Monitoring report form
(Version 03.1)

Monitoring report

Title of the project activity	Repowering Small Hydro Plants (SHP) in the State of São Paulo, Brazil
Reference number of the project activity	0489
Version number of the monitoring report	1
Completion date of the monitoring report	03/05/2013
Registration date of the project activity	15/12/2006
Monitoring period number and duration of this monitoring period	Second Monitoring Period of the Second Crediting Period, from 24/08/2011 until 31/12/2012 (both days included)
Project participant(s)	CPFL Geração de Energia S.A. C-Trade Comercializadora de Carbono Ltda. Lumina Engenharia e Consultoria Ltda. Cantor Fitzgerald Europe
Host Party(ies)	Brazil
Sectoral scope(s) and applied methodology(ies)	Sectoral Scope 1 – Energy Industries (Renewable/Non-renewable sources) ACM0002 – "Consolidated baseline methodology for grid-connected electricity generation from renewable sources", version 12.1
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	25,252 tCO_2e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the monitoring period up to 31/12/2012	11,102 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

This project encompasses the upgrade of CPFL's SHPPs in the State of São Paulo, south-eastern of Brazil. In this region, all major hydropower potential have long been tapped, along with most of the smaller ones as well. Expanding generation in the region brings the advantage of increasing energy supply in the country's richest region with lower transmission losses and thus avoiding hydropower plants in the Amazon region. The plants were built in the early 1900s and have been running basically with the original turbines and generators. As they were extending their lifetime, CPFL sought options to repower them.

All the plants were originally built between 1910 and 1930 when turbine-generator efficiency was significantly lower than today. The additional electricity is produced by the plants without any modifications in their respective existing reservoirs and, thus, the generation occurs without the addition of any negative environmental impacts. The project activity helps meeting the country's demand and increases the renewable share in the Brazilian electricity grid.

The SHPPs Esmeril, Dourados, São Joaquim, Gavião Peixoto, Chibarro and Capão Preto were repowered between 2000 and 2006. The repowering of these six power plants increased their total installed capacity from 25.6 MW to 35.93 MW, adding more than 86 GWh per year to the Brazilian grid.

All the repowering projects kept the same reservoir area and were authorized to run with the same head, thus operating with no additional environmental impacts. The whole gain is an efficiency upgrade by using modern electricity generation technology. In four of the plants, the additional electricity is gained with fewer turbines than before. One of the plants already operated with only one turbine, and the sixth power plant had its two turbines replaced by two new ones.

The equipment installed in the project are the same as the ones mentioned in the registered PDD[1], at Section A.4 as described in the following table:

Table 1 – Project equipment description

SHPP	Startup	Equipment	Type	Flow Rate (m^3/s)	Equipment	Generator Capacity (MW)	Generator Voltage (kV)
Esmeril	1912	Turbine 1	Francis	1.12	Generator	0.58	2.2
		Turbine 2	Francis	1.12	Generator	0.58	2.2
		Turbine 3	Francis	1.86	Generator	0.61	2.2
	2003	**Turbine 1**	**Francis**	**4.88**	**Generator**	**2.5**	**2.2**
		Turbine 2	**Francis**	**4.88**	**Generator**	**2.5**	**2.2**
Dourados	1926	Turbine 1	Francis	33.00	Generator	6.4	6.3
	2002	**Turbine 1**	**Francis**	**44.00**	**Generator**	**10.80**	**6.9**
São Joaquim	1911	Turbine 1	Francis	7.35	Generator	0.84	2.2
		Turbine 2	Francis	7.35	Generator	0.84	1.05
		Turbine 3	Francis	16.2	Generator	1.92	2.2
		Turbine 4	Francis	15.89	Generator	1.92	2.2
	2002	**Turbine 1**	**Kaplan**	**17.5**	**Generator**	**2.79**	**6.9**
		Turbine 2	**Kaplan**	**17.5**	**Generator**	**2.79**	**6.9**
		Turbine 3	**Kaplan**	**17.5**	**Generator**	**2.79**	**6.9**
Gavião Peixoto	1913	Turbine 1	Francis	6.00	Generator	0.7	6.5
		Turbine 2	Francis	6.00	Generator	0.7	6.5
		Turbine 3	Francis	6.00	Generator	0.98	6.3
		Turbine 4	Francis	13.2	Generator	1.73	6.5
	2007	**Turbine 1**	**Francis**	**15.00**	**Generator**	**2.43**	**6.9**
		Turbine 2	**Francis**	**15.00**	**Generator**	**2.43**	**6.9**
Chibarro	1912	Turbine 1	Francis	2.09	Generator	1.21	2.2
		Turbine 2	Francis	2.06	Generator	1.08	2.2

[1] Available at: http://cdm.unfccc.int/Projects/DB/SGS-UKL1151788974.93/view

	2007	**Turbine 1**	**Francis**	**2.2**	**Generator**	**1.3**	**2.2**
		Turbine 2	**Francis**	**2.2**	**Generator**	**1.3**	**2.2**
Capão Preto	1911	Turbine 1	Francis	2.06	Generator	1.76	2.2
		Turbine 2	Francis	3.2	Generator	1.76	2.2
		Turbine 3	Francis	3.6	Generator	2.00	2.2
	2008	**Turbine 1**	**Francis**	**2.2**	**Generator**	**2.00**	**2.2**
		Turbine 2	**Francis**	**3.6**	**Generator**	**2.3**	**2.2**

Relevant dates of the project activity

Table 2 – Relevant dates of the project activity

DATE	EVENT
15/12/2006	Registration under the CDM
22/08/2007	First CER issuance regarding the monitoring period between 01/01/2003 and 30/11/2006
31/08/2008	Second CER issuance regarding the monitoring period between 01/12/2006 and 31/12/2007
28/10/2009	Third CER issuance regarding the monitoring period between 01/01/2008 and 31/12/2008
20/08/2010	Fourth CER issuance regarding the monitoring period between 01/01/2009 and 31/12/2009
09/10/2011	Renewal date for the second crediting period
15/11/2012	First CER issuance of the second crediting period regarding the monitoring period between 01/01/2010 and 23/08/2011

Total GHG emission reductions achieved in this monitoring period (both days included): 11,102 tCO2e

A.2. Location of project activity

The project activity is located in the South-Eastern region of Brazil, on the State of São Paulo, in the cities of Patrocínio Paulista, Nuporanga, Guará, Gavião Peixoto, Araraquara e São Carlos. Their respective geographical coordinates are described below:

Table 3 – List of SHPPs covered by the project activity

SHP	Code	Location		City	River	Basin
		Longitude (W)	Latitude (S)			
Esmeril	USES	20º50'23''	47º18'07''	Patrocínio Paulista	Esmeril	Sapucaí Mirim
Dourados	USDO	20º38'37''	48º40'07''	Nuporanga	Sapucaí	Sapucaí Mirim
São Joaquim	USJO	20º34'25''	47º46'58''	Guará	Sapucaí Mirim	Sapucaí Mirim
Gavião Peixoto	USPE	21º50'53''	47º42'20''	Gavião Peixoto	Jacaré-Guaçu	Tietê
Chibarro	USCH	21º53'17''	48°08'50''	Araraquara	Chibarro	Tietê
Capão Preto	USCP	21º53'54''	47º47'04''	São Carlos	Conxim, Negros, Itaúna, Quilombos	Mogi-Guaçú

A.3. Parties and project participant(s)

Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Brazil (host)	**Private entity:** CPFL Geração de Energia S.A. **Private entity:** C-Trade Comercializadora de Carbono Ltda. **Private entity:** Lumina Engenharia e Consultoria Ltda.	**No.**
United Kingdom of Great Britain and Northern Ireland	**Private entity:** Cantor Fitzgerald Europe	**No.**

A.4. Reference of applied methodology

ACM0002 – "Consolidated baseline methodology for grid-connected electricity generation from renewable sources", version 12.1.

The tools referred by the methodology are:

- "Tool for the demonstration and assessment of additionality" – Version 05.2;
- "Tool to calculate the emission factor for an electricity system" – Version 2;
- "Combined tool to identify the baseline scenario and demonstrate additionality" – Version 02.2.

For more information about the methodology consult the following link:

http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html

A.5. Crediting period of project activity

01/Jan/2010 – 31/Dec/2016 (7-year renewable crediting period)

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

The following table shows the additional electricity and the projected amount of energy to be generated by each power plant:

Table 4 – SHPPs installed capacity

SHPPs	Previous Capacity (MW)	Project Capacity (MW)
Esmeril	1.76	5.00
Dourados	6.40	10.80
São Joaquim	5.52	8.37
Gavião Peixoto	4.11	4.86
Chibarro	2.29	2.60
Capão Preto	5.52	4.30
TOTAL	**25.60**	**35.93**

The modifications in each plant considered in the project activity are described below:

- **SHPP Esmeril**
  - A set of three old turbo-generators were replaced by two new ones, with 2.5 MW of installed capacity each.
  - Old penstocks were replaced with a new one.
  - The canal section was broadened in 3.00 m maintaining previous characteristics of velocity and rugosity coefficient, doubling its capacity.
  - The new machinery was installed in the same place as the previous ones.
  - Basic reinforcement of foundations and structure of the powerhouse were carried out.

- **SHPP Dourados**
  - An old turbo-generator was replaced by a new one more efficient.
  - The buildings, adduction channel and penstocks suffered no modifications.

- **SHPP São Joaquim**
  - Four older turbo-generators were replaced by three new ones, presenting now a total nominal capacity of 8.37MW (with 3 generators of 2.79MW each), but is authorized by ANEEL[2] to operate at 8.05MW. There is a document (Ofício 827-2009-SFG-ANEEL, dated 16/09/2009) that regularizes this difference. This was done in order to have a reserve between the operational capacity and the maximum capacity, being an engineering consideration during the early project phase
  - The buildings, adduction channel and penstocks suffered no modifications.

- **SHPP Gavião Peixoto**
  - The older set of turbo-generators will be replaced by a new 4.86 MW set.
  - The new machines will be installed in the same place as the older ones.

[2] ANEEL Resolution N° 469, of October 31st, 2001

- Basic reinforcement of foundations and structure of the powerhouse will be carried out.
- The buildings and adduction channel will suffer no modifications.

- **SHPP Chibarro**
  - Replacement of the older 1.21 MW and 1.08 MW turbo-generators by two new of 1.3 MW each.
  - The water adduction channel will be broadened.
  - Basic reinforcement of foundations and structure of the powerhouse will be carried out.
  - No changes will be carried out to the remaining facilities.

- **SHPP Capão Preto**
  - The two older 1.76 MW and 2 MW turbo-generators will be replaced by a 2 MW and 2.3 MW.
  - The junction of the existing penstocks will be revised in order to reduce head losses.

The table below lists the main physical characteristics of SHPPs reservoirs, which will remain the same and not be modified by the project activity:

Table 5 – Reservoirs' main physical characteristics

SHPP	Reservoir Area (km²)
Esmeril	0.28
Dourados	0.54
São Joaquim	0.84
Gavião Peixoto	0.077
Chibarro	0.0108
Capão Preto*	2.50

*Capão Preto has four small reservoirs with the following flooded areas (km²): R1 0.46; R2 1.00; R3 0.02; R4 1.03.

Please see section C for the line diagram of the project activity.

1. *Starting date of operation of the project activity*

Table 6 – Project's starting date after repowering

SHPP	Operation start after repowering
Esmeril	January, 2003
Dourados	July, 2002
São Joaquim	July, 2002
Gavião Peixoto	June, 2007
Chibarro	December, 2007
Capão Preto	February, 2008

2. *Information regarding the actual operation of the project activity during this monitoring period (both days included)*

No significant special events or situations (for example overhaul times, downtimes of equipment, exchange of equipment, etc.) have occurred in the actual operation of the project activity during this monitoring which could have an impact on the applicability of the methodology ACM0002. The power plants went through regular maintenance on the period analyzed in the monitoring report.

Also, it's important to highlight that there was no exchanges in any equipment of the project activity during the monitoring period (both days included).

The main maintenance works done in the SHPPs of the project activity in the monitored period are detailed in the table below:

Table 7 – Esmeril main maintenance works

Date	Service	Hours
08/03/2012	Maintenance on generating unit #1 (UG-1)	24
03/05/2012	UG-1 by-pass valve maintenance	48
14/05/2012	UG-2 maintenance	48
08/03/2012	UG-1 maintenance	24
20/07/2012	UG-2 maintenance	32
31/07/2012	UG-1 adjustment	24
31/10/2012	UG-2 adjustment	24
20/08/2012	Grating general maintenance	240
26/10/2012	UG-1 automation system maintenance	16
30/10/2012	Floodgate maintenance	16
29/11/2012	UG-1 maintenance	40
13/11/2012	UG-1 general revision	72

Table 8 – Dourados main maintenance works

Date	Service	Hours
18/10/2011	Hidraulic unit maintenance	64
18/10/2011	UG protection system adequacy	24
10/01/2012	Floodgate triggering system maintenance	24
19/01/2012	UG-1 heat exchanger maintenance	18
13/08/2012	Heat exchanger maintenance	24
06/08/2012	Floodgate maintenance	24
16/08/2012	Cooling tower maintenance	24
28/08/2012	Heat exchanger maintenance	24
30/08/2012	Heat exchanger maintenance	48
10/09/2012	UG annual maintenance	300
11/09/2012	Heat exchanger general maintenance	30
19/09/2012	General maintenance	48
05/11/2012	UG annual inspection	150

Table 9 – São Joaquim main maintenance works

Date	Service	Hours
04/10/2011	Protective relay replacement on UG-1	96
31/10/2011	Floodgates maintenance	160
18/10/2011	UG-1 protection adequacy	16
03/11/2011	UG-3 automation maintenance	16
28/11/2011	UG-2 floodgate triggering system maintenance	80
30/11/2011	Floodgate triggering system maintenance	32
01/12/2011	UG-2 floodgate maintenance	24
07/12/2011	UG-1 instrument replacement	16
12/12/2011	UG-1 locking key maintenance	10
19/12/2011	UG-1 coupling maintenance	90
26/12/2011	Floodgate maintenance	16
26/12/2011	UG-3 distributor maintenance	64
12/01/2012	UG-3 maintenance	48

16/01/2012	UG-3 maintenance	16
06/03/2012	Adduction canal maintenance	48
06/03/2012	UG-1 inspection	32
19/03/2012	Power plant's automation maintenance	48
21/03/2012	Automation cleaning system maintenance	16
22/03/2012	Control pannel inspection and maintenance	24
22/03/2012	Control pannel maintenance	100
28/03/2012	UG-3 operational tests	24
26/03/2012	UG-1 distributor maintenance	30
26/03/2012	UG-1 inspection	52
27/03/2012	UG-1 pump replacement	16
29/03/2012	UG-2 pump replacement	16
15/06/2012	UG-2 maintenance	48
19/06/2012	UG-2 pump replacement	24
19/06/2012	UG-2 maintenance	24
04/07/2012	UG-2 sealing system maintenance	64
06/07/2012	Entrance floodgate maintenance	120
02/08/2012	UG-1 maintenance	24
10/08/2012	UG-1 general revision	50
16/10/2012	UG-3 annual inspection	150
23/10/2012	Ug-2 annual inspection	150
19/11/2012	UG-1 general recomposition	400
12/11/2012	UG-3 maintenance	32

Table 10 – Gavião Peixoto main maintenance works

Date	Service	Hours
22/12/2011	UG-1 floodgate triggering system maintenance	24
27/03/2012	UG-2 inspection	72
27/03/2012	UG-2 electromechanical tests	24
02/07/2012	UG-2 inspection and maintenance	48
16/10/2012	UG-1 inspection	24
08/11/2012	Automation system inspection	24
03/12/2012	UG-1 annual maintenance	72

Table 11 – Chibarro main maintenance works

Date	Service	Hours
18/10/2011	General maintenance	48
07/03/2012	Cooling pump replacement	48
15/03/2012	Generators collector ring maintenance	24
20/03/2012	UG-2 by-pass piping maintenance	24
18/05/2012	UG-2 directional valve replacement	24
25/05/2012	UG-1 collector ring maintenance	24
14/08/2012	UG-2 maintenance	48
20/09/2012	Remote controll pannel installation	48
22/10/2012	UG-1 electromechanical inspection	48
24/10/2012	UG-2 electromechanical inspection	48
11/12/2012	UG-1 colletor ring maintenance	24

Table 12 – Capão Preto main maintenance works

Date	Service	Hours
20/10/2011	General maintenance	24
03/05/2012	UG-1 maintenance	24
29/03/2012	Adduction canal maintenance	24
20/08/2012	UG-1 inspection	24
22/08/2012	UG-2 inspection	24
30/08/2012	Remote installation	200
17/10/2012	Hydraulic cylinder maintenance	120

The energy meters of the SHPPs were calibrated as indicated in the following table:

Table 13 – Energy meter calibration details

SHPP	Serial Number		Penult Calibration	Last Calibration	Period Delayed	Correction Factor
	Main Meter	Back-up Meter				
Capão Preto	40086175-5	40086176-3	24/May/2011	Valid until 24/May/2013	-	-
Chibarro	40071225-3	40071226-1	16/May/2011	Valid until 16/May/2013	-	-
Dourados	40092314-9	40092315-7	21/Nov/2011	Valid until 21/Nov/2013	-	-
Esmeril	40071230-0	40071228-8	14/Oct/2010	08/Nov/2012	25 days	0.3%
Gavião Peixoto	40060768-9	40060769-7	28/Dec/2009	06/Feb/2012	39 days	0.3%
São Joaquim	40071231-8	40071229-6	06/Oct/2010	08/Nov/2012	33 days	0.3%

As can be verified in the table above, the following SHPPs had their calibration delayed:

i. SHPP Esmeril: 25 days;
ii. SHPP Gavião Peixoto: 39 days;
iii. SHPP São Joaquim: 33 days.

According to EB52, Annex 60 – "Guidelines for assessing compliance with the calibration frequency requirements", if during verification the calibration has been delayed, the following conservative approach shall be adopted in the calculation of emission reductions:

(a) Applying the maximum permissible error[3] of the instrument to the measured values, if the results of the delayed calibration do not show any errors in the measuring equipment, or if the error is smaller than the maximum permissible error; or
(b) Applying the error identified in the delayed calibration test, if the error is beyond the maximum permissible error of the measuring equipment.

The maximum permissible error considered for the power plants is 0.3%, as mentioned in the energy meters calibration certificates, and is the most conservative value to be adopted. Therefore, for the SHPPs identified above, this corrective index was applied in order to correct the project's emission reductions resulting in a lower baseline emissions.

3. Events or situations that occurred during the monitoring period which may impact the applicability of the methodology, and how the issues resulting from these events or situations are being addressed

No events have been identified in this monitoring period (both days included) that affects the applicability of the methodology.

[3] The maximum permissible error of all the measuring instruments are specified by the respective manufacturers as their technical specification.

B.2. Post registration changes

B.2.1. Temporary deviations from registered monitoring plan or applied methodology

There were no temporary deviations from the registered monitoring plan or applied methodology made in the project activity.

B.2.2. Corrections

There were no corrections made in the project activity.

B.2.3. Permanent changes from registered monitoring plan or applied methodology

There were no permanent changes from the registered monitoring plan or applied methodology made in the project activity.

B.2.4. Changes to project design of registered project activity

There were no changes in the project design of the registered project activity.

B.2.5. Changes to start date of crediting period

There were no changes in the start date of the crediting period made in the project activity.

B.2.6. Types of changes specific to afforestation or reforestation project activity

Not applicable.

SECTION C. Description of monitoring system

Electricity generation is the core business of CPFL and therefore all measurements comply with national regulations for the electric sector that describe the technical specifications of measuring, reporting and storing data.

The electrical energy generation data collection is made automatically with the utilization of the ZFA-F Remote Reading System and stored in the Data Base. This information is utilized by the COG Engineer to generate the Energy Production Report, used for the GHG monitoring report.

There is a procedure # 4,987, version 1.1, for the operation of the ZFA system, which includes a process flow diagram, describing the entire process from gathering raw data to reporting totals, including the process for validating the readings.

Each power plant has one main electricity meter in use and a back-up meter that is used in emergency

situations in which the main meter might fail, in a way that the electricity generation information is not lost. Every five minutes the electricity generated is integrated and recorded and, in an hourly basis, this information is transmitted via satellite to the server in CPFL's Generating Operation Center (COG – *Centro de Operação de Geração*) in São Paulo. Afterwards, in a monthly basis this information is consolidated by the COG and sent to Lumina Engenharia e Consultoria Ltda to be used in the project activity's monitoring report. Such information is also sent to the Electric Power Commercialization Chamber (CCEE – *Câmara de Comercialização de Energia Elétrica*) by CPFL's director of Energy Sales and Purchasing to invoice purposes. The following scheme summarizes the electricity generation information flow:

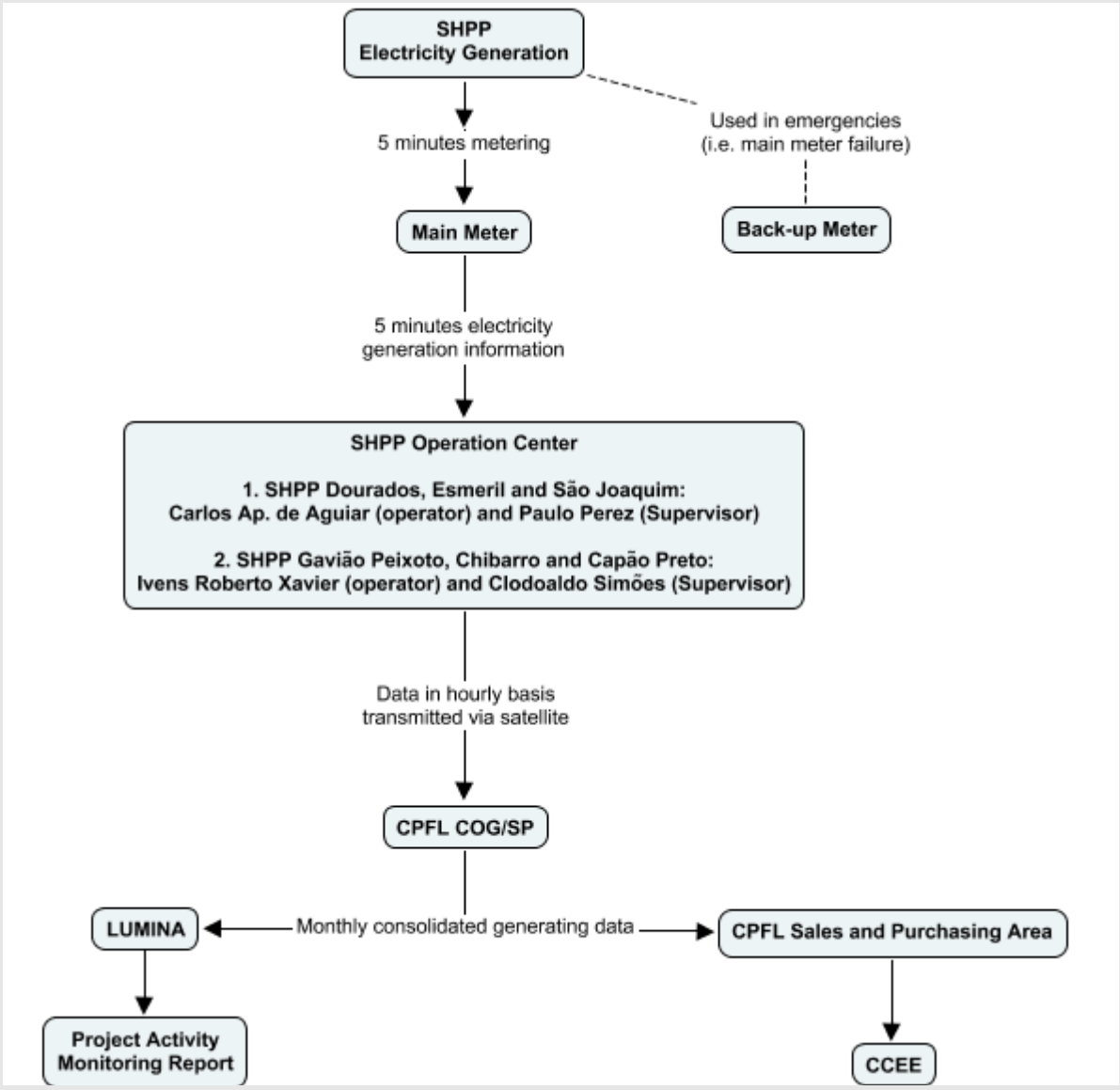

Figure 1 – Electricity Generating Information Flow

Line diagrams

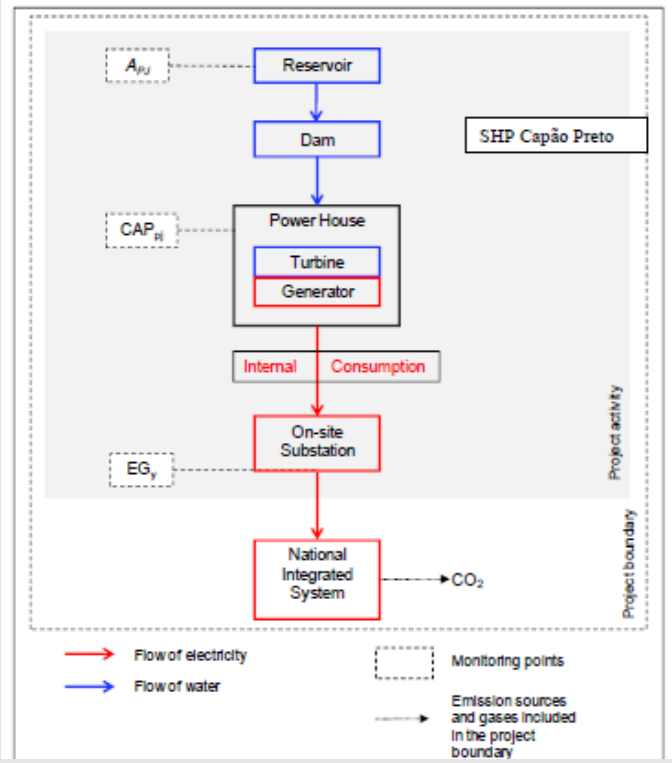

Figure 2 – SHPP Capão Preto Line Diagram

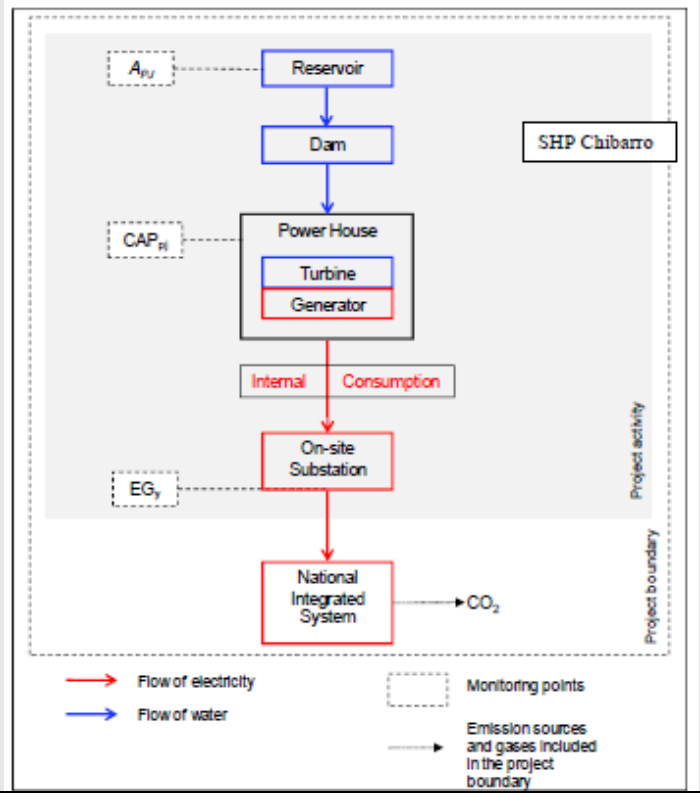

Figure 3 – SHPP Chibarro Line Diagram

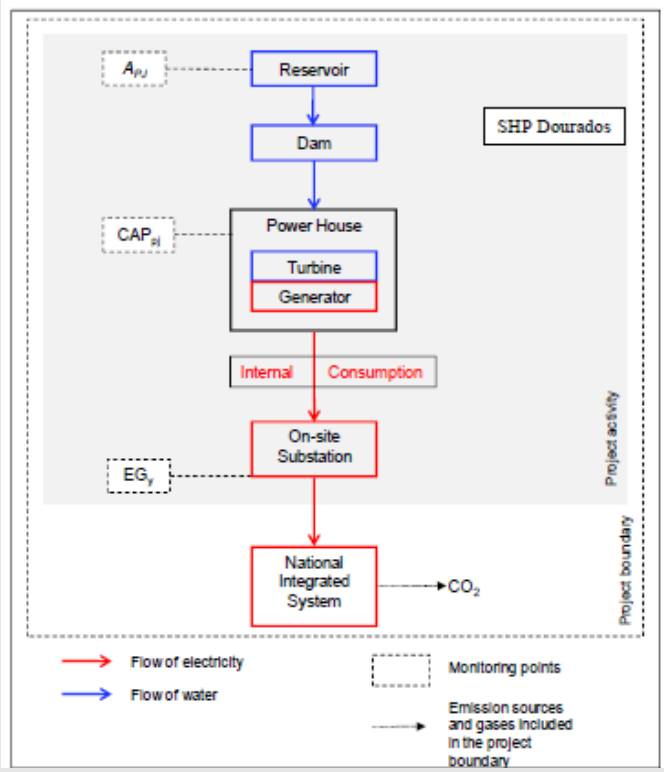

Figure 4 – SHPP Dourados Line Diagram

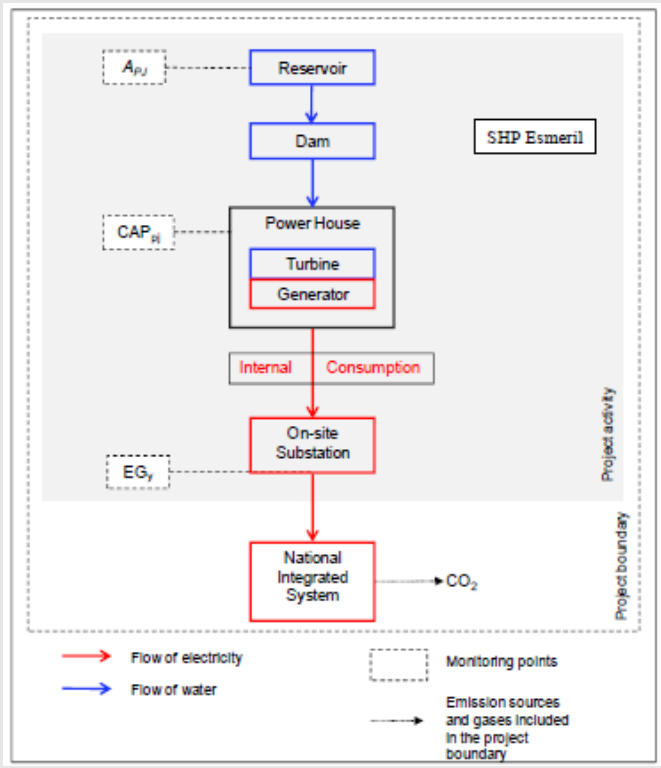

Figure 5 – SHPP Esmeril Line Diagram

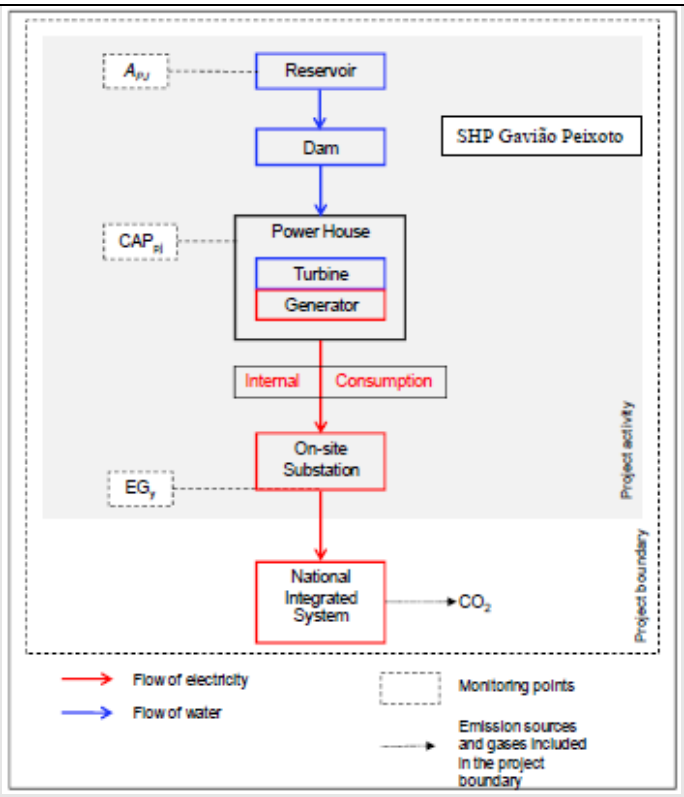

Figure 6 – SHPP Gavião Peixoto Line Diagram

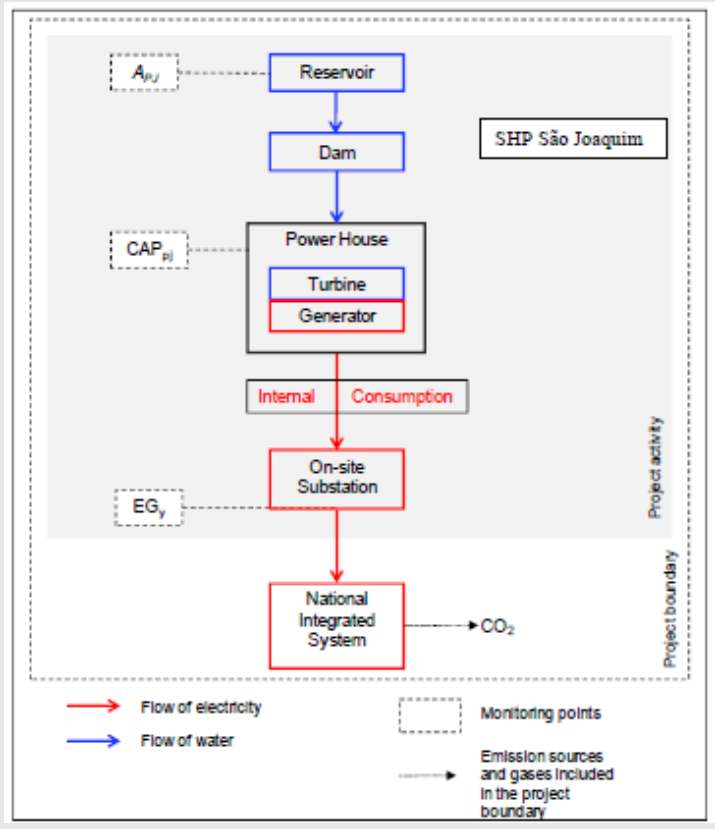

Figure 7 – SHPP São Joaquim Line Diagram

1. Organizational Structure

CPFL is responsible for training its personnel, including the power plants local operators and supervisors, as well as supervisors from the Generation Operation Center (COG). In between this monitored period, CPFL sponsored two trainings, described below:

Table 14 – CPFL Trainings

Date	Duration (hours)	Training	Participants
19/Mar/2012	08:00	Technical operation (overhead crane)	Marcos Daniel Ribeiro Carlos Aparecido Aguiar Paulo Roberto Becaletti Perez Clodoaldo Antonio Simões José Valteir de Melo Lourival Delpasso
20/Mar/2012 to 21/Mar/2012	16:00	Technical operation (confined spaces)	Carlos Aparecido Aguiar Paulo Roberto Becaletti Perez Clodoaldo Antonio Simões José Valteir de Melo Lourival Delpasso
22/Mar/2012	04:00	Defensive driving	Marcos Daniel Ribeiro Carlos Aparecido Aguiar Paulo Roberto Becaletti Perez
22/Mar/2012	04:00	First aid	Carlos Aparecido Aguiar Paulo Roberto Becaletti Perez Clodoaldo Antonio Simões José Valteir de Melo Lourival Delpasso
23/Mar/2012	08:00	Technical operation (working at height)	Marcos Daniel Ribeiro Carlos Aparecido Aguiar Paulo Roberto Becaletti Perez Clodoaldo Antonio Simões José Valteir de Melo Lourival Delpasso
26/Mar/2012 to 30/Mar/2012	40:00	Technical operation (pressure vessels)	Marcos Daniel Ribeiro Carlos Aparecido Aguiar Paulo Roberto Becaletti Perez Clodoaldo Antonio Simões José Valteir de Melo Lourival Delpasso
21/May/2012 to 25/May/2012	40:00	NR-10 (basic concepts)	Carlos Aparecido Aguiar Paulo Roberto Becaletti Perez Clodoaldo Antonio Simões José Valteir de Melo Lourival Delpasso
28/May/2012 to 01/Jun/2012	40:00	NR-10 (complementary)	Marcos Daniel Ribeiro Carlos Aparecido Aguiar Paulo Roberto Becaletti Perez
04/Jun/2012	08:00	Fire brigade	Marcos Daniel Ribeiro Carlos Aparecido Aguiar Paulo Roberto Becaletti Perez

1. Emergency Procedures

The power plants have a manual for emergency cases "Emergency Situations Operation System" (SOSEM – *Sistema de Operação em Situações de Emergência*"), which addresses the entire power plants operation aiming to save CPFL's patrimony and therefore protect others patrimony downstream. Also, this emergency procedure aims to reduce the occurance of damages to the environment both upstream and downstream of the power plants dam (i), provide organizational and administrative flexibility to mobilize resources needed to overcome abnormal situations (ii), facilitate the contact between units involved in abnormal situations in the power plants operation (iii), and coordination with public agencies and entities responsible for protecting the population and properties.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante or at renewal of crediting period

Data / Parameter:	$EG_{historical}$
Unit:	MWh/yr
Description:	Annual average historical net electricity generation delivered to the grid by the existing renewable energy plant that was operated at the project site prior to the implementation of the project activity
Source of data:	Project activity site
Value(s) applied):	

$EG_{Historical}$	MWh
Esmeril	7,261.5
Dourados	44,912.5
São Joaquim	30,408.7
Gavião Peixoto	22,185.7
Chibarro	9,523.4
Capão Preto	13,388.7

Purpose of data:	Baseline emission calculations.
Additional comment:	-

Data / Parameter:	$\sigma_{historical}$
Unit:	MWh/yr
Description:	Standard deviation of the annual average historical net electricity generation delivered to the grid by the existing renewable energy plant that was operated at the project site prior to the implementation of the project activity
Source of data:	Calculation from data used to establish $EG_{historical}$
Value(s) applied):	

Standard Deviation Historical (σ)	
SHPP	**MWh**
Esmeril	107.92
Dourados	520.57
São Joaquim	338.85
Gavião Peixoto	200.43
Chibarro	173.65
Capão Preto	415.89

Purpose of data:	Baseline emission calculations.
Additional comment:	This value will not be altered.

Data / Parameter:	$DATE_{BaselineRetrofit}$
Unit:	Date
Description:	Point in time when the existing equipment would need to be replaced in the absence of the project activity
Source of data:	Project activity site
Value(s) applied):	

SHPP	$DATE_{BaselineRetrofit}$
Esmeril	Nov/2027
Dourados	Nov/2027
São Joaquim	Nov/2027
Gavião Peixoto	Nov/2027
Chibarro	Nov/2027
Capão Preto	Nov/2027

Purpose of data:	Baseline emission calculations.
Additional comment:	-

Data / Parameter:	CAP_{BL}
Unit:	W
Description:	Installed capacity of the hydro power plant before the implementation of the project activity
Source of data:	Project site
Value(s) applied):	

SHPPs	Previous Capacity (MW)	Project Capacity (MW)
Esmeril	1.76	5.00
Dourados	6.40	10.80
São Joaquim	5.52	8.37
Gavião Peixoto	4.11	4.86
Chibarro	2.29	2.60
Capão Preto	5.52	4.30

Purpose of data:	Baseline emission calculations
Additional comment:	This value will not be altered

Data / Parameter:	**A_{BL}**
Unit:	m^2
Description:	Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full.
Source of data:	Project site
Value(s) applied):	**SHPP** / **Reservoir Area (km^2)** Esmeril: 0.28 Dourados: 0.54 São Joaquim: 0.84 Gavião Peixoto: 0.077 Chibarro: 0.0108 Capão Preto*: 2.50 *Capão Preto has four small reservoirs with the following flooded areas (km^2): R1 0.46; R2 1.00; R3 0.01; R4 1.03.
Purpose of data:	Baseline emission calculations
Additional comment:	This value will not be altered

Data / Parameter:	**w_{OM}**
Unit:	%
Description:	Operating margin weight
Source of data:	"Tool to calculate the emission factor for an electricity system"
Value(s) applied):	25
Purpose of data:	Baseline emission calculations
Additional comment:	-

Data / Parameter:	**w_{BM}**
Unit:	%
Description:	Build margin weight
Source of data:	"Tool to calculate the emission factor for an electricity system"
Value(s) applied):	75
Purpose of data:	Baseline emission calculations
Additional comment:	-

D.2. Data and parameters monitored

Data / Parameter:	**$EG_{facility,y}$**
Unit:	MWh/yr
Description:	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y
Measured/ Calculated / Default:	Measured
Source of data:	It will be used a spreadsheet got every month directly of the meters with the hourly generation information. In a monthly basis, the information will be confronted with the available generation spreadsheet at the website of CCEE.
Value(s) of monitored parameter:	229,911
Monitoring equipment:	• **SHPP Capão Preto** Main meter Sr. number 40086175-5 Back-up meter Sr. number 40086176-3 Precision class: 0.2% Last calibration: 24/May/2011 Calibration delayed in: n/a • **SHPP Chibarro** Main meter Sr. number 40.071.225-3 Back-up meter Sr. number 40.071.226-1 Precision class 0.2% Last calibration: 16/May/2011 Calibration delayed in: n/a • **SHPP Dourados** Main meter Sr. number 40092314-9 Back-up Sr. number 40092315-7 Precision class 0.2% Last calibration: 21/Nov/2011 Calibration delayed in: n/a • **SHPP Esmeril** Main meter Sr. number 40.071.230-0 Back-up meter Sr. number 40.071.228-8 Precision class 0.2% Last calibration: 08/Nov/2012 Calibration delayed in: 25 days • **SHPP Gavião Peixoto** Main meter Sr. number 40.060.768-9 Back-up meter Sr. number 40.060.769-7 Precision class 0.2% Last calibration: 06/Feb/2012 Calibration delayed in: 39 days • **SHPP São Joaquim** Main meter Sr. number 40.071.231-8 Back-up meter Sr. number 40.071.229-6 Precision class 0.2% Last calibration: 08/Nov/2012 Calibration delayed in: 33 days

Measuring/ Reading/ Recording frequency:	Continuous measurement, monthly recording
Calculation method (if applicable):	n/a
QA/QC procedures:	Uncertainty level of data is low. These data will be used to calculate the project's emission reductions. The electricity generated will be monitored by project participants and will be checked by available spreadsheets in the CCEE website (information comparison between operation data and CCEE reports).
Purpose of data:	Baseline emission calculation
Additional comment:	-

Data / Parameter:	**$EF_{grid,CM,y}$**
Unit:	tCO_2e/MWh
Description:	Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system"
Measured/ Calculated / Default:	Calculated
Source of data:	Brazilian DNA (MCT)
Value(s) of monitored parameter:	0.1957
Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	-
Calculation method (if applicable):	Ex-post emission factor will be calculated by MCT with ONS data. The operating margin and build margin emission factors will be also monitored and calculated by MCT and ONS, with the Dispatch Data of the National Grid Subsystem.
QA/QC procedures:	Uncertainty level of data is low
Purpose of data:	Baseline emission calculations
Additional comment:	-

Data / Parameter:	**$EF_{grid,OM,y}$**
Unit:	tCO_2/MWh
Description:	National grid emission factor
Measured/ Calculated / Default:	Calculated
Source of data:	Brazilian DNA (MCT)
Value(s) of monitored parameter:	0.1165
Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	-
Calculation method (if applicable):	Ex-post emission factor will be calculated by MCT with ONS data. The operating margin emission factor will be monitored and calculated by MCT and ONS, with the Dispatch Data of the National Grid Subsystem.
QA/QC procedures:	Uncertainty level of data is low
Purpose of data:	Baseline emission calculations
Additional comment:	-

Data / Parameter:	**$EF_{grid,BM,y}$**
Unit:	tCO_2/MWh
Description:	National grid emission factor
Measured/ Calculated / Default:	Calculated
Source of data:	Brazilian DNA (MCT)
Value(s) of monitored parameter:	0.1056
Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	-
Calculation method (if applicable):	Ex-post emission factor will be calculated by MCT with ONS data. The build margin emission factor will be monitored and calculated by MCT and ONS with the Dispatch Data of the National Grid Subsystem.
QA/QC procedures:	Uncertainty level of data is low
Purpose of data:	Baseline emission calculations
Additional comment:	-

Data / Parameter:	**Cap_{BL}**
Unit:	W
Description:	Installed capacity of the hydro power plant after the implementation of the project activity
Measured/ Calculated / Default:	Measured
Source of data:	Project site
Value(s) of monitored parameter:	<table><tr><th>SHPPs</th><th>Previous Capacity (MW)</th><th>Project Capacity (MW)</th></tr><tr><td>Esmeril</td><td>1.76</td><td>5.00</td></tr><tr><td>Dourados</td><td>6.40</td><td>10.80</td></tr><tr><td>São Joaquim</td><td>5.52</td><td>8.37</td></tr><tr><td>Gavião Peixoto</td><td>4.11</td><td>4.86</td></tr><tr><td>Chibarro</td><td>2.29</td><td>2.60</td></tr><tr><td>Capão Preto</td><td>5.52</td><td>4.30</td></tr></table>
Monitoring equipment:	As seen on board equipment
Measuring/ Reading/ Recording frequency:	-
Calculation method (if applicable):	-
QA/QC procedures:	n/a
Purpose of data:	Baseline emission calculations
Additional comment:	-

Data / Parameter:	**A_{PJ}**
Unit:	m²
Description:	Area of the reservoir measured in the surface of the water after the implementation of the project activity, when the reservoir is full
Measured/ Calculated / Default:	Measured
Source of data:	Project site
Value(s) of monitored parameter:	n/a
Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	-
Calculation method (if applicable):	-
QA/QC procedures:	-
Purpose of data:	Baseline emission calculations
Additional comment:	-

D.3. Implementation of sampling plan

n/a

SECTION E. Calculation of emission reductions or GHG removals by sinks

E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

$BE_y = EF_y * EG_y$

Where:

BE_y	Baseline emission in year (y), (tCO_2e);
EF_y	CO_2 emission factor of grid defined ex-ante (tCO_22/MWh);
EG_y	Electricity supplied to the grid by the project in year (y), (MWh)

I. EF_y

The emission factor was calculated according to the description on Section B.6.1 of the registered PDD, considering the Brazilian DNA last published emission factor values as follows:

Table 15 – Last published emission factors
Source: Brazilian DNA[4]

BUILD MARGIN – 2011
Average Emission Factor (tCO_2/MWh)
0.1056

Average Montlhy Emission Factor Operating Margin (tCO2/MWh) – 2012											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov*	Dec*
0.2935	0.3218	.04050	0.6236	0.5943	0.5056	0.3942	0.4490	0.6433	0.6573	0.3565	0.3495

Average emission factor operating margin: 0.4661
*2011 values, since the 2012 were not yet published when developing the project's Monitoring Report.

Thus, the project's emission factor is:

$EF_y = [(0.1056 * 0.75) + (0.4661 * 0.25)]$

$EF_y = (0.0792 + 0.1165)$

$EF_y = 0.1957$

[4] Available at: http://www.mct.gov.br/index.php/content/view/72764.html

I. EG_y

The electricity generation of the SHPPs in the monitored period was as follows:

Table 16 – Project activity electricity generation in 2011 (from August 24th onwards)

Generation (MWh) 2011													
SHPP/Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug*	Sep	Oct	Nov	Dec	TOTAL
Capão Preto	-	-	-	-	-	-	-	243.78	730.59	1,027.86	1,042.52	1,163.32	**4,208.07**
Chibarro	-	-	-	-	-	-	-	221.61	746.29	859.94	948.10	991.62	**3,767.56**
Dourados	-	-	-	-	-	-	-	1,072.04	2,244.46	2,875.13	3,153.58	5,491.23	**14,836.44**
Esmeril	-	-	-	-	-	-	-	318.33	760.11	1,091.94	1,143.16	2,078.79	**5,392.32**
Gavião Peixoto	-	-	-	-	-	-	-	593.10	1,831.86	2,268.46	2,452.92	2,786.41	**9,932.75**
São Joaquim	-	-	-	-	-	-	-	1,001.13	2,624.17	3,354.18	3,238.97	4,210.27	**14,428.71**
*From August 24th onwards													**52,565.84**

Table 17 – Project activity electricity generation in 2012

Generation (MWh) 2012													
SHPP/Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
Capão Preto	2,359.41	1,858.81	1,511.93	1,181.29	1,447.08	1,665.94	1,374.67	1,029.34	872.89	843.47	934.16	1,511.10	16,590.10
Chibarro	1,390.11	908.18	952.90	983.04	1,168.79	1,229.19	1,005.71	881.31	687.58	505.27	893.89	1,037.12	11,643.10
Dourados	6,824.65	5,979.78	6,631.70	5,422.55	6,089.86	5,488.19	4,798.19	2,650.38	1,254.37	904.54	1,578.79	4,776.50	52,399.50
Esmeril	3,184.57	2,929.43	3,217.98	2,533.46	1,430.48	2,043.74	1,484.87	1,024.63	784.11	626.00	887.53	1,479.57	21,626.37
Gavião Peixoto	3,031.64	2,783.07	2,664.51	2,641.23	2,939.93	2,842.57	2,869.55	2,245.96	1,880.81	1,964.03	2,099.34	2,675.81	30,638.45
São Joaquim	5,060.80	5,217.30	4,340.91	4,311.66	4,837.27	4,222.95	3,435.10	2,515.43	2,221.54	2,170.16	2,620.71	3,494.52	44,448.34
													177,345.84

I. BE_y

The project's baseline emissions are calculated based on the net electricity of the project activity. The net electricity is calculated as the difference between the verified electricity (presented in table 12 and 13) and the baseline electricity, defined in the registered PDD as follows:

Table 18 – Project's baseline electricity as per registered PDD

EG Baseline	MWh
Capão Preto	13,388.70
Chibarro	9,523.40
Dourados	44,912.50
Esmeril	7,261.50
Gavião Peixoto	22,185.70
São Joaquim	30,408.70

Thus, the project's baseline emissions are as follows:

Table 19 – Project's baseline emissions

SHPP	Baseline Emissions (tCO_2e)	Baseline Emissions (tCO_2e)
	2011*	**2012**
Capão Preto	(227)	1,465
Chibarro	549	2,812
Dourados	704	2,748
Esmeril	398	1,654
Gavião Peixoto	(110)	627
São Joaquim	74	415
TOTAL	**1,387**	**9,721**

*From August 24th onwards.

E.2. Calculation of project emissions or actual net GHG removals by sinks

As per methodology and PDD, project emissions are not to be accounted.

E.3. Calculation of leakage

As per methodology and PDD, leakage emissions are not to be accounted.

E.4. Summary of calculation of emission reductions or net anthropogenic GHG removals by sinks

As justified in section B.1, the SHPPs Dourados, Esmeril and São Joaquim have suffered an adjustment in the electricity they generated in the months affected by the delay in the energy meters calibration. According to the "Guidelines for assessing compliance with the calibration frequency requirements" (EB52, Annex 60), the maximum permissible error was applied as follows:

- **SHPP Esmeril**

The calibration of the energy meter of SHPP Esmeril was delayed in 25 days, from 14/Oct/2012 until 08/Nov/2012. Thus, as per the "Guidelines for assessing compliance with the calibration frequency requirements", a 0.3% adjustment was applied in the period. Therefore, the electricity generated in in the period was:

Table 20 – SHPP Esmeril effective electricity generation in the uncovered period

Uncovered Period	Days Uncovered (1)	Days/Month (2)	Electricity Generated MWh (3)	Adjustment (4)	Effective Generation MWh (3) - [(1) * (3) / (2)] * (4)
14/Oct – 31/Oct	17	31	625.99	0.3%	624.96
01/Nov – 08/Nov	7	30	887.53	0.3%	886.82

- **SHPP Gavião Peixoto**

The calibration of the energy meter of SHPP Gavião Peixoto was delayed in 39 days, from 28/Dec/2011 to 06/Feb/2012. Thus, as per the "Guidelines for assessing compliance with the calibration frequency requirements", a 0.3% adjustment was applied in the period. Therefore, the electricity generated in the period was:

Table 21 – SHPP Gavião Peixoto effective electricity generation in the uncovered period

Uncovered Period	Days Uncovered (1)	Days/Month (2)	Electricity Generated MWh (3)	Adjustment (4)	Effective Generation MWh (3) - [(1) * (3) / (2)] * (4)
28/Dec – 31/Dec	3	31	2,786.41	0.3%	2,785.60
01/Jan – 31/Jan	31	31	3,031.64	0.3%	3,022.54
01/Feb – 06/Feb	5	29	2,783.07	0.3%	2,781.63

- **SHPP São Joaquim**

The calibration of the energy meter of SHPP São Joaquim was delayed in 33 days, from 06/Oct/2012 until 08/Nov/2012. Thus, as per the "Guidelines for assessing compliance with the calibration frequency requirements", a 0.3% adjustment was applied in the period. Therefore, the electricity generated in the period was:

Table 22 – SHPP São Joaquim effective electricity generation in the uncovered period

Uncovered Period	Days Uncovered (1)	Days/Month (2)	Electricity Generated MWh (3)	Adjustment (4)	Effective Generation MWh (3) - [(1) * (3) / (2)] * (4)
06/Oct – 31/Oct	25	31	2,170.16	0.3%	2,164.91
01/Nov – 08/Nov	7	30	2,620.70	0.3%	2,618.61

The monthly average of emission reductions achieved by the project activity – considering the adjustment of the SHPPs Esmeril and São Joaquim, are as follows:

Table 23 – SHPPs Monthly Emission Reductions Calculation

SHPP	Certified Emission Reductions (tCO_2e)	
	2011*	2012
Capão Preto	(277)	1,465
Chibarro	549	2,811
Dourados	704	2,747
Esmeril	397	1,652
Gavião Peixoto	(110)	627
São Joaquim	74	415
TOTAL	**1,387**	**9,715**

*From 24/08/2011 until 31/12/2011 (130 days)

The table below summarizes the project activity net electricity generation, adjusted as justified above, and its respective emission reductions:

Table 24 – Emission Reductions Calculation

	SYMBOL	AMOUNT	UNIT	FORMULA
Total Net Electricity Generation	EG_y	56,734	MWh	--
Grid Emission Factor	EF_y	0.1957	tCO_2e/MWh	--
Total Baseline Emissions	BE_y	11,102	tCO2e	$BE_y = EF_y * EG_y$
Total Project Emissions	PE_y	0	tCO2e	--
Total Leakage Emissions	LE_y	0	tCO2e	--
Total Emissions Reductions	ER_y	11,102	tCO2e	$ER_y = BE_y - PE_y - LE_y$

Total days on the monitored period = 496 days

Table 25 – Summary of project's emission reductions

Item	Baseline emissions or baseline net GHG removals by sinks (t CO_2e)	Project emissions or actual net GHG removals by sinks (t CO_2e)	Leakage (t CO_2e)	Emission reductions or net anthropogenic GHG removals by sinks (t CO_2e)
Total	11,102	0	0	11,102

E.5. Comparison of actual emission reductions or net anthropogenic GHG removals by sinks with estimates in registered PDD

Item	Values estimated in ex-ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (t CO_2e)	25,252	11,102

E.6. Remarks on difference from estimated value in registered PDD

This monitoring period covers a 496 days period (from 24/Aug/2011 to 31/Dec/2012, both days included). According to the registered PDD, the annual emission reduction estimated ex-ante is 18,583 tCO_2e. Thus, the emission reductions achieved by the project activity in this monitoring period are 56.03% lower than the value estimated ex-ante in the registered PDD. The actual electricity production was 48,66% lower than the estimated in the PDD (81,327 MWh/year). This lower electricity generation thus reduced the actual emission reductions achieved.

E.7. Actual emission reductions or net anthropogenic GHG removals by sinks during the first commitment period and the period from 1 January 2013 onwards

Item	Actual values achieved up to 31 December 2012	Actual values achieved from 1 January 2013 onwards
Emission reductions or GHG removals by sinks (t CO_2e)	11,102	n/a

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