Monitoring report form for CDM project activity
(Version 06.0)

Complete this form in accordance with the instructions attached at the end of this form.

MONITORING REPORT		
Title of the project activity	SHPs Tambaú, das Pedras and Rio do Sapo CDM Project (JUN1132), Brazil	
UNFCCC reference number of the project activity	9925	
Version number of the PDD applicable to this monitoring report	3.2	
Version number of this monitoring report	1.1	
Completion date of this monitoring report	27/03/2018	
Monitoring period number	first monitoring period	
Duration of this monitoring period	10/07/2014 until 31/12/2017	
Monitoring report number for this monitoring report	1	
Project participants	Tambaú Energética S.A. ; Euclides Maciel Energética S/A ; Rio do Sapo Energia S.A ; Carbotrader Assessoria e Consultoria em Energia Eireli	
Host Party	Brazil	
Sectoral scopes	1	
Applied methodologies and standardized baselines	ACM0002 version 14 - Grid-connected electricity generation from renewable sources	
Amount of GHG emission reductions or net anthropogenic GHG removals achieved by the project activity in this monitoring period	Amount achieved before 1 January 2013	Amount achieved from 1 January 2013
	0	88,737
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the PDD	96,131	

SECTION A. Description of project activity

A.1. General description of project activity

The project activity consist in the construction of three Small Hydro Power Plants (SHPs) installed in Brazil called Tambaú, das Pedras and Rio do Sapo, which together have a total installed capacity of 20.25 MW.

The **SHP Tambaú** has installed capacity of 8.82 MW and is located on the Guarita river, between the Erval Seco and Redentora cities, Rio Grande do Sul state.

The **SHP das Pedras** has installed capacity of 5.67 MW and is located on the Chapecó river, Água Doce city, Santa Catarina state.

The **SHP Rio do Sapo** has installed capacity of 5.76[1] MW and is located on the "do Sapo" river, in Tangará da Serra city, Mato Grosso state.

The project activity main purpose is to provide renewable electricity power to the National Interconnected System - *SIN* (from portuguese – *Sistema Interligado Nacional*), displacing the fossil fuelled thermal generation presented in the system for renewable energy generation . The baseline scenario is the same as the scenario existing prior to the project activity implementation, and shall be detailed in section B3 and B4. Also the scenario existing prior to the project activity implementation is only the place without any other power plant constructed (this is a greenfield project for the 3 SHPs).

Moreover, it improves the country electricity supply , contributing to its environmental sustainability due to increasing the renewable energy share in relation to total electricity consumption. Thus, the project activity supports the construction of new renewable energy project as environmentally sustainable alternative to electric energy generation (emission reductions are 25,523.25 tCO_2/year or 88,737 tCO_2 for this first monitoring report).

Considering that project activity forecasts three small reservoirs construction (0.2060[2] km^2, 0.46[3] km^2, and 1.005[4] km^2 respectively to Tambaú, das Pedras and Rio do Sapo), it represents a virtually zero environmental impact when compared to large hydroelectric facilities. This fact is important because the Small Hydro Power plants construction can really contributes to natural resources efficient use , avoiding growth of environmental and social liabilities caused by new large hydroelectric plants implementation and those which have fossil fuels associated.

Concerning project contribution for Greenhouse Gas emissions (GHG) mitigation, the project activity reduces emissions of these gases avoiding thermoelectric plants operation that use fossil fuels as energy source. In absence of the project activity, fossil fuels would be burned in thermoelectric plants connected to the grid to supply the country electrical demand. The project activity initiative helps Brazil to meet its goals of promoting sustainable development.

The project activity is also aligned with the specific requirements of the host country, because:

- It contributes to environmental sustainability as reduce the fossil energy use (non-renewable sources). Thus the project contributes to natural resources best use and makes use of clean and efficient technologies;

[1] Besides generator plaques totalizes 7.27 MW, the PA power capacity limatation are the turbines.

[2] ANEEL Dispatch Nº 617, 27.02.2012 (http://www.aneel.gov.br/cedoc/dsp2012617.pdf)

[3] Installation License 476/08/CRO

[4] ANEEL Dispatch Nº 1.298, 11.05.2010 (http://www.aneel.gov.br/cedoc/atdsp20101298.pdf)

- It enlarges the employment opportunity in areas where the projects are located;
- It contributes to local economy better conditions, because the renewable energy use reduces our fossil fuels dependence, reduce the amount of pollution and the associated social costs related to it.

Moreover, the project diversifies the generation sources and also decentralize the energy generation, bringing specific benefits such as:

- Increased reliability, with shorter and less extensive interruptions;
- Less demands related to reserve margin;
- Better quality energy for the region;
- Less losses in transmission and distribution lines;
- Reactive energy control;
- Mitigation of transmission and distribution congestion.

A.2. Location of project activity

Region/State/Province etc.:

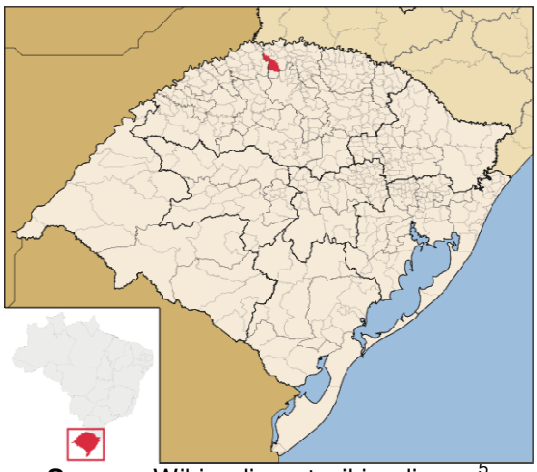
SHP Tambaú	- South Region	– Rio Grande do Sul State
SHP das Pedras	- South Region	– Santa Catarina State
SHP Rio do Sapo	- Midwest Region	– Mato Grosso State

City/Town/Community etc.:

SHP Tambaú	- Erval Seco and Redentora cities
SHP das Pedras	- Água Doce city
SHP Rio do Sapo	- Tangará da Serra city

The **SHP Tambaú** is located on the Guarita river, Uruguai basin, Brazil south region . The project activity geographical coordinates (dam) are: 27º 26' 24" S and 53º 33'41" W (in UTM Latitude -53.5620327248 ; Longitude -27.4404164163).

The figures 1 and 2 illustrate Erval Seco and Redentora cities localization.



Source: Wikipedia - pt.wikipedia.org[5]

Figure 1: Erval Seco city localization in Rio Grande do Sul state

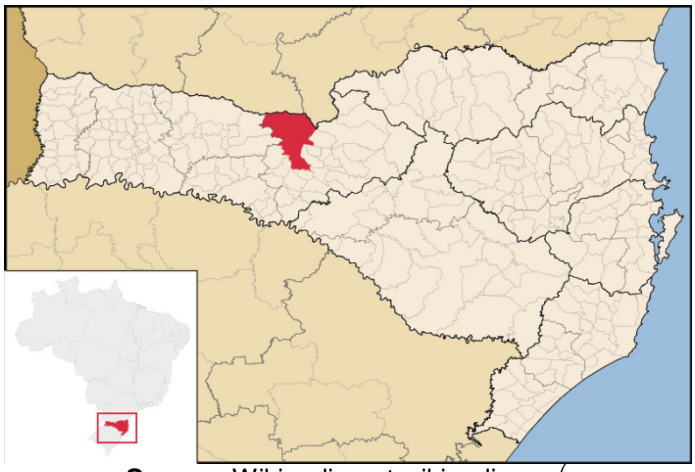
[5] See the weblink: http://pt.wikipedia.org/wiki/Erval_seco

Source: Wikipedia - pt.wikipedia.org[6]

Figure 2: Redentora city localization in Rio Grande do Sul state

The **SHP das Pedras** is located on the Chapecó river, Uruguai basin, Brazil south region . The project activity geographical coordinates (dam) are: 26º 40' 43" S and 51º 46' 50" W (in UTM Latitude -26.6786111111; Longitude -51.7805555556).

The figure 3 illustrates the localization of Água Doce city.



Source: Wikipedia - pt.wikipedia.org[7]

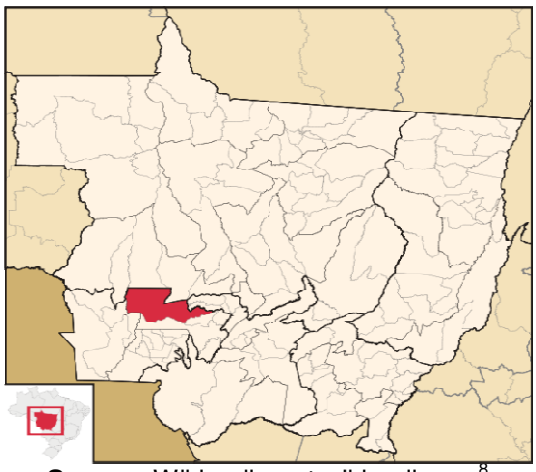
Figure 3: Água Doce city localization in Santa Catarina state

The **SHP Rio do Sapo** is located on the Rio do Sapo river, Paraná basin, Midwest region of Brazil. The project activity geographical coordinates (dam) are: 14º 37' 03" S and 57º 44' 44" W (in UTM Latitude -14.6175; Longitude -57.7455555556).

The figure 4 illustrates the localization of Tangará da Serra city.

[6] See the weblink: http://pt.wikipedia.org/wiki/Redentora

[7] See the weblink: http://pt.wikipedia.org/wiki/%C3%81gua_Doce



Source: Wikipedia - pt.wikipedia.org[8]

Figure 4: Tangará da Serra city localization in Mato Grosso state

A.3. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Brazil (Host Country)	Tambaú Energética S.A (private entity)	No
	Rio do Sapo Energia S.A (private entity)	
	Euclides Maciel Energética S.A (private entity)	
	Carbotrader Assessoria e Consultoria em Energia Eireli. (private entity)	

A.4. Reference to applied methodologies and standardized baselines

The Project uses the methodology ACM0002: "*Consolidated baseline methodology for grid-connected electricity generation from renewable sources*" - version 14.0.

The ACM0002 also refers to the following tools:

- Tool to calculate the emission factor for an electricity system (version 04.0.0);

Available in the link:

http://cdm.unfccc.int/UserManagement/FileStorage/A04BWNRKLUEP6O1QX75YVTH28JDICZ

A.5. Crediting period type and duration

Renewable, 10/07/2014 until 09/07/2021.

[8] See the weblink: http://pt.wikipedia.org/wiki/Tangar%C3%A1_da_Serra

SECTION B. Implementation of project activity

B.1. Description of implemented project activity

The **SHP Tambaú** has installed capacity of 8.82 MW and is located on the Guarita river, between the Erval Seco and Redentora cities, Rio Grande do Sul state.

The **SHP das Pedras** has installed capacity of 5.67 MW and is located on the Chapecó river, Água Doce city, Santa Catarina state.

The **SHP Rio do Sapo** has installed capacity of 5.76[9] MW and is located on the "do Sapo" river, in Tangará da Serra city, Mato Grosso state.

Based on the equipments' plaques.

B.2. Post-registration changes

B.2.1. Temporary deviations from the registered monitoring plan, applied methodologies or standardized baselines

Not Applicable

B.2.2. Corrections

Not Applicable

B.2.3. Changes to the start date of the crediting period

Not Applicable

B.2.4. Inclusion of monitoring plan

Not Applicable

B.2.5. Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other applied standards or tools

Not Applicable

B.2.6. Changes to project design

Not Applicable

[9] See footnote number 1

SECTION C. Description of monitoring system

The monitoring plan for the project activity was based on the CDM methodology ACM0002 - "*Consolidated baseline methodology for grid-connected electricity generation from renewable sources*" version 14.0, and consists in project activity monitoring electricity generation, the surface area of the reservoirs at their full levels, their CO_2 emissions (project emissions), the installed capacities of the plants and CO_2 emission factors for the Brazilian grid.

1) Power generation and measurement system - $EG_{facility,y}$ (= $EG_{PJ,y}$):

The procedures designed for monitoring electricity generation of the project activity follows the parameters and regulations of the Brazilian energy sector. The National Grid Operator (ONS) and the Electric Power Commercialization Chamber - *CCEE* are the entities responsible for technical requirements specification for energy measurement system for billing.

The agent responsible for the Measurement System for Billing - *SMF* (from the Portuguese *Sistema de Medição para Faturamento*) develops the project in accordance with these technical specifications, which should include the location of measurement points, measurement panels, meters and systems for local and remote measurement.

As stated by the sub-module 12.1 of Grid Procedures[10], the SMF is a system composed of main and back-up meters, through the transformers instruments, communication channels between the agents and CCEE and data collecting systems for billing measures.

The data stored in the meters are collected by the Energy Data Collecting System – *SCDE* (from Portuguese *Sistema de Coleta de Dados de Energia*) of the CCEE, remotely and automatically, through direct access to agent's meters or intermediated by the Meter Collecting Unit – UCM of the agent."

The measurement system records the energy generated. In this project activity, there are six meters to register the generation data (three main meters and three back up). They are installed in panels (one main meter and one back up in each powerhouse or concessionaire's substation). The meters installed allows PPs to check the energy generated and fed to the grid by each plant. To this system is guaranteed the data inviolability. After each calibration, it is sealed for safety.

Besides electricity measurements performed by PPs, all energy generated by the project activity is monitored online by the CCEE. The measurement system contains a communication system that sends the dispatched electricity data to CCEE.
CCEE is responsible for monthly readings and storage the records referent to the energy dispatched. If any problem occurs at the local meter level, the reading lecture corresponding to the amount of energy generated during the time of the problem will not be lost because due to the online reading performed by CCEE.

Data monitoring:

The meters reading are used to calculate emission reductions and project emissions. The monitoring steps are as follow:

(1) The data is measured hourly and recorded monthly;

[10] http://ons.org.br/%2FProcedimentosDeRede%2FM%C3%B3dulo%2012%2FSubm%C3%B3dulo%2012.1%2FSubm%C3%B3dulo%2012.1%202016.12.pdf

(2) Spreadsheets containing the electricity dispatched to the grid and consumed by the plant are generated; CCEE data measured (from CCEE databank – SINERCOM - third part) is used to cross check the monitored data;
(3) The project owner provides the generation and consumes measurement data and the SINERCOM (restricted access website) generation spreadsheets to the DOE, so it can check the authenticity of declared information.
(4) The emission reductions, and any project emissions, are handled by the project manager responsible at Carbotrader;

Quality control:

(1) Calibration of meters:

The calibration of meters was conducted at least every two years by a qualified organization that must comply with national standards and industrial regulations to ensure the system accuracy (before January 2017). After calibration, the meters were sealed for safety and the calibration certificates were archived with other monitoring records. The class of accuracy of the equipment used in the project activity is under the national standards (class 0.2) stated in "*Grid Procedures*" from the National Grid Operator: Module 12, submodule12.2[11].

(2) Emergency treatment

In case of unavailability of measures from any point of measurement, due to maintenance, commissioning or for any other reason, was used the methodology to estimate data as the item 7.1 of the Procedure of Energy Commercialization – Module 2[12].

Data Management:

All data gathered in the monitoring range will be electronically filled and kept for at least 2 years after the last crediting period. The emission reductions generated was calculated regularly by the project proponents and kept for the verification phase.

Training Procedures:

All training necessary for the plants operational team was provided by the equipments suppliers, during the installation and pre operational phases, and by the PPs during the project lifecycle.
The emergency procedures related to the project activity operation (for instance: workers' safety and health, dam safety related emergency drills/exercises, etc, according to the Brazilian legislation), are included in the training courses that the third party company is supposed to offer.

Furthermore, an operation, maintenance and calibration procedure follows the national guidelines set by the National Grid Operator.

2) **Total electricity produced by the project activity** – ***TEG:***

Total electricity produced by the project activity, considering the electricity supplied to the grid and the electricity supplied to internal loads (autoconsume), in year y. Applicable to hydro power project activities with a Power Density of the project activity (PD) greater than 4 W/m^2 and less than or equal to 10 W/m^2. As SHP Rio do Sapo has PD of 5.7 W/m^2, this parameter was monitored to be used at project emission reductions calculation.

3) Emission Factors - $EF_{grid,CM,y}$, $EF_{grid,OM\text{-}DD,y}$ and $EF_{grid,BM,y}$**:**

[11] http://ons.org.br/pt/paginas/sobre-o-ons/procedimentos-de-rede/vigentes

[12] http://www.ccee.org.br/portal/wcm/idc/groups/regrasprocedlegis/documents/conteudoccee/ccee_058269.pdf

The CO_2 emission factors related to estimation ex-ante of GHG reductions of this project activity ($EF_{grid,OM-DD,y}$ and $EF_{grid,BM,y}$) as mentioned previously, are the values correspondent to the year 2014 until 2017 (made available by the Brazilian DNA). It can be viewed at DNA website (http://www.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/textogeral/emissao_despacho.html).

4) Installed capacity – Cap_{PJ}:

The installed capacity of the hydro power plant after the implementation of the project activity were monitored yearly through one of the following options:

- Technical specifications on the installed equipments;
- Installed plaques in the equipments;
- Factsheets.

In Brazil, the installed capacity of hydropower plants is determined and authorized by the competent regulatory agency. Furthermore, any modification must also be authorized and made available to the public. Thus, any new authorization to increase the installed capacity of the plants will be monitored. It will be used to installed capacity, which is also a recognized standard, to assure the project technical characteristics.

It is also important to highlight that according the ANEEL resolution number 407, issued on 19th October 2000[13], if the present/real installed capacity is greater than +/- 5 % of the authorized (granted) capacity, a revision of the authorized installed capacity should be requested. It must be considered after the total capacity of the plant be installed.

5) Area of the reservoir – A_{PJ}:

After the implementation of the project activity, the area of the reservoir was measured yearly in the surface of the water, when the reservoir is full. For this purpose, will be used measures from topographical surveys or satellite pictures.

Authority and Responsibility:

The Tambaú Energética S.A, Euclides Maciel Energética S.A and Rio do Sapo Energética S.A are responsible for monitoring equipments maintenance and calibration, compliance to operational requirements and corrective actions related to the functionality of SHP Tambaú, SHP das Pedras and SHP Rio do Sapo respectively. Moreover, the companies have authority and responsibility for registration, monitoring and measurements as well as managing all the issues related to the project activity and to organize staff training to use appropriated techniques in those procedures.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante

All data and parameters used in the baseline emission calculation were monitored.

D.2. Data and parameters monitored

[13] http://www.aneel.gov.br/cedoc/res2000407.pdf

Data/Parameter	$EG_{Tambaú,y}$
Unit	MWh/yr
Description	Quantity of net electricity generation supplied by the SHP Tambaú to the grid in year y.
Measured/calculated/ default	Measured
Source of data	Project site - Energy Meters located in a panel inside the Frederico Westphalen substation (one main and one backup)
Value(s) of monitored parameter	Per year 2014 (July): 28,995.75 2015: 61,880.34 2016: 53,193.67 2017: 53,952.72
Monitoring equipment	Two meters type Elo model 2180 (one main and one back-up) installed in a metering panel, which is in Nortelândia substation. The main meter has the serial number 9002235. The back-up meter has the serial number 9002236. Both have accuracy class 0.2 and the calibration frequency must be done according Brazilian regulations.
Measuring/reading/recording frequency	Hourly measuring and reading, Monthly Recording.
Calculation method (if applicable)	Not Applicable
QA/QC procedures	The measurement of the energy generated and delivered to the grid will be done by two three-phases four wire electronic redundant meters which send data to the grid through a gateway. If the main meter fails the back-up meter starts reading and the information is not lost. The calibration of the meters is done complying with the National System Operator (Operador Nacional do Sistema – ONS) regulations.
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	

Data/Parameter	$EG_{das\ Pedras,y}$
Unit	MWh/yr
Description	Quantity of net electricity generation supplied by the SHP das Pedras to the grid in year y.
Measured/calculated/ default	Measured
Source of data	Project site - Energy Meters (one main and one backup that shall be located in a panel inside the powerhouse or inside the Palmas substation)
Value(s) of monitored parameter	Per year 2014 (July): 0 2015: 0 2016: 0 2017: 0
Monitoring equipment	Two meters type Landis + Gyr E750 (one main and one back-up) installed in a metering panel, which is in Nortelândia substation. The main meter has the serial number 1514997. The back-up meter has the serial number 1514995. Both have accuracy class 0.2 and the calibration frequency must be done according Brazilian regulations.
Measuring/reading/recording frequency	Hourly measuring and reading, Monthly Recording.
Calculation method (if applicable)	Not Applicable

QA/QC procedures	The measurement of the energy generated and delivered to the grid will be done by two three-phases four wire electronic redundant meters which send data to the grid through a gateway. If the main meter fails the back-up meter starts reading and the information is not lost. The calibration of the meters is done complying with the National System Operator (Operador Nacional do Sistema – ONS) regulations.
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	

Data/Parameter	$EG_{Rio\ do\ Sapo,y}$
Unit	MWh/yr
Description	Quantity of net electricity generation supplied by the SHP Rio do Sapo to the grid in year y.
Measured/calculated/ default	Measured
Source of data	Project site - Energy Meters (one main and one backup that shall be located in a panel inside the powerhouse or inside the Itanorte substation)
Value(s) of monitored parameter	Per year 2014 (July): 0 2015: 0 2016: 11,962.64 2017: 18,885.62
Monitoring equipment	Two meters type ION8650 (one main and one back-up) installed in a metering panel, which is in Nortelândia substation. The main meter has the serial number MW-1502A397-02. The back-up meter has the serial number MW-1501A860-01. Both have accuracy class 0.2 and the calibration frequency must be done according Brazilian regulations.
Measuring/reading/recording frequency	Hourly measuring and reading, Monthly Recording.
Calculation method (if applicable)	Not Applicable
QA/QC procedures	The measurement of the energy generated and delivered to the grid will be done by two three-phases four wire electronic redundant meters which send data to the grid through a gateway. If the main meter fails the back-up meter starts reading and the information is not lost. The calibration of the meters is done complying with the National System Operator (Operador Nacional do Sistema – ONS) regulations.
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	

Data/Parameter	$TEG_{Rio\ do\ Sapo,y}$
Unit	MWh/yr
Description	Quantity of electricity generation supplied by the SHP Rio do Sapo in year y.
Measured/calculated/ default	Measured
Source of data	Project site - Energy Meters (one main and one backup that shall be located in a panel inside the powerhouse)
Value(s) of monitored parameter	Per year 2014 (July): 0 2015: 0 2016: 11,994.90 2017: 18,907.25

Monitoring equipment	Two meters type ION8650 (one main and one back-up) installed in a metering panel, which is in Nortelândia substation. The main meter has the serial number MW-1502A397-02. The back-up meter has the serial number MW-1501A860-01. Both have accuracy class 0.2 and the calibration frequency must be done according Brazilian regulations.
Measuring/reading/recording frequency	Hourly measuring and reading, Monthly Recording.
Calculation method (if applicable)	Not Applicable
QA/QC procedures	The measurement of the energy generated and delivered to the grid will be done by two three-phases four wire electronic redundant meters which send data to the grid through a gateway. If the main meter fails the back-up meter starts reading and the information is not lost. The calibration of the meters is done complying with the National System Operator (Operador Nacional do Sistema – ONS) regulations.
Purpose of data/parameter	Calculation of project emissions.
Additional comments	

Data/Parameter	$EF_{grid,CM,y}$
Unit	tCO_2e/MWh
Description	Combined margin CO_2 emission factor for the project electricity system in year y
Measured/calculated/ default	Calculated.
Source of data	Based on data provided by the DNA (Designated National Authority).
Value(s) of monitored parameter	SHP Tambaú: 2014: 0.4414 2015: 0.4076 2016: 0.3907 2017: 0.3755 SHP Rio do Sapo: 2016: 0.3899 2017: 0.3715
Monitoring equipment	Not applicable.
Measuring/reading/recording frequency	Annually.
Calculation method (if applicable)	The Combined Margin is calculated through a weighted-average formula, considering the $EF_{grid,OM-DD,y}$ and the $EF_{grid,BM,y}$ and the weights w_{OM} and w_{BM} default 0.5 as defined in the "Tool to calculate the emission factor for an electricity system".
QA/QC procedures	Data will be archived electronically up to two years after the completion of the crediting period.
Purpose of data/parameter	Calculation of baseline emissions.
Additional comments	

Data/Parameter	$EF_{grid,OM-DD,y}$
Unit	tCO_2/MWh
Description	CO_2 Operating Margin emission factor of the grid, in a year *y*
Measured/calculated/ default	Calculated.
Source of data	Data provided by the DNA (Designated National Authority) monthly.

Value(s) of monitored parameter	SHP Tambaú: 2014: 0.5866 2015: 0.5598 2016: 0.6233 2017: 0.5929 SHP Rio do Sapo: 2016: 0.6217 2017: 0.5849
Monitoring equipment	Not applicable.
Measuring/reading/recording frequency	Monthly.
Calculation method (if applicable)	As defined in the "Tool to calculate the emission factor for an electricity system".
QA/QC procedures	Data will be archived electronically up to two years after the completion of the crediting period.
Purpose of data/parameter	Calculation of baseline emissions.
Additional comments	This data is available on the web-site: http://www.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/textogeral/emissao_despacho.html

Data/Parameter	$EF_{grid,BM,y}$
Unit	tCO_2/MWh
Description	CO_2 Build Margin emission factor of the grid, in a year *y*
Measured/calculated/ default	Calculated.
Source of data	Data provided by DNA (Designated National Authority) to the year *y*.
Value(s) of monitored parameter	2014: 0.2963 2015: 0.2553 2016: 0.1581 2017: 0.1581
Monitoring equipment	Not applicable.
Measuring/reading/recording frequency	Monthly.
Calculation method (if applicable)	As defined in the "Tool to calculate the emission factor for an electricity system".
QA/QC procedures	Data will be archived electronically up to two years after the completion of the crediting period.
Purpose of data/parameter	Calculation of baseline emissions.
Additional comments	This data is available on the web-site: http://www.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/textogeral/emissao_despacho.html

Data/Parameter	$Cap_{PJ\ -\ SHP\ Tambaú}$
Unit	W
Description	Installed capacity of the hydro power plant after the implementation of the project activity
Measured/calculated/ default	Measured
Source of data	Equipments plaques
Value(s) of monitored parameter	8,820,000
Monitoring equipment	Technical specifications on the installed equipments (plaques)
Measuring/reading/recording frequency	Annual
Calculation method (if applicable)	Not applicable

QA/QC procedures	
Purpose of data/parameter	Calculation of project emissions
Additional comments	

Data/Parameter	$Cap_{PJ - SHP\ das\ Pedras}$
Unit	W
Description	Installed capacity of the hydro power plant after the implementation of the project activity
Measured/calculated/ default	Measured
Source of data	Equipments plaques
Value(s) of monitored parameter	5,670,000
Monitoring equipment	Technical specifications on the installed equipments (plaques)
Measuring/reading/recording frequency	Annual
Calculation method (if applicable)	Not applicable
QA/QC procedures	
Purpose of data/parameter	Calculation of project emissions
Additional comments	

Data/Parameter	$Cap_{PJ - SHP\ Rio\ do\ Sapo}$
Unit	W
Description	Installed capacity of the hydro power plant after the implementation of the project activity
Measured/calculated/ default	Measured
Source of data	Equipments plaques
Value(s) of monitored parameter	7,272,000
Monitoring equipment	Technical specifications on the installed equipments (plaques)
Measuring/reading/recording frequency	Annual
Calculation method (if applicable)	Not applicable
QA/QC procedures	
Purpose of data/parameter	Calculation of project emissions
Additional comments	

Data/Parameter	$A_{PJ - SHP\ Tambaú}$
Unit	m^2
Description	Area of the reservoir measured in the water surface, after the implementation of the project activity, when the reservoir is full.
Measured/calculated/ default	Measured
Source of data	Dispatch 2,359 issued by ANEEL on 10 October 2006.
Value(s) of monitored parameter	206,000
Monitoring equipment	Third party companies will be hired for the development of topographic surveys and/or satellite image processing.
Measuring/reading/recording frequency	Annual
Calculation method (if applicable)	Not applicable
QA/QC procedures	
Purpose of data/parameter	
Additional comments	

Data/Parameter	$A_{PJ - SHP\ das\ Pedras}$
Unit	m^2
Description	Area of the reservoir measured in the water surface, after the implementation of the project activity, when the reservoir is full.
Measured/calculated/ default	Measured
Source of data	Installation License 476 issued by Environmental Foundation of Santa Catarina state on 24 July 2008.
Value(s) of monitored parameter	460,000
Monitoring equipment	Third party companies will be hired for the development of topographic surveys and/or satellite image processing.
Measuring/reading/recording frequency	Annual.
Calculation method (if applicable)	Not applicable
QA/QC procedures	
Purpose of data/parameter	
Additional comments	

Data/Parameter	$A_{PJ - SHP\ Rio\ do\ Sapo}$
Unit	m^2
Description	Area of the reservoir measured in the water surface, after the implementation of the project activity, when the reservoir is full.
Measured/calculated/ default	Measured
Source of data	Installation License Nº 027 issued by Environmental Secretary of Mato Grosso state on 01 February 2008.
Value(s) of monitored parameter	1,005,000
Monitoring equipment	Third party companies will be hired for the development of topographic surveys and/or satellite image processing.
Measuring/reading/recording frequency	Annual
Calculation method (if applicable)	Not applicable
QA/QC procedures	
Purpose of data/parameter	
Additional comments	

D.3. Implementation of sampling plan

Not Applicable

SECTION E. Calculation of emission reductions or net anthropogenic removals

E.1. Calculation of baseline emissions or baseline net removals

The baseline methodology considers the determination of the emissions factor to the grid which the project activity is connected as the core data to be determined in the baseline scenario. In Brazil, the grid is interconnected by the National Interconnected System (SIN) in a single system.

"Operating Margin *OM* Emission Factor" calculation ($EF_{grid,OM,y}$)

The Emission Factor (OM) calculated by the Dispatch Data Analysis is summarized as follows:

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

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 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.

The calculation of the $EF_{grid,OM-DD,y}$ was done using the formula above and the datas from the document "CERs 1st MR_rev1.xls", tabs "Hourly 2014", "Hourly 2015" "Hourly 2016", "Hourly 2017".

Below, follow a summary of $EF_{OM,y}$ by month. In the document "CERs 1st MR_rev1.xls", tabs "Hourly 2014", "Hourly 2015" "Hourly 2016 and "Hourly 2017", it is possible to see the complete calculation.

EF $_{grid,OM,2014}$ (tCO_2/MWh)

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
0.6155	0.5989	0.5699	0.5772	0.5605	0.5678	0.5674	0.5862	0.5994	0.5901	0.5885	0.5825

EF $_{grid,OM,2015}$ (tCO_2/MWh)

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
0.5953	0.5784	0.5767	0.5465	0.5469	0.5785	0.5686	0.5545	0.5308	0.5434	0.5513	0.5450

EF $_{grid,OM,2016}$ (tCO_2/MWh)

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
0.5953	0.6032	0.6281	0.6291	0.6356	0.6368	0.6288	0.6344	0.6402	0.6180	0.6217	0.6022

EF $_{grid,OM,2017}$ (tCO_2/MWh)

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
0.5419	0.5148	0.5867	0.5905	0.6086	0.5846	0.6052	0.6102	0.6060	0.5997	0.6019	0.6078

Thus, the Emission Factors of Operating Margin calculated in the tabs "Hourly 2014", "Hourly 2015" "Hourly 2016 and "Hourly 2017", in the document "CERs 1st MR_rev1.xls", are:

SHP Tambaú

$EF_{grid,OM,2014}$ = 0.5866 tCO_2/MWh

$EF_{grid,OM,2015}$ = 0.5598 tCO_2/MWh

$EF_{grid,OM,2016}$ = 0.6233 tCO_2/MWh

$EF_{grid,OM,2017}$ = 0.5929 tCO_2/MWh

SHP Rio do Sapo

$EF_{grid,OM,2016}$ = 0.6217 tCO_2/MWh

$EF_{grid,OM,2017}$ = 0.5849 tCO_2/MWh

"Building Margin *BM* Emission Factor" ($EF_{grid,BM,y}$)

The $EF_{grid,BM,y}$ also is published by the Brazilian DNA annually and it is available in its website[14]. The last available data is for 2016 year.

$EF_{grid,BM,2014}$ = 0.2963 tCO_2/MWh

$EF_{grid,BM,2015}$ = 0.2553 tCO_2/MWh

$EF_{grid,BM,2016}$= 0.1581 tCO_2/MWh

$EF_{grid,BM,2017}$ = 0.1581 tCO_2/MWh

"Baseline Emission Factor" calculation ($EF_{grid,CM,y}$)

The baseline emission factor ($EF_{grid,CM,y}$) is calculated through a weighted-average formula, considering the $EF_{OM,,y}$ and the $EF_{BM,,y}$ weighted 50% each, by definition, that gives:

$$EF_{grid,CM,y} = EF_{grid,OM,y} * 0.5 + EF_{grid,BM,y} * 0.5 \ (tCO_2/MWh)$$

SHP Tambaú

For 2014, SHPP Power Generation (MWh)

$EF_{grid,CM2014y}$ = 0.5866 *0.5 + 0.2963 *0.5

$EF_{grid,CM,2014y}$ = 0.4414 tCO_2/MWh

For 2015, SHPP Power Generation (MWh)

$EF_{grid,CM,2015}$ = 0.5598 *0.5 + 0.2553 *0.5

$EF_{grid,CM,2015}$ = 0.4076 tCO_2/MWh

For 2016, SHP Power Generation (MWh)

$EF_{grid,CM,2016}$ = 0.6233 *0.5 + 0.1581 *0.5

$EF_{grid,CM,2016}$ = 0.3907 tCO_2/MWh

[14] http://www.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/textogeral/emissao_despacho.html

For 2017, SHP Power Generation (MWh)

$EF_{grid,CM,2017}$= 0.5929 *0.5 + 0.1581 *0.5
$EF_{grid,CM,2017}$ = 0.3755 tCO_2/MWh

SHP Rio do Sapo

For 2016, SHP Power Generation (MWh)

$EF_{grid,CM,2016}$ = 0.6217 *0.5 + 0.1581 *0.5
$EF_{grid,CM,2016}$ = 0.3899 tCO_2/MWh

For 2017, SHP Power Generation (MWh)

$EF_{grid,CM,2017}$= 0.5849 *0.5 + 0.1581 *0.5
$EF_{grid,CM,2017}$ = 0.3715 tCO_2/MWh

Emission Reduction

The emissions reduction (**ER**) of this project activity is:

$$ER = BE_y - (L_y + PE_y)$$

Since to this project leakages is not considered, thus:

L_y **= 0**

And also the project emission is:

SHP Tambaú
***PEy* =0**

SHP Rio do Sapo
Details about *PEy* calculation on Section E.2.

For 2016
PE_{2016} **= 1,080**

For 2017
PE_{2017} **= 1,702**

So

$$ER = BE_y \text{ for SHP Tambaú}$$
$$\text{and}$$
$$ER = BE_y - PEy \text{ for SHP Rio do Sapo}$$

The baseline emissions (BE_y) would be then proportional to the electricity delivered to the grid throughout the project's lifetime. Baseline emissions due to displacement of electricity are calculated by multiplying the electricity baseline emissions factor ($EF_{grid,CM,y}$) with the electricity generation of the project activity (EG_y).

$$BE_y = EF_{grid,CM,y}. EG_y$$

Then:
$ER_y=EF_{grid,CM,y}* EG_{BL,y}$

SHP Tambaú

For 2014:
ER_{2014}= 0.4414 * 28,995.75
ER_{2014}= 12,799 tCO_2

For 2015:
ER_{2015}= 0.4076 * 61,880.34
ER_{2015}= 25,220 tCO_2

For 2016:
ER_{2016}= 0.3907 * 53,193.67
ER_{2016}= 20,783 tCO_2

For 2017:
ER_{2017}= 0.3755 * 53,952.72
ER_{2017}= 20,258 tCO_2

SHP Rio do Sapo

For 2016:
ER_{2016}= 0.3899 * 11,962.24 – 1,080
ER_{2016}= 4,364 tCO_2

For 2017:
ER_{2017}= 0.3715 * 18,885.62 – 1,702
ER_{2017}= 5,313 tCO_2

E.2. Calculation of project emissions or actual net removals

Project emissions are only applicable for SHP Rio do Sapo since the PD is below 10 W/m^2.

SHP Rio do Sapo
PEy = TEGy . 90/1000

For 2016
PE_{2016} = 11,994.90 . 90/1000
PE_{2016} = 1,080

For 2017
PE_{2017} = 18,907.25 . 90/1000

PE_{2017} = 1,702

E.3. Calculation of leakage emissions

There is no leakage associated with this project activity.

E.4. Calculation of emission reductions or net anthropogenic removals

	Baseline GHG emissions or baseline net GHG removals (t CO_2e)	Project GHG emissions or actual net GHG removals (t CO_2e)	Leakage GHG emissions (t CO_2e)	GHG emission reductions or net anthropogenic GHG removals (t CO_2e)		
				Before 01/01/2013	From 01/01/2013	Total amount
Total	91,519	2,782	0	0	88,737	88,737

E.5. Comparison of emission reductions or net anthropogenic removals achieved with estimates in the registered PDD

Amount achieved during this monitoring period (t CO_2e)	Amount estimated ex ante (t CO_2e)
88,737	96,131

E.6. Remarks on increase in achieved emission reductions

The actual GHG emission reductions achieved isn´t greater than the amount based on the ex ante estimation in the registered PDD

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Document information

Version	*Date*	*Description*
06.0	7 June 2017	Revision to: • Ensure consistency with version 01.0 of the "CDM project standard for project activities" (CDM-EB93-A04-STAN); • Make editorial improvements.
05.1	4 May 2015	Editorial revision to correct version numbering.
05.0	1 April 2015	Revisions to: • Include provisions related to delayed submission of a monitoring plan; • Provisions related to the Host Party; • Remove reference to programme of activities; • Overall editorial improvement.
04.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1; • Change the reference number from *F-CDM-MR* to *CDM-MR-FORM*; • Editorial improvement.
03.2	5 November 2013	Editorial revision to correct table in page 1.
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 GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB 70, 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).
01.0	28 May 2010	EB 54, Annex 34. Initial adoption.

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