MONITORING REPORT
210 MW MUSI HYDRO POWER PLANT BENGKULU

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Contact Information:

Project Title	210 MW Musi Hydro Power Plant, Bengkulu
Version	2.0
Report ID	**VCS MUSI #2**
Date of Issue	16-May-2013
Project ID	VCS Database Project ID 487
Monitoring Period	01-Apr-2010 to 31-March-2013 (both days include)
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1 PROJECT DETAILS

1.1 Summary Description of Project

The 210 MW Musi Hydro Power Plant (hereinafter refer to project activity) is a new run-off-river type hydropower plant located in Bengkulu Province, Indonesia. Total installed capacity is 210 MW[1], consist of 3 x 70 MW turbines. Annual energy output is expected at 1,140 GWh, harnessing a gross water head of 404.4 m by diverting water at 42.3 m3/sec from the Musi river to the Simpangaur river. Below is the technical description of the turbines:

No	Description	VA TECH HYDRO #1	VA TECH HYDRO #2	VA TECH HYDRO #3
1	Type	Francis Turbine	Francis - Turbine	Francis - Turbine
2	Serial No	MB9 – 146/UNIT 1	MB9 – 146/ UNIT 2	MB9 – 146/ UNIT 3
3	Rated Head	396.0 m	396.0 m	396.0 m
4	Rated Output	73.6 MW	73.6 MW	73.6 MW
5	Rated Speed	500 rpm	500 rpm	500 rpm
6	Year of Commissioning	2005	2005	2005

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 Musi Hydroelectric project was registered as VCS project with ID Number 487. Further background on this project can be found in the Verified Carbon Standard Project Description (VCS PD) Version 3 dated 09 November 2009.

The project area of Musi Hydroelectric Power Plant is situated in Bengkulu Province about 30 km northeast of Bengkulu city, the capital of the province.

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 CO_2 emissions reduction of the project is 847,020 tCO_2e per year. During this monitoring period of 01 April 2010 – 31 March 2013, total amount of emissions reduction is 1,743,705 tCO_2e with detail as below:

Vintage Year	Emissions Reduction	Unit

[1] Based on 'Musi Completion Report : Engineering services for detailed design" page I - 7

01 April 2010 – 31 December 2010	544,337	tCO_2e
01 January 2011 – 31 December 2011	517,927	tCO_2e
01 January 2012 – 31 December 2012	534,274	tCO_2e
01 January 2013 – 31 March 2013	147,167	tCO_2e
Total	**1,743,705**	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 '210 MW Musi Hydro Power Plant, Bengkulu'

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 three units' commissioning date:

- Musi Hydro Power Plant Unit 1: 19 July 2006 (commissioning certificate)
- Musi Hydro Power Plant Unit 2: 19 July 2006 (commissioning certificate)
- Musi Hydro Power Plant Unit 3: 19 July 2006 (commissioning certificate)

1.6 Thus, the project-start date where project activity starts reducing emissions on 19 July 2006.Project Crediting Period

- HEPP Project starting date : 19 July 2006
- VCS Crediting period start date : 01 August 2006
- VCS crediting period : 10 years (01-Aug-2006 until 31-Jul-2016)

1.7 Project Location

The project area of the Musi Hydroelectric Power Plant is situated in Bengkulu Province about 30 km northeast of Bengkulu city, the capital of the Province. It involves the inter-basin transfer of water from the Musi river in Rejang Lebong Regency to the Simpangaur river in North Bengkulu Regency through a 7.5 km long waterway and an underground powerhouse.

The geographical coordinate of Musi Hydroelectric Power Plant is located on -3.618497 South Latitude and 102.457186 East Longitude. The location of the project site is shown in the following maps:

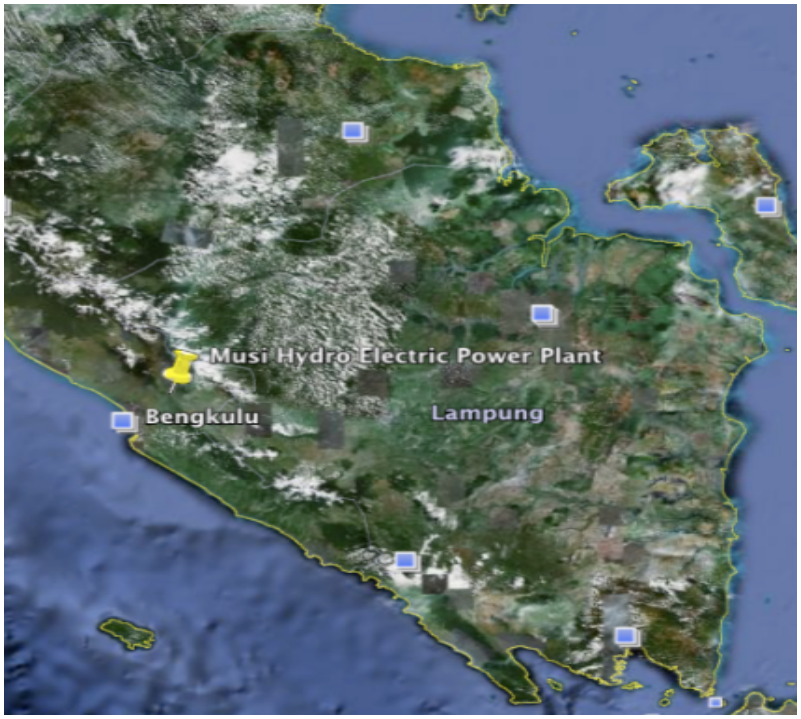

Figure 1 - Location of Musi Hydroelectric Power Plant

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

The project activity has started the operation since 19 July 2006. From the validated VCS PD Version 3, dated 09 November 2009, the installed capacity of 210 MW Musi HEPP generates about 1,140,000 MWh per year. During this monitoring period, the project activity has generated power of 2,346,874 MWh in total with details as below:

1. 01 April – 31 December 2010 : 732,627 MWh
2. 01 January – 31 December 2011 : 697,087 MWh
3. 01 January – 31 December 2012 : 719,084 MWh
4. 01 January – 31 March 2013 : 198,076 MWh

2.2 Project Description Deviations

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

A. Deviation to parameter $EG_{PJ,y}$

As per validated VCS PD, PP must monitor parameter $\boldsymbol{EG_{PJ,y}}$ as described in the baseline methodology of ACM0002 – Consolidated methodology for grid-connected electricity generation from renewable sources (Version 10, 28th May 2009, EB 47).

Subject	Original Monitoring Plan as per validated VCS PD	Deviation of the Monitoring Plan
QA/QC procedures to be applied:	a. The QA/QC will be conducted through cross-checking with sales electricity receipts.	a. The QA/QC will be conducted through cross-checking the main meter reading report (Monthly Electricity Protocol report) at the transaction point with the Water Tax payment receipt issued by Bengkulu Province Tax Office (local government).
	b. Data measured by meters will be cross-checked by electricity sales receipts	b. Sentence is removed.
	c. The meter (s) will either: • be read frequently and jointly by the generation unit and transmission unit, • be read by the project proponent and the data will then be double checked with the electricity sales receipts using comparison meter • only be read by the grid company (transmission department).	c. The main meter at the transaction point will be read regularly and jointly by the person in charge from PLN Musi HEPP Generation unit and PLN Transmission unit.

B. Deviation to parameter $FC_{PJ,y}$

As per validated VCS PD, PP must monitor parameter $\boldsymbol{FC_{PJ,y}}$ as described in the latest version of the "Tool to calculate project or leakage CO_2 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:	Fuel consumption will be recorded monthly, specifically for each fuel (currently only diesel consumption is available). Fuel consumption will be calculated from static graduated level gauges on the fuel injection tanks by using emergency diesel genset, resulted in litres then converted to tonnes using fuel specific density or scientifically proven fuel densities.	- Fuel consumption will be calculated from the monitored running hours on monthly operation report of the diesel generators, converted to liters using the default diesel oil consumption per hour, from engine manufacturer datasheet on 100% load. Then, liters shall be converted to tonnes 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).

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:	815 kg/m^3 = 0.815 kg/liter
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:	0.0741
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:	–

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

3.2 Data and Parameters Monitored

<table>
<tr><td>Data Unit / Parameter:</td><td>EG_y</td></tr>
<tr><td>Data unit:</td><td>kWh</td></tr>
<tr><td>Description:</td><td>Electricity supplied by the project activity to the grid.</td></tr>
<tr><td>Source of data:</td><td>Measured by main electricity meter (Actaris type SL 7000) at the project activity site (the switchyard)

Electricity Generation (EG) data used for monitoring is the monthly electricity generation delivered to grid summarized in Electricity Transfer Protocol Report signed by both parties of Generation department and Transmission department.</td></tr>
<tr><td>Description of measurement methods and procedures to be applied:</td><td>The net electricity sent to the grid measured by a watt-hour meter Actaris type SL 7000 (connected to a digital control system and recorded continuously), which can measure power produced, used and delivered to the grid.

The measurement of electricity generation conducted on a continuous basis, where monthly data is recorded and continuous total electricity measurement will be available. The measurement results summarized in regular production reports.</td></tr>
<tr><td>Frequency of monitoring/recording:</td><td>The measurement of electricity generation conducted by joint meter reading taken at the transaction point on a continuous basis, (monthly). The measurement results 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>732,627</td></tr>
<tr><td>01 Jan – 31 Dec 2011</td><td>697,087</td></tr>
<tr><td>01 Jan – 31 Dec 2012</td><td>719,084</td></tr>
<tr><td>01 Jan – 31 Mar 2013</td><td>198,076</td></tr>
</table>
</td></tr>
<tr><td>Monitoring equipment:</td><td>Type: Digital Watt-hour meter 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>36027156</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>36027159</td><td>SL 7000</td><td>Actaris</td><td>0.2s</td><td>Code MU-2 to monitor the electricity supply</td></tr>
</table>
</td></tr>
</table>

					from Unit 2
	36027158	SL 7000	Actaris	0.2s	Code MU-3 to monitor the electricity supply from Unit 3
	35008966	SL 7000	Actaris	0.2s	Code PS to monitor the power plant own consumption
QA/QC procedures to be applied:	The QA/QC conducted through crosschecking the main meter reading report (Monthly Electricity Protocol Report) at the transaction point with water tax payment receipts issued by Bengkulu Province Tax Office (local government). The main meters at the transaction point read regularly and jointly by the person in charge from PLN Musi HEPP Generation Unit and PLN Transmission Unit. Meters at the transaction point are calibrated annually. However, the meters were calibrated once every five-year in period 2005 – 2010 as per required by the national regulation[2] as indicated here: The date of 1st calibration: 28 July 2005 The date of 2nd calibration: 27 July 2010 The date of 3rd calibration: 07 July 2011 The date of 4th calibration: 06 July 2012 (except for Musi #Unit 3 which is calibrated in 08 July 2012)				
Calculation method:	Net electricity supplied to grid is calculated as the difference between EG_{export} , EG_{import} and consideration of $EG_{Own\ Consumption}$ with formula as below : $(EG_{export} – EG_{import}) - EG_{Own\ Consumption})$.				
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 three emergency diesel generator sets (DG sets) located at MCH, RRD and Intake.
Source of data:	Generator sets operational logbook
Description of measurement methods and procedures to be applied:	Fuel consumption calculated from the monitored running hours on monthly operation report of the diesel generators, converted to liters using the diesel oil consumption per hour, from engine manufacturer datasheet on 100% load. Then, liters converted to tonnes using fuel specific density or scientifically proven fuel densities.

[2] 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)

<table>
<tr><td></td><td></td></tr>
<tr><td>Frequency of monitoring/recording:</td><td>Fuel consumption is recorded monthly, specifically for each fuel (currently only diesel consumption is available).</td></tr>
<tr><td>Value monitored:</td><td>
<table>
<tr><th>Year</th><th>Diesel Oil Purchase based on purchase receipt (in ton)</th></tr>
<tr><td>01 Apr – 31 Dec 2010</td><td>1.63</td></tr>
<tr><td>01 Jan – 31 Dec 2011</td><td>2.66</td></tr>
<tr><td>01 Jan – 31 Dec 2012</td><td>1.77</td></tr>
<tr><td>01 Jan – 31 Mar 2013</td><td>0.95</td></tr>
</table>

7.01 ton</td></tr>
<tr><td>Monitoring equipment:</td><td>-</td></tr>
<tr><td>QA/QC procedures to be applied:</td><td>The operator of Musi HEPP Generation Unit recorded and calculated the diesel oil consumption, whenever they operate the Emergency DG set. No equipment is used to measure the diesel oil consumption. The consumption record is checked with the DG set operational hours.</td></tr>
<tr><td>Calculation method:</td><td>Converted from litre to ton using the density of diesel.</td></tr>
<tr><td>Any comment:</td><td>The fuel consumption on the project site is taken from the operational of Emergency DG Set. The plant operator recorded both the ‘fuel usage record’ and ‘DG Set Operational Hours’ on the ‘Monthly Diesel Oil Usage for Emergency DG Set’ (or ‘Laporan Pemakaian Bahan Bakar Solar Diesel Genset’). For conservative approach, the ‘fuel usage record’ is compare with the fuel consumption calculated from ‘DG Set Operational Hours data’.

For this monitoring period, the value applies for Fuel Consumption parameter is taken from the Emergency DG Set Running Hours in monthly basis, converted to liter using the fuel consumption default from engine manufacturer datasheet on 100% load. Then litre converted into ton using the density of diesel.

Fuel consumption only occur during emergency situation whereas the 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 run on grid electricity. DG set usage is only for critical instrument/control system during turbine trip, startup and shutdown.</td></tr>
</table>

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 Musi Hydroelectric Power Plant Project in Indonesia in accordance with ACM0002 version 10.

3.3.1 Monitoring period

The monitoring period covers 01 April 2010 to 31 March 2013 (both days include)

3.3.2 Monitoring organization

The monitoring team has been established and integrated within the existing organization structure of Musi hydropower plant prior to the start of the verification[3]. 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 staffs have clearly defined roles and responsibilities. The VCS manager managed 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 detailed 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

g) Equipment failure

The procedures agreed and signed off by PT PLN (Persero) and South Pole Carbon Asset Management Ltd. Any changes to procedures would 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.[4]

[3] The PLN Bengkulu Sector Office manages the Musi HEPP Generation Unit. During the crediting period of 01 April 2010 – 31 December 2011 no specific VCS monitoring team has been established. Therefore, the existing organization structure of Musi HEPP Generation Unit was assigned by PLN Bengkulu Sector Office to monitor the VCS project.

Subsequently, the PLN Bengkulu Sector has formed the VCS Monitoring Team through the 'Lampiran I Keputusan Manajer PT PLN (Persero) Sektor Pembangkitan Bengkulu Nomor : 007.K/432/MSBKL/2012' letter (or Management Decision Letter of PT PLN (Persero) Bengkulu Generation Sector Office No : 007.K/432/MSBKL/2012) in January 15, 2012.

[4] The Bengkulu 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, Musi HEPP has develop some SOPs as follow:

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

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 Musi power plant. This electricity meter is the main meter (revenue meter), measuring the quantity of electricity supplied (net electricity delivered) to the grid from Musi Power Plant. Net electricity delivered to the grid is the difference of electricity export, electricity import and electricity own consumption. As this meter provides the main VCS measurement, it is the key part of the verification process. The main meter is located at the Musi power station. The main electricity meter reading record (Joint Meter Reading) then recorded on the Monthly Transfer Electricity Protocol Record (METPR).

The main electricity meter read together by representatives from PT PLN (Persero) Generation Division (PT PLN (Persero) Generation Unit Musi HEPP) and PT PLN (Persero) Load Dispatcher and Transmission Division (PT PLN (Persero) Tanjung Karang Transmission Unit). Since both parties are under the same Head Company (PT PLN (Persero)), no other check meter (comparison meter) installed at the transaction point.

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) will be retained in the quality control system on-site.

All equipment calibrated by the manufacturer according to relevant local regulation standards[5] and maintained 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

The project developer owns the meter and is responsible for its maintenance and calibration, as stated in the SOPs agreed upon with the PLN. PLN and its representative are entitled to be present during any test, inspection, maintenance, and replacement of any part of the metering system, which 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 and Measurement equipment) to ensure

All those SOPs are in-line with the need for VCS project at Musi HEPP. Therefore, no need to develop a new SOP for VCS Project. Musi VCS Team would continue to follow the SOP during the monitoring period. Newly developed SOP for VCS Monitoring would make available after the activation of the VCS Monitoring team.

[5] 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)

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 located at the Musi HEPP project site is calibrated by external party. The calibration conducted by PT. PLN (Persero) Penelitian dan Pengembangan Ketenagalistrikan: Calibration Laboratory, a Certified Calibration Agency by National Accreditation Committee (Komite Akreditasi Nasional / KAN). The PLN Calibration Laboratory applies the Calibration Procedure B1IK0329 – 1 and IEC Standard 687 to calibrate the electricity meter. 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. Starting from 2011, the periodic calibration is conducted annually.

The Power Plant Operator periodically check if all tools and equipment work in a good condition as per the SOP[6]. 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.

No check meter (comparison meter) installed at the transaction point. In case of failure of the main meter, the production meter and the plant own consumption meter (which were also located at generation site of each power generation unit) will be use as cross-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.

There was no metering devices breakdown or malfunction during the following monitoring period (01 April 2010 – 31 March 2013). All the meters listed above have performed well. However, any plant shut down or any other malfunctions are recorded in the logbook.

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 outlined in the Standard Operating Procedure signed between the project owner and the Grid Operator (both are under PLN)[7]. All relevant data 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

[6] http://kepustakaan-presiden.pnri.go.id/uploaded_files/pdf/government_regulation/normal/UU_2_1981_soeharto.pdf

[7] Musi HEPP is following the "Prosedur Pembuatan BA Pengiriman Energi Listrik PLTA Musi" or the 'Procedure to develop Musi HEPP Monthly Electricity Protocol Report' as the detail procedure for Electricity 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"

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 (as described on the registered VCS PD, page 31):

- 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 further reported to the Sector Manager. VCS manager keep the copy of such report and be notified as well.

- O & M supervisor with other authorized staff from Generation unit extracted the data by downloading via computer from the kWh electronic meter and then record it in the form of Monthly Electricity Protocol (MEP), which signed by both Generating unit (PLN Musi Generation Unit) and PT. PLN P3B Pekalongan 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 then rechecked by authorized person from PT. P3B (UPT Tanjung Karang / Tanjung Karang Transmission Unit) and PT PLN Generation Sector Office (Bengkulu Sector Office).

After all such information is rechecked and agreed by all related parties, the MEP is signed by all authorized parties from Generation unit and Transmission unit. The report will thus be sent to PLN KITSBS as headquarter for all power plant units in South Sumatra.

All relevant data 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.

Main Electricity Meter specification:

Serial Number	Type	Factory	Class	Location
MUSI UNIT 1				
36027156	SL 7000	Actaris	0.2s	Main electricity meter 1 (MU 1) → to monitor electricity supply from turbine MUSI UNIT 1
MUSI UNIT 2				
36027159	SL 7000	Actaris	0.2s	Main electricity meter 2 (MU 2)

	(Digital)			→ to monitor electricity supply from turbine MUSI UNIT 2
MUSI UNIT 3				
36027158	SL 7000 (Digital)	Actaris	0.2s	Main electricity meter 3 (MU 3) → to monitor electricity supply from turbine MUSI UNIT 3
MUSI TRANSFORMER 150/20 kV				
35008966	SL 7000	Actaris	0.2s	Code PS to monitor the power plant own consumption

Picture of the main meters are shown below:

	MUSI UNIT 1 : 36027156
	MUSI UNIT 2 : 36027159
	MUSI UNIT 3 : 36027158

	MUSI PS : 35008966

Figure 3 - Picture of electricity meters

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

The fossil fuel consumption is calculated from the total 'Emergency DG set Operational Hours' on monthly basis during the vintage year (operational hour is converted into liter using the fuel consumption default then convert into ton using the density for diesel oil) at the project site. No equipment use to measure the diesel oil consumption. The PP uses total diesel oil consumption record for all activities (MCH, RRD and Intake) at the project site. The calculation is shown on section 4.2.2.

3.3.4 VCS data collection and record keeping arrangements

Every month the Operation Supervisor from Musi 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 (Musi HEPP Generation Unit) and transmission department (Tragi Pekalongan).

At the end of each month the monitoring data needs to be filled electronically. The electronic files need to have CD back-up and/or print-out. The project developer needs to keep recorded Monthly Transfer Electricity Protocol Record (METPR). 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 9th 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	1,743,727	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	2,346,874	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	73,431	54,559
1 May 2010 - 31 May 2010	79,868	59,342
1 June 2010 - 30 June 2010	84,104	62,489
1 July 2010 - 31 July 2010	88,996	66,124
1 August 2010 - 31 August 2010	87,315	64,875
1 September 2010 - 30 September 2010	79,096	58,768
1 October 2010 - 31 October 2010	86,203	64,049
1 November 2010 - 30 November 2010	77,452	57,547
1 December 2010 - 31 December 2010	76,163	56,589
TOTAL BEy per 2010	**732,627**	**544,342**
1 January 2011 - 31 january 2011	60,758	45,143
1 February 2011 - 28 February 2011	54,378	40,403
1 March 2011 - 31 March 2011	59,030	43,859
1 April 2011 - 30 April 2011	55,461	41,208
1 May 2011 - 31 May 2011	77,085	57,274
1 June 2011 - 30 June 2011	60,909	45,255
1 July 2011 - 31 July 2011	56,696	42,125
1 August 2011 - 31 August 2011	41,892	31,126
1 September 2011 - 30 September 2011	41,057	30,506
1 October 2011 - 31 October 2011	43,381	32,232
1 November 2011 - 30 November 2011	71,811	53,355
1 December 2011 - 31 December 2011	74,628	55,449
TOTAL BEy per 2011	**697,087**	**517,935**
1 January 2012 - 31 january 2012	71,941	53,452
1 February 2012 - 29 February 2012	68,319	50,761
1 March 2012 - 31 March 2012	70,420	52,322
1 April 2012 - 30 April 2012	70,124	52,102
1 May 2012 - 31 May 2012	70,094	52,080
1 June 2012 - 30 June 2012	57,425	42,667

1 July 2012 - 31 July 2012	69,219	51,430
1 August 2012 - 31 August 2012	42,574	31,633
1 September 2012 - 30 September 2012	32,676	24,278
1 October 2012 - 31 October 2012	41,479	30,819
1 November 2012 - 30 November 2012	59,776	44,414
1 December 2012 - 31 December 2012	65,036	48,322
TOTAL BEy per 2012	**719,084**	**534,279**
1 January 2013 - 31 january 2013	66,941	49,737
1 February 2013 - 28 February 2013	61,908	45,998
1 March 2013 - 31 March 2013	69,227	51,435
TOTAL BEy per 2013	**198,076**	**147,170**
Total per 2010 - 2013	**2,346,874**	**1,743,727**

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 9th 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 Musi 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	**22.34** 2010 5.19 2011 8.48 2012 5.64 2013 3.04	Equation (3)
$FC_{i,j,y}$	Quantity of fuel type I combusted in process j during the year y	ton/y	**7.01** 2010 1.63 2011 2.66 2012 1.77 2013 0.95	Measured in liter than converted into ton with formula as below: Fuel Consumption (litre) x Fuel Density (0.815 kg/liter)
$COEF_{i,y}$	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	Musi 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	Musi HEPP

4.2.2 Project emissions from the consumption of fossil fuels

Year	Fuel Consumption (ton)	PEy (tCO2/year)
2010 (Apr – Dec)	1.63	5.19
2011 (Jan – Dec)	2.66	8.48
2012 (Jan – Dec)	1.77	5.64

2013 (Jan – Mar)	0.95	3.04
TOTAL	**7.01**	**22.34**

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:

$ER_y = BE_y - PE_y$ (5)

Parameter	Description	Unit	Value	Source
BE_y	Baseline emissions in the period *y*	tCO_2e	Calculated	Equation (1)
PE_y	Project emissions in the period *y*	tCO_2e	Calculated	Equation (2)
ER_y	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	544,342	5.19	544,337
1 January - 31 December 2011	517,935	8.48	517,927
1 January - 31 December 2012	534,279	5.64	534,274
1 January - 31 March 2013	147,170	3.04	147,167
TOTAL	**1,743,727**	**22.34**	**1,743,705**

5 ADDITIONAL INFORMATION

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

Document	Electricity Supply (in MWh)	Emission Reduction (in tCO2)
Ex-ante calculation (VCS PD Version 3, dated 9th November 2011)	1,140,000	847,020
Actual monitored data for current monitoring period : 01 April 2010 – 31 March 2013 (Monitoring Report with Report ID: VCS MUSI #2	**2,346,874**	**1,743,705**
Average monitored data per annum	782,291	581,235