MONITORING REPORT
82 MW LAU RENUN HYDRO POWER PLANT NORTH SUMATRA

Document Prepared By Ikke Martha Prasetyaning

Contact Information:

Project Title	82 MW Lau Renun Hydro Power Plant, North Sumatra
Version	3.0
Report ID	
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Project ID	VCS Database Project ID 488
Monitoring Period	01-Apr-2010 to 29-Feb-2012 (both days include)
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1 PROJECT DETAILS

1.1 Summary Description of Project

The 82 MW Lau Renun Hydro Power Plant (hereinafter refer to project activity) is a run-off the river type hydropower plant with a daily regulating pond at the five-hour peak power generation, diverting from the Renun river main stream and eleven (11) tributaries into Lake Toba. The regulating pond has a storage capacity of 500,000 m^3 and a power density of 820 W/m^2. The total actual installed capacity of the project is 82 MW, consisting of two 41 MW turbines. The project is owned and developed by PT. PLN (Persero), a state-owned electricity company. The project supplies electricity to the connected Sumatra grid.

The Lau Renun Hydroelectric project was registered as VCS project with ID Number 488. Further background on this project can be found in the Verified Carbon Standard Project Description (VCS PD).

The geographical coordinate of Lau Renun Hydroelectric Power Plant is located on 2.6500 North Latitude and 98.4094 East Longitude, Northwestern part of Lake Toba in North Sumatera Province, about 100 km South of Medan City.

Prior to the implementation of the project activity there is no power generation existing at the project location, electricity in grid is generated mainly from fossil fuel sources and is solely distributed to consumers via the electricity grid.

According to the registered VCS-PD, the record on diesel consumption taken from the generator sets operational logbook is included in the project emission calculation of the project activity. Since the project emission is less than 1% of baseline emission, hence the emission by the project activity is neglected. As result, the project activity generates renewable power with negligible Greenhouse Gas (GHG) emissions, which displaces part of the electricity otherwise supplied by fossil fuel fired power plants. The estimated annual CO_2 emissions reduction of the project is 229,048 tCO_2e. During this monitoring, total amount of emissions reduction is 417,704 tCO_2e.

Vintage Year	**Emissions Reduction**	**Unit**
01 April 2010 – 31 December 2010	153,291	tCO_2e
01 January 2011 – 31 December 2011	218,484	tCO_2e
01 January 2012 – 29 February 2012	45,930	tCO_2e
Total	417,704	tCO_2e

The project did not participate in any of the Environmental Credit Scheme other than VCS.

The project was validated under VCS and final report was issued on 16 November 2009. This monitoring report has been prepared in accordance with the monitoring plan contained in the

validated VCS-PD. The VCS-PD will serve as the basis for the verification, certification and issuance of the emission reductions during the monitoring period.

1.2 Sectoral Scope and Project Type

Sectoral scope	:	01. Energy industries (renewable - /non-renewable sources)
Project Type	:	I. Renewable energy project
Project Category	:	Grid connected electricity generation from renewable sources

1.3 Project Proponent

PT. PLN (Persero) – the project owner of '82 MW Lau Renun Hydro Power Plant, North Sumatra'

Address:	Jl. Trunojoyo blok M 1/135, Kebayoran Baru Jakarta – 12160 Indonesia
Telephone:	+62-21-725 1234
Fax:	+62 21 722 7026
URL:	www.pln.co.id
Represented by:	Ms. Assistia Semiawan
Mobile:	+62-811-962 833
Direct Fax:	+62 21 722 7026
Direct Tel:	+62-21 726 1122 ext. 1112
Personal E-Mail:	assistias@pln.co.id

South Pole Carbon Asset Management Ltd., - the VER Consultant and Buyer of project activity

Address	: Technoparkstr.1 8005 Zurich, Switzerland
Telephone	: + 41 43 501 3550
Represented by	: Mr. Renat Heuberger
Email	: registration@southpolecarbon.com

1.4 Other Entities Involved in the Project

Not applicable

1.5 Project Start Date

As per the VCS policy announcement from the 10 September 2008, the project start date is the date on which the project activity began reducing or removing GHG emissions.

Following are the two units' commissioning date:

- Renun Hydro Power Plant Unit 1 : 19 December 2006 (commissioning certificate)
- Renun Hydro Power Plant Unit 2 : 14 August 2006 (commissioning certificate)

Thus, the project start date where project activity starts reducing emissions is 14 August 2006, as the earliest project start date of two units at Renun Hydro Power Plant.

1.6 Project Crediting Period

- HEPP Project starting date : 14 August 2006
- VCS Crediting period start date : 01 September 2006
- VCS crediting period : 10 years (01-Sep-2006 until 31-Aug-2016)

1.7 Project Location

The project area of the Renun Hydro Power Plant is situated at Northwestern part of Lake Toba in North Sumatra Province, and it is about 100 km south of Medan city as the crow flies. It includes part of the upper-reaches of the Renun River and part of Lake Toba. The principal structures of the Renun project such as the main intake and waterway are situated in the upper-reaches of the Renun River basin and the power station on Lake Toba. The proposed main intake is situated at about 750 m downstream from the public bridge of Sidikalang-Tarutung road on the upstream reach of the Renun river at Pangiringan. The power station is located at foot of the spur of Toba Escarpment about 2 km southeast of Silalahi village. The waterway is about 24 km long, including such structures as several stream intake weirs, surge tank and the penstock line is located between the main intake site and power station.

The exact location is 2.6500 N and 98.4094 E. The location of the project site is shown in the following maps:

The location of the project site is shown in the following maps:

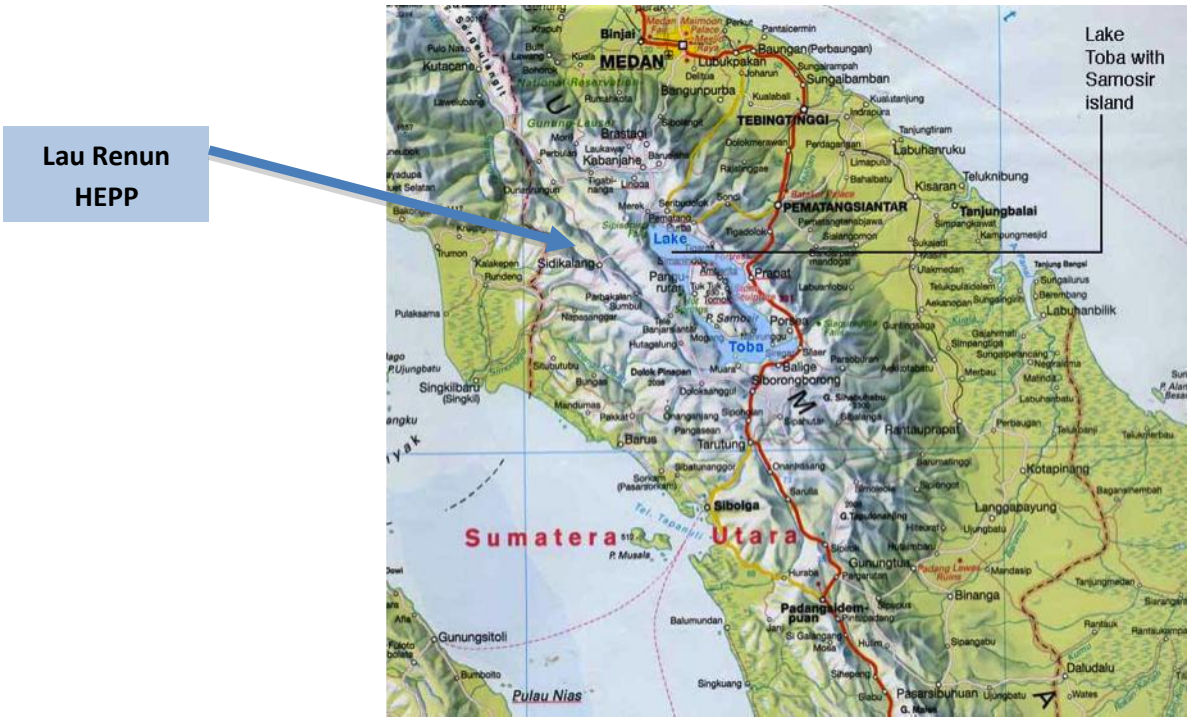

Figure 1 - Location of Lau Renun Hydroelectric Power Plant

1.8 Title and Reference of Methodology

Approved consolidated baseline methodology ACM0002 – "Consolidated baseline methodology for grid-connected electricity generation from renewable sources", version 10 (EB 47 annex 7).

Sectoral scope 01 - Energy Industries (renewable-/non-renewable sources).

2 IMPLEMENTATION STATUS

2.1 Implementation Status of the Project Activity

- From the validated VCS PD Version 3, dated 06 November 2009, the 82 MW installed capacity Lau Renun HEPP generates about 313,500 MWh per year. During this monitoring period, the project activity has generated power of 562,196 MWh with details as below:
  1. 01 April – 31 December 2010 : 206,317 MWh
  2. 01 January – 31 December 2011 : 294,061 MWh
  3. 01 January – 29 February 2012 : 61,818 MWh

2.2 Project Description Deviations

There is no deviation from the monitoring plan in the registered VCS-PD "82 MW Lau Renun Hydro Power Plant, North Sumatra".

2.3 Grouped Project

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

3 DATA AND PARAMETERS

3.1 Data and Parameters Available at Validation

Data Unit / Parameter:	**$EF_{grid,CM,y}$**
Data unit:	tCO_2/MWh
Description:	Grid Emission Factor of Sumatra
Source of data:	DNA of Indonesia http://pasarkarbon.dnpi.go.id/web/index.php/komnasmpb/read/14/faktor-emisi-jaringan-listrik-sumatera-dan-jamali-2008.html
Value applied:	0.743
Purpose of the data:	The data is used for baseline emission calculation as per 'Tool to calculate the emission factor for an electricity system', Version 01.1 29 July 2008 (EB 35, Annex 12).
Any comment:	The 2008 grid emission factor has been crosschecked with the 2006 value, which was with 0.855 tCO_2/MWh significantly higher and therefore less conservative. Hence, following the tool by using the most current data available at submission to validation and in terms of conservativeness the emission factor of 2008 is the appropriate value to be used in the emission reduction calculation.

Data Unit / Parameter:	**$NCV_{i,y}$**
Data unit:	GJ/kg
Description:	Net calorific value of diesel fuel
Source of data:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	0.043

Purpose of the data:	The data is used for project emission calculations as per approved methodology ACM0002, "Consolidated monitoring for zero-emissions grid-connected electricity generation from renewable sources", version 10
Any comment:	–

Data Unit / Parameter:	ρ_i
Data unit:	kg/m^3
Description:	Density of diesel fuel
Source of data:	Pertamina diesel fuel specification[26]
Value applied:	0.815 kg/liter = 815 kg/m^3
Purpose of the data:	The data is used for project emission calculations as per approved methodology ACM0002, "Consolidated monitoring for zero-emissions grid-connected electricity generation from renewable sources", version 10
Any comment:	–

Data Unit / Parameter:	$\mathbf{EF_{CO2,i,y}}$
Data unit:	tCO_2/GJ
Description:	Weighted average CO_2 emission factor of diesel fuel in year 'y'
Source of data:	IPCC default value is used Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook volume 2 chapter 1 (Table 1.4).
Value applied:	0.074
Purpose of the data:	The data is used for project emission calculations as per 'Tool to calculate project or leakage CO2 emissions from fossil fuel combustion', version 02
Any comment:	–

3.2 Data and Parameters Monitored

[26] http://www.pertamina.com/index.php?option=com_content&task=view&id=3262&Itemid=697

<table>
<tr><td>Data Unit / Parameter:</td><td>$EG_{PJ,y}$</td></tr>
<tr><td>Data unit:</td><td>kWh</td></tr>
<tr><td>Description:</td><td>Net electricity supplied to the grid by the project activity during the year ‘y’</td></tr>
<tr><td>Source of data:</td><td>kWh meter at project activity site (switchyard)

The electricity generation data used for monitoring is the monthly electricity generation report delivered to grid signed by both parties of generation department and transmission department (Joint Meter Reading).</td></tr>
<tr><td>Description of measurement methods and procedures to be applied:</td><td>Electricity supplied to the grid will be measured by a watt-hour meter (connected to a digital control system and continuously monitored), which can measure export and import electricity data separately. Therefore net electricity delivered to the grid would be the difference of export and import electricity.</td></tr>
<tr><td>Frequency of monitoring/recording:</td><td>The measurement of electricity supplied to the grid will be conducted by joint meter reading taken at the transaction point on a regular basis and continuous monitoring (recorded in monthly basis). The measurement results will be summarized in regular production reports (‘Monthly Electricity Protocol Report’ or ‘Berita Acara tentang Penyerahan dan Penerimaan kWh Penyaluran’ / BAP).</td></tr>
<tr><td>Value monitored:</td><td>
<table>
<tr><th>Year</th><th>Net electricity supplied to the grid (MWh)</th></tr>
<tr><td>01 Apr – 31 Dec 2010</td><td>206,317</td></tr>
<tr><td>01 Jan – 31 Dec 2011</td><td>294,061</td></tr>
<tr><td>01 Jan – 29 Feb 2012</td><td>61,818</td></tr>
</table>
</td></tr>
<tr><td>Monitoring equipment:</td><td>Type: Digital Watt-hour meter type ACTARIS SL7000 (Main Meter)
Accuracy class: 0.2s
<table>
<tr><th>Serial number</th><th>Type</th><th>Manufacture</th><th>Class</th><th>Remark</th></tr>
<tr><td>36027216</td><td>SL 7000</td><td>Actaris</td><td>0.2s</td><td>Code MU-1 to monitor the electricity supply from Unit 1</td></tr>
<tr><td>36027222</td><td>SL 7000</td><td>Actaris</td><td>0.2s</td><td>Code MU-2 to monitor the electricity supply from Unit 2</td></tr>
</table>
</td></tr>
<tr><td>QA/QC procedures</td><td>The QA/QC will be conducted through crosschecking the main meter</td></tr>
</table>

to be applied:	reading report (Monthly Electricity Protocol Report) at the transaction point with sales electricity receipts. The main meters at the transaction point will be read regularly and jointly by the person in charge from PLN Lau Renun HEPP Generation Unit and PLN Transmission Unit. Meters at the transaction point will be calibrated once every five-year according to the national regulation[1]. The date of 1st calibration: 28 July 2005 The date of 2nd calibration: 22 April 2010
Calculation method:	Net electricity supplied to grid is calculated as the difference between EG_{export} and EG_{import} ($=EG_{export} - EG_{import}$).
Any comment:	

Data Unit / Parameter:	$\boldsymbol{FC_{i,y}}$
Data unit:	Ton
Description:	Amount of diesel fuel used in the hydropower plant operation in the reported monitoring period. Fuel consumption occurs in case of operation of two emergency diesel generator sets (DG sets) located at Power House and Main Intake.
Source of data:	Generator sets operational logbook
Description of measurement methods and procedures to be applied:	Fuel consumption is calculated from the generator sets operational logbook. The highest diesel fuel restock value recorded in the logbook is taken and applied for every months in the reported monitoring period, then converted to ton using fuel specific density ($FC_{i,y} * \rho_i$) Hence the above reported figure is higher than the actual fuel consumption data.
Frequency of monitoring/recording:	Fuel consumption will be recorded monthly, specifically for each fuel (currently only diesel consumption is available).
Value monitored:	2.25 ton (2,760 litre)
Monitoring equipment:	-
QA/QC procedures to be applied:	The operator of Lau Renun HEPP Generation Unit will record and calculated the diesel oil consumption, whenever they operate the DG set. No equipment is used to measure the diesel oil consumption. The consumption record will be crosschecked with the diesel oil purchase

[1] The Ministry of Energy and Mineral Resource's regulation number 37 year 2008 dated November 27, 2008 on the Grid Code Sumatra Electricity Power System, the calibration of kWh meter must be done every 5 (five) years, as stated in the Metering Code section, MC 4.1.1 (Test after metering code commissioning, page 138)

	receipt.
Calculation method:	*Converted from litre to ton using the density of diesel.*
Any comment:	The value applies for fuel consumption calculation was taken from the highest diesel oil monthly restock amount (120 liters occurs in August 2011 was the highest value) of diesel generator set operational logbook. This value of 120 l/month is then applied for the whole crediting months. (120 l/month x 23 months). : 120 l/month * 12 month/year * 0.815 kg/liter = 2.25 ton/y Fuel consumption will only occur 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 will run on grid electricity. DG set usage is only for critical instrument/control system during turbine trip and shutdown.

3.3 Description of the Monitoring Plan

VCS team has been required to do several key monitoring system features including:

a) VCS staff training

b) VCS data and record keeping arrangements

c) Data collection

d) VCS data quality control and quality assurance

e) Equipment maintenance

f) Equipment calibration

g) Equipment failure

PT PLN (Persero) is a major state own company, has adopted ISO 9001, ISO 14001 and OHSAS from the head office until the sector scope (ISO certificates are given to the Pandan Sector Office). PLN (in general), and Pandan Sector as the managing sector for Lau Renun Generation Unit (in specific) have implemented the key monitoring system as mentioned above by having the ISO system on their management system.

As part of the ISO management system requirement, Lau Renun HEPP has developed some SOPs as follow:

- Standard Operational Procedure (SOP) Lau Renun HEPP (procedure for plant operational)
- SOP to calibrate the Test and Measurement equipments.
- SOP to develop an Electricity Transfer Monthly Protocol Report (BAP)
- SOP for Electricity Transfer
- SOP for Emergency Response

All those SOPs are in-line with the need for VCS project at Lau Renun HEPP. Therefore, Renun VCS Team would continue to follow the SOP Lau Renun HEPP for its operation.

3.3.1 Monitoring equipment and installation

Given the emission factor is calculated *ex-ante* and according to the Monitoring Methodology ACM0002 version 10, data to be monitored are:

I. Total net electricity supplied to the grid by the project activity during this reported monitoring period ($EG_{PJ,y}$),

II. Total fuel consumption, from the operational of DG set logbook ($FC_{i,j,y}$).

A. Total net electricity supplied to the gird by the project activity, as measured by the main meters

The main electricity meter of each power generation unit for establishing the electricity delivered to the grid (detailed in section 3.2) is installed at the transaction point in Lau Renun HEPP. This electricity meter will be the main meter that measures the net quantity of electricity supplied to the grid. As this meter provides the main VCS measurement, it will play a key role in the verification process.

Main Meter Quality Control

The main meter is specified to have 0.2s class. The calibration of test and measurement equipment shall be conducted to ensure the measurement accuracy of the main meter. PT. PLN (Persero) Penelitian dan Pengembangan Ketenagalistrikan, National government approved laboratory certified 1702 and authorized by the Government of Indonesia, to conduct such calibration. The competency proof of PT. PLN (Persero) Penelitian dan Pengembangan Ketenagalistrikan is provided to the DOE. Periodic calibrations are to be done at least once every five years as per applicable metering standard issued by the Minister of Energy and Mineral Resource of Republic of Indonesia.

There was no metering devices breakdown or malfunction during the reported monitoring period. The main meters listed in the table of monitoring parameter working on condition with permissible error. In case of failure of the main meter, data net of electricity supply would be determined from the recorded in the generation meter and the plant own consumption meter (which were also located at generation site of each power generation unit) as check meters to measure the quantity of electricity exported from the project.

The JMR is done presence of representative from Generation Unit of PLTA Renun and Transmission unit of PT. PLN Tragi Sidakalang on the first date of each month at 10 A.M. After all such information is rechecked and agreed by all related parties, the JMR will be signed by all authorized parties from Generation unit and Transmission unit. The report will thus be sent to PLN Medan as headquarter for all power plant units in North Sumatra.

Main meter failure

The main meter is used as the instrument to monitor and measure the net electricity supplied to the grid and the basis for the baseline emission calculation. In case of failure of the main meter, generation meter and own consumption meter which also located at generation site of each power generation unit will be used as check meters, measuring the quantity of electricity exported from the project. The difference between electricity produced and consumed on-site shall be valid for claiming carbon credits. In the special case of total failure of all meters no credits will be claimed during such period.

During monthly monitoring of electricity delivered, the main meter and check-meters will be read and if the difference between the respective main meter and check-meters exceeds the maximum error for such meters then all meters shall be tested in turn.

During testing, if all meters are found to be working beyond the permissible limits of error, then the electricity delivered for the previous recorded month for billing shall be corrected to account for this error.

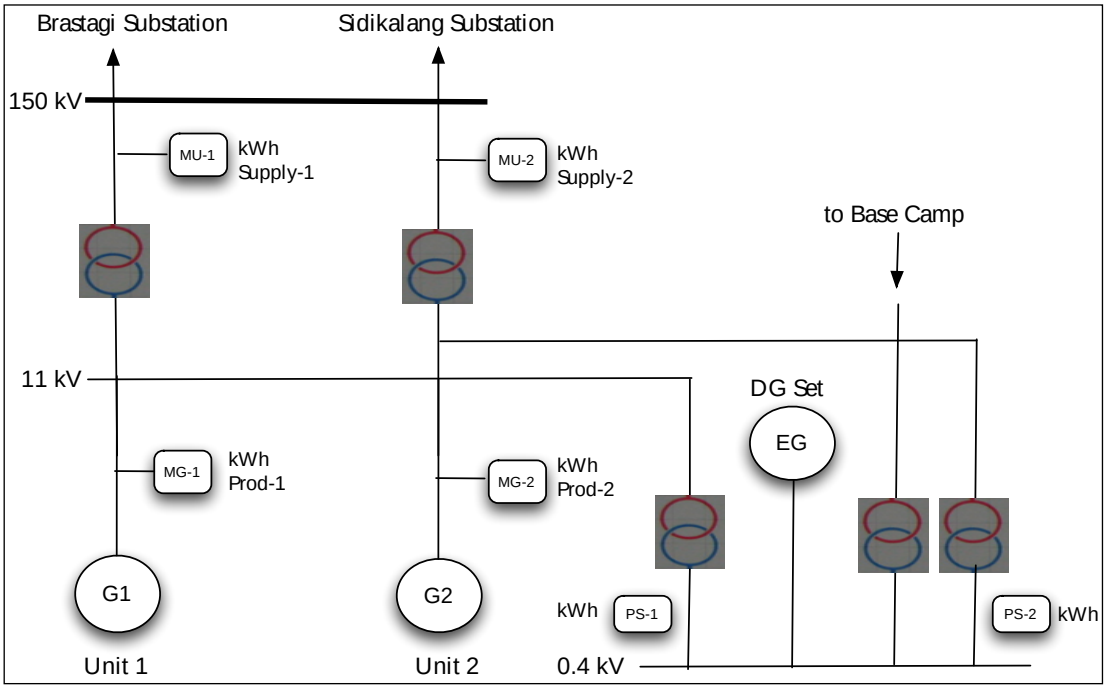

Figure 2 - Project's Simplified Schematic Diagram, including relative position of its metering devices

Picture of the main meters are shown below:

Figure 3 - Picture of main meter

B. Total diesel oil consumption, from the operational of DG Set

The fossil fuel consumption is calculated from the maximum diesel oil purchase amount per month (in liter then convert into ton). The data is taken from diesel generator set operational logbook for reported monitoring period. No equipment use to measure the diesel oil consumption. For conservative approach, the PP has used the highest value for diesel fuel restock amount, as recorded on the diesel generator set operational logbook and applied the figure for every month in this reported monitoring period. The calculation is shown on section 4.2.2.

3.3.2 VCS data collection and record keeping arrangements

Every month the Operation Supervisor from Renun Generation Unit (member of VCS Team) and Transmission Sub-station read the meter together and record the data on their journal. Based on this reading, a monthly electricity generation report was signed by both the generation department (Renun HEPP Generation Unit) and transmission department (Tragi Sidikalang).

At the end of each month the monitoring data needs to be filed electronically. The electronic files need to have CD back-up and/or print-out. The project developer needs to keep electricity sale and purchase invoices. All written documentation such as maps, drawings, the EIA and the Feasibility study, should be stored for the crediting period and two years afterwards, and be made available to the verifier so that the reliability of the information may be checked.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

4.1.1 Formula used for baseline emissions calculation

The formula used for determination of the baseline emissions are described in section 4.3 of the registered VCS PD Ver. 3 dated 6th November 2009.

Baseline emissions are calculated as follows:

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

Parameter	Description	Unit	Value	Source
BE_y	Baseline emission in the reported monitoring period	tCO_2/year	417,712	Equation (1)
$EG_{PJ,y}$	Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the project activity in the reported monitoring period	MWh/year	562,196	Joint Meter Reading (JMR)
$EF_{grid,CM,y}$	Combined margin CO_2 emission factor for grid connected power generation in the reported monitoring period	tCO_2/MWh	0.743	Indonesian DNA published grid emission factor for Sumatra.

4.1.2. Baseline emissions calculation

Vintage Month	$EG_{PJ,y}$ (MWh)	Be_y (tCO_2/year)
1 April 2010 - 30 April 2010	29,602	21,994
1 May 2010 - 31 May 2010	24,457	18,172
1 June 2010 - 30 June 2010	21,428	15,921
1 July 2010 - 31 July 2010	20,098	14,933
1 August 2010 - 31 August 2010	16,134	11,988
1 September 2010 - 30 September 2010	24,485	18,192
1 October 2010 - 31 October 2010	22,155	16,461
1 November 2010 - 30 November 2010	24,565	18,252
1 December 2010 - 31 December 2010	23,393	17,381
TOTAL BEy per 2010	**206,317**	**153,294**
1 January 2011 - 31 january 2011	21,186	15,741
1 February 2011 - 28 February 2011	18,233	13,547
1 March 2011 - 31 March 2011	23,811	17,692
1 April 2011 - 30 April 2011	28,598	21,248
1 May 2011 - 31 May 2011	23,787	17,674
1 June 2011 - 30 June 2011	20,692	15,374
1 July 2011 - 31 July 2011	17,028	12,652
1 August 2011 - 31 August 2011	22,195	16,491
1 September 2011 - 30 September 2011	25,382	18,859
1 October 2011 - 31 October 2011	23,730	17,631
1 November 2011 - 30 November 2011	27,850	20,693
1 December 2011 - 31 December 2011	41,569	30,886
TOTAL BEy per 2011	**294,061**	**218,487**
1 January 2012 - 31 January 2012	27,798	20,654
1 February 2012 - 29 February 2012	34,020	25,277
TOTAL BEy per 2012	**61,818**	**45,931**
Total per 2010 - 2012	**562,196**	**417,712**

4.2 Project Emissions

4.2.1 Formula used for project emissions calculation

The formula used for determination of the baseline emissions are described in section 4.3 of registered VCS PD Ver. 3 dated 6th November 2009.

Project emissions are calculated as follows:

$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y}$ (2)

Parameter	Description	Unit	Value	Source
PE_y	Project emission in the reported monitoring period	tCO_2e/yr	Calculated	Equation (2)
$PE_{FF,y}$	Project emissions from fossil fuel consumption in the reported monitoring period	tCO_2/yr	Calculated	"Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"
$PE_{GP,y}$	Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in the reported monitoring period	tCO_2/yr	0	Not applicable Project activity is not a geothermal powerplant.
$PE_{HP,y}$	Project emissions from water reservoirs in the reported monitoring period	tCO_2/yr	0	Not applicable Lau Renun HEPP is a run-off river hydro powerplant.

$PE_{FF,y} = PE_{FC,j,CO2}$,

$PE_{FC,j,CO2} = \Sigma FC_{i,j,y} \times COEF_{i,y}$ (3)

Parameter	Description	Unit	Value	Source
$PE_{FC,j,CO2}$	CO_2 emissions from fossil fuel combustion in process j during year y	tCO_2/y	**7.17** 2010 2.8 2011 3.74 2012 0.62	Equation (3) 2010 0.0019% 2011 0.0017% 2012 0.0014% Avg 0.0017%
$FC_{i,j,y}$	Quantity of fuel type I combusted in process j during the year y	ton/y	2010 0.88 2011 1.17 2012 0.20	Measured in litre than converted into ton with formula as below: Fuel Consumption

				(litre) x Fuel Density (0.815 kg/litre)
$COEF_{i,y}$	CO_2 emission coefficient of fossil fuel type i in year y	tCO_2/ton	3.1863	Equation (4)
i	Fuel types combusted in process j during year y	-	i= Diesel oil	Lau Renun HEPP

$COEF_{i,y}$ is calculated using option B. Option B calculates $COEF_{i,y}$ based on net calorific value and CO_2 emission factor of fuel type i, as follows:

$COEF_{i,y} = NCV_{i,y} \times EF_{CO2,i}$ (4)

Parameter	Description	Unit	Value	Source
$COEF_{i,y}$	CO_2 emission coefficient of fossil fuel type i in year y	tCO_2 / ton fuel	3.1863	Equation (4)
$NCV_{i,y}$	Weighted average net calorific value of fuel type i in year	TJ/ton fuel	Diesel Fuel: 0.043	IPCC 2006 default for diesel oil
$EF_{CO2,i}$	Weighted average CO_2 emission factor of fuel type i in year y	tCO_2/TJ	Diesel Fuel: 74.1	IPCC 2006 default for diesel oil
i	Fuel types combusted in process j during year y	-	i=Diesel oil	Lau Renun HEPP

4.2.2 Project emissions from the consumption of fossil fuels

Year	Fuel Consumption (Litre)	Fuel Consumption (ton)	PEy (tCO2/year)	% PEy to BEy
2010 (Apr – Dec)	1,080	0.88	2.80	0.0019%
2011 (Jan – Dec)	1,440	1.17	3.74	0.0017%
2012 (Jan – Feb)	240	0.20	0.62	0.0014%
TOTAL	2,760	2.25	7.17	

% PEy to BEy	0.0017%

4.3 Leakage

No leakage emissions are considered. The main emissions potentially giving rise to leakage in the context of electric sector projects are emissions arising due to activities such as power plant construction and upstream emissions from fossil fuel use (e.g. extraction, processing, transport). These emissions sources are neglected.

$$LE_y = 0$$

4.4 Summary of GHG Emission Reductions and Removals

4.4.1 Formula used for emission reductions calculation

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \quad (5)$$

Parameter	Description	Unit	Value	Source
BEy	Baseline emissions in the period *y*	tCO_2e	Calculated	Equation (1)
PEy	Project emissions in the period *y*	tCO_2e	Calculated	Equation (2)
ERy	Project emission in the period y	tCO_2e	Calculated	Equation (3)

4.4.2 Emission reduction calculation

Vintage Year	BE_y	PE_y	ER_y
1 April - 31 December 2010	153,294	2.80	153,291
1 January - 31 December 2011	218,487	3.74	218,484
1 January - 29 February 2012	45,931	0.62	45,930
TOTAL	**417,712**	**7.17**	**417,704**

5 ADDITIONAL INFORMATION

A. Comparison between Ex-ante calculation and actual monitored Emission Reduction

Document	Estimated power supply (in MWh /yr)	Estimated ER (in tCo2/year)
Ex-ante calculation (VCS PD Version 3, dated 6th November 2011)	313,500	229,048
VCS MR Ver.3	562,196 *)	417,704 *)

Note : The total actual monitored month for this crediting period is 23 months.

B. Operational Hours and Outage Recapitulation

Year	Operation Hours		Stand-by Hours		Outage Hours		Maintenance Hours		Total non-operation Hours		Total non-operation Days	
	Unit 1	Unit 2	Unit 1	Unit 2	Unit 1	Unit 1	Unit 1	Unit 2	Unit 1	Unit 2	Unit 1	Unit 2
01 APR - 31 DEC 2010	2,958.75	3,154.40	3,500.33	3,210.45	14.65	2.55	105.07	232.60	3,620.05	3,445.60	150.84	143.57
01 JAN - 31 DEC 2011	4,041.53	4,545.75	4,221.89	4,199.16	11.34	0.90	456.01	11.68	4,689.24	4,211.74	195.39	175.49
01 JAN - 29 FEB 2012	840.24	949.53	646.16	522.63	1.30	1.87	0.30	8.00	647.76	532.50	26.99	22.19
01 APR 2010 - 29 FEB 2012	7,840.52	8,649.68	8,368.38	7,932.24	27.29	5.32	561.38	252.28	8,957.05	8,189.84	373.21	341.24