

MONITORING REPORT

82 MW LAU RENUN HYDRO POWER PLANT NORTH SUMATRA



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Contact Information:

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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 m³ and a power density of 820 W/m². 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. The estimated annual CO₂ emissions reduction of the project is 229,048 tCO₂e. During this monitoring, total amount of emissions reduction is 280,356 tCO₂e with detail as below:

Vintage Year	Emissions Reduction	Unit
01 March 2012 – 31 December 2012	230,806	tCO ₂ e
01 January 2013 – 28 February 2013	49,549	tCO ₂ e
Total	280,355	tCO ₂ e

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

Sectorial 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'

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 Jakarta – 12160
 Indonesia

Telephone: +62-21-725 1234

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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 since no other project participant involved in the project beside South Pole Carbon Asset Management Ltd and PT. PLN (Persero).

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 (Certificate for Proper Operation or *Sertifikat Laik Operasi*)
- Renun Hydro Power Plant Unit 2: 14 August 2006 (Certificate for Proper Operation or *Sertifikat Laik Operasi*)

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 377,331 MWh with details as below:
 - 01 March – 31 December 2012 : 310,643 MWh
 - 01 January – 28 February 2013 : 66,688 MWh

2.2 Project Description Deviations

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

A. Deviation to parameter $FC_{P,J,y}$

As per validated VCS PD, PP must monitor parameter $FC_{P,J,y}$ as described in the latest version of the “Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion” (Version 02, 2nd August 2008, EB 41).

Subject	Original Monitoring Plan as per validated VCS PD	Deviation of the Monitoring Plan
Description of measurement methods and procedures to be applied:	<p>Fuel consumption will be recorded monthly, specifically for each fuel (currently only diesel consumption is available).</p> <p>Fuel consumption will be calculated from static graduated level gauges on the fuel injection tanks by using emergency diesel genset, resulted in liters then converted to tonnes using fuel specific density or scientifically proven fuel densities.</p>	<p>Fuel consumption will be recorded monthly, specifically for each fuel (currently only diesel consumption is available).</p> <p>Fuel consumption will be calculated based on diesel oil purchase receipt.</p> <p>If the purchase receipt not available for particular month, the largest purchase amount during this monitoring period is taken for conservative estimation. Hence the project emission of PE_y is higher and this is conservative.</p> <p>Fuel consumption value in litres is converted to tonnage using fuel specific density or scientifically proven fuel densities.</p>

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/komnasmpp/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

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

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:	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 CO ₂ emissions from fossil fuel combustion', version 02
Any comment:	–

3.2 Data and Parameters Monitored

Data Unit / Parameter:	EG_{P,y}
Data unit:	kWh
Description:	Net electricity supplied to the grid by the project activity during the year 'y'
Source of data:	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).
Description of measurement methods and procedures to be applied:	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.
Frequency of monitoring/recording:	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 Renun HEPP

	summarized the measurement results in sales electricity receipts ('Monthly Electricity Protocol Report' or 'Berita Acara tentang Penyerahan dan Penerimaan kWh Penyaluran' / BAP).																		
Value monitored:	<table border="1"> <thead> <tr> <th>Year</th> <th>Net electricity supplied to the grid (MWh)</th> </tr> </thead> <tbody> <tr> <td>01 Mar – 31 Dec 2012</td> <td>310,643</td> </tr> <tr> <td>01 Jan – 28 Feb 2013</td> <td>66,688</td> </tr> </tbody> </table>	Year	Net electricity supplied to the grid (MWh)	01 Mar – 31 Dec 2012	310,643	01 Jan – 28 Feb 2013	66,688												
Year	Net electricity supplied to the grid (MWh)																		
01 Mar – 31 Dec 2012	310,643																		
01 Jan – 28 Feb 2013	66,688																		
Monitoring equipment:	<p>Type: Digital Watt-hour meter type ACTARIS SL7000 (Main Meter) Accuracy class: 0.2s</p> <table border="1"> <thead> <tr> <th>Serial number</th> <th>Type</th> <th>Manufacture</th> <th>Class</th> <th>Remark</th> <th>Calibrator¹</th> </tr> </thead> <tbody> <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> <td>Laboratorium Kalibrasi - PT. PLN (Persero) Penelitian dan Pengembangan Ketenagalistrikan</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> <td>Laboratorium Kalibrasi - PT. PLN (Persero) Penelitian dan Pengembangan Ketenagalistrikan</td> </tr> </tbody> </table>	Serial number	Type	Manufacture	Class	Remark	Calibrator ¹	36027216	SL 7000	Actaris	0.2s	Code MU-1 to monitor the electricity supply from Unit 1	Laboratorium Kalibrasi - PT. PLN (Persero) Penelitian dan Pengembangan Ketenagalistrikan	36027222	SL 7000	Actaris	0.2s	Code MU-2 to monitor the electricity supply from Unit 2	Laboratorium Kalibrasi - PT. PLN (Persero) Penelitian dan Pengembangan Ketenagalistrikan
Serial number	Type	Manufacture	Class	Remark	Calibrator ¹														
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36027222	SL 7000	Actaris	0.2s	Code MU-2 to monitor the electricity supply from Unit 2	Laboratorium Kalibrasi - PT. PLN (Persero) Penelitian dan Pengembangan Ketenagalistrikan														
QA/QC procedures to be applied:	<p>The QA/QC conducted through crosschecking the sales electricity receipts (Monthly Electricity Protocol Report) at the transaction point with water tax payment receipts issued by North Sumatera Province Tax Office (local government).</p> <p>Meters at generation unit is calibrated once every five-year according to the national regulation (refer to http://prokum.esdm.go.id/permen/2008/Permen%20ESDM%2037%202008.pdf)</p> <p>The meter at the Generation Unit (Main meter at the transaction point) will be read regularly and jointly by the person in charge from Generation unit and Transmission unit.</p> <p>Note for Monitoring Frequency:</p> <p>Lau Renun HEPP has conducted regular calibration round with details as below:</p> <p>The date of 1st calibration: 28 July 2005</p>																		

¹ Laboratorium Kalibrasi - PT. PLN (Persero) Penelitian dan Pengembangan Ketenagalistrikan (Calibration Laboratory - PT. PLN (Persero) Research and Development of Electricity) has been accredited by the National Accreditation Committee (Komite Akreditasi Nasional / KAN) with certificate number of LK-007-IDN for Laboratory of Calibration.

	The date of 2 nd calibration: 14 April 2010
Calculation method:	Net electricity supplied to grid is calculated as the difference between EG_{export} and EG_{import} ($=EG_{\text{export}} - EG_{\text{import}}$).
Any comment:	

Data Unit / Parameter:	$FC_{i,y}$
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:	Calculated – Project Owner – diesel fuel purchase receipt
Description of measurement methods and procedures to be applied:	Fuel consumption is calculated from the monthly diesel oil purchase receipt, then converted to ton using fuel specific density or scientifically proven fuel densities.
Frequency of monitoring/recording:	Fuel consumption will be recorded monthly, specifically for each fuel (currently only diesel consumption is available).
Value monitored:	0.90 ton (1,103 liter)
Monitoring equipment:	-
QA/QC procedures to be applied:	No equipment is use to measure the actual diesel oil consumption. Fuel consumption calculated based on the diesel oil purchase receipt. Since the purchase receipt was not available for each particular month, the largest purchase amount during this monitoring period was taken for conservative estimation. Hence the above reported figure is higher than the actual fuel consumption data. Operator of Lau Renun HEPP recorded the diesel oil consumption assumption on the historical card, whenever they operate the DG set. The diesel oil purchase receipt will be crosschecked with this historical card.
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 diesel oil purchase receipt during period of 2012 – 2013. 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.
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3.3 Description of the Monitoring Plan

This section details the steps taken to monitor on a regular basis the GHG emissions reductions from the Lau Renun Hydroelectric Power Plant Project in Indonesia in accordance with ACM0002 version 10.

The Monitoring Plan for this project has been developed to ensure that the project collects and archives complete data from the very start.

3.3.1 Monitoring Period

The monitoring period covers 01 March 2012 to 28 February 2013 (both days included)

3.3.2 Monitoring Organization

The monitoring team has been established and integrated within the existing organization structure of Lau Renun hydropower plant prior to the start of the verification². Clear roles and responsibilities are assigned to all staff involved in the VCS project and the prospect of nominating a VCS Manager have been considered. The VCS Manager has the overall responsibility for the monitoring system on this project.

All other VCS monitoring staff will have clearly defined roles and responsibilities. The VCS manager will manage the process of training new staff; ensure trained staff performs the monitoring duties as necessary; and ensure that where trained monitoring staff is absent; the integrity of the monitoring system is maintained by other trained staff.

A formal set of monitoring procedures is established prior to the start of the verification. These procedures will detail the organization, control, and the steps required for certain key monitoring system features, including:

- a) VCS staff training
- b) VCS data and record keeping arrangements
- c) Data collection
- d) VCS data quality control and quality assurance
- e) Equipment maintenance
- f) Equipment calibration

² The PLN Pandan Sector has formed the VCS Monitoring Team (for both Lau Renun and Lau Renun VCS Project) through the 'Keputusan Manajer PT PLN (Persero) Sektor Pembangkitan Pandan Nomor : 067.K/MSPDN/2012' letter (or Management Decision Letter of PT PLN (Persero) Pandan Generation Sector Office No : 067.K/MSPDN/2012).

g) Equipment failure

The procedures agreed and signed off by PT PLN (Persero) and South Pole Carbon Asset Management Ltd. Any changes to procedures need to be agreed by both parties. The VCS manager responsible for ensuring that the procedures are followed on site and for continuously improving the procedures to ensure a reliable monitoring system is established.³

3.3.3 Monitoring equipment and installation

Considering that the emission factor is calculated *ex-ante* and according to the Monitoring Methodology ACM0002 version 10, the only data to be monitored is electricity supplied to the grid by the project (detailed in section 3.2). The primary instruments include:

Metering of Electricity Supplied to the Grid

The main electricity meter for establishing the net electricity delivered to the grid (detailed in section 3.2) is installed at the Lau Renun 150 kV transmission line. This electricity meter will be the main meter (revenue meter), measuring the quantity of electricity supplied (net electricity delivered) to the grid. Net electricity delivered to the grid would be the difference of electricity export and import. As this meter provides the main VCS measurement, this is the key part of the verification process. The main meter is located at the Lau Renun power station. The main electricity meter reading record (Joint Meter Reading) then recorded on the Monthly Transfer Electricity Protocol Record (METPR) issued by Lau Renun HEPP Generation Unit.

The main electricity meter read together by representatives from PT PLN (Persero) Generation Division (PT PLN (Persero) Generation Unit Lau Renun HEPP) and PT PLN (Persero) Load Dispatcher and Transmission Division (PT PLN (Persero) Sidikalang Sub-Station).

Electricity meters should meet the relevant local standards at the time of installation and calibrated by the manufacturer before installation. The meters installed by the project according to the Indonesian standard “Standard Electricity Meter Equipment”. Records of the meter (type, make, model, and calibration documentation) retained in the quality control system on-site.

All equipment calibrated by the manufacturer according to relevant local standards at the time of installation and maintained in accordance with the manufacturer’s recommendations to ensure accuracy of measurements. Records of the meter (type, make, model, calibration, and maintenance documentation) retained as part of the VCS monitoring system.

Main Meter Quality Control

³ The Pandan Sector has implemented the key monitoring system as mentioned above by having the PLN monitoring system on their management system.

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

- SOP to read the Electricity Meter
- SOP to calibrate the Test and Measurement equipment.
- SOP to develop an Electricity Transfer Monthly Protocol Report (BAP)
- SOP for Electricity Transfer
- SOP for Emergency Response

The project developer owns the meter and is responsible for its maintenance and calibration, as stated in the SOPs. PLN Transmission Division and its representative are entitled to be present during any test, inspection, maintenance, and replacement of any part of the metering system, which will be performed by the meter manufacturer on request of the project developer.

The project developer specifies the QC (flow-chart) procedure for calibration of test and measurement equipment (SOP to calibrate the Test Equipment and Measurement Equipment) to ensure the measurement accuracy of values shown by the instrument / measuring device and test or a measurement system (one of the instrument mentioned on this SOP is the electricity meter). The calibration can be done internally or externally depend on the type of measuring equipment and resource capability. The electricity meter, which located at the Lau Renun HEPP project site is calibrated by the external party.

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. 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.

Main Electricity Meter specification:

Serial Number	Type	Factory	Class	Location
MAIN METER (MU 1)				
36027216	SL 7000 (Digital)	Actaris	0.2s	Main electricity meter 1 (MU 1) → to monitor electricity supply from turbine Renun #1
MAIN METER (MU 2)				
36027222	SL 7000 (Digital)	Actaris	0.2s	Main electricity meter 2 (MU 2) → to monitor electricity supply from turbine Renun #2

Picture of the main meters are shown below:



Figure 3 - Picture of main meter

The Power Plant Operator periodically checked if all tools and equipment work in a good condition as per the SOP⁴. In the event of any broken security seal in the metering system; or when the system fails to register, or if the measurement result is found upon testing to vary more than the allowable error from the standard meter used in the test, then an adjustment shall be made correcting all measurements of energy made by the metering system, as described in the SOP.

There was no metering devices breakdown or malfunction during the following monitoring period (01 April 2010 – 28 February 2013). All the meters listed above have performed well. In case of failure of the main meter, production meter and own consumption meter (hereinafter refer as cross-check meters) located at generation site of each power generation unit will be read to measure 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.

Data recording procedure

The procedures for collecting the electricity meter data is outlined in the Standard Operating Procedure as explained below.

The procedures for collecting the electricity meter data will be outlined in the Standard Operating Procedure signed between the project owner and the Grid Operator (both are under PLN)⁵. All

⁴ http://kepuustakaan-presiden.pnri.go.id/uploaded_files/pdf/government_regulation/normal/UU_2_1981_soeharto.pdf

⁵ Lau Renun HEPP is following the "Prosedur Pembuatan BA Pengiriman Energi Listrik PLTA Lau Renun" or the 'Procedure to develop Lau Renun HEPP Monthly Electricity Protocol Report' as the detail procedure for Electricity

relevant data will be archived electronically and backed up regularly. Uncertainty will be considered to achieve conservative results. Moreover, it will be kept for the full crediting period, plus two years after the end of the crediting period or the last issuance of VCUs for this project activity (whichever occurs later). The Monitoring Plan would develop to ensure that the project has robust data collection, processing, and archiving procedures.

Procedure for Joint Meter Reading (JMR) as per 'Procedure to develop Monthly Electricity Protocol Report' in general view:

- Joint meter reading by operator from Generation Unit (Unit Pembangkitan / UP) and Transmission Service Unit (Unit Pelayanan Transmisi / UPT P3B) conducted on the first date of each month at 10 A.M
- Operating and maintenance supervisor (O & M supervisor) responsible for recording the amount of EG imported and exported by Generation unit as the result from kWh meter downloading.
- Operating and maintenance supervisor responsible for constructing the electricity generating protocol report, which includes calculation of net electricity delivered to PLN transmission unit. This report has to be reported and signed by Unit Manager, which will then be further reported to the Sector Manager. VCS manager will have the copy of such report and be notified as well. The Sector Manager and VCS Manager have been handled by the same person during this monitoring period.
- O & M supervisor with other authorized staff from Generation unit will extract the data by downloading via computer from the kWh electronic meter and then record it in the form of Monthly Electricity Protocol (MEP), which shall be signed by both Generating unit (PLN Lau Renun Generation Unit) and PT. PLN P3B (Tragi Sidikalang / Sidikalang Sub-station). The joint meter reading taken at the transaction point is witnessed by the presence of P3B officials as transmission department and the PP representative as generation department.
- The MEP will be then rechecked by authorized person from PT. P3B (UPT Pematang Siantar / Pematang Siantar Transmission Unit) and PT PLN Generation Sector Office (Pandan Sector Office).

After all such information is rechecked and agreed by all related parties, the MEP 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.

Transfer to the Sumatera Grid. This procedure is a further development refer to the General Operational Procedure for PLN generation unit located in the North and South Sumatera, titled "Prosedur tetap transfer tenaga listrik antara PT PLN (Persero) Pembangkitan Sumbagut, PT PLN (Persero) Pembangkitan Sumbagsel dengan PT PLN (Persero) P3B Sumatera"

All relevant data will be archived electronically and backed up regularly. Uncertainty will be considered to achieve conservative results. Moreover, it will be kept for the full crediting period, plus two years after the end of the crediting period or the last issuance of VCUs for this project activity (whichever occurs later). The Monitoring Plan has been developed to ensure that the project has robust data collection, processing, and archiving procedures.

Total diesel oil consumption, from the operational of DG Set

The Project Emission resulted from the consumption of diesel oil for the operational of Emergency Diesel Generator Set (Emergency DG Set). No equipment available on the project activity site to measure the actual diesel oil consumption (FC_{i,y} monitoring parameter). Fuel consumption calculated based on the diesel oil purchase receipt. If the purchase receipt not available for particular month, the largest purchase amount during this monitoring period is taken for conservative estimation.

Operator of Lau Renun HEPP recorded the diesel oil consumption assumption on the historical card, whenever they operate the DG set. The diesel oil purchase receipt is crosschecked with this historical card.

VCS data collection and record keeping arrangements

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

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

Parameter	Description	Unit	Value	Source
BE _y	Baseline emission in the reported monitoring period	tCO ₂ /year	280,357	Equation (1)
EG _{PJ,y}	Quantity of net electricity	MWh/year	377,331	Joint Meter Reading

	generation that is produced and fed into the grid as a result of the implementation of the project activity in the reported monitoring period			(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 _{P,J,y} (MWh)	BE _y (tCO ₂ /year)
1 March 2012 - 31 March 2012	34,284	25,473
1 April 2012 – 30 April 2012	42,574	31,632
1 May 2012 - 31 May 2012	31,149	23,144
1 June 2012 - 30 June 2012	24,857	18,469
1 July 2012 - 31 July 2012	23,056	17,131
1 August 2012 - 31 August 2012	25,836	19,196
1 September 2012 - 30 September 2012	21,346	15,860
1 October 2012 - 31 October 2012	28,510	21,183
1 November 2012 - 30 November 2012	38,292	28,451
1 December 2012 - 31 December 2012	40,739	30,269
TOTAL BE_y per 2012	310,643	230,808
1 January 2013 - 31 January 2013	31,719	23,567
1 February 2013 - 28 February 2013	34,969	25,982
TOTAL BE_y per 2013	66,688	49,549
Total per 2012 – 2013	377,331	280,357

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:

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y} \tag{2}$$

Parameter	Description	Unit	Value	Source
PE _y	Project emission in the reported monitoring period	tCO ₂ e/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.

$$PE_{FF,y} = PE_{FC,j,CO_2}$$

$$PE_{FC,j,CO_2} = \sum FC_{i,j,y} \times COEF_{i,y} \quad (3)$$

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	2.46 <table border="1" style="margin-left: 20px;"> <tr> <td>2012</td> <td>2.08</td> </tr> <tr> <td>2013</td> <td>0.39</td> </tr> </table>	2012	2.08	2013	0.39	Equation (3)
2012	2.08							
2013	0.39							
FC _{i,j,y}	Quantity of fuel type I combusted in process j during the year y	ton/y	0.77 <table border="1" style="margin-left: 20px;"> <tr> <td>2012</td> <td>0.65</td> </tr> <tr> <td>2013</td> <td>0.12</td> </tr> </table>	2012	0.65	2013	0.12	Measured in litre than converted into ton with formula as below: Fuel Consumption (litre) x Fuel Density (0.815 kg/litre)
2012	0.65							
2013	0.12							
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 CO₂ emission factor of fuel type i, as follows:

$$COEF_{i,y} = NCV_{i,y} \times EF_{CO_2,i} \quad (4)$$

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)
2012 (March – Dec)	800	0.65
2013 (Jan – Feb)	149	0.12
TOTAL	949	0.77

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
<i>BE_y</i>	Baseline emissions in the period <i>y</i>	tCO ₂ e	Calculated	Equation (1)
<i>PE_y</i>	Project emissions in the period <i>y</i>	tCO ₂ e	Calculated	Equation (2)
<i>ER_y</i>	Project emission in the period <i>y</i>	tCO ₂ e	Calculated	Equation (3)

4.4.2 Emission reduction calculation

Vintage Year	<i>BE_y</i>	<i>PE_y</i>	<i>ER_y</i>
1 March - 31 December 2012	230,808	2.08	230,806
1 January - 28 February 2013	49,549	0.39	49,549
TOTAL	280,357	2.46	280,355

5 ADDITIONAL INFORMATION

A. Comparison of actual emission reductions with estimates in registered VCS PD

Item	Values estimated in ex-ante calculation of registered VCS PD	Actual values achieved during this monitoring period
Emission reductions (t CO₂e)	232,931	280,355

B. Remarks on difference from estimated value in registered VCS PD

Electricity generation and plant operation days during present monitoring period was high as compared than estimated in the registered VCS PD. Since emission reduction depends on the total electricity generation multiplying with emission factor defined by the registered VCS PD therefore emission reduction amount for this monitoring period is higher as compared to the estimated in the registered VCS PD.