

CAPACITY UPGRADE OF GUNUNG SALAK GEOTHERMAL POWER PLANT PROJECT, INDONESIA



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Project Title	Capacity Upgrade of Gunung Salak Geothermal Power Plant Project, Indonesia
Version	Version 2.3
Report ID	
Date of Issue	24/12/2012
Project ID	144
Monitoring Period	3 rd verification period for 01/04/2011 to 31/07/2012 (both days included)
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1 PROJECT DETAILS

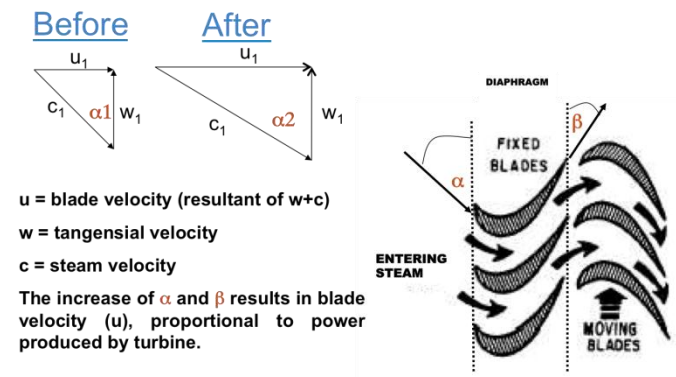
1.1 Summary Description of Project

The project activity is comprised 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:	PT. Indonesia Power
Street/P.O.Box:	Jl. Jenderal Gatot Subroto Kav. 18
Building:	
City:	Jakarta
State/Region:	
Postfix/ZIP:	12950
Country:	Indonesia
Telephone:	+62-21-526 7666
FAX:	
E-Mail:	agcc@indonesiapower.co.id
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Carbon credit buyer:

Organization:	South Pole Carbon Asset Management Ltd.
Street/P.O.Box:	Technoparkstrasse 1
Building:	
City:	Zurich
State/Region:	
Postfix/ZIP:	8005
Country:	Switzerland
Telephone:	+41-44 633 7870
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E-Mail:	registration@southpolecarbon.com
URL:	www.southpolecarbon.com
Representedby:	
Salutation:	Mr.
Last Name:	Heuberger
Middle Name:	
First Name:	Renat
Mobile:	+41-79 549 3951
Direct FAX:	
Direct tel:	
Personal E-Mail:	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.

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 3rd verification period from 01/04/2011 to 31/07/2012, 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 01/04/2011 to 31/12/2011

No.	Unit #	Reasons	Period of outages	
			Start date & time	Finish date & time
1	1	Problem with 150 kV connection (Host load)	07/04/2011 08:59	07/04/2011 09:50
2	1	Simple Inspection	21/04/2011 00:31	7/05/2011 23:28
3	1	Steam pipe investigation	14/05/2011 00:38	17/05/2011 22:15
4	1	Problem with 150 kV connection	08/10/2011 00:44	09/10/2011 21:47
5	1	Maintenance of Gas Circuit Breaker	03/12/2011 00:19	04/12/2011 19:07
6	1	Problem in steam turbine	07/12/2011 19:37	08/12/2011 02:30
7	1	Problem in transformer	20/12/2011 07:00	20/12/2011 08:00
8	1	Earthquake	30/12/2011 05:31	30/12/2011 05:47
9	2	Problem with 150 kV connection	07/04/2011 08:59	07/04/2011 13:15
10	2	Problem in steam turbine	29/07/2011 01:02	30/07/2011 20:32
11	2	Problem in steam turbine	30/07/2011 20:40	31/07/2011 00:15
12	2	Problem with 150 kV connection	08/10/2011 00:44	10/10/2011 02:46
13	2	Problem in steam turbine	20/10/2011 09:09	20/10/2011 10:03
14	2	Problem in steam turbine	09/11/2011 19:33	09/11/2011 21:30
15	2	Problem in steam turbine	09/11/2011 22:57	10/11/2011 02:56
16	2	Problem in transformer	20/12/2011 07:00	20/12/2011 10:52
17	3	Earthquake	04/04/2011 03:09	04/04/2011 03:17
18	3	Problem with 150 kV connection	07/04/2011 08:59	07/04/2011 13:15
19	3	Problem in steam turbine	07/04/2011 13:22	07/04/2011 14:00
20	3	Earthquake	23/04/2011 04:21	23/04/2011 04:26
21	3	Maintenance of Fiber Glass Discharge pipe of Main Cooling Water Pump	14/05/2011 09:46	19/05/2011 15:02
22	3	Problem in steam turbine	30/05/2011 11:44	30/05/2011 11:54
23	3	Problem in Filter Servo Valve	05/06/2011 11:39	05/06/2011 16:20

		Discharge MCWP		
24	3	Problem in VSD MCWP No.1	06/07/2011 16:51	06/07/2011 18:19
25	3	Problem in VSD MCWP No.1	07/07/2011 06:57	07/07/2011 09:59
26	3	Problem in VSD MCWP No.1	30/07/2011 05:40	30/07/2011 06:34
27	3	Problem with 150 kV connection	08/10/2011 00:44	08/10/2011 15:43
28	3	Problem in steam turbine	06/12/2011 20:11	06/12/2011 21:00
29	3	Problem in transformer	20/12/2011 07:00	20/12/2011 11:32
30	3	Earthquake	30/12/2011 05:31	30/12/2011 05:52

Table 2:Planned and forced outages from 01/01/2012 to 31/07/2012

No.	Unit #	Reasons	Period of outages	
			Start date & time	Finish date & time
1	1	Earthquake	05/01/2012 04:28	05/01/2012 04:51
2	1	Maintenance of unit	02/06/2012 04:18	03/06/2012 00:33
3	1	Earthquake	04/06/2012 18:17	04/06/2012 18:32
4	1	Earthquake	04/06/2012 18:36	05/06/2012 06:15
5	1	Earthquake	09/06/2012 05:35	09/06/2012 05:51
6	2	Maintenance of generator	16/01/2012 00:25	21/01/2012 05:03
7	2	Broken oil seal of CV2 Fast Acting	21/01/2012 10:06	21/01/2012 13:40
8	2	Problem in DCS	21/01/2012 15:07	21/01/2012 17:55
9	3	Earthquake	05/01/2012 04:28	05/01/2012 04:59
10	3	Problem in MCWP No.1	17/02/2012 12:39	17/02/2012 14:30
11	3	Problem in DCS	16/04/2012 14:48	16/04/2012 16:41
12	3	Earthquake	04/06/2012 18:17	04/06/2012 18:36
13	3	Earthquake	09/06/2012 05:35	09/06/2012 06:07

Table3:Total shutdowns and blackouts from 01/04/2011 to 31/07/2012

Year	Shutdown and blackout	
	Total (Times)	Total (Hours)
2011	30	846.23
2012	13	168.97
Total 01/04/2011 - 31/07/2012	43	1,015.20

In addition to that, during implementation period from 01/04/2011 to 31/07/2012 there are several changes happened within the project boundary as per Table 4.

Table 4: Changes happened during implementation period from 01/04/2011 to 31/07/2012.

No.	Unit #	Date	Activities	Reasons
1.	1	16/02/2012 – 01/06/2012	kWh revenue meter malfunction and corrective action	Due to an Ethernet communication device (LAN) problem in revenue meter, a corrective action is taken by uninstalling revenue meter. During this period, electricity generation was measured

				using PLN owned backup meter ² (do not change the project design and monitoring plan as per registered VCS PD).
2.	1	01/06/2012	kWh revenue meter Unit #1 was swapped for Unit #3	In order to minimize electricity measurement deviation between revenue and back-up meters in Unit #3, management decided to swap existing revenue meter Unit #1 for existing revenue meter Unit #3. The meters swap did not involve any new revenue meter except 2 existing revenue meters of Unit #1 and Unit #3. Therefore, as of 01/06/2012, serial number of revenue meter Unit #1 and Unit #3 are PT 0806A119-01 and MT 1006A500-01 (do not change the project design and monitoring plan as per registered VCS PD).
3.	2	16/02/2012 – 01/06/2012	kWh revenue meter malfunction and corrective action	Due to an Ethernet communication device (LAN) problem in revenue meter, a corrective action is taken by uninstalling revenue meter. During this period, electricity generation was measured using PLN owned backup meter ³ (do not change the project design and monitoring plan as per registered VCS PD).
4.	3	16/02/2012 – 01/06/2012	kWh revenue meter malfunction and corrective action	Due to an Ethernet communication device (LAN) problem in revenue meter, a corrective action is taken by uninstalling revenue meter. During this period, electricity generation was measured

² The meter reading from date of 16/02/2012 until 01/06/2012 was taken from PLN owned backup meter and so the date of electricity invoices remains not changed (still starts from 1st date of every month)

³ The meter reading from date of 16/02/2012 until 01/06/2012 was taken from PLN owned backup meter and so the date of electricity invoices remains not changed (still starts from 1st date of every month)

				using PLN owned backup meter ⁴ (do not change the project design and monitoring plan as per registered VCS PD).
5.	3	01/06/2012	kWh revenue meter Unit #3 was swapped for Unit #1	In order to minimize electricity measurement deviation between revenue and back-up meters in Unit #3, management decided to swap existing revenue meter Unit #3 for existing revenue meter Unit #1. The meters swap did not involve any new revenue meter except 2 existing revenue meters of Unit #1 and Unit #3. Therefore, as of 01/06/2012, serial number of revenue meter Unit #1 and Unit #3 are PT 0806A119-01 and MT 1006A500-01 subsequently (do not change the project design and monitoring plan as per registered VCS PD).

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

⁴ The meter reading from date of 16/02/2012 until 01/06/2012 was taken from PLN owned backup meter and so the date of electricity invoices remains not changed (still starts from 1st date of every month)

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										
Purpose of the data:	Baseline emission calculation										
Any comment:	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><td></td><td>Commissioning date</td><td>DATE_{BaselineRetrofit}</td></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><tr><td>Unit 3</td><td>16/07/1997</td><td>16/07/2027</td></tr></table> The DATE_{BaselineRetrofit} comes from commissioning date of each unit added by the average technical lifetime of 30 years				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
	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													
Purpose of the data:	Baseline emission calculation														
Any comment:	-														

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
Purpose of the data:	Project emission calculation
Any comment:	-

Data Unit / Parameter:	P _i
Data unit:	Kg/m ³
Description:	Density of diesel fuel
Source of data:	Pertamina diesel fuel specification ⁵
Value applied:	0.815 kg/litre = 815 kg/m ³
Purpose of the data:	Project emission calculation
Any comment:	-

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 weighted average of EF _{OM,y} and EF _{BM,y}
Source of data:	PLN
Value applied:	EF _{CM,y} = 0.882 tCO ₂ /MWh
Purpose of the data:	Baseline and project emission calculations
Any comment:	No measurement required. Data is obtained based on analysis of PLN published information.

Data Unit / Parameter:	EF _{OM,y}
Data unit:	tCO ₂ /MWh

⁵ Material Safety Data Sheet (MSDS) of Diesel fuel from Pertamina, <http://www.pertamina.com/index.php/detail/read/solar>, retrieved on 24/05/2012

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
Purpose of the data:	Baseline and project emission calculations
Any comment:	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.

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 tCO ₂ /MWh
Purpose of the data:	Baseline and project emission calculations
Any comment:	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
Purpose of the data:	Baseline and project emission calculations
Any comment:	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
Purpose of the data:	Baseline and project emission calculations
Any comment:	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
Purpose of the data:	Baseline and project emission calculations
Any comment:	No measurement required. Data is obtained based on analysis of PLN published information.

Data Unit / Parameter:	$\Sigma_m EG_{m,y}$
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
Purpose of the data:	Baseline and project emission calculations
Any comment:	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
Purpose of the data:	Baseline and project emission calculations
Any comment:	-

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
Purpose of the data:	-
Any comment:	-

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 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><th rowspan="2"></th><th colspan="2">Steam produced during the year 'y' (tons/year)</th></tr><tr><th>01/04/2011 - 31/12/2011</th><th>01/01/2012 - 31/07/2012</th></tr><tr><td>Unit 1</td><td>2.737.882,80</td><td>2.319.349.2</td></tr><tr><td>Unit 2</td><td>3.050.712,50</td><td>2.358.544.8</td></tr><tr><td>Unit 3</td><td>2.927.757,00</td><td>2.323.762.8</td></tr><tr><td>Total</td><td>8.716.352,30</td><td>7.001.656.8</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)		01/04/2011 - 31/12/2011	01/01/2012 - 31/07/2012	Unit 1	2.737.882,80	2.319.349.2	Unit 2	3.050.712,50	2.358.544.8	Unit 3	2.927.757,00	2.323.762.8	Total	8.716.352,30	7.001.656.8
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	01/04/2011 - 31/12/2011	01/01/2012 - 31/07/2012																
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Unit 3	2.927.757,00	2.323.762.8																
Total	8.716.352,30	7.001.656.8																
Monitoring equipment:	Steam flow meters used from 01/04/2011 to 31/07/2012 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 Current: 25/07/2012 Next: 25/07/2013</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</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 Current: 25/07/2012 Next: 25/07/2013	Unit #2	2LBA01CF001-B01	0.25%	Previous: 08/09/2008 15/07/2009 27/07/2010					
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Unit #1	1LBA01CF001-B01	0.25%	Previous: 08/09/2008 13/07/2009 26/07/2010 25/07/2011 Current: 25/07/2012 Next: 25/07/2013															
Unit #2	2LBA01CF001-B01	0.25%	Previous: 08/09/2008 15/07/2009 27/07/2010															

				25/07/2011 Current: 25/07/2012 Next: 25/07/2013
	Unit #3	3LBA01CF001-B01	0.25%	Previous: 08/09/2008 14/07/2009 28/07/2010 26/07/2011 Current: 26/07/2012 Next: 26/07/2013
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.			
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.			
Any comment:	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">Analysis #</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>04/2011</td><td>0.0045232</td><td>0.0066379</td><td>0.0062917</td></tr><tr><td>05/2011</td><td>0.0045232</td><td>0.0066379</td><td>0.0062917</td></tr><tr><td>06/2011</td><td>0.0045232</td><td>0.0066379</td><td>0.0062917</td></tr><tr><td>07/2011</td><td>0.0045232</td><td>0.0066379</td><td>0.0062917</td></tr><tr><td rowspan="4">2</td><td>08/2011</td><td>0.0047250</td><td>0.0054187</td><td>0.0078943</td></tr><tr><td>09/2011</td><td>0.0047250</td><td>0.0054187</td><td>0.0078943</td></tr><tr><td>10/2011</td><td>0.0047250</td><td>0.0054187</td><td>0.0078943</td></tr><tr><td>11/2011</td><td>0.0047250</td><td>0.0054187</td><td>0.0078943</td></tr><tr><td rowspan="4">3</td><td>12/2011</td><td>0.0050104</td><td>0.0049344</td><td>0.0067791</td></tr><tr><td>01/2012</td><td>0.0050104</td><td>0.0049344</td><td>0.0067791</td></tr><tr><td>02/2012</td><td>0.0050104</td><td>0.0049344</td><td>0.0067791</td></tr><tr><td>03/2012</td><td>0.0050104</td><td>0.0049344</td><td>0.0067791</td></tr><tr><td rowspan="4">4</td><td>04/2012</td><td>0.0027585</td><td>0.0035314</td><td>0.0026140</td></tr><tr><td>05/2012</td><td>0.0027585</td><td>0.0035314</td><td>0.0026140</td></tr><tr><td>06/2012</td><td>0.0027585</td><td>0.0035314</td><td>0.0026140</td></tr><tr><td>07/2012</td><td>0.0027585</td><td>0.0035314</td><td>0.0026140</td></tr></table> As per monitoring plan of VCS PD, NCG analysis must be 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></table>					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	04/2011	0.0045232	0.0066379	0.0062917	05/2011	0.0045232	0.0066379	0.0062917	06/2011	0.0045232	0.0066379	0.0062917	07/2011	0.0045232	0.0066379	0.0062917	2	08/2011	0.0047250	0.0054187	0.0078943	09/2011	0.0047250	0.0054187	0.0078943	10/2011	0.0047250	0.0054187	0.0078943	11/2011	0.0047250	0.0054187	0.0078943	3	12/2011	0.0050104	0.0049344	0.0067791	01/2012	0.0050104	0.0049344	0.0067791	02/2012	0.0050104	0.0049344	0.0067791	03/2012	0.0050104	0.0049344	0.0067791	4	04/2012	0.0027585	0.0035314	0.0026140	05/2012	0.0027585	0.0035314	0.0026140	06/2012	0.0027585	0.0035314	0.0026140	07/2012	0.0027585	0.0035314	0.0026140	NCG Analysis			Analysis #	Planned date	Realization date
Analysis #	Period to be used in PES _y calculation	CO ₂ values to be used in PES _y calculation (non-dimensional)																																																																																						
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1	04/2011	0.0045232	0.0066379	0.0062917																																																																																				
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Analysis #	Planned date	Realization date																																																																																						

		1	23/03/2011	22/03/2011
		2	23/07/2011	21/07/2011
		3	23/11/2011	21/11/2011
		4	23/03/2012	22/03/2012
		5	23/07/2012	23/07/2012
	NCG analysis is conducted as per 4-months schedule.			
Monitoring equipment:	Equipment's needed as per Monitoring Methodology ACM0002 version 07.			
QA/QC procedures to be applied:	Gunung Salak Geothermal Laboratory QA/QC Procedure			
Calculation method:	-			
Any comment:	-			

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.												
Frequency of monitoring/recording:	Every 4 months												
Value monitored:	<table> <tr> <th rowspan="2">Analysis #</th><th>Period to be used in PESy calculation</th><th colspan="3">CH₄ 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> </table>	Analysis #	Period to be used in PESy calculation	CH ₄ values to be used in PES _y calculation (non-dimensional)			Month/Year	UNIT #1	UNIT #2	UNIT #3			
Analysis #	Period to be used in PESy calculation		CH ₄ values to be used in PES _y calculation (non-dimensional)										
	Month/Year	UNIT #1	UNIT #2	UNIT #3									

	1	04/2011	0.0000011952	0.0000012834	0.0000016951																			
		05/2011	0.0000011952	0.0000012834	0.0000016951																			
		06/2011	0.0000011952	0.0000012834	0.0000016951																			
		07/2011	0.0000011952	0.0000012834	0.0000016951																			
	2	08/2011	0.0000014798	0.0000010360	0.0000027378																			
		09/2011	0.0000014798	0.0000010360	0.0000027378																			
		10/2011	0.0000014798	0.0000010360	0.0000027378																			
		11/2011	0.0000014798	0.0000010360	0.0000027378																			
	3	12/2011	0.0000008320	0.0000014280	0.0000037170																			
		01/2012	0.0000008320	0.0000014280	0.0000037170																			
		02/2012	0.0000008320	0.0000014280	0.0000037170																			
		03/2012	0.0000008320	0.0000014280	0.0000037170																			
	4	04/2012	0.0000035760	0.0000043624	0.0000021084																			
		05/2012	0.0000035760	0.0000043624	0.0000021084																			
		06/2012	0.0000035760	0.0000043624	0.0000021084																			
		07/2012	0.0000035760	0.0000043624	0.0000021084																			
	As per monitoring plan of VCS PD, NCG analysis must be 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>23/03/2011</td><td>22/03/2011</td></tr><tr><td>2</td><td>23/07/2011</td><td>21/07/2011</td></tr><tr><td>3</td><td>23/11/2011</td><td>21/11/2011</td></tr><tr><td>4</td><td>23/03/2012</td><td>22/03/2012</td></tr></table>						NCG Analysis			Analysis #	Planned date	Realization date	1	23/03/2011	22/03/2011	2	23/07/2011	21/07/2011	3	23/11/2011	21/11/2011	4	23/03/2012	22/03/2012
	NCG Analysis																							
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3	23/11/2011	21/11/2011																						
4	23/03/2012	22/03/2012																						
NCG analysis is conducted as per 4-months schedule.																								
Monitoring equipment:	Equipment's needed as per Monitoring Methodology ACM0002 version 07.																							
QA/QC procedures to be applied:	Gunung Salak Geothermal Laboratory QA/QC Procedure																							
Calculation method:	-																							
Any comment:	-																							

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	Electricity produced is measured by a watt-hour meter

procedures to be applied:	(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="2">EG_y (MWh)</th></tr><tr><th>01/04/2011-31/12/2011</th><th>01/01/2012-31/07/2012</th></tr><tr><td>Unit 1</td><td>339,997.34</td><td>287,878.27</td></tr><tr><td>Unit 2</td><td>362,828.97</td><td>282,510.30</td></tr><tr><td>Unit 3</td><td>364,625.03</td><td>291,745.46</td></tr><tr><td>Total</td><td>1,067,451.34</td><td>862,134.03</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. However, there was a calibration delay for revenue meter of Unit #2 in 2010. Based on the UNFCCC “Guidelines for assessing compliance with the calibration frequency requirements” v.01, where described that a maximum permissible error must be considered in BE_y calculation in case of the revenue meter calibration delay as per following formula: EG_{exp} = EG_{exp} x (100% - accuracy of revenue meter) = EG_{exp} x (100% - 0.2%) EG_{imp} = EG_{imp} x (100% + accuracy of revenue meter) = EG_{imp} x (100% + 0.2%)		EG _y (MWh)		01/04/2011-31/12/2011	01/01/2012-31/07/2012	Unit 1	339,997.34	287,878.27	Unit 2	362,828.97	282,510.30	Unit 3	364,625.03	291,745.46	Total	1,067,451.34	862,134.03
	EG _y (MWh)																	
	01/04/2011-31/12/2011	01/01/2012-31/07/2012																
Unit 1	339,997.34	287,878.27																
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Total	1,067,451.34	862,134.03																

	Therefore, net electricity generation (EG _y) values used in the ER calculation as following table: <table><tr><td></td><td colspan="2">EG_y (MWh) with conservative value due to delayed calibration</td></tr><tr><td></td><td>01/04/2011-31/12/2011</td><td>01/01/2012-31/07/2012</td></tr><tr><td>Unit 1</td><td>339,997.34</td><td>287,878.27</td></tr><tr><td>Unit 2</td><td>362,749.97</td><td>282,510.30</td></tr><tr><td>Unit 3</td><td>364,625.03</td><td>291,745.46</td></tr><tr><td>Total</td><td>1,067,372.34</td><td>862,134.03</td></tr></table>		EG _y (MWh) with conservative value due to delayed calibration			01/04/2011-31/12/2011	01/01/2012-31/07/2012	Unit 1	339,997.34	287,878.27	Unit 2	362,749.97	282,510.30	Unit 3	364,625.03	291,745.46	Total	1,067,372.34	862,134.03						
	EG _y (MWh) with conservative value due to delayed calibration																								
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Unit 3	364,625.03	291,745.46																							
Total	1,067,372.34	862,134.03																							
Monitoring equipment:	Revenue meters used between 01/04/2011 – 31/07/2012 are: <table><tr><th>Revenue meter</th><th>Serial number</th><th>Class of Accuracy</th><th>Calibration date</th></tr><tr><td rowspan="4">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 (PLN owned back-up meter)</td><td>0.2</td><td>Valid: 20/12/2010 Next: 20/12/2015</td></tr><tr><td>PT 0806A119-01</td><td>0.2</td><td>Current: 01/06/2012 Next: 01/06/2014</td></tr><tr><td rowspan="2">Unit #2</td><td>PT 0806A118-01</td><td>0.2</td><td>Previous: 12/09/2008 20/04/2011</td></tr><tr><td>PT- 0802A471-01 (PLN</td><td>0.2</td><td>Valid: 20/12/2010 Next:</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 (PLN owned back-up meter)	0.2	Valid: 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	0.2	Valid: 20/12/2010 Next:
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 (PLN owned back-up meter)	0.2	Valid: 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	0.2	Valid: 20/12/2010 Next:																						

		owned back-up meter)		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 ⁶ 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
	On 10/08/2010, PO replaced revenue meter Unit #1 with a new revenue meter with serial number MT-1006A500-01 due to memory of revenue meter (upgraded revenue meter). On 16/02/2012 at 10:01 AM until 01/06/2012 at 10:00 AM, PO uninstalled and repaired revenue meters of Unit #1, #2, and #3 due to LAN communication problem. During this period, electricity generation was measured using PLN backup revenue meters⁷ with serial number MT-1009A635-01 (Unit #1), PT-0802A471-01 (Unit #2),			

⁶ 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

⁷ The latest updated SOP (Standard Operating Procedure) of Metering System dated June 2011 described if errors or malfunctions in MU/Meter Utama (or revenue meter) are observed, the data recorded on the MP/Meter Pembanding (or back-up meter owned by PLN) shall be used (page 41, section 2.1.3.7.3. Error Found in Meter).

	and PT-0802A475-01 (Unit #3). On 01/06/2012 at 10:01 AM, PO decided to swap revenue meters of Unit #1 and #3 in order to reduce deviation measurement of revenue and back up meters of Unit #3.
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 regulations⁸. 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
Calculation method:	-
Any comment:	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)

⁸ 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.

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 measurement is available.												
Value monitored:	$EG_{baseline} = EG_{historical} \times \frac{Unit\ 1\ DME}{Unit\ 1\ DME_{Baseline\ Retrofit}}$$EG_{baseline} = EG_{y, on / after Date\ Basel\ 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</td><td>0.2</td><td>1994,1999</td></tr></table>	Revenue meter	Serial number	Class of Accuracy	Calibration date	Unit #1	PS 0512A040-01	0.2	1994,1999 and 2005	Unit #2	PS	0.2	1994,1999
Revenue meter	Serial number	Class of Accuracy	Calibration date										
Unit #1	PS 0512A040-01	0.2	1994,1999 and 2005										
Unit #2	PS	0.2	1994,1999										

		0512A041-01		and 2005
	Unit #3	PS 0512A042-01	0.2	1994,1999 and 2005
	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.			
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			
Calculation method:	-			
Any comment:	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><th rowspan="2"></th><th colspan="2">EG_{imp} (MWh)</th></tr><tr><th>01/04/2011-31/12/2011</th><th>01/01/2012-31/07/2012</th></tr><tr><td>Unit 1</td><td>125.28</td><td>75.41</td></tr><tr><td>Unit 2</td><td>115.79</td><td>53.65</td></tr><tr><td>Unit 3</td><td>68.68</td><td>10.24</td></tr><tr><td>Total</td><td>309.75</td><td>139.30</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. However, there was a calibration delay for revenue meter of Unit #2 in 2010. Thus, based on the UNFCCC guidelines, the revenue meter calibration delay must be considered in EG_{imp} calculation as per following formula: EG_{imp} = EG_{imp} x (100% + accuracy of revenue meter) = EG_{imp} x (100% + 0.2%)		EG _{imp} (MWh)		01/04/2011-31/12/2011	01/01/2012-31/07/2012	Unit 1	125.28	75.41	Unit 2	115.79	53.65	Unit 3	68.68	10.24	Total	309.75	139.30
	EG _{imp} (MWh)																	
	01/04/2011-31/12/2011	01/01/2012-31/07/2012																
Unit 1	125.28	75.41																
Unit 2	115.79	53.65																
Unit 3	68.68	10.24																
Total	309.75	139.30																

	Therefore, electricity imported from the grid (EG_{imp}) values used in the ER calculation as following table: <table><tr><th rowspan="2"></th><th colspan="2">EG_{imp} (MWh) with conservative value due to delayed calibration</th></tr><tr><th>01/04/2011- 31/12/2011</th><th>01/01/2012- 31/07/2012</th></tr><tr><td>Unit 1</td><td>125.28</td><td>75.41</td></tr><tr><td>Unit 2</td><td>115.80</td><td>53.65</td></tr><tr><td>Unit 3</td><td>68.68</td><td>10.24</td></tr><tr><td>Total</td><td>309.76</td><td>139.30</td></tr></table> The data above is based on regular production spreadsheet that is recorded by PT. Indonesia Power.		EG_{imp} (MWh) with conservative value due to delayed calibration		01/04/2011- 31/12/2011	01/01/2012- 31/07/2012	Unit 1	125.28	75.41	Unit 2	115.80	53.65	Unit 3	68.68	10.24	Total	309.76	139.30				
	EG_{imp} (MWh) with conservative value due to delayed calibration																					
	01/04/2011- 31/12/2011	01/01/2012- 31/07/2012																				
Unit 1	125.28	75.41																				
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Unit 3	68.68	10.24																				
Total	309.76	139.30																				
Monitoring equipment:	Revenue meters used between 01/04/2011 – 31/07/2012 are: <table><tr><th>Revenue meter</th><th>Serial number</th><th>Class of Accuracy</th><th>Calibration date</th></tr><tr><td rowspan="4">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 (PLN owned back-up meter)</td><td>0.2</td><td>Valid: 20/12/2010 Next: 20/12/2015</td></tr><tr><td>PT 0806A119-01</td><td>0.2</td><td>Current: 01/06/2012 Next: 01/06/2014</td></tr><tr><td>Unit #2</td><td>PT 0806A118-01</td><td>0.2</td><td>Previous: 12/09/2008 20/04/2011</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 (PLN owned back-up meter)	0.2	Valid: 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
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 (PLN owned back-up meter)	0.2	Valid: 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 ⁹ 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
	On 10/08/2010, PO replaced revenue meter Unit #1 with a new revenue meter with serial number MT-1006A500-01 due to memory of revenue meter (upgraded revenue meter). On 16/02/2012 at 10:01 AM until 01/06/2012 at 10:00 AM, PO uninstalled and repaired revenue meters of Unit #1, #2, and #3 due to LAN communication problem. During this period, electricity generation was measured using PLN backup revenue meters with serial number			

⁹ 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

	MT-1009A635-01 (Unit #1), PT-0802A471-01 (Unit #2), and PT-0802A475-01 (Unit #3). On 01/06/2012 at 10:01 AM, PO decided to swap revenue meters of Unit #1 and #3 in order to reduce deviation measurement of revenue and back up meters Unit #3.
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.
Calculation method:	-
Any comment:	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:	<table border="1"> <thead> <tr> <th rowspan="2">Monitoring year</th><th rowspan="2">Power shutdown/</th><th colspan="2">Diesel specification</th><th rowspan="2">Diesel fuel (litres/year)</th></tr> <tr> <th>Energy</th><th>Fuel</th></tr> </thead> <tbody> <tr> <td></td><td></td><td></td><td></td><td></td></tr> </tbody> </table>				Monitoring year	Power shutdown/	Diesel specification		Diesel fuel (litres/year)	Energy	Fuel					
Monitoring year	Power shutdown/	Diesel specification		Diesel fuel (litres/year)												
		Energy	Fuel													

		diesel usage (hours)	(kWh)	consump tion	
	01/04/2011- 31/12/2011	882.92	320	0.260	73,458.67
	01/01/2012- 31/07/2012	172.55	320	0.260	14,356.16
	Total 01/04/2011- 31/07/2012	1,055.47			87,814.83
The data above is based on actual data recorded by PT. Indonesia Power. Power shutdown data is recorded for the whole power plant. Therefore, it is calculated once in the ER calculation of Gunung Salak Unit 1.					
Monitoring equipment:	-				
QA/QC procedures to be applied:	-				
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: $\sum_i FC_{i,j,y} = \text{Total shutdown time (hours)} \times \text{Energy (kWh)} \times \text{specific fuel consumption (0.260)}$ Example of fuel consumption calculation for 01/04/2011-31/12/2011: $\sum_i FC_{i,j,y} = 598.75 \text{ hour} \times 320 \text{ kWh} \times 0.260 = 49,816.00 \text{ litres}$				
Any comment:	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.				

Table 5. Technical details of monitoring instruments

S.No	Equipment	Description
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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 AM) 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: 12/09/2008 & 20/04/2011 Range: 5 A; 57.7 V; 50 Hz
6	PLN Owned Back Up Electricity Revenue Meter Unit #2	Name: Static Energy Meter Manufacturer: Power Measurement

	(16/02/2012 at 10:01 AM – 01/06/2012 at 10:00 AM) For EG _y and EG _{imp}	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) For EG _y and EG _{imp}	Name: Static Energy Meter Manufacturer: Schneider Electric Type: ION 8600 Unit #3: MT-1006A500-01 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
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
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

3.3 Description of the 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 01/04/2011 to 31/07/2012

No.	Date	Name of Training	Participants	Organizer
1	13/04/2011	Total Productive Maintenance (TPM)	Control & Instrument Maintenance Supervisor	P2M FTUI

Besides above Total Productive Maintenance (TPM) trainings, there are also other internal trainings such as risk management, workshop Life Cycle Management (LCM), training end user asset & work management batch II, Supply Chain Management (SCM) and also other competencies such as health education, etc that have been conducted from 01/04/2011 to 31/07/2012 referring to internal training documentation.

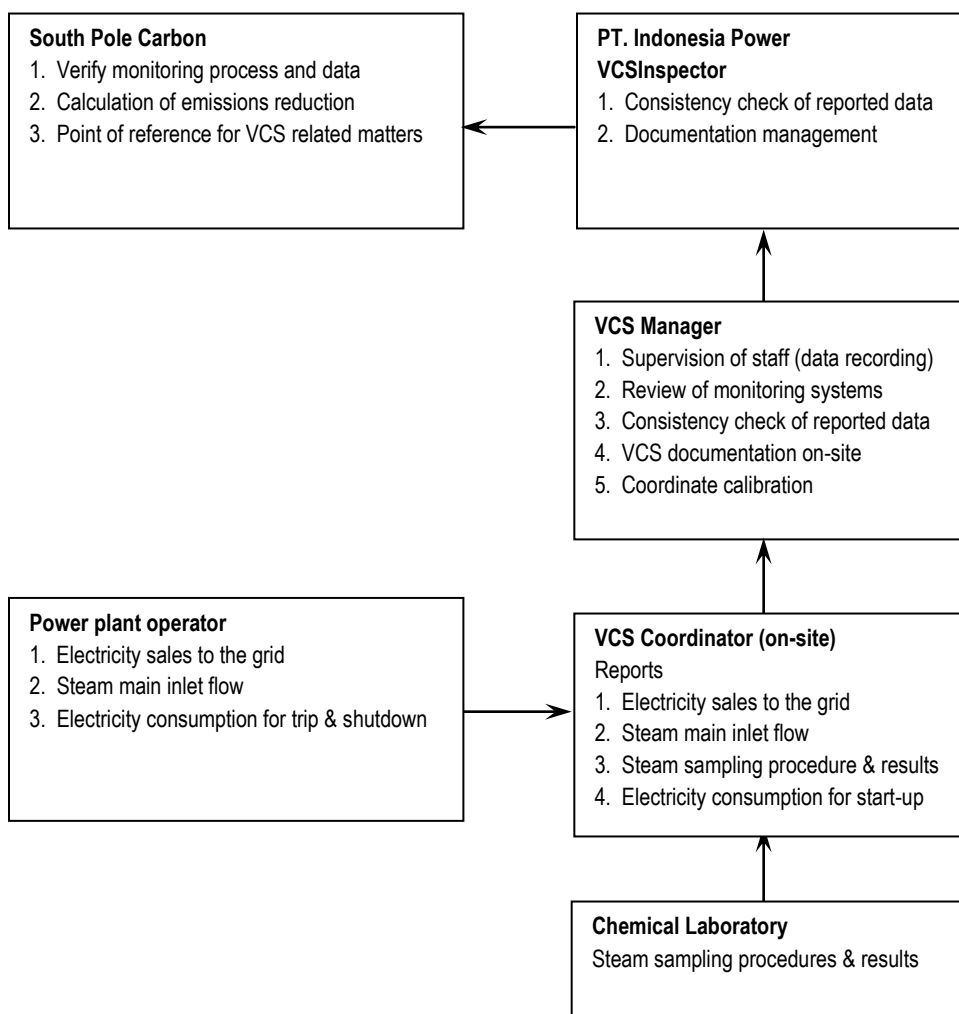
Details of Monitoring Team and Responsibilities

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 01/04/2011 to 31/07/2012, there are no changes of person in charge (PICs) due to regular internal rotation or promotion. Therefore, following table shows person in charge during monitoring period from 01/04/2011 to 31/07/2012.

Table 7. 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	Gunung Salak Site	Mr. Doni Bakar

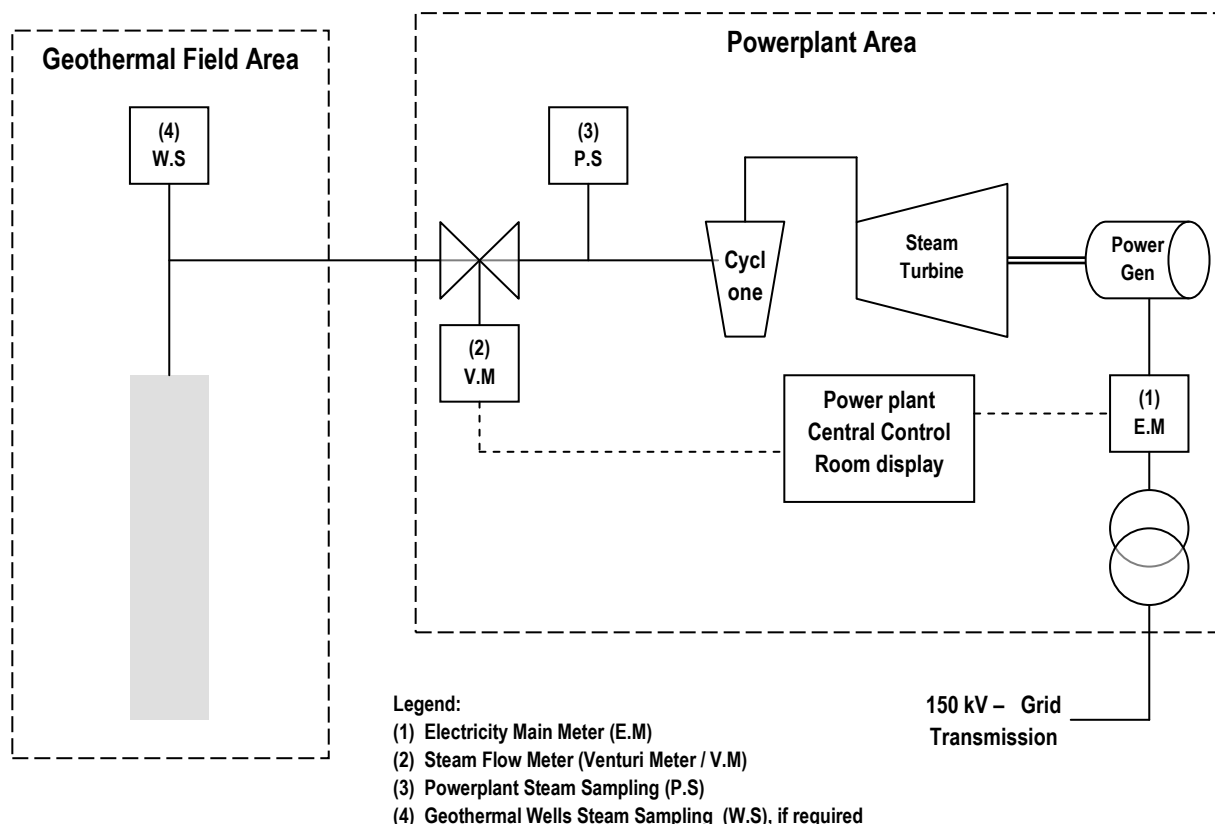
	report. • Prepare yearly report.	Manager	
VCS Coordinator	• Prepare monthly report in the excel sheet	AMA Renval Operation	Mr. Rinduan
Power plant operator (per shift)	• Record hourly data of steam flow, EG_y, EG_{imp}, blackouts/power shutdowns and any emergencies occurred.	Operator	Operator
Chemical 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:

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

$$EG_{baseline} = EG_{historical} \text{ until Date}_{Baseline \text{ \& } retrofit}$$

$$EG_{baseline} = EG_{y,on/after Date}_{Baseline \text{ \& } retrofit}$$

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 tCO₂/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 tCO₂e/MWh. The average Operating Margin Emission Factor (2004, 2005 and 2006) is 0.829 tCO₂e/MWh. While the ex-ante Build Margin Emission Factor is calculated to be 0.936 tCO₂e/MWh by dividing total CO₂ 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

During current monitoring period from 01/04/2011 to 31/07/2012, there are several changes happened as following:

1. On 16/02/2012 at 10:01 AM until 01/06/2012 at 10:00 AM, PO uninstalled and repaired revenue meters of Unit #1 due to LAN communication problem. During this period, electricity generation was measured using PLN back up revenue meters with serial number MT-1009A635-01.
2. On 01/06/2012 at 10:01 AM, PO decided to swap revenue meters of Unit #1 and #3 in order to reduce deviation measurement of revenue and back up meters Unit #3.

These changes did not and will not affect electricity export or import measurement.

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	Conservative (with 0.2% permissible error due to a delayed calibration schedule)	EG_y	$EG_{baseline}$	Total
	kWh	kWh	kWh	kWh	kWh	MWh	MWh	tCO ₂
04/2011	26,841,693.09	10,039.20	26,831,653.89	26,841,693.09	26,831,653.89	26,831.65	34,280.27	-6,569.68
05/2011	27,097,450.39	39,283.78	27,058,166.61	27,097,450.39	27,058,166.61	27,058.17	34,280.27	-6,369.90
06/2011	41,543,518.68	0.00	41,543,518.68	41,543,518.68	41,543,518.68	41,543.52	34,280.27	6,406.18
07/2011	42,592,760.41	0.00	42,592,760.41	42,592,760.41	42,592,760.41	42,592.76	34,280.27	7,331.61
08/2011	42,339,668.93	0.00	42,339,668.93	42,339,668.93	42,339,668.93	42,339.67	34,280.27	7,108.39
09/2011	40,629,224.87	0.00	40,629,224.87	40,629,224.87	40,629,224.87	40,629.22	34,280.27	5,599.77
10/2011	39,133,927.16	23,055.58	39,110,871.58	39,133,927.16	39,110,871.58	39,110.87	34,280.27	4,260.59
11/2011	40,579,414.60	0.00	40,579,414.60	40,579,414.60	40,579,414.60	40,579.41	34,280.27	5,555.84
12/2011	39,364,957.67	52,899.83	39,312,057.84	39,364,957.67	39,312,057.84	39,312.06	34,280.27	4,438.03
Total 2011	340,122,615.80	125,278.39	339,997,337.41	340,122,615.80	339,997,337.41	339,997.34	308,522.47	27,760.83
Total 2011 ROUND DOWN								27,760
01/2012	42,276,977.60	1,332.84	42,275,644.76	42,276,977.60	42,275,644.76	42,275.64	34,280.27	7,051.92
02/2012	39,297,723.15	0.00	39,297,723.15	39,297,723.15	39,297,723.15	39,297.72	34,280.27	4,425.39
03/2012	42,257,618.64	0.00	42,257,618.64	42,257,618.64	42,257,618.64	42,257.62	34,280.27	7,036.02
04/2012	40,820,670.74	0.00	40,820,670.74	40,820,670.74	40,820,670.74	40,820.67	34,280.27	5,768.63
05/2012	42,323,683.41	0.00	42,323,683.41	42,323,683.41	42,323,683.41	42,323.68	34,280.27	7,094.29
06/2012	38,677,294.93	74,072.81	38,603,222.12	38,677,294.93	38,603,222.12	38,603.22	34,280.27	3,812.84
07/2012	42,299,709.77	0.00	42,299,709.77	42,299,709.77	42,299,709.77	42,299.71	34,280.27	7,073.14
Total 2012	287,953,678.24	75,405.65	287,878,272.59	287,953,678.24	287,878,272.59	287,878.27	239,961.92	42,262.22
Total 2012 ROUND DOWN								42,262
TOTAL 2011- 2012 ROUND DOWN								70,022

BE_y Calculation for Gunung Salak unit #2

During current monitoring period from 01/04/2011 to 31/07/2012, there is a calibration delay for revenue meter Unit #2 in 2010, which has been considered in the ER calculation for Unit #2. The calibration delay is caused by procurement difficulties as to assign 3rd party contractor to do the calibration. However, since then, the project owner commits to do its best to avoid this unnecessary delay in the future. This revenue meter calibration delay affected emission reduction calculation in 04/2011, which considered a deduction

of 0.2% for EG_{exp} and an additional of 0.2% of EG_{imp} referring to the UNFCCC “Guideline for assessing compliance with the calibration frequency requirement v.1”, which described that a maximum permissible error from the manufactures specification should be taken into baseline emissions (BE_y) calculation as explained in section 3.2 above.

In addition to that, on 16/02/2012 at 10:01 AM until 01/06/2012 at 10:00 AM, PO uninstalled and repaired revenue meters of Unit #2 due to LAN communication problem. During this period, electricity generation was measured using PLN backup revenue meters with serial number PT-0802A471-01 with no affect to electricity export and import measurement.

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	Conservative (with 0.2% permissible error due to a delayed calibration schedule)	EG_y	$EG_{baseline}$	Total
	kWh	kWh	kWh	kWh	kWh	MWh	MWh	tCO ₂
04/2011	39,416,762.70	5,737.05	39,411,025.65	39,495,754.21	39,411,025.65	39,411.03	33,258.54	5,426.50
05/2011	40,625,809.04	0.00	40,625,809.04	40,625,809.04	40,625,809.04	40,625.81	33,258.54	6,497.93
06/2011	40,120,463.40	0.00	40,120,463.40	40,120,463.40	40,120,463.40	40,120.46	33,258.54	6,052.22
07/2011	38,940,119.59	57,692.41	38,882,427.18	38,940,119.59	38,882,427.18	38,882.43	33,258.54	4,960.27
08/2011	42,416,209.35	0.00	42,416,209.35	42,416,209.35	42,416,209.35	42,416.21	33,258.54	8,077.07
09/2011	40,351,463.37	0.00	40,351,463.37	40,351,463.37	40,351,463.37	40,351.46	33,258.54	6,255.96
10/2011	38,878,641.14	35,964.26	38,842,676.88	38,878,641.14	38,842,676.88	38,842.68	33,258.54	4,925.21
11/2011	40,320,004.49	16,202.51	40,303,801.98	40,320,004.49	40,303,801.98	40,303.80	33,258.54	6,213.92
12/2011	41,796,301.39	207.24	41,796,094.15	41,796,301.39	41,796,094.15	41,796.09	33,258.54	7,530.13
Total 2011	362,865,774.47	115,803.47	362,749,971.00	362,944,765.98	362,749,971.00	362,749.97	299,326.83	55,939.21
Total 2011 ROUND DOWN								55,939
01/2012	34,653,524.33	53,633.33	34,599,891.00	34,653,524.33	34,599,891.00	34,599.89	33,258.54	1,183.07
02/2012	39,317,486.16	0.00	39,317,486.16	39,317,486.16	39,317,486.16	39,317.49	33,258.54	5,343.99
03/2012	41,676,555.94	0.00	41,676,555.94	41,676,555.94	41,676,555.94	41,676.56	33,258.54	7,424.69
04/2012	41,066,280.04	0.00	41,066,280.04	41,066,280.04	41,066,280.04	41,066.28	33,258.54	6,886.43
05/2012	42,474,573.37	0.00	42,474,573.37	42,474,573.37	42,474,573.37	42,474.57	33,258.54	8,128.54
06/2012	40,898,102.27	0.00	40,898,102.27	40,898,102.27	40,898,102.27	40,898.10	33,258.54	6,738.10
07/2012	42,477,427.73	17.54	42,477,410.19	42,477,427.73	42,477,410.19	42,477.41	33,258.54	8,131.05
Total 2012	282,563,949.84	53,650.87	282,510,298.97	282,563,949.84	282,510,298.97	282,510.30	232,809.76	43,835.88
Total 2012 ROUND DOWN								43,835
TOTAL 2011- 2012 ROUND								99,774

DOWN								
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BE_y Calculation for Gunung Salak unit #3

During current monitoring period from 01/04/2011 to 31/07/2012, revenue meter Unit #3 uninstalled and repaired between 16/02/2012 at 10:01 AM until 01/06/2012 at 10:00 AM due to LAN communication problem. During this period, electricity generation was measured using PLN backup revenue meters with serial number PT-0802A475-01. While on 01/06/2012 at 10:01 AM, PO decided to swap revenue meters of Unit #1 and #3 in order to reduce deviation measurement of revenue and back up meters Unit #3. These changes did not and will not affect electricity export or import measurement.

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	Conservative (with 0.2% permissible error due to a delayed calibration schedule)	EG _y	EG _{baseline}	Total
	kWh	kWh	kWh	kWh	kWh	MWh	MWh	tCO ₂
04/2011	40,206,585.12	5,367.29	40,201,217.83	40,206,585.12	40,201,217.83	40,201.22	32,891.36	6,447.30
05/2011	34,267,473.01	30,617.53	34,236,855.48	34,267,473.01	34,236,855.48	34,236.86	32,891.36	1,186.73
06/2011	41,281,340.35	7,169.64	41,274,170.71	41,281,340.35	41,274,170.71	41,274.17	32,891.36	7,393.64
07/2011	42,317,219.58	11,459.13	42,305,760.45	42,317,219.58	42,305,760.45	42,305.76	32,891.36	8,303.50
08/2011	42,819,543.28	0.00	42,819,543.28	42,819,543.28	42,819,543.28	42,819.54	32,891.36	8,756.66
09/2011	40,057,571.67	0.00	40,057,571.67	40,057,571.67	40,057,571.67	40,057.57	32,891.36	6,320.60
10/2011	41,163,595.08	7,827.18	41,155,767.90	41,163,595.08	41,155,767.90	41,155.77	32,891.36	7,289.21
11/2011	40,831,330.49	0.00	40,831,330.49	40,831,330.49	40,831,330.49	40,831.33	32,891.36	7,003.06
12/2011	41,749,054.93	6,240.50	41,742,814.43	41,749,054.93	41,742,814.43	41,742.81	32,891.36	7,806.98
Total 2011	364,693,713.51	68,681.27	364,625,032.24	364,693,713.51	364,625,032.24	364,625.03	296,022.23	60,507.68
Total 2011 ROUND DOWN								60,507
01/2012	42,916,411.47	1,210.91	42,915,200.56	42,916,411.47	42,915,200.56	42,915.20	32,891.36	8,841.03
02/2012	39,584,423.08	2,557.25	39,581,865.83	39,584,423.08	39,581,865.83	39,581.87	32,891.36	5,901.03
03/2012	42,517,320.67	0.00	42,517,320.67	42,517,320.67	42,517,320.67	42,517.32	32,891.36	8,490.10
04/2012	40,863,510.99	4,467.64	40,859,043.35	40,863,510.99	40,859,043.35	40,859.04	32,891.36	7,027.50
05/2012	42,399,934.70	0.00	42,399,934.70	42,399,934.70	42,399,934.70	42,399.93	32,891.36	8,386.56
06/2012	40,700,994.67	2,007.11	40,698,987.56	40,700,994.67	40,698,987.56	40,698.99	32,891.36	6,886.33
07/2012	42,773,106.42	0.00	42,773,106.42	42,773,106.42	42,773,106.42	42,773.11	32,891.36	8,715.70
Total 2012	291,755,702.00	10,242.91	291,745,459.09	291,755,702.00	291,745,459.09	291,745.46	230,239.51	54,248.25
Total 2012 ROUND DOWN								54,248

TOTAL 2011- 2012 ROUND DOWN								114,755
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4.2 Project Emissions

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

$$PE_y = PES_y + PEF_y$$

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

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)
PEF_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 01/04/2011 to 31/07/2012, 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	CH ₄ values to be used in PES_y calculation (non dimensional)
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	calculation			
	Month/Year	UNIT #1	UNIT #2	UNIT #3
1	04/2011	0.0000011952	0.0000012834	0.0000016951
	05/2011	0.0000011952	0.0000012834	0.0000016951
	06/2011	0.0000011952	0.0000012834	0.0000016951
	07/2011	0.0000011952	0.0000012834	0.0000016951
2	08/2011	0.0000014798	0.0000010360	0.0000027378
	09/2011	0.0000014798	0.0000010360	0.0000027378
	10/2011	0.0000014798	0.0000010360	0.0000027378
	11/2011	0.0000014798	0.0000010360	0.0000027378
3	12/2011	0.0000008320	0.0000014280	0.0000037170
	01/2012	0.0000008320	0.0000014280	0.0000037170
	02/2012	0.0000008320	0.0000014280	0.0000037170
	03/2012	0.0000008320	0.0000014280	0.0000037170
4	04/2012	0.0000035760	0.0000043624	0.0000021084
	05/2012	0.0000035760	0.0000043624	0.0000021084
	06/2012	0.0000035760	0.0000043624	0.0000021084
	07/2012	0.0000035760	0.0000043624	0.0000021084

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	04/2011	0.0045232	0.0066379	0.0062917
	05/2011	0.0045232	0.0066379	0.0062917
	06/2011	0.0045232	0.0066379	0.0062917
	07/2011	0.0045232	0.0066379	0.0062917
2	08/2011	0.0047250	0.0054187	0.0078943
	09/2011	0.0047250	0.0054187	0.0078943
	10/2011	0.0047250	0.0054187	0.0078943
	11/2011	0.0047250	0.0054187	0.0078943
3	12/2011	0.0050104	0.0049344	0.0067791
	01/2012	0.0050104	0.0049344	0.0067791
	02/2012	0.0050104	0.0049344	0.0067791
	03/2012	0.0050104	0.0049344	0.0067791
4	04/2012	0.0027585	0.0035314	0.0026140
	05/2012	0.0027585	0.0035314	0.0026140
	06/2012	0.0027585	0.0035314	0.0026140
	07/2012	0.0027585	0.0035314	0.0026140

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
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	$W_{Main,CH_4,y}$	$W_{Main,CO_2,y}$	$M_{S,y}$	Total
	tCH_4/t_{Steam}	tCO_2/t_{Steam}	tonnes / month	tCO_2
04/2011	0.0000011952	0.0045231648	213,417.40	970.68
05/2011	0.0000011952	0.0045231648	219,288.60	997.38
06/2011	0.0000011952	0.0045231648	340,720.00	1,549.68
07/2011	0.0000011952	0.0045231648	338,043.00	1,537.51
08/2011	0.0000014798	0.0047249524	339,566.00	1,614.99
09/2011	0.0000014798	0.0047249524	328,830.00	1,563.92
10/2011	0.0000014798	0.0047249524	318,486.00	1,514.73
11/2011	0.0000014798	0.0047249524	325,761.00	1,549.33
12/2011	0.0000008320	0.0050104340	313,770.80	1,577.61
Total 2011			2,737,882.80	12,875.83
Total 2011 ROUNDUP				12,876
01/2012	0.0000008320	0.0050104340	338,791.50	1,703.41
02/2012	0.0000008320	0.0050104340	314,909.00	1,583.33
03/2012	0.0000008320	0.0050104340	341,448.00	1,716.77
04/2012	0.0000035760	0.0027585090	329,462.00	933.57
05/2012	0.0000035760	0.0027585090	341,437.00	967.50
06/2012	0.0000035760	0.0027585090	313,386.70	888.01
07/2012	0.0000035760	0.0027585090	339,915.00	963.18
Total 2012			2,319,349.20	8,755.77
Total 2012 ROUNDUP				8,756
TOTAL 2011- 2012 ROUNDUP				21,632

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			
	$W_{Main,CH_4,y}$	$W_{Main,CO_2,y}$	$M_{S,y}$	Total
	tCH_4/t_{Steam}	tCO_2/t_{Steam}	tonnes / month	tCO_2
04/2011	0.0000012834	0.0066378552	342,611.00	2,283.44
05/2011	0.0000012834	0.0066378552	355,637.00	2,370.25
06/2011	0.0000012834	0.0066378552	351,353.00	2,341.70
07/2011	0.0000012834	0.0066378552	335,178.50	2,233.90
08/2011	0.0000010360	0.0054186888	338,505.00	1,841.62
09/2011	0.0000010360	0.0054186888	318,162.00	1,730.94
10/2011	0.0000010360	0.0054186888	327,872.00	1,783.77
11/2011	0.0000010360	0.0054186888	334,791.00	1,821.41
12/2011	0.0000014280	0.0049343724	346,603.00	1,720.66
Total 2011			3,050,712.50	18,127.69
Total 2011 ROUNDUP				18,128
01/2012	0.0000014280	0.0049343724	271,632.00	1,348.48
02/2012	0.0000014280	0.0049343724	331,829.10	1,647.32
03/2012	0.0000014280	0.0049343724	358,708.70	1,780.76

04/2012	0.0000043624	0.0035313704	350,159.00	1,268.62
05/2012	0.0000043624	0.0035313704	360,140.00	1,304.78
06/2012	0.0000043624	0.0035313704	348,118.00	1,261.22
07/2012	0.0000043624	0.0035313704	337,958.00	1,224.42
Total 2012			2,358,544.80	9,835.60
Total 2012 ROUNDUP				9,836
TOTAL 2011- 2012 ROUNDUP				27,964

PESy 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
04/2011	0.0000016951	0.0062916886	322,566.20	2,040.97
05/2011	0.0000016951	0.0062916886	274,750.20	1,738.42
06/2011	0.0000016951	0.0062916886	328,051.60	2,075.68
07/2011	0.0000016951	0.0062916886	336,982.50	2,132.18
08/2011	0.0000027378	0.0078943086	340,422.80	2,706.97
09/2011	0.0000027378	0.0078943086	325,816.90	2,590.83
10/2011	0.0000027378	0.0078943086	332,215.80	2,641.71
11/2011	0.0000027378	0.0078943086	329,602.10	2,620.93
12/2011	0.0000037170	0.0067790800	337,348.90	2,313.25
Total 2011			2,927,757.00	20,860.95
Total 2011 ROUNDUP				20,861
01/2012	0.0000037170	0.0067790800	340,553.30	2,335.22
02/2012	0.0000037170	0.0067790800	315,782.50	2,165.36
03/2012	0.0000037170	0.0067790800	339,077.10	2,325.10
04/2012	0.0000021084	0.0026139820	326,424.80	867.72
05/2012	0.0000021084	0.0026139820	338,228.10	899.10
06/2012	0.0000021084	0.0026139820	325,770.00	865.98
07/2012	0.0000021084	0.0026139820	337,927.00	898.30
Total 2012			2,323,762.80	10,356.78
Total 2012 ROUNDUP				10,357
TOTAL 2011- 2012 ROUNDUP				31,218

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:

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

$$COEF_{i,y} = NCV_{i,y} \times EF_{CO_2,i,y}$$

Where:

$PEFF_y$ Project emissions from combustion of fossil fuels related to the operation of the geothermal power plant in year y (tCO₂/yr)

$PE_{FC,j,y}$ CO₂ emissions from fossil fuel combustion in process 'j' during the year 'y' (t CO₂ e/year). This parameter shall be calculated as per the latest version of the Tool to calculate project or leakage CO₂ 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)

$COEF_{j,y}$ CO₂ emissions coefficient of fuel type 'i' in year 'y' (t CO₂ 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 CO₂ emission factor of fuel type 'i' in year 'y' (t CO₂ /GJ)

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

Monitoring period from 01/04/2011 to 31/07/2012 as following in Table 17.

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

Month/year	$PEFF_y$					
	$FC_{j,i,y}$			$NCV_{i,y}$	$EF_{CO_2,i,y}$	Total
	Diesel usage	Diesel density	Total			
	litre	kg/litre	tonnes			
04-12/2011	71,413.33	0.815	58.20	0.043	0.074	0.1852
Total 2011 ROUNDUP						1
01-07/2012	14,371.41	0.815	11.70	0.043	0.074	0.0373
Total 2012 ROUNDUP						1
TOTAL 2011-2012 ROUNDUP						2

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 Summary of 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 (tCO₂/yr)

BE_y Baseline emissions in year y (tCO₂/yr)

PE_y Project emissions in year y (tCO₂/yr)

LE_y Leakage emissions in year y (tCO₂/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 2011	27,760.83	12,875.83	0.1852	
Total 2011 ROUNDUP/DOWN	27,760	12,876	1	14,883
Total 2012	42,262.22	8,755.77	0.0373	
Total 2012 ROUNDUP/DOWN	42,262	8,756	1	33,505
TOTAL 2011-2012 ROUNDUP/DOWN	70,022	21,632	2	48,388

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 2011	55,939.21	18,127.69	0	

Total 2011 ROUNDUP/DOWN	55,939	18,128	0	37,811
Total 2012	43,835.88	9,835.60	0	
Total 2012 ROUNDUP/DOWN	43,835	9,836	0	33,999
TOTAL 2011-2012 ROUNDUP/DOWN	99,774	27,964	0	71,810

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 2011	60,507.68	20,860.95	0	
Total 2011 ROUNDUP/DOWN	60,507	20,861	0	39,646
Total 2012	54,248.25	10,356.78	0	
Total 2012 ROUNDUP/DOWN	54,248	10,357	0	43,891
TOTAL 2011-2012 ROUNDUP/DOWN	114,755	31,218	0	83,537

The summary of emission reductions for the chosen monitored period i.e. from 01/04/2011 to 31/07/2012 is provided in

Table **21**.

Table 21. Summary of emission reduction calculation from 01/04/2011 to 31/07/2012

Year	BE	PE	ER
Vintage 2011 : 1/04/2011- 31/12/2011	144,206	51,866	92,340
Vintage 2012 : 01/01/2012- 31/07/2012	140,345	28,950	111,395
TOTAL	284,551	80,816	203,735

5 ADDITIONAL INFORMATION

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