Monitoring report form
(Version 03.1)

Monitoring report

Title of the project activity	Pesqueiro Energia Small Hydroelectric Project (PESHP)
Reference number of the project activity	0242
Version number of the monitoring report	04
Completion date of the monitoring report	31/03/2014
Registration date of the project activity	16/08/2012 (second crediting period)
Monitoring period number and duration of this monitoring period	First Monitoring Period of the second crediting period (from January, 27th 2010 up to January 26th, 2017 of crediting period) 27/01/2010 – 30/09/2013
Project participant(s)	• Pesqueiro Energia S.A • Trading Emissions PLC • CM Capital Markets Holding S.A. • Ecopart Assessoria em Negocios Empresariais Ltda.
Host Party(ies)	Brazil
Sectoral scope(s) and applied methodology(ies)	Sectoral scope 1 : Energy industries (renewable - / non-renewable sources) AMS-I.D. ver. 17 - Grid connected renewable electricity generation
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	65,919tCO_2e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	68,415tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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The primary objective of the PESHP Project is to help meet Brazil's rising demand for energy due to economic growth and to improve the supply of electricity, while contributing to the environmental, social and economic sustainability by increasing renewable energy's share of the total Brazilian (and the Latin America and the Caribbean region's) electricity consumption.

The PESHP is located in the south of Brazil, where the largest coal reserves are located as well as the most of thermo power plants using this fuel. The project consists of a run-of-river small hydro power plant (12.44MW) with a very small reservoir (0.33km²) located in the Jaguariaíva River, in the city of Jaguariaíva, state of Paraná (Figure 1). The plant construction started in May 2001 and was concluded in December 2002. The small hydropower plant started its commercial operations in January 2003.

This monitoring report corresponds to the **first** verification of the second crediting period of "*Pesqueiro Energia Small Hydroelectric Project (PESHP)*" CDM Project Activity, covering the period from January, 27th 2010 until September, 30th 2013 during which 68,415tCO_2etCO_2 emissions reductions are achieved.

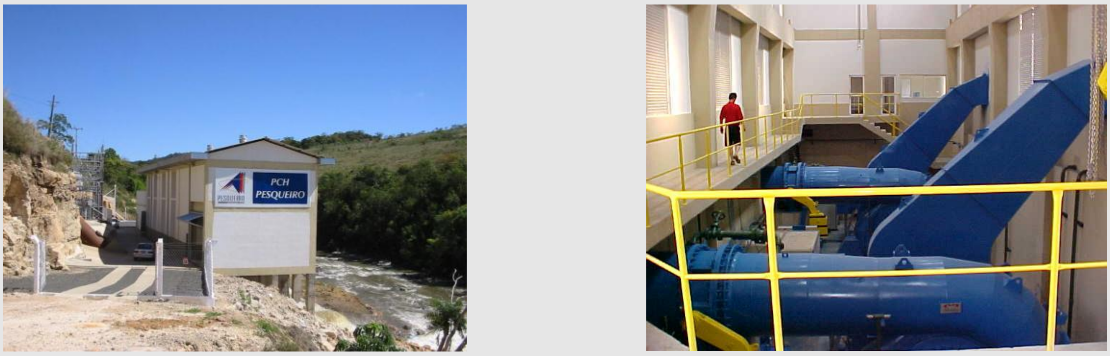

Figure 1 - View of PESHP (on the left the power housed, on the right the turbines)

A.2. Location of project activity

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The project is located in the south of Brazil, state of Paraná, city of Jaguariaíva (latitude 24º07'58'' South and longitude 49º38'09'' West, Figure 2), and uses using the hydro potential of the Jaguariaíva River. The Jaguariaíva River is part of the Paraná River basin (Figure 3).

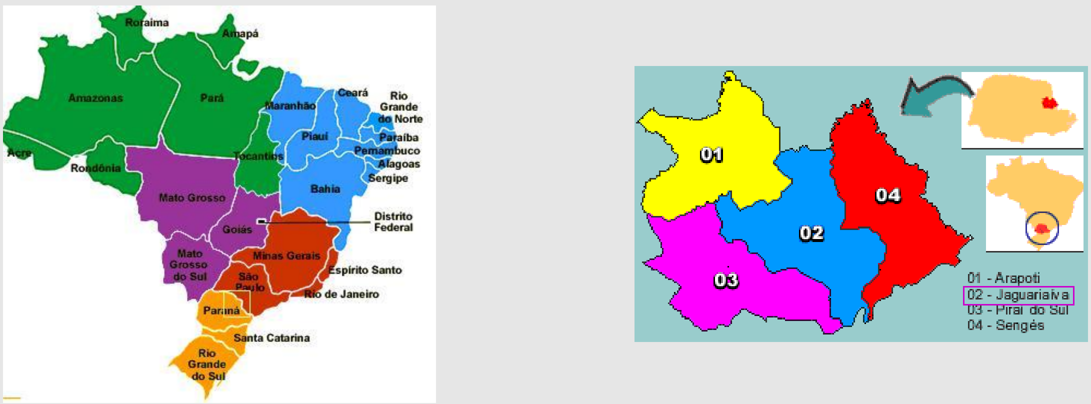

Figure 2 - Political division of Brazil showing the Paraná State and the city of Jaguariaíva (Sources: http://www.citybrazil.com.br/).

Figure 3 - Major Brazilian river basins (Source: http://www.portalbrasil.net/)

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 - Pesqueiro Energia S.A.	No
United Kingdom of Great Britain and Northern Ireland	Private entity - Ecopart Assessoria em Negócios Empresariais Ltda.	No
Switzerland	Private entity - CM Capital Markets Holding S.A	No
Switzerland	Private entity - Trading Emissions PLC	No

A.4. Reference of applied methodology

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AMS-I.D – *"Grid connected renewable electricity generation"* (version 17)

In addition to the methodology, the following methodology/tools are used:

– *"Consolidated baseline methodology for grid-connected electricity generation from renewable sources"* (version 12.2.0) – used with the purpose of estimating possible emissions from the reservoir.
– *"Tool to calculate the emission factor for an electricity system"* (version 2.2.1)

A.5. Crediting period of project activity

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The proposed project activity have adopted the renewable crediting period. This monitoring period corresponds to the first verification related to the second crediting period which starts on January 27th, 2010.

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

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The Pesqueiro project utilizes water from the Jaguariaíva River to generate electricity (installed power = 12.44MW). The facility contains a small dam (reservoir area = 0.33km2, power density = 37.70W/m2) which

stores water in order to generate electricity for short periods of time. Run-of-River schemes do not include significant water storage, and must therefore make complete use of the water flow. A typical run-of-river scheme involves a low-level diversion dam and is usually located on swift flowing streams (Figure 4).

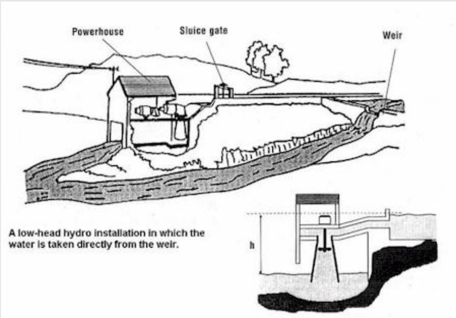

Figure 4 - Schematic view of a run-of-river power plan

According to Eletrobrás[1] (1999), run-of-river projects are defined as "the projects where the river's dry season flow rate is the same or higher than the minimum required for the turbines".

A low-level diversion dam raises the water level in the river sufficiently to enable an intake structure to be located on the side of the river. The intake consists of a trash screen and a submerged opening with an intake gate.

Water from the intake is normally taken through a pipe (called a penstock) downhill to a power station constructed downstream of the intake and at as low a level as possible to gain the maximum head on the turbine.

The technology employed at Pesqueiro project is established in the industry. The Francis turbine (Figure 5) is the most widely used among water turbines. This turbine is a type of hydraulic reactor turbine in which the flow exits the turbine blades in the radial direction. Francis turbines are common in power generation and are used in applications where high flow rates are available at medium hydraulic head. Water enters the turbine through a volute casing and is directed onto the blades by wicket gates. The low momentum water then exits the turbine through a draft tube. In the model, water flow is supplied by a variable speed centrifugal pump. A load is applied to the turbine by means of a magnetic brake, and torque is measured by observing the deflection of calibrated springs. The performance is calculated by comparing the output energy to the energy supplied.

Figure 5 - Francis Turbine (Source: Alstom, http://www.alstom.com.br/)

The equipment and technology used in the PESHP Project has been successfully applied to similar projects in Brazil and around the world. The below table presents a description of the equipment installed in the plant.

Table 1 - Specifications of the equipment used at PESHP

Turbines

[1] **Eletrobrás (1999).** *Diretrizes para estudos e projetos de pequenas centrais hidrelétricas.* Centrais Elétricas Brasileiras S.A.

Type	Simple Francis
Quantity	2
RPM	514,3
Power(MW)	6.22
Nominal Liquid Head(m)	86
Generators	
Type	SPA 1250
Quantity	2
Frequency (HZ)	60
Power (MVA)	6.8
Nominal Voltage (kW)	6.9

B.2. Post registration changes

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

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Not applicable. This section has been intentionally left blank.

B.2.2. Corrections

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Not applicable. This section has been intentionally left blank.

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

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Not applicable. This section has been intentionally left blank.

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

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Not applicable. This section has been intentionally left blank.

B.2.5. Changes to start date of crediting period

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Not applicable. This section has been intentionally left blank.

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

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Not applicable. This section has been intentionally left blank.

SECTION C. Description of monitoring system

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The monitoring plan of the emission reductions by the project activity is in accordance with the procedures

set by the methodology "*AMS-I.D - Grid connected renewable electricity generation*".

The project will proceed with the necessary measures for the power control and monitoring. Together with the information produced by CCEE, it will be possible to monitor the power generation of the project and the grid power mix. Information about power generation and energy supplied to the grid are controlled by the Chamber of Electric Energy Commercialization CCEE (from the Portuguese Câmara de Comercialização de Energia Elétrica). CCEE makes feasible and regulates the electricity energy commercialization. Hence, the energy monitored by the project owner can be cross checked using the Reports issued by CCEE.

From what is established in the relevant regulation of the energy sector in Brazil, all the plants dispatching electricity to the grid have to implement a Billing Commensuration System (from the Portuguese, Sistema de Medição e Faturamento - SMF) in accordance with the specifications set by the Chamber of Electrical Energy Commercialization (from the Portuguese Câmara de Comercialização de Energia Elétrica - CCEE).

There are two energy meters (principal and backup) model SAGA 1000, used for electricity measurement, which are in accordance with the specifications of the regulatory agencies of the country and are located at the COPEL Substation[2]. The table below presents technical specifications of the meters used at Pesqueiro Small Hydropower Plant.

Table 2 - Energy Meters at the Substation

Description		Manufacturer	Type / Model	Number
Substation	Principal	LANDIS + GYR	SAGA 1000 – 1681 D	226377
	Back-up	LANDIS + GYR	SAGA 1000 – 1681 D	226378

Meters are bidirectional. The measurement is redundant, so that, in case the first meter fails, the second automatically replaces it. These meter´s recalibration are scheduled to occur every two years, the recalibration procedures will be executed by a specialized metrology company that will be hired to this specific purpose (Figure 6).

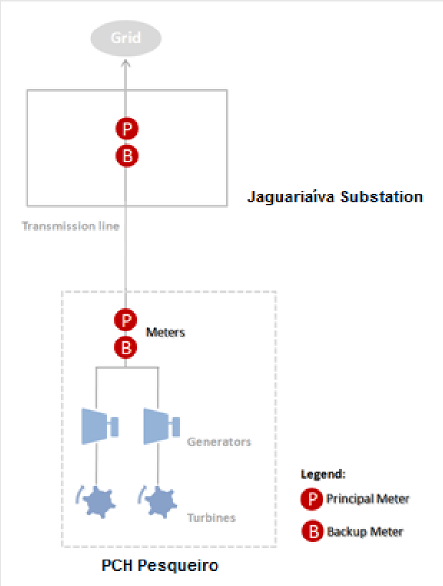

Figure 6 – Monitoring System diagram.

Energy measured by the meters is accumulated in five minutes interval. CCEE has remote access to energy information. The energy generated by the plants is informed by the project owner to CCEE in an hourly frequency. CCEE verifies the consistency of information and accounts for all the energy generated and dispatched to the system as well as consumed, CCEE issues an official report named CB02 that presents a consolidated data indicating, per week, the dispatched energy during the specific month.

It's important to mention that in October 2012 was implemented a new system at CCEE for accounting called

[2] Located at 17 km from the Power plant, at Jaguariaíva.

"*CliqCCEE*". During this period all data was migrated from Sinercom to CliqCCEE. Hence, since September 2012, new reports (MRE001) present the information regarding net energy generation in the new system, replacing CB002 report. Therefore, during the current monitored period both CB002 and MRE001 are used to certify the energy generation reported by the Project Participant (PP).

Pesqueiro Energia S.A. is also be responsible for the maintenance of the monitoring equipment located at the plant (the ones located in the substation, that are under the local concessionary responsibility[3]), for dealing with possible monitoring data adjustments and uncertainties, for review of reported results/data, for internal audits of GHG project compliance with operational requirements and for corrective actions. Yet, it is also responsible for the project management, as well as for organising and training of the staff in the appropriate monitoring, measurement and reporting techniques.

In summary, the responsibilities of project participants regarding monitoring and reporting activities during the current monitored period are described below.

- Pesqueiro Energia S.A.: To supervise, calibrate, operate, verify the metering and recording.
- Pesqueiro Energia S.A.: Collection of any additional data deemed necessary;
- Pesqueiro Energia S.A.: Train the personal involved;
- CDM Consultancy: Provide the calculation template, continuous advice the staff on a need basis and prepare monitoring report
- Pesqueiro Energia S.A. / CDM Consultancy: Archive the monitoring data, in accordance with internal procedures

SECTION D. Data and parameters

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

Data / Parameter:	$\mathbf{EF_{grid,BM,y}}$
Unit:	tCO_2/MWh
Description:	Build margin CO_2 emission factor in year 2008
Source of data:	Brazilian DNA
Value(s) applied):	0.1458
Purpose of data:	Calculation of baseline emissions
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:	ACM0002
Value(s) applied):	0
Purpose of data:	Calculation of Project Emissions
Additional comment:	In accordance with the ACM0002 methodology, for new hydropower plants, this value is zero.

Data / Parameter:	A_{BL}
Unit:	m^2
Description:	Area of the single or multiple reservoirs measured in the surface of the water, before the implementation of the project activity, when the reservoir is full

[3] COPEL, from Portuguese "Companhia Paranaense de Energia".

Source of data:	ACM0002
Value(s) applied):	0
Purpose of data:	Calculation of project emissions
Additional comment:	In accordance with the ACM0002 methodology, for new hydropower plants, this value is zero.

D.2. Data and parameters monitored

Data / Parameter:	$EG_{BL,y}$
Unit:	MWh
Description:	Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year *y*
Measured/ Calculated / Default:	Measured
Source of data:	Local measurements
Value(s) of monitored parameter:	*Year* / $EG_{BL,y}$: 2010 – 78,972; 2011 – 76,735; 2012 – 78,341; 2013 – 69,520
Monitoring equipment:	(see table below)
Measuring/ Reading/ Recording frequency:	The electricity delivered to the grid is monitored both by the project owner (seller) as well as by the energy buyer. A Brazilian government entity, CCEE – Câmara Comercializadora de Energia Elétrica - controls and monitors the electricity available on the national interconnected grid. The amount of electricity delivered to the grid by the project activity shall be cross-checked with the Reports issued by CCEE (records for sold electricity). This parameter is hourly measured and monthly recorded by the project owner. The CCEE reports presents this information consolidated on a weekly basis.
Calculation method (if applicable):	Not applicable. This information is measured by project participants.
QA/QC procedures:	Energy metering QA/QC procedures are explained in Section C (the equipment used have by legal requirements extremely low level of uncertainty).
Purpose of data:	Calculation of baseline emissions

Value(s) of monitored parameter:

Year	$EG_{BL,y}$
2010	78,972
2011	76,735
2012	78,341
2013	69,520

Monitoring equipment:

	Principal meter	*Back-up meter*
Type	SAGA 1000 – 1681 D	SAGA 1000 – 1681 D
Accuracy	0.2%	0.2%
Class	D	D
Serial number	226377	226378
Calibration frequency	2 years	2 years
Date of previous calibration	19/03/2010	19/03/2010
Validity of previous calibration	18/03/2012	18/03/2012
Date of last calibration	15/05/2012	15/05/2012
Validity of last calibration	14/05/2014	14/05/2014

Additional comment:	This parameter is equivalent to the parameter $EG_{PJ,y}$ used to calculate the operating margin CO_2 emission factor of the grid, as mentioned in the *"Tool to calculate the emission factor for an electricity system"*. Additionally, as it can be seen from monitoring equipment data presented above, the recalibration of the meters was delayed. Therefore, the the provisions of paragraph 238 a) of the "Clean development mechanism validation & verification standard" were considered when calculating the emission reductions by the CDM project activity. Therefore, the maximum permissible error of the equipment was considered during March, April and May 2012.

Data / Parameter:	$EG_{PJ,h}$
Unit:	MWh
Description:	Electricity displaced by the project activity in hour h of the year y
Measured/ Calculated / Default:	Measured
Source of data:	Local measurements
Value(s) of monitored parameter:	Large amount of data. Please refer to the CERs calculation spreadsheet (file name "Pesqueiro_CERs_2014.02.17_v.02").
Monitoring equipment:	(see table below)
Measuring/ Reading/ Recording frequency:	The electricity delivered to the grid is monitored by the project owner. Hourly aggregated information will be used to determine the operating margin CO_2 emission factor.
Calculation method (if applicable):	Not applicable. This information is measured by project participants.
QA/QC procedures:	Energy metering QA/QC procedures are explained above (the equipment used have by legal requirements extremely low level of uncertainty). Hourly information provided by project participants can be weekly aggregated and crosschecked with the Reports issued by CCEE.
Purpose of data:	Calculation of baseline emissions.
Additional comment:	For the purpose of estimative, it was considered a constant energy generation by the plant. Hourly generation of electricity by the plant will be monitored and used to calculate the operating margin CO2 emission factor.

	Principal meter	*Back-up meter*
Type	SAGA 1000 – 1681 D	SAGA 1000 – 1681 D
Accuracy	0.2%	0.2%
Class	D	D
Serial number	226377	226378
Calibration frequency	2 years	2 years
Date of previous calibration	19/03/2010	19/03/2010
Validity of previous calibration	18/03/2012	18/03/2012
Date of last calibration	15/05/2012	15/05/2012
Validity of last calibration	14/05/2014	14/05/2014

Data / Parameter:	$EF_{EL,DD,h}$
Unit:	tCO_2/MWh
Description:	CO_2 emission factor for power units in the top of the dispatch order in hour *h* in year *y*
Measured/ Calculated / Default:	Calculated
Source of data:	Brazilian DNA website (http://www.mct.gov.br/index.php/content/view/317399.html#ancora)
Value(s) of monitored parameter:	Large amount of data. Please refer to the CERs calculation spreadsheet (file name "Pesqueiro_CERs_2014.02.05_v.02").

Monitoring equipment:	Not applicable.
Measuring/ Reading/ Recording frequency:	-
Calculation method (if applicable):	The selected option to calculate the operating margin was the dispatch analysis which does not permit the vintage of ex-ante calculation of the emission factor. Hence, this value will be calculated annually applying the numbers published by the Brazilian DNA and following the steps provided in the *"Tool to calculate the emission factor for an electricity system"*.
QA/QC procedures:	-
Purpose of data:	Calculation of baseline emissions
Additional comment:	-

Data / Parameter:	Cap_{PJ}
Unit:	W
Description:	Installed capacity of the hydro power plant after the implementation of the project activity
Measured/ Calculated / Default:	Measured
Source of data:	ANEEL Resolution nr. 410 dated June 29th, 2001 available at http://www.aneel.gov.br/cedoc/dsp2001410.pdf
Value(s) of monitored parameter:	12,440,000
Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	-
Calculation method (if applicable):	-
QA/QC procedures:	-
Purpose of data:	Calculation of project emissions
Additional comment:	-

Data / Parameter:	A_{PJ}
Unit:	m^2
Description:	Area of the single or multiple reservoirs 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:	ANEEL's Geo-referenced Information Systems of the Electric Sector
Value(s) of monitored parameter:	330,000
Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	-
Calculation method (if applicable):	-
QA/QC procedures:	-
Purpose of data:	-

Additional comment:	-

D.3. Implementation of sampling plan

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Not applicable. This section has been intentionally left blank.

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

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

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Baseline emissions are calculated using the annual generation (project annual electricity dispatched to the grid) times the CO_2 average emission rate of the estimated baseline and correspond to the CO_2 emissions that are displaced as a consequence of the project activity, calculated as follows:

$$BE_y = EG_{BL,y} * EF_{CO2,grid,y}$$ **Equation 1**

Where,

BE_y = Baseline emissions in year y (tCO_2/yr)

$EG_{BL,y}$ = Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year y (MWh)

$EF_{CO2,grid,y}$ = CO_2 emission factor of the grid in year y (t CO_2/MWh).

Total electricity generated by the plant during the monitoring period is presented in the below table.

Table 3 – Monitored electricity generated by the plant.

Year	*Electricity generated (MWh)*
2010	78,972
2011	76,735
2012	78,341
2013	69,520

According to the selected approved methodology CO_2 emission factor of the grid ($EF_{CO2,grid,y}$) is calculated using the methodological tool “*Tool to calculate the emission factor for an electricity system*” (paragraph 12.a). According to this tool Project Participants shall apply six steps to calculate the grid emission factor as further detailed below.

- **STEP 1 -** Identify the relevant electricity systems

According to the tool, “If the DNA of the host country has published a delineation of the project electricity system and connected electricity systems, these delineations should be used. If such delineations are not available, project participants should define the project electricity system and any connected electricity system and justify and document their assumptions in the CDM-PDD”.

Brazilian DNA has published the Resolution nr. 8 issued on 26th May, 2008 that defines the Brazilian Interconnected Grid as a single system that covers all the five macro-geographical regions of the country (North, Northeast, South, Southeast and Midwest). Hence, this figure will be used to calculate the baseline emission factor of the grid.

- **STEP 2** - Choose whether to include off-grid power plants in the project electricity system (optional).

Option I of the tool is chosen, which is to include in the calculation only grid power plants.

- **STEP 3** - Select a method to determine the operating margin (OM)

The calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on one of the following methods:

(a) Simple OM, or

(b) Simple adjusted OM, or

(c) Dispatch data analysis OM, or

(d) Average OM.

The Brazilian DNA made available the operating margin emission factor calculated using option c – Dispatch data analysis OM. Detailed information on the methods and data applied can be obtained in the DNA's website (http://www.mct.gov.br/index.php/content/view/317399.html#ancora). In accordance with the tool, for the dispatch data analysis, the emission factor shall be up-dated annually, *i.e.* the ex-post data vintage is chosen.

- **STEP 4** - Calculate the operating margin emission factor according to the selected method

The dispatch data analysis OM emission factor ($EF_{grid,OM-DD,y}$) is determined based on the power units that are actually dispatched at the margin during each hour h where the project is displacing electricity. This approach is not applicable to historical data and, thus, requires annual monitoring of $EF_{grid,OM-DD,y}$. As consequence it will be calculated ex-post.

The $EF_{grid,OM-DD,y}$ will be calculated using the below formula:

$$EF_{grid,OM-DD,y} = \frac{\sum_{h} EG_{PJ,h} \cdot EF_{EL,DD,h}}{EG_{PJ,y}}$$ **Equation 2**

Where,

$EF_{grid,OM-DD,y}$ = Dispatch data analysis operating margin CO_2 emission factor in year y (tCO_2/MWh);

$EG_{PJ,h}$ = Electricity displaced by the project activity in hour h of the year y (MWh);

$EF_{EL,DD,h}$ = CO_2 emission factor for power units in the top of the dispatch order in hour h in year y (tCO_2/MWh);

$EG_{PJ,y}$ = Total electricity displaced by the project activity in year y (MWh);

h = Hours in year y in which the project activity is displacing grid electricity;

y = Year in which the project activity is displacing grid electricity.

Calculation of hourly CO_2 emission factor for grid power units ($EF_{EL,DD,h}$)

As mentioned above, the host country's DNA will provide $EF_{EL,DD,h}$ in order to Project Participants to calculate the operating margin emission factor. However, the project participants neither have access to the decisions that the Brazilian DNA took in order to calculate the hourly CO_2 emission factor nor to the spreadsheet used. Only final values are available for public consultation. Hence, the project participants are not able to describe which method has been used to calculate the hourly emission factor.

Nevertheless, this data will be updated annually applying the official number published by the Brazilian DNA.

Calculation to determine the set of grid power units n in top of the dispatch

The Brazilian DNA made available the calculation of the operating margin emission factor based on option (c) dispatch data analysis. Therefore, the project participants used this figure for the proposed project activity calculation of the grid emission factor.

However, the project participants neither have access to the decisions that the Brazilian DNA took in order to determine the set of power units n nor to the spreadsheet used. Only final values for the hourly emission factor ($EF_{EL,DD,h}$) are available for public consultation. Hence, the project participants are not able to describe which method has been used to determine the set of power units n.

- **STEP 5** – Calculate the build margin (BM) emission factor

The build margin emissions factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units m during the most recent year y for which electricity generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} \qquad \textbf{Equation 3}$$

Where,

$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year y (tCO_2/MWh)

$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)

$EF_{EL,m,y}$ = CO_2 emission factor of power unit m in year y (tCO_2/MWh)

m = Power units included in the build margin

y = Most recent historical year for which electricity generation data is available

During the first crediting period of the proposed project activity, the build margin emission factor was determined ex-ante. Therefore, the provision of Option 1 applies, which is "*for the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. (…) This option does not require monitoring the emission factor during the crediting period.*"

The build margin was also calculated by the DNA. The number was published in the website and the data from 2008 is used, since it was the most recent available information by the time the renewal of the crediting period was request to the DOE.

However, the project participants neither have access to the decisions that the Brazilian DNA took in order to determine the set of power units *m* and their CO_2 emission factor nor to the spreadsheet used. Only final values are available for public consultation. Hence, the project participants are not able to describe which method has been used to determine the set of power units *m*.

- **STEP 6** – Calculate the combined margin (CM) emissions factor

The calculation of the combined margin (CM) emission factor may be based on one of the following methods:

(a) Weighted average CM; or

(b) Simplified CM.

The weighted average CM method (option A) should be used as the preferred option.

The simplified CM method (option b) is not applicable since it can only be used if:

- The project activity is located in a Least Developed Country (LDC) or in a country with less than 10 registered CDM projects at the starting date of validation; and
- The data requirements for the application of step 5 above cannot be met.

(a) Weighted average CM

Under this option, the combined margin is calculated as follows:

$$EF_{grid,CM,y} = w_{OM} \cdot EF_{grid,OM,y} + w_{BM} \cdot EF_{grid,BM,y} \qquad \textbf{Equation 4}$$

The following default values should be used for w_{OM} and w_{BM}:

- Wind and solar power generation project activities: w_{OM} = 0.75 and w_{BM} = 0.25 (owing to their intermittent and non-dispatchable nature) for the first crediting period and for subsequent crediting periods;
- All other projects: w_{OM} = 0.5 and w_{BM} = 0.5 for the first crediting period, and w_{OM} = 0.25 and w_{BM} = 0.75 for the second and third crediting period, unless otherwise specified in the approved methodology which refers to this tool.

Therefore, in accordance with the tool, the weights w_{OM} and w_{BM}, for the second crediting period, by default, are w_{BM} = 0.75 and w_{OM} = 0.25.

Following the procedures described in steps 1 to 6 presented above, the emission factor for each one of the years comprised in the monitored period are presented in the below table.

Table 4 – Emission factor of the grid for the years considered in the monitored period.

Year	$EF_{grid.OM,y}$ (tCO_2e/MWh)	$EF_{grid.BM,y}$ (tCO_2e/MWh)	$EF_{grid.CM,y}$ (tCO_2e/MWh)
2010	0.4765	0.1458	0.2285
2011	0.3032	0.1458	0.1852
2012	0.4945	0.1458	0.2330
2013	0.5944	0.1458	0.2580

Applying the result presented above in Table 3 and Table 4 to Equation 1, we have:

For 2010

BE = 78,972 * 0.2285 = 18,037tCO_2e

For 2011

BE = 76,735 * 0.1852 = 14,202tCO_2e

For 2012

BE = 78,341 * 0.2330 = 18,247tCO_2e

For 2013

BE = 69,520 * 0.2580 = 17,929tCO_2e

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

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According to the SSC methodology, emissions from reservoirs, if there is any, shall be estimated considering the procedure described in the most recent version of ACM0002. According with to methodology, for hydro power project activities that result in new single (…) reservoirs (…), as it is the case of the proposed project activity, project proponents shall account for CH_4 and CO_2 emissions from the reservoirs, estimated as follows:

(a) if the power density of the single or multiple reservoirs (PD) is greater than 4W/m^2 and less than or equal to 10W/m^2:

$$PE_{HP,y} = \frac{EF_{Res} \cdot TEG_y}{1000} \qquad \textbf{Equation 5}$$

Where,

$PE_{HP,y}$	=	Project emissions from water reservoirs (tCO_2e/yr)
EF_{Res}	=	Default emission factor for emissions from reservoirs of hydro power plants in year *y* ($kgCO_2e$/MWh)
TEG_y	=	Total electricity produced by the project activity, including the electricity supplied to the grid and the electricity supplied to internal loads, in year *y* (MWh)

(b) If power density of the project is greater than 10W/m^2, $PE_y = 0$.

The power density of the project activity (PD) is calculated as follows:

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}} \quad \textbf{Equation 6}$$

Where:

PD	=	Power density of the project activity (W/m^2)
Cap_{PJ}	=	Installed capacity of the hydro power plant after the implementation of the project activity (W)
Cap_{BL}	=	Installed capacity of the hydro power plant before the implementation of the project activity (W). For new hydro power plants, this value is zero
A_{PJ}	=	Area of the single or multiple reservoirs measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m^2)
A_{BL}	=	Area of the single or multiple reservoirs measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m^2). For new reservoirs, this value is zero

The reservoir area as established in the environmental license of the plant is equal to 330,000 m^2. The installed capacity is 12,440,000 MW. Hence, the power density of the plant is 37.70 W/m^2. Therefore option b) is applicable and no project emissions are to be calculated, $PE_y = 0$.

E.3. Calculation of leakage

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Estimation of leakage emissions is not required because the energy generating equipment wasn't transferred from another activity nor the existing equipment was transferred to another activity.

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

Considering the formulae presented above in Sections E.1., E.2. and E.3., emission reductions are calculated as follows:

$$ER_y = BE_y – PE_y - LE_y$$

Where,

ER_y	=	Emission Reductions in year *y* (tCO_2/y)
BE_y	=	Baseline Emissions in year *y* (tCO_2/y)
PE_y	=	Project Emissions in year *y* (tCO_2/y)
LE_y	=	Leakage Emissions in year *y* (tCO_2/y)

The below table summarizes the results of emission reductions achieved by the proposed CDM Project Activity during the monitoring period.

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	68,415	0	0	68,415

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)	65,919	68,145

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

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As per information presented in the previous section, a total difference of 3.7% is noted when comparing the total emission reductions claimed during the monitored period (68,415tCO2e) against the total emission reductions estimated in the registered PDD (65,968tCO2e). Therefore, an assessment of the increase in the emission reductions monitored is to be carried out, considering what is established in paragraphs 201 and 202 of the “*Clean development mechanism project standard*” (EB 65, Annex 05)[4].

First, the difference observed between the emission reductions calculated in the registered PDD and verified during the monitored period, can be attributed to increase of the monitored emission factor. The estimated CO_2 emission factor of the grid considered for estimative proposes in the registered PDD was 0.2215tCO_2/MWh based on the values published by the Brazilian DNA for the year of 2008. This value is lower than the emission factor determined for years 2010, 2012 and 2013, as presented in the table below.

Table 5 - Estimated and monitored CO2 emission factor of the grid

Year	Estimated	Monitored	Difference
2010	0.2215	0.2285	3,15%
2011	0.2215	0,1852	-16,41%
2012	0.2215	0,2329	5,15%
2013	0.2215	0,2580	16,46%

Brazil possesses a large share of hydroelectricity and, for this reason, it presents a low CO_2 emission factor of the grid when comparing to other Latin American countries. However, during the years when an atypical short rainy season is observed, the generation of electricity by the thermal power plants fuelled with fossil fuels rises.

Secondly, it is important to mention that there was also a slight increase (2%) when comparing the in the electricity generated during the monitoring period (303,567MWh) against the electricity generation estimated in the registered PDD (297,824MWh). However, when annual electricity generation is considered, only for 2010 and 2013 the monitored electricity generation was above the estimated levels (Table 3).

Table 6 - Estimated and monitored electricity generation by the plant

Year	Estimated	Monitored

[4] Available at: <http://cdm.unfccc.int/filestorage/e/x/t/extfile-20131011143951951-reg_stand01.pdf/reg_stand01.pdf?t=UWR8bjBqYXF2fDCT1sD0_QRExJbu8hpYv4J6>.

2010	75,177	78,972
2011	80,942	76,735
2012	81,164	78,341
2013	60,540	69,520

In Brazil, the electricity generation is estimated considering the assured energy of the plant, which is determined by the regulatory agency based on historic values of river flow from the region the plant is located. As it can be seen in Figure 7, the river flows observed during 2010 and 2013 are above the average historic values and for some months, near the highest registered values. This justifies the electricity generation above the expected values during those years.

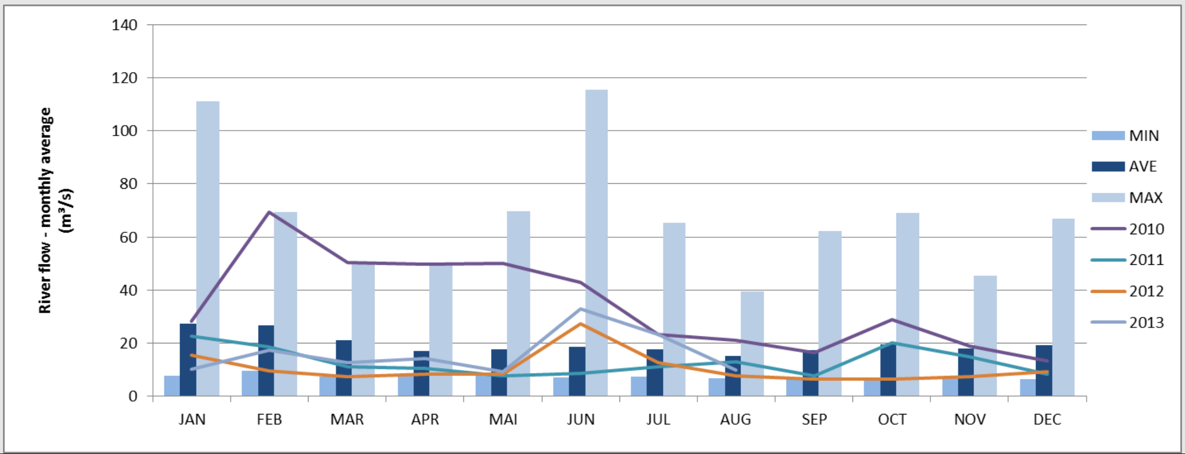

Figure 7 – Monitored river flow

Considering the explanations above, there was a significantly increase in the CO_2 emission factor of the grid and an unexpected increase in the river flow during the monitored period when compared to the estimated value. Therefore, this increase undeniable impacted the emission reductions generated by the project activity.

Finally, it is important to reinforce that PCH Pesqueiro participates on the Energy Reallocation Mechanism (from the Portuguese, *Mecanismo de Realocação de Energia* - MRE) which is a financial mechanism aimed at sharing the hydrologic risks affecting generation agents, seeking to ensure the optimization of hydropower resources of the National Interconnected System (SIN). The MRE accounting reallocates energy, transferring the surplus generated those beyond their physical guarantee for those that generated below. Moreover, the plants participating on this scheme do not get additional revenues from the electricity generated beyond their physical guarantee.

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)	50,486	17,929

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Document information

Version	*Date*	*Description*
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net anthropogenic GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	28 May 2010	EB 54, Annex 34. Initial adoption.

Decision Class: Regulatory
Document Type: Form
Business Function: issuance
Keywords: monitoring report, performance monitoring