Half-hourly production E _{imp}	Half-hourly production (E _{exp} -E _{imp})	As per invoice	EG _y	EG _{baseline}	Total
	kWh	kWh	kWh	kWh	MWh	MWh	tCO ₂
08/2012	29,795,228.06	9,000.84	29,786,227.22	29,786,227.22	29,786.23	32,891.36	-2,738.73
09/2012	7,113,975.55	131,063.75	6,982,911.80	6,982,911.80	6,982.91	32,891.36	-22,851.25
10/2012	41,380,990.54	26,406.07	41,354,584.47	41,354,584.47	41,354.58	32,891.36	7,464.57
11/2012	40,822,682.85	6,360.14	40,816,322.71	40,816,322.71	40,816.32	32,891.36	6,989.82
12/2012	42,332,694.27	4,981.93	42,327,712.34	42,327,712.34	42,327.71	32,891.36	8,322.86
Total 2012	161,445,571.27	177,812.73	161,267,758.54	161,267,758.54	161,267.76	164,456.79	-2,812.73
Total 2012 ROUND DOWN							-2,812
01/2013	31,306,828.48	30,281.49	31,276,546.99	31,276,546.99	31,276.55	32,891.36	-1,424.26
02/2013	38,695,103.87	0.00	38,695,103.87	38,695,103.87	38,695.10	32,891.36	5,118.90
03/2013	42,862,821.17	0.00	42,862,821.17	42,862,821.17	42,862.82	32,891.36	8,794.83
04/2013	40,984,473.03	6,598.57	40,977,874.46	40,977,874.46	40,977.87	32,891.36	7,132.31
05/2013	41,698,689.04	2,025.95	41,696,663.09	41,696,663.09	41,696.66	32,891.36	7,766.28
06/2013	40,108,585.13	0.00	40,108,585.13	40,108,585.13	40,108.59	32,891.36	6,365.59
07/2013	42,011,038.00	0.00	42,011,038.00	42,011,038.00	42,011.04	32,891.36	8,043.56
08/2013	41,509,836.00	8,209.00	41,501,627.00	41,501,627.00	41,501.63	32,891.36	7,594.26
09/2013	40,762,151.79	0.00	40,762,151.79	40,762,152.00	40,762.15	32,891.36	6,942.04
10/2013	39,371,167.00	42,601.00	39,328,566.00	39,328,566.00	39,328.57	32,891.36	5,677.62
11/2013	39,759,426.00	0.00	39,759,426.00	39,759,426.00	39,759.43	32,891.36	6,057.64
12/2013	39,921,488.00	2,140.00	39,919,348.00	39,919,347.00	39,919.35	32,891.36	6,198.69
Total 2013	478,991,607.51	91,856.01	478,899,751.50	478,899,750.71	478,899.75	394,696.30	74,267.44
Total 2013 ROUND DOWN							74,267
01/2014	40,356,769.00	2,420.00	40,354,349.00	40,354,349.00	40,354.35	32,891.36	6,582.36
02/2014	32,520,307.00	19,442.00	32,500,865.00	32,500,866.00	32,500.87	32,891.36	-344.42
03/2014	40,811,713.00	9,378.00	40,802,335.00	40,802,335.00	40,802.34	32,891.36	6,977.48
Total 2014	113,688,789.00	31,240.00	113,657,549.00	113,657,550.00	113,657.55	98,674.08	13,215.42
Total 2014 ROUND DOWN							13,215
TOTAL 2012- 2014 ROUND DOWN							84,670

4.2 Project Emissions

Project emissions as described in the ACM0002 v.07 are considered from:

- a) Fugitive carbon dioxide and methane emissions due to release of non-condensable gases from the produced steam (PES_y); and

$$PE_y = PES_y + PEFF_y$$

$$PES_y = (w_{main,CO_2} + w_{main,CH_4} \times GWP_{CH_4}) M_{s,y}$$

Where:

PE_y	Project emissions in year y (tCO ₂ /yr)
PES_y	Project emissions of carbon dioxide and methane due to the release of non-condensable gases from the steam produced in the geothermal power plant in year y (tCO ₂ /yr)
$PEFF_y$	Project emissions from combustion of fossil fuels related to the operation of the geothermal power plant in year y (tCO ₂ /yr)
w_{main,CO_2}	Average mass fraction of carbon dioxide in the produced steam (non-dimensional)
w_{main,CH_4}	Average mass fraction of methane gas in the produced steam (non-dimensional)
GWP_{CH_4}	Global warming potential of methane valid for the relevant commitment period (tCO ₂ /tCH ₄)
$M_{s,y}$	Quantity of steam produced during the year 'y' (tonnes)

During current monitoring period from 01/08/2012 to 31/03/2014, there is 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 PES_y calculation are presented in **Table 12** and **Table 13**.

Table 12. CH₄ weight fraction values used in the project emission of NCG from the produced steam (PES_y) calculation

Analysis #	Period to be used in PES_y calculation	CH ₄ values to be used in PES_y calculation (non dimensional)		
	Month/Year	UNIT #1	UNIT #2	UNIT #3
1	08/2012	0.0000000076	0.0000000657	0.0000000129
	09/2012	0.0000000076	0.0000000657	0.0000000129
	10/2012	0.0000000076	0.0000000657	0.0000000129

	11/2012	0.0000000076	0.0000000657	0.0000000129
2	12/2012	0.0000054747	0.0000102960	0.0000040500
	01/2013	0.0000054747	0.0000102960	0.0000040500
	02/2013	0.0000054747	0.0000102960	0.0000040500
	03/2013	0.0000054747	0.0000102960	0.0000040500
3	04/2013	0.0000369772	0.0000002704	0.0000122793
	05/2013	0.0000369772	0.0000002704	0.0000122793
	06/2013	0.0000369772	0.0000002704	0.0000122793
	07/2013	0.0000369772	0.0000002704	0.0000122793
4	08/2013	0.0000584800	0.0000117936	0.0001064525
	09/2013	0.0000584800	0.0000117936	0.0001064525
	10/2013	0.0000584800	0.0000117936	0.0001064525
	11/2013	0.0000584800	0.0000117936	0.0001064525
5	12/2013	0.0000000080	0.0000087480	0.0000178362
	01/2014	0.0000000080	0.0000087480	0.0000178362
	02/2014	0.0000000080	0.0000087480	0.0000178362
	03/2014	0.0000000080	0.0000087480	0.0000178362
6	04/2014	0.0000002703	0.0000050115	0.0001529004
	05/2014	0.0000002703	0.0000050115	0.0001529004
	06/2014	0.0000002703	0.0000050115	0.0001529004
	07/2014	0.0000002703	0.0000050115	0.0001529004

Table 13. CO₂ weight fraction values used in the project emission of NCG from the produced steam (PES_y) calculation

Analysis #	Period to be used in PES _y calculation	CO ₂ values to be used in PES _y calculation (non dimensional)		
	Month/Year	UNIT #1	UNIT #2	UNIT #3
1	08/2012	0.0073685	0.0070751	0.0041449
	09/2012	0.0073685	0.0070751	0.0041449
	10/2012	0.0073685	0.0070751	0.0041449
	11/2012	0.0073685	0.0070751	0.0041449
2	12/2012	0.0030059	0.0036804	0.0024562
	01/2013	0.0030059	0.0036804	0.0024562
	02/2013	0.0030059	0.0036804	0.0024562
	03/2013	0.0030059	0.0036804	0.0024562
3	04/2013	0.0048223	0.0050337	0.0058743
	05/2013	0.0048223	0.0050337	0.0058743
	06/2013	0.0048223	0.0050337	0.0058743
	07/2013	0.0048223	0.0050337	0.0058743
4	08/2013	0.0046304	0.0046802	0.0044174
	09/2013	0.0046304	0.0046802	0.0044174
	10/2013	0.0046304	0.0046802	0.0044174
	11/2013	0.0046304	0.0046802	0.0044174
5	12/2013	0.0037524	0.0042938	0.0048715
	01/2014	0.0037524	0.0042938	0.0048715
	02/2014	0.0037524	0.0042938	0.0048715
	03/2014	0.0037524	0.0042938	0.0048715
6	04/2014	0.0051340	0.0037354	0.0043279

	05/2014	0.0051340	0.0037354	0.0043279
	06/2014	0.0051340	0.0037354	0.0043279
	07/2014	0.0051340	0.0037354	0.0043279

PES_y calculation for Gunung Salak unit #1

Table 14. Project emission from fugitive carbon dioxide and methane emissions due to release of non-condensable gases from the produced steam (PES_y) for Gunung Salak unit #1

Month/year	PES _y			
	W _{Main,CH₄,y}	W _{Main,CO₂,y}	M _{S,y}	Total
	tCH ₄ /t _{Steam}	tCO ₂ /t _{Steam}	tonnes / month	tCO ₂
08/2012	0.0000000076	0.0073684812	338,786.00	2,496.39
09/2012	0.0000000076	0.0073684812	259,443.00	1,911.74
10/2012	0.0000000076	0.0073684812	244,073.00	1,798.49
11/2012	0.0000000076	0.0073684812	333,988.00	2,461.04
12/2012	0.0000054747	0.0030058974	345,489.00	1,078.22
Total 2012			1,521,779.00	9,745.88
Total 2012 ROUND DOWN				9,746
01/2013	0.0000054747	0.0030058974	342,471.00	1,068.81
02/2013	0.0000054747	0.0030058974	312,947.00	976.67
03/2013	0.0000054747	0.0030058974	345,432.00	1,078.05
04/2013	0.0000369772	0.0048223292	334,287.00	1,871.62
05/2013	0.0000369772	0.0048223292	339,844.00	1,902.74
06/2013	0.0000369772	0.0048223292	328,123.00	1,837.11
07/2013	0.0000369772	0.0048223292	344,637.00	1,929.57
08/2013	0.0000584800	0.0046303950	341,529.00	2,000.84
09/2013	0.0000584800	0.0046303950	334,929.00	1,962.17
10/2013	0.0000584800	0.0046303950	266,640.00	1,562.10
11/2013	0.0000584800	0.0046303950	143,451.00	840.40
12/2013	0.0000000080	0.0037523760	257,515.00	966.34
Total 2013			3,691,805.00	17,996.42
Total 2013 ROUND DOWN				17,997
01/2014	0.0000000080	0.0037523760	326,743.00	1,226.12
02/2014	0.0000000080	0.0037523760	313,657.00	1,177.01
03/2014	0.0000000080	0.0037523760	340,710.00	1,278.53
Total 2014			981,110.00	3,681.66
Total 2014 ROUND DOWN				3,682
TOTAL 2012- 2014 ROUND DOWN				31,425

PES_y calculation for Gunung Salak unit #2

Table 15. Project emission from fugitive carbon dioxide and methane emissions due to release of non-condensable gases from the produced steam (PES_y) for Gunung Salak unit #2

Month/year	PES _y			
	W _{Main,CH₄,y}	W _{Main,CO₂,y}	M _{S,y}	Total
	tCH ₄ /t _{Steam}	tCO ₂ /t _{Steam}	tonnes / month	tCO ₂
08/2012	0.0000000657	0.0070750578	308,024.00	2,179.71
09/2012	0.0000000657	0.0070750578	303,033.00	2,144.39
10/2012	0.0000000657	0.0070750578	344,973.50	2,441.18
11/2012	0.0000000657	0.0070750578	339,482.10	2,402.32
12/2012	0.0000102960	0.0036804360	338,925.00	1,320.67
Total 2012			1,634,437.60	10,488.29
Total 2012 ROUNDDOWN				10,489
01/2013	0.0000102960	0.0036804360	345,216.00	1,345.19
02/2013	0.0000102960	0.0036804360	311,808.00	1,215.01
03/2013	0.0000102960	0.0036804360	344,797.00	1,343.55
04/2013	0.0000002704	0.0050337092	333,769.00	1,681.99
05/2013	0.0000002704	0.0050337092	342,877.00	1,727.89
06/2013	0.0000002704	0.0050337092	151,726.00	764.61
07/2013	0.0000002704	0.0050337092	259,345.00	1,306.94
08/2013	0.0000117936	0.0046801664	335,697.00	1,654.26
09/2013	0.0000117936	0.0046801664	328,364.00	1,618.12
10/2013	0.0000117936	0.0046801664	318,742.00	1,570.71
11/2013	0.0000117936	0.0046801664	284,162.00	1,400.30
12/2013	0.0000087480	0.0042938460	168,777.00	755.71
Total 2013			3,525,280.00	16,384.27
Total 2013 ROUNDDOWN				16,385
01/2014	0.0000087480	0.0042938460	191,260.00	856.38
02/2014	0.0000087480	0.0042938460	301,429.00	1,349.66
03/2014	0.0000087480	0.0042938460	264,634.00	1,184.91
Total 2014			757,323.00	3,390.95
Total 2014 ROUNDDOWN				3,391
TOTAL 2012- 2014 ROUNDDOWN				30,265

PES_y calculation for Gunung Salak unit #3

Table 16. Project emission from fugitive carbon dioxide and methane emissions due to release of non-condensable gases from the produced steam (PES_y) for Gunung Salak unit #3

Month/year	PES _y			
	W _{Main,CH₄,y}	W _{Main,CO₂,y}	M _{S,y}	Total
	tCH ₄ /t _{Steam}	tCO ₂ /t _{Steam}	tonnes / month	tCO ₂

08/2012	0.0000000129	0.0041449377	234,968.00	973.99
09/2012	0.0000000129	0.0041449377	57,846.00	239.78
10/2012	0.0000000129	0.0041449377	328,632.10	1,362.25
11/2012	0.0000000129	0.0041449377	324,725.00	1,346.05
12/2012	0.0000040500	0.0024562035	337,320.00	857.22
Total 2012			1,283,491.10	4,779.29
Total 2012 ROUNDDOWN				4,780
01/2013	0.0000040500	0.0024562035	252,152.00	640.78
02/2013	0.0000040500	0.0024562035	306,954.00	780.05
03/2013	0.0000040500	0.0024562035	339,896.00	863.76
04/2013	0.0000122793	0.0058743488	325,485.00	1,995.94
05/2013	0.0000122793	0.0058743488	332,263.00	2,037.51
06/2013	0.0000122793	0.0058743488	320,238.00	1,963.77
07/2013	0.0000122793	0.0058743488	334,056.00	2,048.50
08/2013	0.0001064525	0.0044174137	330,623.00	2,199.61
09/2013	0.0001064525	0.0044174137	327,338.00	2,177.75
10/2013	0.0001064525	0.0044174137	314,347.00	2,091.32
11/2013	0.0001064525	0.0044174137	311,444.00	2,072.01
12/2013	0.0000178362	0.0048714804	310,696.00	1,629.92
Total 2013			3,805,492.00	20,500.93
Total 2013 ROUNDDOWN				20,501
01/2014	0.0000178362	0.0048714804	319,739.00	1,677.36
02/2014	0.0000178362	0.0048714804	262,352.00	1,376.31
03/2014	0.0000178362	0.0048714804	322,654.00	1,692.66
Total 2014			904,745.00	4,746.33
Total 2014 ROUNDUP				4,747
TOTAL 2012- 2014 ROUNDUP				30,028

b) Carbon dioxide emissions from fossil fuel combustion ($PEFF_y$)

As referred to the “Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion” v.01, project emissions coming from fossil fuel combustion is calculated as following:

$$PEFF_y = PE_{FC,j,y} = \sum_i FC_{i,j,y} \times COEF_{i,y}$$

$$COEF_{i,y} = NCV_{i,y} \times EF_{CO2,i,y}$$

Where:

$PEFF_y$	Project emissions from combustion of fossil fuels related to the operation of the geothermal power plant in year y (tCO ₂ /yr)
$PE_{FC,j,y}$	CO ₂ emissions from fossil fuel combustion in process ‘j’ during the year ‘y’ (t CO ₂ e/year). This parameter shall be calculated as per the latest version of the Tool to calculate project or leakage CO ₂ emissions from fossil fuel combustion,

where 'j' stands for the processes required for the operation of the geothermal power plant.

$FC_{j,i,y}$	Quantity of fuel type 'i' combusted in process 'j' during the year 'y' (mass or volume unit)
$COEF_{j,y}$	CO ₂ emissions coefficient of fuel type 'i' in year 'y' (t CO ₂ e/mass or volume unit)
$NCV_{i,y}$	Weighted average net calorific value of the fuel type 'i' in year 'y' (GJ/mass or volume)
$EF_{CO_2,i,y}$	Weighted average CO ₂ emission factor of fuel type 'i' in year 'y' (t CO ₂ /GJ)

PEFF_y calculation for the whole power plant (Unit #1, #2 and #3)

Monitoring period from 01/08/2012 to 31/03/2014 as following in Table 17.

Table 17. Project emission from carbon dioxide emissions from fossil fuel combustion (PEFF_y) for all units

Month/year	PEFF _y					
	FC _{j,i,y}			NCVi,y	EF _{CO₂,i,y}	Total
	Diesel usage	Diesel density	Total			
	litre	kg/litre	tonnes			
08-12/2012	104,759.89	0.815	85.38	0.043	0.074	0.2717
1-12/2013	167,745.07	0.815	136.71	0.043	0.074	0.4350
1-3/2014	44,509.23	0.815	36.28	0.043	0.074	0.1154
TOTAL 2012-2014						0.8221

4.3 Leakage

Leakage emissions as described in the ACM0002 v.07 is 0 for retrofit project as following:

$$LE_y = 0$$

Where:

LE_y Leakage emissions in year y (tCO₂/yr)

4.4 Net GHG Emission Reductions and Removals

The emission reductions calculations as described in the ACM0002 v.07 are as follows:

$$ER_y = BE_y - PE_y - LE_y$$

Where:

ER_y	Emission reductions in year y (tCO ₂ /yr)
BE_y	Baseline emissions in year y (tCO ₂ /yr)
PE_y	Project emissions in year y (tCO ₂ /yr)
LE_y	Leakage emissions in year y (tCO ₂ /yr)

ER calculation for Gunung Salak Unit 1

Table 18. Emission reduction calculation for Gunung Salak unit #1

Month/Year	BE_y	PE_y		ER_y
		PES_y	$PEFF_y$	
Total 2012	13,766.77	9,745.88	0.2717	
Total 2012 ROUNDUP/DOWN	13,766	9,746		4,020
Total 2013	37,615.34	17,996.42	0.4350	
Total 2013 ROUNDUP/DOWN	37,615	17,997		19,618
Total 2014	15,148.03	3,681.66	0.1154	
Total 2014 ROUNDUP/DOWN	15,148	3,682		11,466
TOTAL 2012-2014 ROUNDUP/DOWN	66,529	31,425	0.8221	35,103

ER calculation for Gunung Salak Unit 2

Table 19. Emission reduction calculation for Gunung Salak unit #2

Month/Year	BE_y	PE_y		ER_y
		PES_y	$PEFF_y$	
Total 2012	35,361.14	10,488.29	0	
Total 2012 ROUNDUP/DOWN	35,361	10,489	0	24,872
Total 2013	30,301.27	16,384.27	0	
Total 2013 ROUNDUP/DOWN	30,301	16,385	0	13,916
Total 2014	-6,380.14	3,390.95	0	
Total 2014 ROUNDUP/DOWN	-6,380	3,391	0	-9,771
TOTAL 2012-2014 ROUNDUP/DOWN	59,282	30,265	0	29,017

ER calculation for Gunung Salak Unit 3

Table 20. Emission reduction calculation for Gunung Salak unit #3

Month/Year	BE _y	PE _y		ER _y
		PES _y	PEFF _y	
Total 2012	-2,812.73	4,779.29	0	
Total 2012 ROUNDUP/DOWN	-2,812	4,780	0	-7,592
Total 2013	74,267.44	20,500.93	0	
Total 2013 ROUNDUP/DOWN	74,267	20,501	0	53,766
Total 2014	13,215.42	4,746.33	0	
Total 2014 ROUNDUP/DOWN	13,215	4,747	0	8,468
TOTAL 2012-2014 ROUNDUP/DOWN	84,670	30,028	0	54,642

The summary of emission reductions for the chosen monitored period i.e. from 01/08/2012 to 31/03/2014 is provided in

Table 21.

Table 21. Summary of emission reduction calculation from 01/08/2012 to 31/03/2014

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 2012 : 01/08/2012- 31/12/2012	46,315	25,015	0	21,300
Vintage 2013 : 01/01/2013- 31/12/2013	142,183	54,883	0	87,300
Vintage 2014 : 01/01/2014- 31/03/2014	21,983	11,820	0	10,163
Total	210,481	91,718	0	118,763

Additional information related to this Monitoring Report and ER calculation will be provided separately to the DOE.